Minimum Construction and Testing Standards For Cluster and Community Wastewater Systems

ADOPTED BY THE
STANDARDS ADVISORY GROUP
On
June 22, 2011

TABLE OF CONTENTS

CLUSTER AND COMMUNITY WASTEWATER SYSTEMS 1

Policy and Purpose. 1

Applicability. 1

Long Term Goal. 1

Design Requirements. 1

Special Designs 1

Alternate Materials and Methods. 1

Amendments. 2

Definitions. 2

SECTION 1 Sanitary Sewer System and System Expansion Projects 12

1.01 Sanitary Sewer System Policy 12

1.01-1 General Policy 12

1.01-2 Project Requirements. 12

1.01-3 Developer Agreements. 13

1.01-4 System Engineering and Design Review. 14

1.01-5 System Construction and Inspections. 14

1.01-6 System Testing. 15

1.01-7 As-Built Drawings. 15

1.01-8 Final Acceptance of Projects. 15

1.01-9 Contractor Qualification. 16

SECTION 2 General Design Guidelines for Sanitary Sewer Systems 17

2.01 Guidelines 17

2.01-1 General. 17

2.01-2 Surveys and Investigations. 17

2.01-3 Contents of Construction Drawings. 17

2.01-4 Rights-of-Way and Easement Deed Descriptions. 21

2.01-5 As-Built Drawings. 21

SECTION 3 Design Guidelines for Gravity Sanitary Sewer Systems 23

3.01 Gravity Sanitary Sewer 23

3.01-1 General. 23

3.01-2 Manholes. 24

3.01-3 Pipe Material. 25

3.01-4 Project System Layout. 25

3.01-5 Depth of Gravity Collector Lines. 26

3.01-6 Design of Gravity Collector Lines or Service Lines for Various Conditions. 26

3.01-7 Small Diameter Gravity Sewers. 27

3.01-8 Pumping Stations and Force Mains in Gravity Sanitary Sewer Systems, General. 28

3.01-9 Service Lines. 28
SECTION 4 Construction Specifications for Gravity Collection Lines 29
4.01 Gravity Collection Lines 29
4.01-1 Site Preparation. 29
4.01-2 Excavation. 29
4.01-3 Pipe Bedding. 30
4.01-4 Pipe Installation. 30
4.01-5 Pipe Joints. 31
4.01-6 Trench Backfill. 32
4.01-7 Disposal of Materials. 33
4.01-8 Construction Sequence Constraints. 33
4.01-9 Service Lines. 33
4.01-10 Manholes. 34
4.01-11 Concrete Work. 35
4.01-12 Special Construction. 36
4.01-13 Right-of-way and Easement Clean Up and Grassing. 36
4.01-14 Special Slope Protection, General. 36
SECTION 5 Design Guidelines for Low Pressure Collection Systems 37
5.01 Low Pressure Collection System. 37
5.01-1 General. 37
5.01-2 Sanitary Laterals. 37
5.01-3 Residential Pump Station. 38
5.01-4 Interceptor Tank Criteria. 39
5.01-5 Interceptor Tank Testing and Quality Control. 39
5.01-6 Grinder Pump Stations. 39
5.01-7 Service Lines. 40
5.01-8 Service Line and Collector Line Connection. 41
5.01-9 Low Pressure Collector Lines. 41
SECTION 6 Material Specifications for Low Pressure Collector Lines 43
6.01 Low Pressure Pipe 43
6.01-1 Materials. 43
6.01-2 Ductile Iron Pipe. 43
6.01-3 PVC Pipe. 44
6.01-4 High Density Polyethylene Pipe. 44
6.01-5 Casing Pipe. 44
6.01-6 Pipe Bedding and Backfill. 44
6.01-7 Concrete. 45
6.01-8 Grout 45
6.01-9 Pre-cast Manholes. 45

6.1-10 Manhole Frame and Cover. 46
6.1-11 Brick. 46
6.1-12 Masonry Blocks. 46
6.1-13 Mortar. 47
SECTION 7 Testing for Acceptance of Collector Lines 48
7.01 Testing 48
7.01-1 Testing Procedures and Requirements. 48
7.01-2 Gravity Collector Line Testing. 48
7.01-3 Pressure Collector Line Testing. 50
7.01-4 Manhole Testing. 50
SECTION 8 General Design Guidelines for Pumping Stations 53
8.01 Duplex Pump Stations 53
8.01-1- General 53
8.01-2 Acceptable Pump Station Types. 53
8.01-3 Submittals. 53
Force Main 54
8.01-4 Substitutions. 54
8.01-5 Experience Clause 55
8.01-6 Pump Warranty 55
8. 01-7 Pump Requirements 55
Pump No. 1 Overload 55
8. 01-8 Odor Control at Pump Station 56
8. 01-9 Pump Test 56
8. 01-10 Site Test 57
8. 01-11 Service 57
8. 01-12 Motor 57
8. 01-13 Valves and Valve Vaults. 58
8. 01-14 Wet Wells and Storage Basins 58
8. 01-15 Access Doors and Hatches 60
8. 01-16 Controls, General 60
8. 01-17 Pump and Control Panel. 60
8. 01-18 Wiring 61
8. 01-19 Nameplates. 61
8. 01-20 Enclosure. 61
8. 01-21 Motor Starters. 62
8. 01-22 Three Phase Starters. 62
8. 01-23 Single Phase Starters. 62
8. 01-24 Convenience Receptacle. 63
8. 01-25 Area Light Control. 63

8. 01-26 Control Operation (emphasis placed on duplex stations). 63
8. 01-27 Electrical. 65
8. 01-28 Monitoring Equipment, Sensing and Alarms. 66
8. 01-29 Pump Station Lot and Miscellaneous Requirements. 67
8.02 Grinder Pump Stations 67
8.02-1 General. 67
8.02-3 Submittals. 68
8.02-4 Substitutions. 68
8.02-5 Experience Clause. 68
8.02-6 Pump Station Warranty. 68
8.02-7 Pump Requirements. 68
8.02-8 Basin Requirements. 69
8.02-9 Interior Valves and Fittings. 69
8.02-10 Basin Location and Installation. 70
8.02-11 Controls. 70
8.02-12 Pump Control/Alarm Panel. 70
8.02-13 Wiring 71
8.03 Interceptor Tank Pump Stations for STEP Systems 71
8.03-1 General. 71
8.03-2 Acceptable Manufacturers. 71
8.03-3 Submittals 71
8.03-4 Substitutions 71
8.03-5 Experience Clause 72
8.03-6 Pump Warranty 72
8.03-7 Pump Requirements 72
8.03-8 Pump Basin and Vault Requirements 72
8.03-9 Discharge Valves and Assembly 72
8.03-10 Effluent Pumps 73
8.03-11 Pump Controls 73
8.03-11 Installation 74
SECTION 9 Interceptor, Tanks and Pump Tanks 75
9.01 Tank Requirements 75
9.01-1 Interceptor and Septic Tank Standards and Specifications 75
9.02 Tank Installation 77
9.02-1 Tank Installation 77
9.03 Tank Testing 78
9.03-1 Tank Testing and Quality Control 78
SECTION 10 General Design Guidelines for Treatment Systems 81
SECTION 11 General Design Guidelines for Effluent Dispersal Fields 81

CLUSTER AND COMMUNITY WASTEWATER SYSTEMS

Policy and Purpose.

The purpose of this document ("Standards") is to assemble in one volume the policies, procedures, design criteria, standard specifications and details for the construction of Cluster and Community Wastewater Systems.

Applicability.

These Standards are for Developers and Projects to be constructed by others that are to be dedicated to a Management Entity.

Long Term Goal.

The goal of this document is to promote the proper design and construction of Cluster and Community Wastewater Systems. Proper design and construction or these systems are essential to the long term goals of the Alabama Department of Public Health (ADPH) and The Alabama Department of Environmental Management (ADEM). State regulations require that all water entering a Cluster or Community Wastewater System be processed by a Subsurface Wastewater System to meet the standards established to protect the public and the environment. The 2009 law allows ADPH and ADEM to (i) oversee the development of Cluster and Community Wastewater Systems and (ii) implement standards and specifications to ensure reliability and operating effectiveness while maximizing the useful life of these systems.

Design Requirements.

All Cluster and Community Wastewater Systems shall be designed and installed according to the minimum standards and specifications as outlined in this document.. The design, materials of construction, installation and testing of Cluster and Community Systems shall be generally consistent with the criteria set forth herein.

Special Designs.

These Standards represent the minimum approved standards, specifications, practices and procedures for the construction and installation of sanitary sewer facilities associated with Cluster and Community Wastewater Systems. Any designs not covered by this document must be approved by a Professional Engineer in good standing, registered in the State of Alabama and possessing a valid and current license to practice (Licensed Engineer).

Alternate Materials and Methods.

The provisions of these Standards are not intended to prevent the use of any materials of construction or construction techniques, provided that any such alternative to the standard methodologies has been approved and its use authorized by a Licensed Engineer. The Licensed Engineer shall only approve alternates if, for the purpose intended, it is determined that the alternate is at

least equivalent in quality, strength, effectiveness, reliability, durability, and safety to that prescribed herein.

Amendments.

These Standards are subject to change without notice and interested parties are advised to verify with the ADPH or ADEM that they are using the latest version of the published document.

Definitions.

Wherever the words, forms, or phrases defined or pronouns used in their place occur in this document or any revisions hereto, or any document or instrument herein contemplated or to which these Standards apply, the intent and meaning shall be construed and interpreted as described below. Words not defined in this section shall have the meaning in Webster's Ninth Collegiate Dictionary, as revised.

ABBREVIATIONS:

The following organizations are referenced herein by their abbreviations:

AASHTO
American Association of State Highway and Transportation Officials

ANSI
American National Standards Institute

ASA
American Standards Association

ALDOT
State of Alabama Department of Transportation

ASTM
American Society for Testing and Materials

ADEM
Alabama Department of Environmental Management

ADPH
Alabama Department of Public Health

AOWB
Alabama Onsite Wastewater Board

AWWA
American Water Works Association

EPA
U.S. Environmental Protection Agency

HBAA
Home Builders Association of Alabama

NEMA
National Electrical Manufacturer's Association

OSHA Occupational Safety and Health Administration

PSC Public Service Commission

USGS United States Geologic Survey

WUMA

Wastewater Utility Management Association

AS-CONSTRUCTED DRAWINGS: Also referred to as As-Built Drawings. These are Project Drawings that have been revised to show material changes made during Construction.

BACKFILL: Soil, gravel, stone or other material used to replace, or the act of replacing, soil or rock material removed during excavation and construction.

CLUSTER WASTEWATER SYSTEM: A Sanitary Sewer System serving a single development or contiguous developments, which collectively has a design flow of 15,000 gallons per day or less and is designed and permitted for discharge of treated wastewater to a subsurface dispersal system by ADPH, but excluding systems that discharge directly to the surface waters of the State. The Cluster Wastewater System is subject to the Onsite Wastewater Management Entities Act of 2009.

CLUSTER AND COMMUNITY WASTEWATER SYSTEM: A Sanitary Sewer Systems that is subject to the Onsite Wastewater Management Entities Act (§22-25B-1 et seq., Ala. Code (2001) to collect and transport sewage from customers under contract for treatment and dispersal and that complies with specific engineering principles of design, materials of construction, equipment specifications, construction practices and standards of performance, as specified by a Licensed Engineer, and that is constructed, inspected and tested to meet the minimum standards and specifications as set forth herein by ADPH and ADEM. The phrase Cluster and Community Wastewater System may be abbreviated as CCWS in this document. While certain Cluster and Community Wastewater Systems are exempt from regulation by the Alabama Public Service Commission according to the Onsite Wastewater Management Entities Act, all are still subject to these Standards.

COMMUNITY WASTEWATER SYSTEM: A Sanitary Sewer System serving a single development or contiguous developments, which collectively has a design flow of 15,001 gallons per day or more and is designed and permitted for discharge of treated wastewater to a subsurface dispersal system by ADEM, but excluding systems that discharge directly to the surface waters of the State. The Cluster Wastewater System is subject to the Onsite Wastewater Management Entities Act of 2009.

COLLECTOR LINE: A pipe or conduit located in an easement or right-of way, that collects and carries wastewater to a wastewater treatment facility. The Collector Line may be a pipe that allows for the flow of wastewater by gravity or pressure. Manholes, pumping stations, structures and ancillary sewer facilities, including but not limited to pressure/vacuum relief valves, clean-outs and meters, may be appurtenances integral to a Collector Line.

CONNECTION: Any Service Line or Owner, Person or Customer connected to the CCWS.

CONNECTION POINT: The point at which the Management Entity becomes responsible for the operation and maintenance of the CCWS, as more fully defined in the Management Entity's Tariff. The Connection Point is either the point where the Customer's Sanitary Lateral connects to the Residential Pump Station or Septic Tank or where the Sanitary Lateral crosses the plane of the sewer Right-of-Way or where the Sanitary Lateral or Service Line connects to the Collector Line, according to the Tariff.

CONSTRUCTION: Any work, including but not limited to installation of a new CCWS or an extension to an existing CCWS or a modification or repair of a CCWS or any part of thereof.

CONTRACTOR: The person, firm or corporation with whom a Developer or Owner of property to be developed has entered into a written agreement, which includes by reference approved Project documents that specify the work to be performed.

DEED: The granting document to convey fee simple title for a property, right-of-way or easement to the Management Entity using an approved format of the Probate Court of the County in which the property, right-of-way or easement is located.

DESIGN ENGINEER: The Licensed Engineer of record who performs the detailed design of a Sanitary Sewer System and prepares the Project Drawings and Specifications to be used in the construction or modification of the Sanitary Sewer System. The term Engineer and Design Engineer may be used interchangeably in this document.

DEVELOPER: A private interest, municipality, county commission or State agency or other government entity, or any combination of third-parties that assume the responsibility for building or expanding a Cluster and Community Wastewater System that will be conveyed to a Management Entity.

DEVELOPMENT: The real property and improvements constructed thereon which will discharge Domestic Sewage into the Sanitary Sewer System.

DOMESTIC SEWAGE: Sewage that is discharged from residences of Customers or that is equivalent in characteristics to this sewage.

DRAWINGS: The official set of Project Drawings for the Sanitary Sewer System, that shall include, but not be limited to, detailed site plan drawings, engineered design drawings of Service Lines, Collector Lines, pump stations, treatment facilities, dispersal field zones and miscellaneous engineering details of system components for a contractor to build, test and obtain acceptance for completion and operation of a Cluster or Community Wastewater System; or the exact reproduction thereof, as prepared by the Design Engineer, which show and describe at a minimum the Construction to be performed and may include standard notes and written specifications for materials of construction and accepted inspection and testing practices or refer to same in Project Specifications. The term Drawings and Construction Drawings may be used interchangeably in this document.

EASEMENT: As it relates to the Sanitary Sewer System; a strip of land over which a Collector Line or related appurtenances are built or that is used for ingress and egress to sewer facilities, or is temporarily used during construction of a

Sanitary Sewer System or part thereof, or is retained by others for surface rights allowing for specified uses that do not interfere with the ownership and operation of the Sanitary Sewer System.

EFFLUENT: The liquid discharged from a treatment facility that accepts wastewater collected from customers of a Sanitary Sewer System.

EFFLUENT DISPERSAL FIELD (EDF)) – a minimum area as calculated per Rules of State Board of Health Chapter 420-3-1 Onsite Sewage Treatment and Disposal into which sewage treated to at least primary standards is dispersed into the soil.

ENGINEER'S INSPECTOR: An authorized representative selected or approved by a Management Entity to observe the Construction and repair of a Sanitary Sewer System or any part thereof that will be conveyed to or has been conveyed to the Management Entity and conforms with these Standards. The term Inspector and Engineer's Inspector may be used interchangeably in this document.

EQUIPMENT: All machinery, together with the necessary tools for upkeep and maintenance of Sanitary Sewer Systems. Equipment also may refer to includes all machinery, tools and apparatus for the proper construction, inspection and testing of Sanitary Sewer Systems under construction that are necessary to satisfactorily complete Construction and meet the approved standards and specifications herein.

FILL: Soil, gravel, stone, broken rock or other accepted material used to provide the bulk required to raise the elevation of an area.

FORCE MAIN: A pressurized sewer pipeline intended to carry wastewater from a pumping facility to the point where it can flow by gravity.

INDUSTRIAL WASTEWATER: Wastewater that is generated by a industrial process that has other constituents than those found in Sewage, High Strength Sewage, Gray Water Sewage as defined herein.

INFILTRATION: Infiltration shall mean the water entering a Sanitary Sewer System from the ground through broken or cracked pipe, defective pipe joints, improper connections, manhole walls or such other means and is objectionable. Infiltration will consume design capacity and can adversely affect the performance of a Sanitary Sewer System.

INFLOW: Inflow shall mean the water entering a Sanitary Sewer System from roof leaders, cellars, yard and area drains, foundation drains, drains from springs and swampy areas, cross connections from storm sewers, surface runoff and other sources and is objectionable. Unplanned Inflow will consume design capacity and can adversely affect the performance of a Sanitary Sewer System.

INFILTRATION/INFLOW: The term abbreviated (I/I) shall mean the total quantity of water from both infiltration and inflow without distinguishing the source.

INFLUENT: Untreated sewage that enters a wastewater treatment facility for treatment.

INTERNAL PLUMBING: The collection of pipes, drains, traps, and vents located within the building or under the building foot print that collects sewage and

directs all flow to the Sanitary Lateral, which is the pipe outside the building that conveys the sewage away from the building.

INSPECTING ENGINEER: An engineer that is not an employee of the Management Entity, Developer or Contractor that is retained to inspect the work and work product related to Construction of a Sanitary Sewer System.

INTERCEPTOR TANK: A Septic Tank that includes a pumping system for use in a low pressure Sanitary Sewer System.

MANAGEMENT ENTITY: The owner of any system that operates as a Cluster or Community Wastewater System as defined herein. Management Entities are subject to the Onsite Wastewater Management Entities Act (§22-25B-1 et seq., Ala. Code (2001)) and have the responsibility to oversee the engineering, construction and testing of a Cluster and Community Wastewater System to ensure that it meets minimum Standards and Specifications established by ADPH and ADEM, respectively; and, once built accept 'ownership' of the Sanitary Sewer System via a recorded deed to hold in trust for the exclusive purpose of providing sewer service to specified customers (e.g. property owners) and to operate, maintain and manage the Sanitary Sewer System.

MANHOLE:A junction structure from the surface of the ground to the gravity sewer, which allows for changes in direction or grade of Collector Lines and is large enough to enable access for inspection and maintenance of the Collector Lines.

MANHOLE INVERT: A formed channel along the bottom of the manhole constructed of cement mortar to direct and contain the wastewater flow from a Collector Line that discharges flow into the manhole to a Collector Line that accepts flow out of the manhole. Manholes are necessary appurtenances of a gravity Sanitary Sewer System.

MATERIALS: Any substance specified for use in Construction or repair work.

OR EQUAL: Means to allow the use of another process, material, device, detail, or part that the Design Engineer and the Management Entity jointly determine is equal in suitability, quality, reliability, durability, and performance to that specified.

OWNER: Any individual, firm, company, association, society, corporation, group, partnership, co-partnership, trust, estate, governmental or legal entity, or their assigned representatives, agents or assigns, who owns property on which a CCWS is to be built who owns property that is to be connected to a CCWS.

PERMIT: A license to proceed with the work for a Project or Sewer Connection as authorized jointly by the governmental agency with jurisdiction and the Management Entity based on an application and approved documents; not be construed as authority to violate, cancel, alter, or set aside any of the provisions of these Standards nor prevent the Management Entity from thereafter requiring correction of errors in Construction or a violation of these Standards.

PERSON: A Customer or User who connects to, or contributes, causes, discharges or permits the contribution or discharge of wastewater into the Sanitary Sewer System or intends to do so. The masculine gender shall include the feminine,

the singular shall include the plural where indicated by context. (The terms "Person, Customer and User" are equal and may be used interchangeably in this document.)

PLUMBING CONTRACTOR: The person, firm, or corporation that is hired and becomes responsible for the installation, alteration, repair and renovation of Internal Plumbing and Sanitary Laterals before the Connection Point. The Management Entity's responsibility begins at the Connection Point and any work by a Plumbing Contractor between the Connection Point and the subsurface effluent dispersal system of a CCWS will require prior approval of the Management Entity.

PROJECT: The body of work to be performed by third-parties, as described in the Project application and approved Drawings for; (i) the construction, installation, expansion or modification of a Sanitary Sewer System to be dedicated to the Management Entity; or (ii) any excavation or construction that may be performed or built and connects to or crosses an existing or proposed Sanitary Sewer System, or encroaches on any roadway right-of-way or easement that may be used by the Sanitary Sewer System.

RECORD MAP: A drawing or map, commonly referred to as a plat, drawn to scale from a record of a survey that shows property lines, land boundaries and other subjects. For a Development a preliminary plat shows the division of the property or tract of land into separate lots but that has not been recorded with an official government record keeper for use by the public. A Record Map or Final Plat generally includes a legal description of the property, has been reviewed and approved by a governmental agency with jurisdiction and properly recorded.

RESIDENTIAL: Shall have the same meaning as DOMESTIC, as an adjective for Customer or Sewage.

RESIDENTIAL PUMP STATION: The pump station and/or Interceptor Tank that meets the Standards herein and collects sewage from the Sanitary Lateral and utilizes one or more pumps to discharge Sewage to the Collector Pipe for treatment at the Treatment Facility. The Residential Pump Station is generally owned by the Customer but maintained by the Management Entity, unless otherwise specified by the Management Entity's Tariff and covenants of the Development.

RIGHT-OF-WAY: As relates to the Sanitary Sewer System, a strip of land over which a sewer line is built. A right-of-way is a type of easement that gives someone the right to travel across property owned by another person. Typically, a public right-of-way is one that is used for transportation as a road or path.

SANITARY LATERAL: The pipe that is outside a building that conveys sewage collected from the sanitary plumbing inside the building away from the building.

SANITARY SEWER: A pipeline that carries wastewater or is intended to carry wastewater.

SANITARY SEWER SYSTEM: A integrated system of connected underground pipes, pumps and appurtenances for the collection, transportation, treatment and

dispersal of sewage.. A Sanitary Sewer System that is exempted from the Onsite Wastewater Management Entities Act [§22-25B-1 et seq., Ala. Code (2001)] may not always meet the definition of a Cluster or Community Wastewater System but in Alabama all Sanitary Sewer Systems permitted by ADEM or ADPH should comply with these Standards.

SEPTIC TANK: A tank installed below ground level with one or more compartments that is intended to receive sewage by gravity from a Sanitary Lateral for the purpose of separating and accumulating settleable sewage solids as the liquid moves through the tank from inlet to outlet. The accumulated organic solids undergo anaerobic treatment. The tank inlet is connected to the Sanitary Lateral that connects to the building plumbing and the outlet is connected to the Collector Line by a gravity Service Line. Interceptor Tanks are Septic tanks with a pump to deliver settled sewage through a pressure Service Line to the Collector Line. Septic Tanks and Interceptor Tanks must be cleaned periodically to remove excess solids in order to achieve tank design performance levels. 68. SERVICE LINE: The pipe that extends from the Connection Point at the Collector Line to the Customer's building or the outlet of the Residential Pump Station or Septic Tank. Where there is no Residential Pump Station or Septic Tank, the Sanitary Lateral and Service Line are synonymous.

SEWAGE: Any waterborne or non-waterborne waste of similar composition and strength as may be found in the typical residential dwelling and that has typical wastewater (sewage) concentrations of BOD5 - 250 mg/l, Total Suspended Solids – 250 mg/l, Ammonia – 10 mg/l and Total Phosphorus – 9 mg/l and/or includes sanitary waste as defined by ADEM.

High-strength Sewage: Waterborne or non-waterborne waste from establishments that are of similar composition but possess a higher strength than would be found in a typical residential dwelling. High-strength wastes may be permitted in Cluster and Community Wastewater Systems at the discretion of ADPH or ADEM. Historically, a high-strength wastewater that has been permitted is kitchen waste from food preparation establishments that first passes through an approved grease interceptor.

Gray Water: Sewage that is composed of waste streams that does not contain human wastes, i.e. urine or excrement. Gray water is usually the discharge from sinks, tubs and showers in a residential dwelling.

SEWER: A pipe or pipeline intended to carry sewage.

SHALL: "Shall" is mandatory; "may" is permissive

SPECIFICATIONS: That part of Project documents containing the written directions, provisions, and requirements for completing the work specified by the Design Engineer. Those standards for specifying materials or testing which are cited in this document by reference shall have the same force and effect as if set out in full in these Standards.

STANDARD DRAWINGS: The Standard Drawings as detailed and attached in the Appendix herein.

STATE: The State of Alabama.

TAP: The actual connection or opening placed in the Collector Line to allow the wastewater to enter the Collector Line from the Service Line.

TEE: A fitting installed in line with the Collector Line to allow connection of the Service Line at a 90 degree angle from the direction of flow of the Collector Line. A Connection to the Collector Line shall not be made by using a wye type fitting, which would allow connecting at a 45 degree angle.

USER: See Person or Customer.

WASTEWATER: A term used_interchangeably with the term Sewage, but could also include the Industrial Wastewater. Wastewater is a liquid or slurry that contains solids, other liquids, gases, or radiological substances originating from Domestic and Non-Domestic sources, together with any ground water, surface water and storm water that may be present, whether treated or untreated, which is discharged into a Sanitary Sewer System.

STANDARD REFERENCE SPECIFICATIONS: All standard Specifications referenced throughout these Standards are to be taken as the latest revisions available and for new construction. The following is a non-exclusive list of national standard Specifications that may be referenced in these Standards and Specifications.

ANSI/AWWA:

C104/A21.4 Cement-Mortar Lining for Ductile-Iron and Gray-iron Pipe amid Fittings for Water.

C110/A21.10Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch for Water and Other Liquids.

C111/A21.11 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C150/A21.50 Thickness Design of Ductile-Iron Pipe.

C151/A21.51 Ductile-iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

C153/A21.53 Ductile-Iron Compact Fittings, 3-inch Through 12-inch for Water and Other Liquids.

C900 Polyvinyl Chloride (PVC) Pressure Pipe 4-inch through 12-inch with Addendum C-900-92.

C907 Polyvinyl Chloride (PVC) pressure fittings 4-inch through 8-inch.

ASTM:

A-48, Specification for Gray Iron Castings.

A-53, Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seam less.

A-82, Cold-Drawn Steel Wire for Concrete Reinforcement.

A-185, Welded Steel Wire for Concrete Reinforcement.

A-615, Deformed and Plain Billet Steel Bars for Concrete Reinforcement. C-3l

C-31, Making and Curing Concrete Test Specimens in the Field.

C-32, Sewer and Manhole Brick (Made From Clay or Shale).

C-33, Concrete Aggregates.

C-39, Comprehensive Strength of Cylindrical Concrete Specimens.

C-42, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

C-76, Reinforced Concrete. Culvert. Storm Drain and Sewer Pipe.

C-90, Hollow Load-Bearing Concrete Masonry Units.

C-94, Ready Mix Concrete.

C-150, Portland Cement.

C-l72, Sampling Free Concrete.

C-216, Facing Brick.

C-443, Joints for Circular Concrete Sewer and Culvert Pipe.

C-478, Pre-cast Reinforced Concrete Manhole Sections.

C-923, Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

D-448, Standard Sizes of Coarse Aggregate for Highway Construction.

D-1557, Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18in. Drop.

D-l599, Test Method for Short Term Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings:

D-1784, Specification for Rigid Poly (Vinyl Chloride) PVC Compounds and Chlorinated Poly (Vinyl Chloride) CPVC Compounds.

D-2412, Test Method for External Loading Properties of Plastic Pipe by Parallel Plate Loading.

D-2434, Test method for Permeability of Granular Soils.

D-2487,Classification of Soils for Engineering Purposes.

D-3139, Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

F-477,Specifications for Flexible Elastomeric Seals for Join ing Plastic Pipe.

F-6l0, Practice for Estimating the Quality of Molded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings by the Heat Reversion Process.

F-1336, Poly vinyl chloride) (PVC) Gasketed Sewer Fittings.

The following is a list of other helpful publications amid documents that are or may be referenced in these Standards and Specifications:

State of Alabama Department of Transportation Publications:

Alabama Manual on Uniform Traffic Control Devices for Streets, and Highways.

Standard Specifications for Highway Construction.

Utility Manual.

Occupational Safety and Health Administration Publications:

Safety.

American Railway Engineering Association:

Part 5 Specifications for Pipelines.

SECTION 1 Sanitary Sewer System and System Expansion Projects

1.01 Sanitary Sewer System Policy

1.01-1 General Policy

(1) In that an Advisory Group on Minimum Construction Standards was Established Pursuant to Section 22-25B-8, Code of Alabama .ADPH, ADEM, AOWB, WUMA, HBAA and PSC, as directed, are seeking through this document to provide for the public health, safety and general welfare of people served by a Cluster or Community Wastewater System. The purpose of these Standards and Specifications is to establish guidelines for the construction of a new Sanitary Sewer System or one that will connect to the existing Cluster and Community Wastewater System. These guidelines are intended to help ensure the health, safety and welfare of the public through water resource protection and the proper removal and treatment of wastewater.

(2) Sanitary Sewer Systems fall into two basic categories:

A. Original Sanitary Sewer System: A new Sanitary Sewer System designed and built by a Developer who plans to serve an original Development.

B. Sanitary Sewer System Expansion: A Sanitary Sewer System designed and built by one Developer and expanded to serve an additional phase to the original Development or expanded to connect another Development to the Original Sanitary Sewer System.

1.01-2 Project Requirements.

(1) Original Sanitary Sewer Systems design or Sanitary Sewer System expansions are subject to the following:

A. An Original Sanitary Sewer System must be approved by the Management Entity in accordance with these Standards and Specifications prior to the start of any excavation or construction.

B. The Management Entity is responsible to review the design of the Sanitary Sewer System to confirm compliance with these Standards and Specifications, to meet applicable local governmental requirements, and to ensure that the Sanitary Sewer System has sufficient hydraulic and treatment capacity for the ultimate tributary population and anticipated sewage volume.

C All materials, designs, construction, inspections and testing procedures shall be in accordance with these Standards and Specifications, unless otherwise approved by the Engineer and Management Entity.

D. The Sanitary Sewer System shall be inspected and tested in accordance with these Standards and Specifications by an inspector approved by the Management Entity.

E. The Developer has the responsibility to comply with all zoning, planning and other requirements of the governmental entities with jurisdiction over any part of the Sanitary Sewer System.

F. The Developer has the responsibility to comply with all applicable local, state and federal environmental policies and regulations. In the event a Sanitary Sewer System is governed by regulations from multiple entities, the more stringent shall control.

G. The Developer shall indemnify and hold harmless the Management Entity and its officials, officers, employees, representatives, agents and contractors from all suits, actions, or claims of any character arising from the actions, inactions, or operations of the Developer and Developer's Contractor and from the construction of the Sanitary Sewer System prior to its full acceptance by the Management Entity

H. Unless otherwise agreed to by the Management Entity and authorities with jurisdiction, the Developer shall not allow any portion of the Sanitary Sewer System to be used until (i) the Sanitary Sewer System has been completed, including inspection and testing, and properly conveyed to the Management Entity for ownership, operation, maintenance and management, (ii) all regulatory agencies and governmental bodies have been provided written acceptance letters, (iii) all plats, covenants and deeds have been recorded and conveyed to the Management Entity or a trust in acceptable form and acceptable to applicable Probate Court, and (iv) As-Built Drawings have been completed and accepted by the Management Entity.

I. The Developer shall be required to post a warranty and maintenance bond in the amount up to 50% of the cost of the Sanitary Sewer System (or such other amount as the Management Entity shall reasonably determine) to insure that the Development is properly zoned and the Sanitary Sewer System will be properly maintained by the Developer or Contractor for a one (1) year period after Final Acceptance by the Management Entity, as outlined in Section 1.01-8.

J. The Developer shall be required to provide to the Management Entity the Developer's actual cost to build the major components of a Sanitary Sewer System in a format requested by the Management Entity within 90 days of Final Acceptance of the Sanitary Sewer System. The Developer's aggregate cost is recognized as the Contribution-in-aid-of-Construction to be reported to the PSC.

1.01-3 Developer Agreements.

(1) Sewer Service Agreement: The Management Entity and the Developer shall enter into an Agreement that clearly sets forth the obligations of each party in the areas of engineering, design, construction, inspection, testing and final acceptance of a Sanitary Sewer System. To properly protect the Management Entity, this Agreement should be executed before the design of the Sanitary Sewer System has been completed by the Developer's Engineer.

(2) Assignment Agreement: The Sewer Service Agreement may be assigned by the Developer to a successor in title to the development property, but the assignment of the Sewer Service Agreement shall not be effected without the prior written approval of the Management Entity, where such assignment shall not be unreasonably withheld.

1.01-4 System Engineering and Design Review.

(1) Selection of the Design Engineer: It is in the interest of the Management Entity to work with the Developer in the selection of an Engineering Firm or an independent Design Engineer that has demonstrated experience and expertise in the design of collection, treatment and subsurface dispersal systems.

(2) Design Review and Changes: The Sewer Service Agreement between the Management Entity and the Developer shall specify that the Management Entity has the right and responsibility to (i) review the Design Engineer's reports, plans, construction drawings and specifications and to (ii) make changes to the construction Drawings and specifications to incorporate the minimum Standards and Specifications herein before the project is released for construction. The Engineer's final design submittal shall include four (4) sets of Drawings for review by the Management Entity.

(3) Payment for Engineering and Design Review: Any payment to the Management Entity by the Developer for the review and approval of the Engineer's design and Drawings and for construction inspection and monitoring testing shall be stated clearly in the Sewer Service Agreement.

1.01-5 System Construction and Inspections.

(1) Selection of the Contractor: It is in the interest of the Management Entity to work with the Developer in the pre-qualification and selection of the Contractor with an appropriate AOWB license. (2) Construction Inspection: The Sewer Service Agreement between the Management Entity and the Developer shall specify that the Management Entity has the right to inspect the construction of the Sanitary Sewer System as the work is being performed to ensure that the work complies with the minimum Standards and Specifications herein.

(3) Contractor Bond: The Sewer Service Agreement shall also specify that the Contractor must provide a warranty and maintenance bond in the amount of 50% of the cost of construction, or some other percentage mutually agreed upon by the Developer and the Management Entity. The Maintenance Bond shall be in the name of the Management Entity and apply for a 12-month period following final acceptance of the Sanitary Sewer System by the Management Entity.

(4) Payment for Inspections: Any payment to the Management Entity by the Developer for construction inspection shall be stated clearly in the Sewer Service Agreement.

(5) Notification For Inspections: The Developer or Developer's Contractor shall notify the Management Entity of work progress and need for inspection according to the notification schedule and procedure agreed to by the parties prior to start of construction. In general, the Contractor shall notify the Management Entity prior to the placement of any material or pipe in a trench; after installation of pipe bedding and before installation of any pipe; upon installation of a segment of pipe lengths and one (1) foot of backfill material over pipe; upon installation and prior to any backfill of manholes or pumping stations, and prior to scheduling any system testing. The original schedule and procedure shall apply throughout construction unless other arrangements and general inspection schedule are agreed to in writing by the Management Entity.

(6) Quality Control and Enforcement: When an inspection indicates that the work does not meet the requirements of the minimum Standards and Specifications herein, the Management Entity shall advise the Contractor and Developer in writing that the work is being completed at risk of not being accepted and describe the basis for such representations.

1.01-6 System Testing.

(1) Selection of Contractor: It is in the interest of the Management Entity to work with the Developer in the pre-qualification and selection of the Contractor with an appropriate AOWB license.

(2) System Testing: The Sewer Service Agreement between the Management Entity and the Developer should specify that the Management Entity has the right to observe the testing of major portions of the Sanitary Sewer System once construction has been completed to ensure that the completed work complies with the minimum Standards and Specifications herein.

(3) Payment for Testing Review: Any payment to the Management Entity by the Developer for the Management Entity's time involved in observing the testing by a testing contractor that has been pre-qualified to conduct such testing, shall be stated clearly in the Sewer Service Agreement.

(4) Notification For Testing: The Developer or Developer's Contractor shall be responsible for contacting the Management Entity prior to beginning any system testing in accordance with notification procedures and schedule agreed to by both parties prior to commencement of construction.

(5) Quality Control and Enforcement: When testing procedures show that the completed work does not meet the requirements of the minimum Standards and Specifications herein, the Management Entity shall advise the Contractor and/or Developer in writing that the work will not be accepted until the proper testing procedures are followed and met.

1.01-7 As-Built Drawings.

(1) Upon completion of construction of a Sanitary Sewer System, the Design Engineer shall provide a two (2) complete sets of As-Built Drawings to the Management Entity. The Management Entity shall require the Developer to hire an Alabama Licensed Surveyor to locate the constructed facilities on the As-Built Drawings if material changes occurred during construction. With information from the survey and construction logs, the Developer's Engineer shall make revisions to the original set of Construction Drawings approved by the Management Entity to accurately show the facilities that were installed.

1.01-8 Final Acceptance of Projects.

(1) The Management Entity shall not issue a letter of Final Acceptance for a Sanitary Sewer System until:

A. All construction has been completed in accordance with the minimum Standards and Specifications herein.

B. All field final inspections, including required testing, have been performed and accepted.

C. All easement and/or rights of way have been correctly recorded and shown on As-Built Drawings and all permits and licenses have been properly assigned and accepted.

D. Two (2) sets of As-Built Drawings have been submitted and approved.

E. A document approved by the Management Entity conveying the Sanitary Sewer System has been properly executed and recorded by the Developer and a copy of the recordation has been delivered to the Management Entity.

F. All governmental and regulatory agencies with jurisdiction have accepted the Sanitary Sewer System and copies of acceptance letters have been received by the Management Entity.

G. A warranty and maintenance bond has been obtained by the Developer or Developer's Contractor and received by the Management Entity in an amount as the Management Entity and Developer have previously agreed to that will insure that the Sanitary Sewer System will be maintained by the Contractor for a one (1) year period after Final Acceptance.

1.01-9 Contractor Qualification.

(1) All sanitary sewer facilities that are to connect to a previously approved Sanitary Sewer System shall have been or shall be constructed and installed by a pre-qualified Contractor and meet the minimum Standards and Specifications herein. If the new facilities or sewer system do not meet the minimum Standards and Specifications herein and improvements by the Developer or Contractor are not required as a condition of acceptance by the Management Entity, and the Management Entity accepts the Sanitary Sewer System with deficiencies, then the Management Entity shall solely bear the financial and regulatory risk of such connection.

(2) Any Contractor holding an appropriate AOWB license in good standing be approved and listed as an approved Contractor by submitting a proper application and meeting the standard requirements of the Management Entity.

SECTION 2 General Design Guidelines for Sanitary Sewer Systems

2.01 Guidelines

2.01-1 General.

(1) The Developer shall obtain the services of a Professional Engineer ("Engineer"), registered in the State of Alabama and in good standing, to provide engineering design services for the Sanitary Sewer System. Services shall include both surveying by a Professional Land Surveyor and engineering design by a Professional Engineer. An executed copy of the contract between the Developer and the Engineer shall be made available to the Management Entity upon request.

(2) The Engineer shall be knowledgeable of the minimum design standards, laws and regulations relating to Sanitary Sewer Systems. The Engineer will be responsible to prepare Drawings and Specifications for review and approval by the Management Entity prior to start of construction.

(3) The Developer will select and contract with a pre-qualified Contractor that will be responsible for constructing the Sanitary Sewer System according to the Drawings and Specifications prepared by the Engineer and approved by the Management Entity. The Contractor will be responsible for coordinating inspections of the on-going work as stipulated by the Management Entity for Final Acceptance. The Management Entity shall require that a one-year warranty and maintenance bond in the amount agreed to by the Management Entity and Developer shall be conveyed in the name of the Management Entity prior to Final Acceptance.

(4) Any proposed sanitary sewer facilities not specifically covered herein shall be submitted to the Management Entity for review and approval. Before the preparation of Drawings and Specifications begins, the Management Entity shall be consulted regarding specific design requirements for any non-standard pumping stations, manholes deeper than twenty feet, all tunnels and borings, any creek or aerial crossings, all siphons, and any other extraordinary facility.

2.01-2 Surveys and Investigations.

(1) An actual ground centerline survey of the route of the proposed sewer should be performed by the Engineer. The survey should obtain information on existing topography and underground utilities and shown on the Drawings. Base lines or reference marks should be established in the field. Ground profile data must be field surveyed along the actual alignment. Topography may be obtained from either aerial surveys, field measurements, or both methods to meet the requirements of the regulatory agencies and the Management Entity.

2.01-3 Contents of Construction Drawings.

(1) Construction Drawings must be prepared under the direct supervision of and stamped, sealed, and dated by, the Engineer. Drawings

submitted for review and acceptance by the Management Entity shall contain the following minimum items:

A. A land tie stamped, sealed and dated by an Alabama Registered Land Surveyor, shall show the location of the center line (or manholes) of the Sanitary Sewer System in relation to section line, quarter section line, or quarter-quarter section line using two verified monuments and labeled as applicable. Ties made within platted subdivisions may be made to lot lines when the Land Surveyor deems that this is the best and most reproducible tie that can be made. Properties that rely on meets and bounds descriptions should be tied in a manner similar to their deed calls. Direct ties should be made whenever possible. Alignment and property surveys required for Right-of-way acquisitions shall meet Minimum Technical Standards for Land Surveying in the State of Alabama. Closure data for both Horizontal and Vertical Control shall be submitted for review and verification. Drawings should be referenced to the Alabama State Plane Coordinate System.

B. Each Drawing sheet shall contain the name of the Sanitary Sewer System, and the name(s), address, and telephone numbers of the Developer, the Engineer, and the Land Surveyor. Section information (quarter section, township, and range) shall be shown on each sheet near the title block.

C. Drawings shall be prepared using standard drafting practice on 24”x 36” sheets. Sanitary Sewer System drawings shall be on 24”x 36” half plan/profile sheets. The profile grid shall have 50’ (H) and 1’ (V) lines.

D. Drafting media for submittal of Drawings shall be 4-mil polyester drafting film, premium bond paper or tracing paper of reproducible quality.

E. Preliminary Drawings shall be in reproducible black, blue-black ink, or pencil. Final Drawings for approval shall be submitted in permanent ink only.

F. The minimum text height shall be 0.1 inch and shall be legible.

G. Plan and profile of proposed sewer lines shall be on the same sheet, drawn at 1“ =50’ horizontal and 1“=10’ vertical scales. Grades shall be shown in percent (%) and indicated between each manhole for gravity Collector Lines. Both invert and existing profile elevations are to be indicated at every 50 ft. station. The top of manhole elevation and flow-line elevation of each gravity Collector line entering and exiting a manhole shall also be shown.

H. All clean-outs and vacuum/pressure relief valves shall be shown for pressure Collector Lines.

I. Sheets shall be properly numbered, indicating “Sheet_____ of_____”

J. All symbols shall conform to industry standards.

K. Standard Drawing details shall be included in the set of Construction Drawings.

L. Stationing shall commence at the left of the sheet and continue to the right across the sheet. A maximum of 1,500 feet of sewer may be on each sheet.

M. Standard Notes shall be shown on at least one of the Plan/Profile Drawings.

N. The lineal feet and material of pipe shall be shown between each manhole for gravity Collector Lines, between clean-outs and/or relief valves for pressure Collector Lines and where a pipe material change or size occurs for gravity and pressure Collector Lines.

O. Reference number, station location, size, and type material of all sewers shall be indicated on the Construction Drawings.

P. Direction of flow for each proposed Collector Line shall be shown.

Q. Horizontal station location of all manholes, deflection angles at manholes, angles to existing sewers and other system features shall also be shown for gravity Collector Lines. Horizontal station location of all clean-outs, relief valves, angles, tees and other system features shall also be shown for pressure Collector Lines.

R. North arrows shall be indicated on each sheet.

S. An Alabama registered Professional Engineer's seal, signature, and date shall be stamped on each sheet. An Alabama Registered Land Surveyor's seal, signature, and date may be required and affixed to each sheet that indicates right-of-way property boundaries.

T. Temporary Bench Mark elevations shall be based on U.S.G.S. Datum and properly identified on the appropriate sheets.

U. All notable topographic features, both existing and proposed, shall be shown. Examples include but are not limited to storm sewers, drainage ditches, creeks, utilities, etc. In profile, the existing ground shall be shown as a dashed line, and the proposed ground shall be shown as a solid line.

V. All property lines, subdivision block and lot numbers, rights-of-way and required or utilized easements shall be shown. Names of surrounding subdivision plats shall be shown or labeled as "unplatted" if the property has not been platted. All utility rights-of-way, both those to be dedicated by Record Map (or Plats) and those to be dedicated by recorded Deed shall be shown.

W. If rights-of-way are to be dedicated by Record Map, the following dedication shall be properly executed by Developer and notarized prior to recordation:

> OWNER: The undersigned OWNER hereby: (i) certifies to be the Owner of lands described by this record map and that this record map was prepared at the request of OWNER with intent to subdivide said lands into lots as described by this record map; (ii) transfers and conveys in fee free and clear of encumbrances to the Management Entity, its successors and assigns, or a trust established by the Management Entity, all existing and future sanitary sewer improvements, facilities and appurtenances, located or to be located on said lands and all sanitary sewer easements and rights-of-way as described by this record map, along with an access easement across adjoining lands from any point to the nearest public road right-of-way; and (iii) dedicates to the Management Entity, its successors and assigns, or the trust established by the Management Entity, all rights-of-way as described by this record map for public roads,

utilities, storm sewers and storm ditches for public and common use; and (iv) designates and describes all easements to run with the land and be available for use by the Management Entity or its successor. The above dedications, transfers and conveyances are subject to the following conditions and restrictions; (i) no excavation, filling, digging, boring, underground construction, or above ground permanent structure or other obstruction shall be permitted or located within the limits of any easement or right-of-way without prior written consent; and (ii) any easement and right-of-way may be used to serve property within and without this subdivision. In witness thereof, said OWNER executed these presents on the date described.

SOURCE OF TITLE: D.B. _____ PG. _____

by: _____ DATE: _____

OWNER"

X. All Record Maps to be approved and recorded shall contain the following authorization to be properly executed by the Management Entity representative prior to recordation if the Management Entity has been engaged by contract prior to development of the Record Map:

"THIS RECORD MAP IS APPROVED FOR RECORDATION:

_____, the certified Management Entity; (i) assents to the recordation of this record map by OWNER; and (ii) accepts the dedication, transfer and conveyance by OWNER of the Sanitary Sewer System, including all improvements, facilities, appurtenances, rights-of-way, easements and collection system as shown

By: _____ DATE: _____

MANAGEMENT ENTITY REPRESENTATIVE"

Y. Streets shall be shown and named.

Z. Service Line Connections to the Collector Line shall be shown and stationed by the Engineer, unless Connections to the Collector Line must be established in the field and approved by the Engineer once the structure has been selected and oriented for the lot.

AA. Each set of Drawings shall contain detail sheets that at a minimum show the following construction details: pipe installation or penetration details, embedment types, water line and road crossing details, details for connecting Service Lines to gravity and pressure Collector Lines, clean-out station assembly details, flushing station assembly details, typical grinder pump station, discharge piping and service valve station details, interceptor tank and pump tank details, isolation valve details, air/vacuum valve assembly details, service tap details, boring and pipe encasement details, thrust block details, precast manhole details, riprap details, silt fence details and other details as specified by the Engineer.

AB. Drawings shall state the Contractor shall furnish the Engineer with a video tape survey of the constructed sewers that meets the specifications of the Management Entity.

AC. CADD files detailing each of the above Drawings shall also be submitted on electronic media and format as designated by the Management Entity.

2.01-4 Rights-of-Way and Easement Deed Descriptions.

(1) Rights-of-way and easements required for Collector Lines, pumping stations and other sewer facilities to be dedicated to the Management Entity (or trust) shall be transferred as follows or the Management Entity shall be recognized as the benefitted party:

A. Rights-of-way may be described and transferred by Deed, or if located within a new single-family residential subdivision, transferred by Record Map. Rights-of-way not within the boundaries of said Record Map shall be described and transferred by Deed.

C. Rights-of-way for Commercial, churches and school properties shall be transferred by Deed.

D. The minimum recommended right-of-way width is twenty (20) feet, ten (10) feet each side of a gravity Collector Line centerline; right-of-way width for low pressure Collector Lines may be less by mutual agreement. Right-of-way descriptions shall be prepared utilizing field surveys (completed by a registered Professional Land Surveyor) of the land tie, properties being transferred, and the Collector Line alignment.

E. The Management Entity shall allow the grantor of a right-of-way to retain easements for surface rights allowing specified uses that do not interfere with the ownership and operation of the Sanitary Sewer System, on a case by case basis, and/or the Management Entity can be named as the beneficiary of any right-or-way or easement.

2.01-5 As-Built Drawings.

(1) Upon completion of construction, an actual ground survey may be required by the Management Entity where there have been substantial changes to the Construction Drawings during construction to verify location of the constructed facilities relative to the Construction Drawings.

(2) As-Built Drawings shall contain the following information:

A. As-Built Drawings shall reflect all changes made to the approved Construction Drawings and shall accurately show the actual sewer facilities that were installed.

B. The Engineer may require a video tape in addition to a Contractor's log to indicate the constructed location of all Sanitary Laterals and/or Service Lines that connect to the Collector Lines.

C. In general, As-Built Drawings shall have the same format and information, excluding notes, etc., required on the Construction Drawings in Section 2.01-3.

D. As-Built Drawings shall be submitted on 4-mil polyester 24" x 36" plan/profile drafting film with matte finish on both sides.

E. Plan and profile of constructed Sanitary Sewer Systems shall be on the same sheet, drawn at 1"= 50' horizontal and 1"=10' vertical scales and meet the same requirements for gravity and pressure Collector Lines as outlined for Construction Drawings in Section 2.01-3.

F. The following note shall be attached to the drawings:

"I (printed name) certify that this is a true and accurate sewer plan and profile map as field surveyed after construction.

_____ DATE:_____

Alabama Licensed Engineer

_____ Registration Number

G. CADD files detailing each of the above Drawings shall also be provided on electronic media and format as designated by the Management Entity.

(3) Two (2) complete sets of of hard-copy As-Built Drawings shall be delivered to the Management Entity.

SECTION 3 Design Guidelines for Gravity Sanitary Sewer Systems

3.01 Gravity Sanitary Sewer

3.01-1 General.

(1) Sanitary sewers are hydraulic conveyance structures that carry wastewater to a treatment plant or other authorized point of discharge. Groundwater and rain water from roofs, streets and other areas must be excluded from Sanitary Sewer Systems. A typical method of conveyance used in Sanitary Sewer Systems is to transport wastewater by gravity along a downward-sloping pipe gradient. Gravity Collector Lines are designed so that the slope and size of the pipe are adequate to maintain flow towards the discharge point without surcharging manholes or over-pressurizing the pipe.

Gravity Collector Lines shall be sized for the ultimate tributary population and Sewage volume and designed with straight alignment and uniform gradients to maintain self-cleansing velocities. Manholes shall be installed between and within straight runs of pipe to ensure that stoppages can be readily accessed.

While gravity Collector Lines are the most widely used method to collect and convey wastewater in municipal systems, they are not as widely used in Cluster and Community Wastewater System because of the volume of groundwater (infiltration) that can enter the gravity sewer through cracks or pipe separations over time. This excess water can represent up to 15-30% of the capacity of the conveyance system and can overload Collector Lines and, treatment plants and onsite dispersal systems. Infiltration can reduce the number of lots that can be served by a newly constructed Sanitary Sewer System. The Engineer must include a factor for infiltration in the system sizing and design.

(2) General Design Criteria.

Gravity Collector Lines are generally based on the following design criteria:

A. Long-term serviceability: The design of long-lived sewer infrastructure should consider serviceability factors, such as ease of installation, design period, useful life of the conduit, resistance to infiltration, corrosion and maintenance requirements. The design period or service life usually ranges from 30 to 50 years.

B. Design flow: Gravity Collector lines are designed to carry the ultimate Sewage volumes and peak flows, as well as some small percentage of infiltration and inflow. Gravity Collector Lines are designed to flow full at the design peak flow.

C. Minimum pipe diameter: A minimum pipe size is dictated in gravity sewer design to reduce the possibility of clogging. The minimum pipe diameter recommended for a gravity Collector Line is 8 inches but smaller pipe sizes may be used if solids separation or filtration is employed (e.g. residential septic tank) and approved by the Management Entity.

D. Velocity: The velocity of wastewater flow is an important parameter in Sanitary Sewer System design. A minimum velocity must be maintained to reduce solids deposition in the sewer under low flow conditions. The typical design velocity for low flow conditions is one foot per second (1ft/s). During peak dry weather conditions gravity Collector Lines must attain a velocity at least 2 ft/s to ensure that the lines will be self-cleaning (i.e., they will be flushed out once or twice a day by a higher velocity). Velocities higher than 10 ft/s should be avoided because they can cause erosion and damage to sewers and manholes.

E. Slope: Gravity Service Lines and Collector Lines must be adequately sloped to reduce solids deposition and minimize the localized production of hydrogen sulfide and methane.

F. Depth of bury: Depth of bury affects many aspects of sewer design. Slope requirements may drive the pipe deep into the ground, increasing the amount of excavation required and cost to install the pipe. Sewer depth generally averages 3 to 6.5 ft below ground surface. The proper depth of bury depends on the water table, the lowest point to be served (such as a ground floor or basement), the topography of the ground in the service area, the depth of frost line below grade and installation challenges and cost.

G. Appurtenances: Appurtenances include manholes, junction chambers or boxes and terminal cleanouts, among others.

3.01-2 Manholes.

(1) All manholes shall be designed in accordance with the following recommended guidelines, unless otherwise approved by the Management Entity:

A. Minimum inside diameter of manholes on gravity sewers shall be 48-inches.

B. Manholes shall be installed at the end of each pipeline, at all changes in grade, pipe size, alignment, and at intersections of gravity Collection Lines.

C. The maximum distance between manholes shall be 400 feet.

D. The maximum deflection angle of sewer alignment at manholes shall be 90 degrees.

E. For differences of in/out invert elevations greater than 2 feet, a Memphis Tee drop manhole shall be used. Drop manholes should be avoided where practical.

F. Bolt down frames and covers shall be required where the proposed manholes are subject to flooding.

G. Manhole boots are required for all sewer pipe penetrations

H. The minimum depth of manholes shall be 36-inches.

1. Cones shall be the concentric type. Flat slab and eccentric conical sections should not be used.

J. Manhole frame and covers shall be approved by the Management Entity.

K. Manholes deeper than twenty (20) feet require special design and approval by the Management Entity.

3.01-3 Pipe Material.

(1) Gravity flow Collector Lines shall be constructed of the following recommended types of pipe:

A. Gravity Collector Lines 8-inches and less in diameter shall be constructed of SDR-35 PVC pipe, except as specified below. SDR-35 PVC pipe shall be allowed where the slope is less than or equal to 10% and the cut is less than or equal to 12 feet. SDR-26 PVC pipe, Schedule 40 PVC or C-900 PVC pipe shall be allowed where the slope is less than or equal to 14% and the cut is less than or equal to 14 feet. Where the slope is greater than 14% or the cut is greater than 14 feet, Class-350 ductile iron pipe shall be used. Other pipe materials for gravity Collector Lines may be proposed but must be pre-approved by the Management Entity. "Cut" is defined as the vertical distance from the finished ground or surface to the invert of the pipe.

B. Ductile iron shall be used for Collector Lines crossing storm drains, creeks, or ditches or where a gravity Collector Line runs parallel to a storm drain. Any alternative shall be approved by the Management Entity.

C. In areas that have been filled and the proposed gravity Collector Lines will be buried in the fill, ductile iron pipe with restrained joints shall be used unless otherwise approved by the Management Entity.

D. Collector Lines requiring concrete bedding or encasement should be ductile iron pipe unless otherwise approved by the Management Entity.

3.01-4 Project System Layout.

(1) The Sanitary Sewer System layout begins by selecting an outlet, determining the sewer drainage boundary, locating any existing Service or Collector Lines and determining the need for and location of any pumping stations.

(2) The Engineer shall develop preliminary layouts on site topographic maps generally to slope in the same direction as streets and the ground surface. Collector Lines shall be located to serve all parcels of property.

(3) Collector Lines located along back property lines without alleys must have an easement or right-of-way access for construction, inspection, maintenance and repair.

(4) Easements or rights-of-way for Collector Lines must extend to the upper limits of the drainage basin of a particular property to be served.

(5) Collector Lines shall be constructed within the center of a dedicated easement or right-of-way that should have a minimum width of twenty (20) feet, unless otherwise approved by the Management Entity. When the easement or right-of-way is running parallel with a road right-of-way or property line, it shall extend to the road right-of-way or property line.

(6) Separation between Collector Lines and water mains shall be a minimum of five (5) feet horizontally. When crossing a water main, the top of the

sewer pipeline shall be a minimum of 18-inches below the bottom of the water main unless a casing is provided that extends five (5) feet horizontally from the centerline of the water main in each direction. The Collector Line cannot be installed in the same excavated ditch with a water main. More stringent requirements may be dictated by the local water utility or governmental entity but all variations shall be submitted to the Management Entity for review and approval will be considered on a case by case basis.

(7) Gravity collector Lines shall not run parallel under concrete curbs or gutters. To allow for maintenance, the minimum distance between the edge of the curb and centerline of a parallel gravity Collector Line shall be 4 feet. Variations from the above requirements shall be submitted to the Management Entity for approval to be considered on a case by case basis.

3.01-5 Depth of Gravity Collector Lines.

(1) Gravity Collector Lines shall be at such depth that they can receive flows by gravity from all Service Lines. Note: Basements and buildings on lots substantially below street level may require individual Residential Pump Stations to avoid deep Collector Lines. Residential Pump Stations in a Cluster and Community Wastewater System shall be owned and maintained in accordance to the individual Management Entity's Tariff and definition of Connection Point). The depth of Collector Lines along property lines should allow gravity Service Lines to be installed with a minimum slope of 1% from the building or Septic Tank on a STEG System. All Collector Lines shall have a minimum of 30-inches of cover in non-traffic areas and 36-inches in paved areas subject to vehicular traffic. Variations from the above requirements shall be submitted to the Management Entity for approval and to be considered on a case by case basis.

(2) Gravity Collector Lines to be constructed in fill areas shall not be installed until all areas to receive fill have been filled and properly compacted. The following note on the Construction Drawing shall be provided on each tangent of the sewer profile in areas of fill:

"Note: All areas to receive fill shall be filled and compacted according to Engineer's specifications prior to the installation of the sanitary sewer lines or any structures.'

3.01-6 Design of Gravity Collector Lines or Service Lines for Various Conditions.

(1) Minimum Velocities and Maximum Slope: At peak flow, the minimum velocity in the gravity sewer shall be 2 feet/second. Where required, gravity sewers on slopes greater than 15% shall be restrained to prevent separation of pipe joints. When using standard manholes, the maximum grade allowed is 15%. Any slope in excess of 15% requires special pipe restraints and special manholes that must be designed and submitted for pre-approval by the Management Entity. The Design Engineer shall make every effort to not exceed the 15% grade.

(2) Minimum Pipeline Grades: The minimum grade for gravity Collector Lines shall be as follows:

Nominal Pipe Diameter, Inches	Minimum Grade, In/Ft	Minimum Grade, Percent
3	1/4" per foot	2.0%
4	1/4" per foot	2.0%
6	1/8" per foot	1.0%
8	1/16" per foot	0.5%

(3) Open Cuts: In as much as the load imposed on a sewer pipe built in open cut is a function of the bedding, trench width, backfill material and superimposed load on the ground surface, proper consideration must be given to all of these elements by the Design Engineer.

(4) Tunnel and Cased Bores: Where sewer pipes cross roads, railroads, highways or require trenchless installation under the ground surface, tunnels or cased bores may be required. If a tunnel or boring is required, it must be designed and submitted to the Management Entity for approval prior to construction and installed accordingly.

3.01-7 Small Diameter Gravity Sewers.

(1) The following considerations shall be used for the design of small diameter gravity Sanitary Sewer Systems and Collector Lines. Note: Small diameter gravity Collector Lines shall only receive sewage that has been treated to remove suspended solids.

A. No gravity Collector Line or Service Line shall be less than 3 inches in diameter without prior approval of the Management Entity.

B. Since the small diameter gravity sewers may be conveying anaerobic septic tank effluent which could be corrosive and odorous, the pipe and treatment hardware shall be manufactured of suitable materials to tolerate these adverse conditions. Acceptable pipe materials include ABS, PVC and polyethylene as approved by the Management Entity. Concrete, asbestos cement, steel, iron, bituminous-fiber and other metals should not be used.

C. Small diameter gravity sewers conveying partially or fully treated wastewater are acceptable if they are designed and constructed to provide mean velocities, when flowing full, of not less than 1.5 feet per second based on Manning's formula using an "n" value of 0.013. The minimum slope of small diameter sewer pipe shall be as specified in Section 3.01-6(2)

D. Septic tanks shall be properly sized by the Engineer to achieve settled sewage characteristics where the septic tank manufacturer will guarantee

effluent lines can be installed with slopes less than those shown in Section 3.01-6(2).

E. It is preferable that cleanouts and manholes be alternated at a spacing of approximately 200 to 250 feet; however, cleanouts may be allowed at dead-ends and intervals of 300 feet where long stretches of pipe are installed in a straight alignment.

F. Manholes shall be provided at the junctions of two or more small diameter gravity Collector Lines or Services Lines. Manhole and cleanout covers shall be watertight due to grit and inflow problems experienced with conventional covers. Manholes and cleanouts shall be located where they will be least susceptible to damage and vandalism.

G. Drop-type manholes shall be avoided where anaerobic conditions exist. Gases generated in the septic tank under anaerobic conditions can be odorous, toxic and/or flammable; consequently, the creation of turbulence from the free fall of tank effluent will enhance the release of gases.

H. Special consideration shall be given to protect sewage in small diameter gravity sewers from freezing due shallow depths susceptible to frost penetration.

3.01-8 Pumping Stations and Force Mains in Gravity Sanitary Sewer Systems, General.

(1) Because of the continuous costs of maintenance, operation and utilities, the installation of a pumping station and force main should be considered only as a last alternative to gravity sewer service. However, the Engineer must also take into consideration that gravity sewers allow I/I to take up capacity in sewer system and treatment facilities that would otherwise be available for the conveyance and treatment of Sewage from customers. Pumping stations and force mains should be designed and constructed according to specifications in Section 8 of this document.

3.01-9 Service Lines.

(1) Gravity Service Lines shall be installed to properly serve each house or building and each vacant lot facing or abutting the Collector Line easement or right-of-way, and at such other locations as may be required in a Cluster and Community Wastewater System.

(2) Gravity Service Lines shall be designed to connect at one end to a tee in the Collector Line and extend to the Septic Tank in a Decentralized Sanitary Sewer System (STEG System) or the building in a conventional gravity Sanitary Sewer System on the other end. When installed on vacant lots, the Service Line shall extend to a point just beyond the easement or right-of-way line from the Collector Line to facilitate connection of the Service Line to the Septic Tank or the building when installation is required Service Line connections to a manhole may be approved by the Management Entity on a case by case basis.

SECTION 4 Construction Specifications for Gravity Collection Lines

4.01 Gravity Collection Lines

4.01-1 Site Preparation.

(1) Before starting installation of a Collector Line, the Contractor shall remove all vegetative growth, debris and other objectionable matter standing or lying on the surface within the limits of the areas to be excavated or filled; and shall demolish and remove any buildings and other structures as designated on the Construction Drawings.

(2) The Contractor shall comply with Engineer's requirements and all local, County and State regulations regarding site preparation, pollution, burning permits, erosion control and storm water runoff.

4.01-2 Excavation.

(1) Excavation for Collector Lines shall consist of the excavation necessary for installation of the pipelines and all appurtenant facilities including manholes, pipe bedding, and pipe protection as called for on the Construction Drawings. Excavation shall include clearing and grubbing, where necessary, backfilling and tamping of pipe trenches and around structures, and the disposal of waste materials. The Contractor shall comply with all federal, state, and local safety rules and regulations, including those of OSHA, that apply to excavations. The Management Entity shall not be responsible for inspection for compliance with safety regulations, and disclaims any responsibility for the safety of workers during construction of a Sanitary Sewer System.

(2) The bottom of a trench shall be level in cross-section and shall be cut to the depth necessary to place the bedding and install the gravity pipe to design grade as shown on the Construction Drawings.

(3) For bell-and-spigot pipe, bell holes shall be excavated at proper intervals so that the barrel of the pipe will rest its entire length upon the bedding material.

(4) The bottom of the excavation for manholes and other structures shall be true to the required shape and elevations shown on the Construction Drawings. Should the Contractor excavate below the elevations shown or specified, the Contractor shall fill the void thus made with approved pipe bedding material. No earth backfilling shall be permitted under pipes or structures, unless specifically shown on the Construction Drawings and approved by the Management Entity.

(5) When soft clay, swampy, or other materials unsuitable for foundations or sub-grade are encountered which extend below the limits of the excavation, such material shall be removed and replaced with specified crushed stone, thoroughly compacted and inspected by the Design Engineer the Management Entity. The Management Entity shall have the final decision on whether material is unsuitable for sub-grade and shall determine the gradation of the crushed stone on a case by case basis.

(6) Where excavations are made adjacent to existing buildings or other structures or in paved streets or alleys, the Contractor shall take particular care, subject to OSHA regulations, to sheet, shore and/or brace the sides of the excavation adequately so as to prevent any undermining of or settlement beneath such structures or pavement.

(7) Sheeting, shoring, or bracing materials shall be removed before backfilling unless otherwise directed by the Engineer. Such materials shall be removed in a way that will not endanger or damage the new structure or any existing structures or property in the vicinity, either public or private, and so as to avoid cave-ins or slides. Trench sheeting and bracing shall not be removed until the trench has been backfilled one (1) foot above the top of the pipe.

(8) Where the excavation area shown on the Construction Drawings falls under the water surface or near the banks of a flowing stream or other body of water, the Contractor may adopt and carry out any method he may deem feasible for the performance of the excavation work and for the protection of the work thereafter; provided that the method and equipment to be used have received prior approval of the Engineer, the Management Entity and any regulatory body with jurisdiction. In such cases, the excavation area shall be protected from damage during the excavation period and until all of the contemplated construction work has been completed to the satisfaction of the Engineer and Management Entity.

(9) Rock encountered in trench excavation for Collector Lines shall be removed for the overall width of the trench and to a depth below the bottom of the barrel of the pipe as shown on the Construction Drawings. The space excavated below the barrel (and bell) of the pipe shall be backfilled with pipe bedding, as specified by the Engineer. All overshot rock must be removed by the Contractor before placing the bedding. If the Contractor excavates below the required trench bottom, the excess space must be filled with crushed stone approved by the Engineer and the Management Entity.

4.01-3 Pipe Bedding.

(1) A 4-inch cushion of crushed stone shall be provided under all gravity Collector Lines, unless otherwise approved by the Management Entity. Pipe bedding material shall meet the requirements of the Engineer. Pipe bedding shall be placed below the barrel of the pipe, across the full width of the trench and compacted to the exact grade for the full length of the pipe barrel and for the full width of the trench before each pipe section is installed.

4.01-4 Pipe Installation.

(1) The Contractor is responsible for accurately placing pipe to the line and grade shown on the Construction Drawings. The control of vertical and horizontal alignments shall be accomplished ideally by using a laser beam instrument. When a laser is used, the elevation and alignment of the pipe shall be checked by transit and level rod at the first joint out of a manhole, and then every 50 feet. Other approved methods of controlling vertical and horizontal alignments may be used if specifically authorized by the Engineer and approved by the Management Entity. All pipe shall be installed in accordance with the Standards and Specifications herein and the recommendations of the manufacturer. The

practice of bumping or snatching (with a backhoe on crane, etc.) to adjust the pipe after placement in the trench shall not be permitted.

(2) Each section of pipe (and any fittings) shall be carefully inspected before it is backfilled. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells up the hill. Trench bottoms found unsuitable for foundations shall be undercut and brought to exact line and grade with pipe bedding, concrete cradles, or crushed stone as shown on the Construction Drawings or as directed by the Engineer.

(3) For bell and spigot pipe, bell holes shall be of sufficient size to allow ample room for properly making the pipe joints. Bell holes shall be cut not more than five (5) joints ahead of pipe-laying. The bottom of the trench between bell holes shall be carefully graded so that the pipe barrel will rest on a solid foundation over its entire length. Each joint shall be laid so that it will form a close concentric joint with adjoining pipe and to avoid sudden offsets or inequalities in the flow line.

(4) Water in the trench shall not be above the pipe bedding while pipe installation is in progress or before the trench has been backfilled. The Contractor shall not open at any time more trench than his available pumping facilities can de-water. Movement of water that would tend to erode or affect the trench walls shall not be allowed. Under no circumstances shall trench water be allowed to drain into the Sanitary Sewer System.

(5) As the work progresses, the interior of all pipe in place shall be thoroughly cleaned. After each line of pipe has been installed, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the pipe interior.

(6) Backfilling of trenches shall start immediately after the pipe is in place and the pipe and joints have been inspected and approved by the Engineer or his/her designated inspector.

(7) Deflection tests shall be performed on all flexible pipe at least 30 days after final backfilling. No pipe shall exceed a deflection of 5%; excess deflection will require replacement of correction as specified by the Engineer. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95% of the inside diameter of the pipe, unless otherwise approved by the Engineer.

(8) Contractor shall install toning wire and/or tracing tape as specified by the Engineer.

4.01-5 Pipe Joints.

(1) For bell and spigot pipe, the inside of all bells and the outside of all spigots shall be wiped to remove dirt, water, or other foreign matter so that their surfaces are clean and dry when the pipes are joined.

(2) Joints on ductile iron and C-900 PVC and SDR-PVC sewers shall be gasketed compression joints, and shall be installed according to the pipe manufacturer's specifications and recommendations.

(3) Leakage tests shall be specified by the Engineer (refer to Section 7 for the details on approved test procedures). Any leaks or defects discovered after completion of work shall be repaired immediately by removing and reinstalling the failed section(s). All pipe in place shall be carefully protected from damage until backfilling operations have been completed. Any pipe that has been disturbed after jointing shall be taken up, the joint cleaned and re-made and the pipe reinstalled and inspected, as directed by the Engineer or Management Entity.

4.01-6 Trench Backfill.

(1) No backfilling of pipe trenches shall be started until the work has been inspected and approved by the Engineer's inspector. Upon said approval, the pipe trench shall be immediately backfilled. Backfill material as specified in these Standards and Specifications shall be carefully deposited. Care shall be taken to insure that material under haunches of pipe is consistently placed.

(2) Where pipe trenches extend along or across paved streets, roadways, alleys or sidewalks, the Contractor shall obtain approval and conform to the requirements of the local government having jurisdiction over the paved surface.

(3) For trenches that do not extend along or across paved streets, roadways, alleys or sidewalks, backfill material from a height of one (1) foot above the top of the pipe upward will not require tamping unless specified by the Engineer.

(4) Where excavation has been confined within the limits of easements across private property, the surface backfill material shall consist of fine, loose earth free from large clods, vegetable matter, debris, stones, and/or other objectionable materials, unless rip rap is required for erosion control.

(5) Where tamping is not required for the full depth, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation of the backfill material. Any additional quantities of materials for backfilling trenches or filling depressions caused by settlement shall be supplied by the Contractor.

(6) Backfilling around structures located in paved streets shall be done utilizing stone, as approved by the Engineer on a case by case basis.

(7) Backfilling shall be done in such a manner as will not disturb or damage the pipe. Any pipe injured, damaged, or moved from its proper line or grade during backfilling operations shall be replaced or repaired, inspected and then re-backfilled as herein specified.

(8) The Contractor shall replace all surface material and restore paving, curbing, sidewalks, gutters, and other disturbed surfaces, to a condition equal to that before the work began, and in accordance with the local government having jurisdiction.

(9) Backfill materials and backfilling shall meet the requirements of the Engineer and shall be as indicated on the Construction Drawings.

4.01-7 Disposal of Materials.

(1) All materials removed by excavation that are suitable, according to the Engineer, may be used for backfilling and such other purpose as may be shown on the Construction Drawings. All materials not used for such purposes shall be considered waste materials and disposed of by the Contractor in an approved manner off-site.

(2) Upon completion of any part of the work, proper disposal shall be made of all surplus or unused materials left within the construction limits of such work and the surface of the work left in a neat and workmanlike condition.

4.01-8 Construction Sequence Constraints.

(1) Sections of Collector Lines under construction upstream of an existing or recently accepted Collector Line shall be kept isolated, by means of a plug or semi-permanent bulkhead, until the section under construction has been fully tested and accepted by the Inspector and Engineer. The plug or bulkhead may be removed only with the permission of the Management Entity.

(2) New sections of gravity Collector Lines shall be constructed, when feasible, from the lower end to the higher end so that testing and acceptance can proceed in a logical sequence and new sections placed into service when accepted.

(3) Service Line Connections shall not be made and wastewater shall not be discharged into any section of a Collection Line upstream of uncompleted or unaccepted sections, unless special arrangements have been made and pre-approved in writing by the Management Entity

4.01-9 Service Lines.

(1) A Service Line shall be installed and connect to the Collector Line at points shown on the approved Construction Drawings.

(2) Service Lines for vacant lots shall consist of pipe materials and sizes shown on the Construction Drawings and shall be installed from a Tee in the Collector Line to a point just beyond the Right-of-way line or easement of the Collector Line. Service Lines may connect to a manhole for gravity systems on a case by case basis as approved by the Engineer and the Management Entity.

(3) The open end of all Service Lines for vacant lots shall be closed with approved caps or stoppers and properly restrained and it shall be the responsibility of the Contractor to properly mark the location of the open end of all Service Lines to prevent damage while construction on a lot is underway.

(4) During construction the Contractor shall maintain for every sewer reach a record log of the lengths to each Service Line Tee, as measured and recorded by the Contractor prior to backfilling. The Contractor shall obtain a video tape survey of the constructed sewer, which shall contain all information specified by the Engineer. The video tape and Contactor's log shall be furnished to the Engineer to be utilized in preparation of As-Built Drawings and then turned over to the Management Entity once the system has been accepted.

4.01-10 Manholes.

(1) General: Manholes shall be constructed to the sizes, shapes, dimensions and locations as detailed on the Construction Drawings and meet the requirements of ASTM C-478. The cover (or lid) shall be at the finished grade of the pavement or ground surface or for undeveloped or rural areas, at a height above ground surface as specified by the Engineer. Eccentric cone sections shall not be used unless approved by the Management Entity.

(2) Assembly: Manholes shall be assembled with the fewest number of sections to makeup the required height. The use of more than one 16-inch riser section per manhole is prohibited. Where the top section of a manhole is less than 1 foot, it shall be approved by the Engineer. The top of a manhole shall extend 2 feet above the 100 year flood elevation or be provided with an approved sealed cover and vented.

(3) Openings: Openings in manhole walls for incoming and outgoing Collector Lines shall be precast or cored at the manufacturing facility. Bases shall be set on a foundation of compacted crushed stone, 12-inch minimum thickness, covering the entire bottom of the excavation, as shown on the Construction Drawings.

(4) Connections: Flexible manhole sleeves ("boots") are required on all pipe 12-inches and smaller. The boots shall conform to ASTM C-923. Boots shall be secured to pipe by a stainless steel clamp and bolt assembly conforming to ASTM C-923. The space between the pipe and manhole opening shall be filled with non-shrinking grout material inside and outside the boot.

(5) Joints: All joints for pre-cast manhole stacks shall be made as shown on the Construction Drawings, offset tongue and groove type with pre-lubricated gaskets. Gaskets shall meet the requirements of ASTM C-443, latest revision. Each joint shall also be sealed with waterstop sealant. The width and installation of the joint sealant shall be made in accordance with the manufacturer's recommendations.

(6) Invert Elevation: When the difference in invert elevation of two sewer pipes entering a manhole is greater than 6-inches, a standard length of ductile iron pipe shall be installed in the upstream reach to bridge the fill area between the manhole and the undisturbed pipe trench to match invert elevations of the two pipes. Where the difference in the invert elevation of two or more sewers smaller than 12 inches in diameter and intersect one (1) manhole is 2 feet or more, a Memphis Tee Manhole (drop manhole) shall be constructed. Memphis Tee Manholes shall be similar in construction to the standard manhole, except that a drop connection of a pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by Class-A concrete. The manhole and drop connection shall be placed on a concrete foundation base as specified by the Engineer. The drop connection piping assembly shall be bolted to the barrel of the manhole riser using suitable stainless steel (316) bolts and washers to prevent failure caused by pulling the bolt head through the manhole wall.

(7) Inverts: Manhole inverts shall be constructed of cement mortar and brick and shall have the same cross-section as the invert of the sewers they

connect. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the manhole shall be made to a true curve with as large a radius as the size of the manhole will permit.

(8) All water standing in the trench shall be removed before placement of the manhole foundation base is started. The foundation shall be maintained in as dry a condition as possible.

(9) Manholes that are deeper than 36 inches shall have steps. Manhole steps shall be press set plastic, or approved equal. Steps on the outside of the manhole may be specified by the Engineer when the top elevation of raised manholes is more than 3 feet above final grade level.

(10) All manholes shall be tested as specified by the Engineer. Refer to Section 7 of this document for testing procedures.

(12) Manhole frames and covers shall be provided and installed as follows:

A. Manhole covers and frames shall conform to the specifications of the Engineer and all referenced standards, requirements of the manhole manufacturer, and appropriate industry standards.

B. If not otherwise indicated on the Construction Drawings, manhole covers shall be standard, non-bolted type, with perforations and marked “Sewer”.

C. The top elevation of manhole frames must be adjusted to grade as shown on the Construction Drawings. A maximum adjustment of 16-inches will be allowed using brick and mortar.

D. Manhole frame and cover shall be prepared and installed according to the manufacturer’s recommendations. All gaskets shall be checked and missing gaskets replaced.

E. Manhole covers shall be checked for proper fit in the frame; if the fit is excessively loose or tight in the frame, or rocks, wobbles, or otherwise moves in the frame, the frame and cover shall be removed and replaced by the Contractor.

4.01-11 Concrete Work.

(1) All concrete shall be premixed (“Ready Mix”) in accordance with ASTM C-93, delivered and ready to cast-in-place.

A. Class-A: Ready Mix concrete shall have a 28-day minimum compressive strength of 4,000 pounds per square inch, and is generally reinforced, cast-in-place in forms for foundations, pipe collars, footings, piers, head walls, manholes, amid similar structures.

B. Class-B: Ready Mix concrete shall have a 28-day minimum compressive strength of 3,000 pounds per square inch, and is generally not reinforced and cast-in-place unformed for trench bottom stabilization, pipe protection, anchors, massive sections and similar work.

(2) After concrete has been placed, it shall be protected against the loss of moisture and from damage from other adjacent construction operations.

4.01-12 Special Construction.

(1) Where the work requires special or any extraordinary conditions, the materials and construction methods shall be as shown on the Construction Drawings or specified by the Engineer and approved by the Management Entity.

4.01-13 Right-of-way and Easement Clean Up and Grassing.

(1) After the manholes and Collector Lines are installed and backfilled and a sufficient amount of time has elapsed for the backfill to settle, the disturbed area shall be machined to a smooth surface matching the adjacent or adjoining ground surfaces and the ground profile on the Construction Drawings. A vegetative cover shall be established for erosion control as required by the Engineer.

4.01-14 Special Slope Protection, General.

(1) Areas to receive rip rap, or special slope protection materials, shall be graded to the lines and slopes shown on the Construction Drawings, or as directed by the Management Entity. Any loose material shall be compacted. No rip rap shall be placed on a slope greater than 1:1.

(2) Stone for rip rap shall be of the size and weight designated by the Engineer. In addition, the stone shall be durable and of a suitable quality to insure permanence in the structure and in the climate in which it is to be used. It shall be free of cracks, seams, and other defects that would unduly increase its deterioration from natural causes. Not more than 3 percent of the stone shall have shale seams, which would separate when exposed to weathering. The inclusion of objectionable quantities of dirt, sand, clay or rock fines will not be permitted.

SECTION 5 Design Guidelines for Low Pressure Collection Systems

5.01 Low Pressure Collection System

5.01-1 General.

(1) Cluster and Community Wastewater Systems generally utilize small diameter gravity or low pressure Sanitary Sewer Systems. The difference between the small diameter gravity and small diameter low pressure Sanitary Sewer System is that the latter requires a pump to create the pressure and this pressure rather than gravity moves Sewage through the sewer system. The low pressure Sanitary Sewer System may use a Septic Tank to first settle the solids and a centrifugal or vertical turbine pump to pump the Sewage through the Sanitary Sewer System. The Septic Tank with pump may be referred to as an Interceptor Tank in this document to distinguish it from a stand-alone Septic Tank without a pumping system. An accepted alternative to Interceptor Tank and pump is a simplex pump station with a grinder pump to force "ground-up" Sewage through the Collector Line. A low pressure system with the Septic Tank is referred to as the "STEP System", where STEP is an acronym for Septic Tank Effluent, Pressure; the small diameter gravity Sanitary Sewer System using Septic Tanks is referred to as the "STEG System", where STEG is an acronym for Septic Tank Effluent, Gravity. The low pressure system with the grinder pumps is generally referred to as the "Grinder System". Both the Interceptor Tank and the grinder pump station are referred to as the Residential Pump Station in this document.

(2) The Collector Lines for STEP and Grinder Systems have the same design criteria and utilize the same pipe sizes, materials, construction approaches and appurtenances. The key advantages of the STEP and Grinder Systems relative to the conventional gravity Sanitary Sewer System are that they require the less expensive small diameter pipe for Service Lines and Collector Lines, the installation costs are generally lower and ground water infiltration is not a factor.

5.01-2 Sanitary Laterals.

(1) All wastewater from the building or premises in a low pressure collection system must first enter the Residential Pump Station. The Sanitary Lateral is the section of pipe between the building wall that connects to the interior sanitary plumbing and the Residential Pump Station on the outside of the building.

(2) Sanitary Laterals shall be a minimum 4-inch diameter pipe laid on no a less than 1 percent slope. This raw wastewater connection pipe my be made of cast iron, ABS, HDPE, or PVC, as approved by the Engineer.

(3) Sanitary laterals without a Residential Pump Station are found in gravity sewer systems and in such systems may also be referred to as the Service Line. The Engineer shall specify the type and location of a clean-out for all such Sanitary Laterals, however, the Engineer may specify a clean-out for Sanitary Laterals that connects to a Residential Pump Stations under some circumstances.

5.01-3 Residential Pump Station.

(1) As indicated, the Residential Pump Station may be an Interceptor Tank (e.g. septic tank with an effluent pump) or a grinder pump station. Each is discussed separately below. The Residential Pump Station provides the pressure to move the sewage through the low pressure collection system. The selection of either pumping system is determined by a number of factors, including but not limited to the type of wastewater biological treatment system being utilized, the grade and availability of space on a lot, local regulatory requirements, costs, and preferences of the developer and/or the Management Entity.

(2) The Connection Point for the Cluster and Community Wastewater System with a Residential Pump Station will be defined by the Management Entity's Tariff. The operation and maintenance responsibilities of the Management Entity begin at the Residential Pump Station and end at the dispersal field, unless otherwise specified in the Management Entity's Tariff.

(3) All Residential Pump Station shall take into consideration the following design features:

A. Residential Pump Stations shall not be located where the station is subject to damage by flooding and final grading shall divert water away from the station.

B. No more than one (1) single family dwelling (or building with equivalent flow) may be connected to a single Residential Pump Station.

C. Residential Pump Stations shall be designed and installed to overcome damage from buoyancy forces from high groundwater conditions.

D. There shall be no physical connection between any potable water supply and a Residential Pumping Station and the required distances between potable water lines and sanitary lines shall apply.

E. The location and elevation of a Residential Pump Station shall be appropriate for the building's interior plumbing to avoid flooding from Sewage backing up in the building due to a failure of the Residential Pump Station. The location shall also comply with all applicable local, state and federal codes or regulations.

F. Provision must be made for emergency storage or removal of raw sewage in the event of an extended power outage or an electrical or mechanical failure of the Residential Pump Station. This may include an emergency generator, an overflow storage tank or other physical options, approved by the local or State health department, or standard procedures employed by the Management Entity in such emergencies. Also, the Engineer shall provide notes on the Construction Drawings that specify the Management Entity's emergency plan of action to deal with an extended power outage at a development (e.g. Management Entity will use a septic trucks to haul sewage or Management Entity will use a portable generator to energize pumps if power is lost for 48 hours). The equipment or procedures specified shall be consistent with the emergency plan.

F. Safety. Covers for tank access and electrical equipment shall be designed for the anticipated loads and shall be bolted or locked to keep children or pets from opening the covers and being injured.

5.01-4 Interceptor Tank Criteria.

(1) The Interceptor Tank shall be installed at a location and elevation as approved by the Engineer and the Management Entity, be water tight, have a minimum of 2-compartments and be sized for hydraulic retention period equal to twice the daily design flow of Sewage from the building.

(2) All Interceptor Tanks shall comply with requirements specified in Section 9 of this document and the design and construction shall be preapproved by the Engineer and Management Entity.

(3) All Interceptor Tanks shall be fitted with risers, lids and an effluent filter that meets the specifications of the Engineer.

(4) All Interceptor Tanks shall have rubber boots molded into the tank for inlet and outlet, all proper equipment and appurtenances, including electrical controls and alarms, as specified by the Engineer and approved by the Management Entity, for a fully operational pumping system to deliver effluent from the Interceptor Tank through the Service Line and the Collector Line(s) to the designated termination point.

(5) All Interceptor Tanks, including risers, lids, pumps and electrical controls shall be installed according to the Engineer's Drawing or specifications and shall satisfy all local, State and Federal plumbing, electrical and safety codes. All control panels shall be UL approved.

(6) All Interceptor Tanks shall be delivered with installation and operation manuals and carry a minimum warranty period of 12 months unless otherwise approved by the Management Entity.

5.01-5 Interceptor Tank Testing and Quality Control.

(1) All Interceptor Tanks with a capacity of less than 2500 gallons shall demonstrate to the Engineer and Management Entity that the design and construction technique employed are sufficient to ensure that each such tank meets or exceeds the structural, water-tightness and concrete specimen testing protocols set forth in Section 9 of this document.

(2) All Interceptor Tank effluent pump packages shall be first operated with water to demonstrate to the Engineer and Management Entity that the pump starts, stops, alarms and operates in accordance with the manufacturers' recommendations and as required for the particular site and system conditions, as specified by the Engineer.

5.01-6 Grinder Pump Stations.

(1) The grinder pump station shall be a complete package consisting of a tank or basin, pump, equipment and appurtenances, including all electrical controls and alarm systems, as specified by the Engineer and preapproved by the Management Entity. The grinder pump station shall be a fully operation pumping system to deliver effluent from the grinder pump station through the Service Line and the Collector Line(s) to the designated termination point when properly designed and installed.

(2) Each separate single family residence shall have a dedicated simplex grinder pump station. Apartment buildings and commercial buildings shall have duplex grinder pump stations, as specified by the Engineer.

(3) The basin for the grinder pump and all pump station components shall be installed at the location and elevation as specified by the Engineer and as approved by the Management Entity and in compliance with the local regulatory agency with jurisdiction. The basin shall be more than 5 feet and less than 20 feet from the building being served unless approved by the Engineer.

(4) Simplex grinder pump stations shall have a minimum of diameter of 2 feet and a depth of 4 feet, unless a larger size with a larger storage reservoir capacity is specified by the Engineer. The size and reservoir volume of duplex grinder pump stations shall be determined by the Engineer.

(5) All grinder pump station packages shall satisfy all local, State and Federal plumbing, electrical and safety codes. All control panels shall be UL approved.

(6) All grinder pump station packages shall be delivered with installation instructions and operation manuals and carry a minimum warranty period of 12 months, unless otherwise approved by the Management Entity.

(7) The Contractor shall demonstrate to the satisfaction of the Inspector that there is no infiltration or exfiltration at the grinder pump station or on the inlet and outlet piping of the grinder pump station.

5.01-7 Service Lines.

(1) Service Lines connect the Residential Pump Station to the Collector Line.

(2) Service Lines shall be constructed of Class 200 SDR 21 PVC pipe, SCH 40 PVC or DR 11 HDPE (PE) pipe or other pipe with equivalent characteristics and performance as approved by the Engineer and the Management Entity. Ductile iron and concrete pipe are not acceptable options due to the corrosive nature of anaerobic effluent from the Interceptor Tank.

(3) All joints shall be restrained. Compression fittings are not acceptable.

(4) The minimum pipe diameter for Service Lines shall be 1¼ inches, unless otherwise approved by the Engineer.

(5) The diameter of the Service Line shall not be greater than the diameter of the Collector Line.

(5) The minimum depth of the Service Line shall be 12 inches unless otherwise approved by the Engineer.

(6) To eliminate backflow of sewage from the pressurized Collector Line onto the property due to a break or failure of the Service Line, a non-clogging check valve shall be installed on the Service Line in a standard meter box installed on the lot at the edge of the property or right-of-way or easement for the Collector Line. A shut-off valve (a fully closing gate or ball valve) shall also be installed on the Service Line in the meter box between the check valve and the Collector Line.

The meter box shall be installed with the top of the meter box set at final grade for easy access for operation and repairs. The meter box shall be located as shown on the Drawings and meet the specifications of the Engineer.

5.01-8 Service Line and Collector Line Connection.

(1) The Service Line shall be connected to the Collector Line at a tee or a tapping saddle on the Collector Line, as specified by the Engineer and shown in the Construction Drawings.

(2) The connection of the Service Line to the Collector Line shall be inspected and approved by the Inspector prior to backfilling.

5.01-9 Low Pressure Collector Lines.

(1) All proposed low pressure collection systems, including force mains and appurtenances shall be designed and tested to conform to potable water line criteria and the following minimum requirements, unless otherwise specified by the Engineer and approved by the Management Entity. All Collector Line pipes shall be new Class 200 SDR 21 PVC pipe, SCH 40 PVC or DR 11 PE pipe or other pipe as approved by the Engineer. The pipe shall be properly labeled to avoid confusion with potable water pipes. Used pipe shall be rejected.

(2) At the design pumping rates, a cleansing velocity of at least 2 feet per second should be maintained in Collector Lines. The minimum size Collector Line for a low pressure system shall be 2 inches in diameter. Friction losses through force mains shall be based on the Hazen Williams formula or other approved industry standard. When initially installed, force mains will have a significantly higher “c” factor and the “c” factor should be specified by the Engineer.

(3) Low pressure Collector Lines shall be installed at a minimum depth to top of pipe of 30” unless otherwise approved by the Engineer and Management Entity. The low pressure system shall avoid “loops” or parallel pumping segments.

(4) Air relief valves shall be placed at locations specified by the Engineer at high points in the force main to prevent air locking. The Engineer shall also specify vacuum relief valves where necessary to relieve negative pressure that may damage the Collector Line.

(5) Flushing stations and cleanouts shall be specified on Collector Lines at maximum intervals of 1,000 feet on straight runs, where two or more Collector Lines mains come together, at terminal ends or as the Engineer determines to be necessary. The clean-outs shall be shown on the Construction Drawings and installed in accordance with the Engineer’s details and specifications.

(6) Where low pressure Collector Lines connect to a gravity collection system, the force main shall not enter the receiving manhole more than 2 feet above the flow line and more than 4 inches inside the manhole.

(7) Separation of low pressure Collector Lines and potable water mains shall be the same as specified for the separation of gravity sanitary sewer lines and potable water lines (Refer to Section 3.01-4(6) Project System Layout)

(8) Thrust blocks shall be sized and installed at locations shown on the Construction Drawings. The force main and fittings, including reaction blocking, shall be designed to withstand normal pressure and pressure transients or surges (water hammer) expected for each specific Collector Line.

(9) Low pressure Collector Lines shall be installed with locating wire and detectable metallic underground tape. Unless otherwise specified by the Engineer, locating wire shall be 8 gauge, coated copper wire and 3" detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket and labeled "Caution Buried Sewer Lines Below", or equal. The toning wire and detection tape shall be installed as specified by the Engineer. Toning wire shall provide a continuous circuit from one end of the collection system to the other and from the Point of Connection to the Collector Line on each lot.

SECTION 6 Material Specifications for Low Pressure Collector Lines

6.01 Low Pressure Pipe

6.01-1 Materials.

1 All material used in the construction of Collector Lines shall be new and unused, and as approved by the Engineer.

2 All Collector Lines shall be constructed of the types of pipe specified by the Engineer and Management Entity.

3 At points on the Collector Line where a change in pipe material is shown on the Construction Drawings, the Contractor must make the transition at a pipe joint.

6.01-2 Ductile Iron Pipe.

(1) Ductile iron pipe shall be centrifugally cast and manufactured and tested in accordance with ANSI/AWWA C-151/A-21.51, latest revision. Pipe class (wall thickness) shall be as indicated in the Construction Drawings. The minimum thickness for ductile iron pipe 12-inches or less will be Pressure Class-350.

(2) All ductile iron pipe and fittings shall have a cement-mortar lining of standard thickness conforming to the requirements of ANSI/AWWA C-104/A-21.4 and a standard bituminous outer coating unless otherwise specified by the Engineer and approved by the Management Entity. The exterior of all pipe shall bear the manufacturer's name or trademark, the year produced, and the letters "DI" or the word "Ductile".

(3) Joints for ductile iron pipe shall conform to ANSI/AWWA C-111/A-21.11.

(4) Restrained joints for ductile iron pipe shall be the push-on type with restraint systems approved by the Engineer. Gaskets shall be rated for 250 psi.

(5) Unless otherwise specified, mechanical joint fittings shall be used for all pipe types. Ductile iron fittings for mechanical joint pipe shall be designed for the same working pressure, laying conditions and cover as the pipe used. Joints shall be standard mechanical joints.

(6) The joining of push-on joint ductile iron pipe shall be performed in accordance with the installation instructions of the manufacturer of the particular joint furnished.

(7) All ductile iron pipe and fittings shall be new. Pipe and fittings stored by the developer or Contractor will not be accepted unless inspected and approved by the Management Entity.

6.01-3 PVC Pipe.

(1) All PVC pipe for gravity or pressure Collector Lines shall be manufactured and conform to the requirements of ASTM specifications D-3034 and ASTM D-1784. Schedule 40, SDR 21 and C900 PVC pipe are most commonly used for low pressure Collector Lines. When C900 PVC pipe is selected for low pressure systems, it shall be manufactured and conform to AWWA C-900 specifications. The Engineer shall specify and identify the pipe class on the Construction Drawings to meet local conditions, such as: soil characteristics, heavy external loadings, abrasion, and similar problems.

(2) All PVC pipe shall be solid wall and marked with manufacturer's name, production lot number, ASTM designation and nominal diameter.

(3) PVC pipe with integral bell push-on type gasketed joints shall have an elastomeric gasket securely locked in place to prevent displacement during installation. The gasket used shall be as recommended and furnished by the manufacturers. PVC pipe with glued joints shall use glue and be installed as recommended by the manufacturer.

(4) Fittings for use with PVC pipe shall be the type, material and performance rating as specified by the Engineer and conform to requirements of ASTM specifications D-3034 and D-1784.

(5) All PVC pipe and fittings shall be new. Pipe and fittings stored by the developer or contractor will not be accepted, unless inspected and approved by the Management Entity.

6.01-4 High Density Polyethylene Pipe.

(1) High Density Polyethylene (HDPE) pipe that meets ASTM D3035 and ASTM F714 specifications may be used for pressure sewers on a case by case basis. The Engineer and the Management Entity shall determine the DR rating of HDPE that may be used and where it may be used.

6.01-5 Casing Pipe.

(1) Unless approved by the Engineer, steel casing pipe shall be used exclusively to enclose Collector Lines. Casing pipe shall be specified and shown on the Construction Drawings.

(2) Wall thickness of casing pipe shall be determined by the Engineer. The diameter of the casing pipe shall be not less than 4-inches greater than the largest outside diameter of the Collector Line or its joints.

(3) Casing spacers shall be specified and approved by the Engineer.

6.01-6 Pipe Bedding and Backfill.

(1) Crushed Stone: Aggregates used for pipe bedding and backfill shall be either crushed limestone or crushed dolomite. The use of slag will not be allowed. Where reference is made to ASTM D-448 No. 57 stone, No. 67 stone is acceptable and vice versa. No other screening size is acceptable nor is "crusher run" (unscreened gradations that include fine material) acceptable. However, to stabilize the bottom of the pipe trench prior to placement of pipe bedding, a coarse

gradation of either crushed limestone or crushed dolomite may be used as approved by the Engineer.

(2) Pipe Bedding: All pipe bedding, when required, shall be a minimum of 4-inches (or 6-inches in a rock cut trench) of crushed stone. Embedment materials shall be used and compacted, as specified by the Engineer, to support the anticipated load, based on the type soil encountered and potential groundwater conditions.

(3) Backfill: Collector Lines and Services Lines shall only be backfilled using crushed stone or native earth materials of low organic content. If acceptable, the native earth material from the excavation may be used. Stumps, roots, topsoil and other unstable or highly organic materials are not acceptable for use as backfill. Earth backfill shall not contain any rocks, stones or boulders that might be large enough to damage or endanger the Collector Line or Service Line. The decision regarding the suitability of a particular material for use as earth backfill will be at the discretion of the Engineer and the Management Entity. Final backfill shall be placed in such a manner as not to disturb the placement or alignment of the pipe.

6.01-7 Concrete.

(1) All concrete shall be premixed ("Ready Mix") in accordance with ASTM C-93. delivered and ready to cast-in-place.

A. Class-A: Ready Mix concrete shall have a 28 day minimum compressive strength of 4,000 pounds per square inch, and is generally reinforced, cast-in-place in forms for foundations, pipe collars, footings, piers, head walls, manholes, and similar structures.

B. Class-B: Ready Mix concrete shall have a 28 day minimum compressive strength of 3,000 pounds per square inch, and is generally not reinforced and cast-in-place unformed for trench bottom stabilization, pipe protection, anchors, massive sections and similar work.

(2) Re-Bars: Reinforcing bars shall be grade 60 deformed bars and conform to the requirements of ASTM A-615.

(3) Wire Mesh: Welded wire fabric or cold-drawn wire for concrete reinforcement shall conform to the requirements of ASTM A-185 or ASTM A-82, respectively.

6.01-8 Grout.

(1) Site-Mixed Grout: Cement shall consist of a mixture of water and cement or water and one part cement to two parts mortar sand, by volume. The water may be adjusted to produce a mixture suitable for the application.

(2) Non-Shrinking Grout: Cement shall be a product specified or approved by the Engineer.

6.01-9 Pre-cast Manholes.

(1) Unless otherwise approved by the Engineer and Management Entity, all manholes shall be pre-cast reinforced concrete that complies with ASTM C-

478, and consist of base sections, riser, transition, and conical sections. The components shall be configured to minimize the number of joints required per manhole.

(2) Concrete: Concrete shall contain Type I/II Portland cement and meet the requirements of ASTM C-478 and have a minimum compressive strength of 4,000 psi at 28 days.

(3) Reinforcing: Reinforcing shall be steel bars of intermediate grade, open hearth, billet steel, conforming to ASTM A-6 15, or Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A-82; or of wire fabric conforming to ASTM A-185.

(4) Base Sections: Base sections shall be circular, wet cast, and may be supplied in 48", 60" or 72" diameters. Heights shall be specified by the Engineer. All base sections shall be supplied with manhole lift system inserts.

(5) Riser Sections: Riser sections shall be circular, and may be supplied in 48", 60" or 72" diameters. Heights shall be specified or approved by the Engineer. The use of 16" risers shall be minimized and shall only be used to adjust to final grade.

6.1-10 Manhole Frame and Cover.

(1) Manhole covers and frames shall be constructed of cast iron conforming to ASTM A-48-83 Class 30, "Heavy Duty" type.

(2) The seating surfaces of frames and covers shall be machined flat to ensure contact between the cover and frame along the full perimeter, in accordance with Federal Specification RR-F-62 1.

(3) Gaskets shall be installed on all manhole frames and secured to the seating surface of the frame with non-degrading glue by the manufacturer.

(4) Manhole and inlet steps shall be installed at maximum 16" intervals and meet OSHA standards.

6.1-11 Brick.

(1) All brick shall be new and whole, of uniform standard size and width substantially straight and parallel edges and square comers. Bricks shall be of compact textures, burned hard entirely through, tough and strong, free from injurious cracks and flaws and have a clear ring when struck together. No soft or salmon brick shall be used in any part of the work. Brick shall be culled after delivery, if required, and no culls shall be used except at such places, to such extent, and under such conditions as may be approved by the Engineer. Bricks with holes will not be accepted.

6.1-12 Masonry Blocks.

(1) Masonry blocks shall conform to the requirements of ASTM C-90, Grade N, Type I or II, for hollow load bearing blocks.

6.1-13 Mortar.

(1) Mortar shall be prepared only in quantities needed for immediate use. Mortar which has been mixed for more than 30 minutes or which has set or has been re-tempered shall not be used.

SECTION 7 Testing for Acceptance of Collector Lines

7.01 Testing

7.01-1 Testing Procedures and Requirements.

(1) Upon completion of all or part of the Sanitary Sewer System, the Contractor shall test the completed work for acceptability in accordance with the procedures approved by the Engineer and Management Entity prior to construction. The Contractor shall provide all necessary water and equipment for water flushing before testing. Source and quality of water, test procedures, and method of disposal of water shall all be submitted to the Engineer and the Management Entity for review and approval. The method(s) of testing shall be as specified herein.

(2) All tests shall be conducted in the presence of the official Inspector. Test procedures not observed by this Inspector may not be approved by the Management Entity. The Inspector shall be notified at least 48 hours before any work is to be inspected and/or tested. The Inspector may be scheduled, as available, to witness tests from 8:00 a.m. to 3:00 p.m., Monday through Friday, unless special arrangements are agreed to.

(3) All defective work (e.g. work that does not passing the specified test) shall be repaired, or replaced, and retested until acceptable to the Inspector and the Management Entity. Repairs shall be made to the standard of quality specified herein.

(4) Sections of the Collection Line may be tested separately prior to construction of the whole Sanitary Sewer System being completed. However, any defect which may develop in a section previously tested and accepted shall be promptly corrected and retested until acceptable to the Inspector and the Management Entity.

(5) All piping systems shall be tested in accordance with the test methods herein. Any other tests required by local plumbing codes or building authorities shall also be conducted independent of and in addition to these tests.

(6) Testing procedures for gravity Collection Lines for Cluster and Community Wastewater Systems may include internal video inspection as specified by the Engineer and required by the Management Entity.

7.01-2 Gravity Collector Line Testing.

(1) Prior to any testing of gravity Collector Lines, all lines shall be cleaned of debris and flushed clean with water as specified. Debris and flush water shall be caught at a lower manhole, removed and shall not be allowed into any existing live sewers. Before Collector Lines are placed into service, the Inspector shall inspect for line and grade. All gravity sewer pipelines shall be air tested as follows:

A. The Collector Line to be tested shall be tested between manholes. The pipeline shall be sealed with sewer plugs at each end. All Service Lines in the test segment shall be capped securely. The plug at one end of the segment being tested shall have an orifice through which air passes into the pipeline. The air

supply line shall contain an on/off valve and a pressure gauge with a range from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi, and shall have an accuracy of +/- 0.04 psi.

B. The gravity pipe segment being tested shall be pressurized to 4 psig. The pipeline will be allowed to stabilize between 4 psig and 3.5 psig for a period of no less than 5 minutes. If necessary, air should be added to the pipeline to achieve a pressure above 3.5 psig. After the stabilization period, the valve shall be closed. When the pipeline pressure drops to 3.5 psig, timing with a stop watch should begin. The stop watch shall run until the pressure drops to 2.5 psig. Then the stop watch shall be stopped and the time lapse compared with the allowable time lapse in the table below for the pipe size and leakage allowance specified by the Engineer and the Management Entity.

Air Leakage Chart

Size of Pipe Inches	Minutes:Seconds Per 100 ft
4	1:00
6	1.00
8	1:30
10	2:00
12	2:30

C. If the time lapse is greater than that specified, the segment of line being tested shall have passed and the tests may be discontinued. If the time lapse is less than that specified, the segment of pipeline has not passed and the Contractor shall repair the pipeline in accordance with Engineer's standards and specifications until it does pass the test. If the pipeline to be tested is beneath the groundwater level, the test pressure shall be increased 0.433 psi for each foot the groundwater level that is above the invert of the pipe.

(2) Gravity lines may be water or hydrostatically tested in place of air testing and such test procedure shall be submitted to the Engineer for approval. As with air testing, the testing method selected must take into consideration the range of ground water elevations during the test and during the design life of the sewer. The leakage exfiltration or infiltration shall not exceed 200 gallons per inch of pipe per mile per day. Such a test shall be performed with a minimum positive head of 2 feet.

7.01-3 Pressure Collector Line Testing.

(1) Prior to any testing, all lines shall be cleaned of debris and flushed clean with water as specified. Debris and flush water shall be caught and removed. Flushing water shall not be allowed into any existing live sewers.

(2) At least 7 days shall elapse after any concrete thrust or reaction backing has been cast.

(3) The segment of pressure line being tested will be sealed pressure tight at each end with restrained valves, plugs or caps.

(4) The pipeline shall be filled with water and all air removed either at air release valves or through taps into the pipe.

(5) Test pressure for all pipelines shall be 1.5 times the working pressure at the point of testing. The duration of testing shall be two (2) hours or as directed by the Engineer. The allowable leakage shall not be greater than the value calculated from the following formula:

$$L = (SxDxP) \div 133{,}200$$

Where L is the allowable leakage in gallons per hour, S is the length of pipeline segment being tested in feet, D is the nominal diameter of the pipe being tested in inches, and P is the average test pressure during the leakage test in pounds per square inch, gauge.

(6) Any visible or audible leaks in the pressure Collector Line that can be located shall be repaired or corrected as directed by the Engineer. Once the repairs have been made and inspected by the Inspector, the pressure test shall be repeated and the results compared to the maximum allowable leakage. The Engineer shall determine if the section of the pipeline has been accepted.

7.01-4 Manhole Testing.

(1) All manholes on gravity Collector Lines shall be tested by the Contractor using the vacuum test method that follows the manufacturer's recommendations for proper and safe testing procedures. Any leakage in the manhole or structure, before, during, or after the test shall be repaired.

(2) All pipe openings shall be sealed by installing suitable plugs that completely isolate the manhole structure. Any other openings shall be sealed. A suitable vacuum pump shall be connected at the access point of the manhole test cover. A vacuum of 10-inches of mercury (Hg) (5.0 psi) shall be drawn on the manhole, and the time shall be measured for the vacuum to drop to 9-inches of mercury (Hg) (4.5 psi). Manholes will be considered to have failed the test if the time to drop 1-inch of mercury is less than what is shown in the following table.

Vacuum Test Timetable

	Manhole Diameter, Inches			
Depth Feet	48 Inches	60 Inches	72 Inches	96 Inches
4	10 Sec	13 Sec	16 Sec	19 Sec
8	20 Sec	26 Sec	32 Sec	38 Sec
12	30 Sec	39 Sec	48 Sec	87 Sec
16	40 Sec	52 Sec	64 Sec	76 Sec
20	50 Sec	65 Sec	80 Sec	95 Sec
Each 2'	+5.0 Sec	+6.5 Sec	+8.0 Sec	+ 9.5 Sec

(3) Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.

(4) All manholes that fail the test or that have visible leaks shall be repaired or replaced until the manholes pass the test, to the satisfaction of the Inspector and the Management Entity. Manholes that have any visible leaks will not be accepted. Repairs will continue to be made until Inspector's acceptance testing is satisfied.

SECTION 8 General Design Guidelines for Pumping Stations

8.01 Duplex Pump Stations

8.01-1- General

(1) All sewage pump stations shall, at a minimum, meet all applicable regulations and specifications set forth by the governing county or municipality with jurisdiction. Contractor shall defer to the most stringent specification should any contradictory language exist between the county and/or municipal specifications and the standards specified herein.

(2) All sewage pump station structures and electrical and mechanical equipment shall be protected from physical damage by the 100 year flood. Stations shall be designed to remain fully operational and accessible during a 25 year flood.

(3) All sewage pump stations shall be readily accessible by maintenance vehicles during all weather conditions.

(4) Adequate provisions shall be made to effectively protect maintenance personnel from hazards and all OSHA and other applicable regulatory agency safety requirements shall be followed in sewage pump station design.

(5) Management Entity shall stipulate use of auxiliary power or a portable pump system to handle emergency power outages.

8.01-2 Acceptable Pump Station Types.

(1) Sewage pump stations in general for Cluster and Community System fall into three main types: submersible, wet well/dry well and suction lift. Screw pumps used infrequently in large Community Systems will not be addressed herein.

(2) The Engineer and Management Entity shall determine which type of simplex or duplex sewage pump stations shall be used in a Cluster or Community System.

(3) The requirements stated herein may be modified at the discretion of the Engineer with the approval of the Management Entity.

8.01-3 Submittals.

(1) Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section. The data and specifications for each unit shall include, but shall not be limited to, the following:

Pumps.

Name of manufacturer.

Type and model.

Rotative speed.

Size of suction elbow inlet.

Size of discharge elbow outlet.

Net weight of pump and motor only.

Complete performance curves showing capacity versus head, bhp, NPSH required, and efficiency.

Data on shop painting.

Dimensioned pump outline drawing.

Dimensioned drawing of the pump installed on the guide rail system.

Installation, Operation and Maintenance manuals.*

Parts lists .*

* - Shall be provided after shipment of pumps

Motors

Name of manufacturer.

Type and model.

Type of bearings and method of lubrication.

Rated size of motor, hp.

Temperature rating.

Full load rotative speed.

Net weight.

Efficiency at full load and rated pump condition.

Full load current.

Locked rotor current.

Control Panel and Components

Name of manufacturer.

Type and model.

Dimensions and net weight of complete panel.

Overcurrent characteristics and details of motor control.

Liquid level sensors with mounting details and cable lengths, and pump controls.

Force Main

System head curve with roughness factor (C) of both 120 and 160

Plan and profile survey of the line connecting the station to the main.

8.01-4 Substitutions.

(1) Should the Contractor desire to substitute equipment other than that specified by the Engineer and approved by the Management Entity after executing a construction contract, such substitution will be considered if the equipment proposed

for substitution is superior in construction and efficiency to that specified in the contract and a higher quality has been demonstrated by service in a similar installation. In the event the Contractor obtains the written approval of the Engineer and Management Entity for equipment other than that for which the station was originally laid out, the Contractor shall, at his own expense, make any changes in the structures, buildings, or piping necessary to accommodate the substitute equipment, and shall furnish As-Built Drawings to Engineer.

8.01-5 Experience Clause

(1) The pump manufacturer shall have a minimum of 100 units of similar type pumps installed in the United States.

8.01-6 Pump Warranty

(1) The pump manufacturer shall warrant the pumps being supplied against defects in materials and workmanship for a period of five (5) years or 10,000 hours in permanently installed wastewater pump station service. The warranty shall be non-prorated throughout the five (5) year or 10,000 hour period. The warranty shall cover parts and labor. Pumps having warranty policies wherein the coverage decreases or is pro-rated during the warranty period or wherein parts only are covered shall not be acceptable.

8. 01-7 Pump Requirements

(1) Pump stations shall be designed to handle peak flow with a single pump and be sized to handle the minimum spherical size solids as specified by the Engineer. Motors shall be non-overloading over the entire pumping range. Pumping shall be designed to be 45 percent efficient at a minimum.

Levels and alarms shall be as follows:

a. All pumps OFF.

b. Lead pump ON.

c. Lag pump ON.

d. High-water level alarm (detected by both the ultrasonic level transmitter and the float).

Pump No. 1 Overload

Pump No. 2 Overload

Pump No. 1 Moisture Detected

Pump No. 2 Moisture Detected

Pump No. 1 Over Temperature

Pump No. 2 Over Temperature

Pump No. 1 Phase Protection Trip

Pump No. 2 Phase Protection Trip

(2) A minimum distance of 6 inches shall be provided between the invert of the lowest inlet sewer pipe to the pump wet well and the high water alarm level.

(3) Aluminum access covers are to be provided on all wet well chambers and these shall be hinged. Minimum allowable size of personnel access covers is 30”x30” square. All covers must be lockable. Covers shall be suitable for vehicular and/or pedestrian load, when specified. Refer to Part 8.01-15 for requirements.

(4) The pump wet well should be fitted with an access ladder complete with safety hoops where required.

(5) A plate near to the top of a wet well with submersible pumps shall indicate pump No.1 and pump No.2.

(6) For submersible pump stations each pump shall be installed with stainless steel (316 grade) guide rail and lifting chains and one pump hoist shall be supplied for use at duplex pump station.

(7) The floor of the wet well shall be benched to a minimum of 15º towards the pumps or pump inlet to reduce the build up of solids in the chamber.

(8) The pump wet well shall be fitted with a vent stack capped with an anti bird cowl.

(9) Three phase installations shall have single phasing protection fitted to the motor starter to prevent motor burnout due to loss of phase.

(10) Pumps shall be sized for 3 times dry weather flow, unless otherwise specified by the Engineer.

8. 01-8 Odor Control at Pump Station

1 If required by the Engineer, Contractor shall furnish and install an odor control system. The drawings of any proposed odor control system shall be submitted to the Management Entity for review and approval.

8. 01-9 Pump Test

(1) The Engineer shall specify manufacturer’s inspection and testing requirements for pumps before shipment from factory. The following shall apply to submersible pumps:

A. Impeller, motor rating and electrical connections shall first be checked for compliance to the pumps specified.

B. A motor and cable insulation test for moisture content or insulation defects shall be made.

C. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

D. The pump shall be run for 30 minutes submerged a minimum of six (6) feet under water.

E. After operational test D (above), the insulation test B shall be repeated.

(2) A written report from the manufacturer stating that the Engineer’s required inspection and testing procedures have been performed shall be supplied with each pump at the time of shipment, upon the request of the Engineer.

8. 01-10 Site Test

(1) Sewage pumps shall be tested at start-up and voltage, current, and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Only factory-certified service personnel shall perform start-up service unless otherwise approved in writing by the Management Entity. Proof of certification shall be required prior to acceptance of the pump station for use.

8. 01-11 Service

(1) Pump supplier shall employ factory-trained service personnel. These technicians shall be authorized by the manufacturer to perform all maintenance and repair work on the pumps. Factory certification of service technicians shall be provided to the Engineer prior to approval of pumps. Only factory-certified personnel shall perform start up on the specified equipment, unless otherwise approved by the Management Entity.

8. 01-12 Motor

(1) The Engineer shall specify the minimum requirements for sewage pump motors. The following shall be used for submersible pumps.

A. The motor shall be protected from moisture intrusion from the pump's hydraulic end. Motors shall be a squirrel-cage induction motor, continuous duty NEMA Design B, at 40 degrees C ambient, and designed for at least six starts per hour. Motors shall have moisture resistant Class "F" (155 degrees C) insulation. Motors shall have at minimum 1.25 service factor, shall be oil-filled, and shall be designed for continuous operation half-submerged for at least 24 hours under pump cut-off conditions, without exceeding the temperature rise limits for the motor insulation system. High efficiency motors should be used in all cases. Air-filled motors may be used as an allowable alternative to oil-filled motors, if approved by the Engineer.

B. The motor and pump shall have a shaft of stainless steel that is completely isolated from the pump media by a mechanical seal. Mechanical seals of tungsten carbide shall be provided when highly abrasive conditions are anticipated as determined by the Engineer. Impellers shall be secured from rotation on the shaft through the use of a shaft key or locking collet. Pump impellers shall be ASTM A48 Class 30B cast iron except in designated locations as determined by the Engineer where pump impellers shall be ductile iron or stainless steel as required for the specific application. Pump volutes shall be of, at a minimum, ASTM A48 Class 30B cast iron having a minimum Brinell hardness rating of 180. The volute shall be further protected from wear through the use of a replaceable wear ring. Lesser grades of cast iron or materials having a Brinell hardness rating less than 180 shall not be acceptable as compatible with the normal grit contaminate of the service. Lower seals shall be carbon to ceramic. Pumps shall be equipped with a plug on the outside of the oil chamber, in order to inspect lower seal condition. Bearing shall be lubricated per manufacturer's specifications and have a bearing life. as approved by the Engineer.

C. Moisture detection and telemetry shall be required on all pumps. Moisture detection shall be connected to a detection indicator alarm light on the control panel.

D. Overheat detection and telemetry shall be required on all motors. Overheat detection shall be connected to a separate detection indicator alarm light on the control panel.

E. High-water detection and telemetry shall be required at all duplex pump stations. High-water detection shall be connected to a separate detection indicator alarm light on the control panel.

F. Monitoring units shall be provided with necessary auxiliary relays and terminals for wiring of sensor leads and external alarm/control functions. Operating voltage power supply requirements required to interrogate the moisture sensing device within each motor shall be provided as necessary within the control panel enclosure.

8. 01-13 Valves and Valve Vaults.

(1) Valves shall meet the specifications of the Engineer, including the passage of a minimum spherical size solid. The valve configuration shall be installed according to the Construction Drawings.

(2) For suction lift pump stations the valves and valve layout shall be pre-packaged by the manufacturer. For wet well/dry well pump stations the contractor's installation of the valves and discharge piping shall follow the Construction Drawings. For submersible duplex pump stations the following shall apply:

A. All shutoff valves and check valves shall be installed in a concrete valve vault or box with an approved cover outside of the wet well and inside the pump station lot. Shutoff valves shall be plug valves or gate valves. Check valves shall be of the lever weight reset type. All valves shall be manufacturer's recommended type unless otherwise detailed and approved by Engineer and Management Entity. There shall be a tee, isolation valve, quick-connect adapter fitting with cap and oil filled pressure gauge with isolation valve installed on the force main side of the check and shutoff valves of the size and pressure required for the force main to accommodate an auxiliary portable pump in the event the existing pump station motors are inoperable. The quick-connect adapter provided for connection to an auxiliary pumping system shall be sized based on the peak design flow capacity of the duplex pump station. The piping and valving shall be arranged according to Construction Drawings.

B. All valve boxes shall be sized to provide 12-inch minimum overall clearance (top, bottom, sides) between the walls of the box and internal components. A drain between the wet well and valve box shall be required with a suitable p-trap and/or approved backflow device. The floor of the box shall be sloped to the drain. All piping through the walls of the box shall be sealed watertight in a manner approved by the Engineer. All valve boxes shall be set on a minimum of 6 inches of crushed stone. Over-excavation areas or valve vaults placed over fill material shall be done in a manner approved by the Engineer.

8. 01-14 Wet Wells and Storage Basins.

(1) Wet wells and storage basins shall be designed and sized to accommodate expected wastewater flows tributary to the pump station for the entire project/development at build out. Unless otherwise approved by the Engineer, wet wells shall be designed with an emergency storage capacity of 2-hours of peak flow in the event of pump failure. Approval of staged capacities based on phased

development shall be allowed, but provisions, requirements, facilities, and costs shall be delineated and accounted for in the initial design. If staged capacity is under consideration, the Engineer shall furnish a development construction schedule that sets the construction sequence for time when additional capacity is added. Staged capacity projects shall not adversely affect the Management Entity's ability to properly operate any pump station.

(2) Duplex suction lift, wet well/dry pit and submersible pump stations are often required for large Community Wastewater Systems. Wet wells for small to medium sized duplex pump stations may be built of pre-cast concrete sections, as specified by the Engineer. The Engineer and Management Entity may also approve different wet well designs and materials of construction, including but not limited to fiberglass basins, provided the stations have a 30-year design life. Manufacturer's data sheet and installation instructions for substitute basins shall be submitted for Engineer approval.

(3) Precast concrete wet wells shall have a roof slab with a minimum slab thickness of 5 inches.

(4) The minimum size allowed for any circular wet well shall be 5 feet in diameter, unless approved by the Engineer.

(5) In cases where a storage basin(s) is needed in addition to the pump wet well, the storage basin diameter and depth shall be designed to match the pump wet well, unless a larger storage basin is specified by the Engineer. The storage basin shall be designed with a uniform cross section from top to bottom.

(6) The bottom slab of a concrete wet well shall be set on a minimum of 12 inches of crushed stone. All over-excavated areas over 18 inches below the wet well bottom shall be filled as specified by the Engineer. When accepted by the Engineer, fiberglass basins shall be installed according to Construction Drawings. The Management Entity shall require the Engineer to provide buoyancy calculations for fiberglass basins and/or wet wells greater than five (5) feet of depth to determine the need for anti-flotation ballasts.

(7) Surfaces inside a concrete wet well shall be protected from sewer gas attack by a coating especially formulated to resist such attack, as specified by the Engineer. Such coating shall be installed leaving a relatively smooth surface; all joints in a wet well shall be grouted before any coating is applied. Wet wells shall be vented to the atmosphere and shall be screened to prevent vermin access. Wet well vents shall be located as far as possible from maintenance work stations.

(8) Special additives may be mixed with the concrete during batching as specified by the Engineer to provide chemical resistance and water proofing.

(9) When needed and approved, steps shall be protected from corrosion by use of non-corrosive material or approved protective non-corrosive coating. All exposed metal items, such as nuts, bolts, cables, supports, rails, etc., shall be of materials and coatings as specified by the Engineer. While the Engineer may specify steps in a wet well, the Management Entity should evaluate the risk of using these steps and consider use of an appropriate ladder to ensure safety of personnel. Employment of appropriate confined space equipment and procedures are the responsibility of the Contractor until the facility is accepted and then the responsibility of the Management Entity.

(10) Metal items shall be configured, covered, protected, or made so as to present non-sparking surfaces. The supplier shall review this protection with the Engineer for approval before installation. Exceptions to this are manufacturer "package systems" that are pre-approved for use by both the Engineer and Management Entity.

8. 01-15 Access Doors and Hatches

(1) Access doors or hatches to below-ground pump stations wet wells or valve boxes shall be sized and located so as to provide easy and direct access for maintenance crews and equipment. Placement shall also factor non-interference with other station components and safety concerns. As far as possible, all hatches and doors shall be located to avoid traffic loading.

(2) Access doors, including related accessories, to any below-ground wet well or dry pit shall be of a heavy-duty aluminum or stainless steel type that is weatherproof and rated for either a 300 PSF live loadings or wheel loads from maintenance vehicles in potential traffic applications. Access frames and covers shall be provided with a continuous concrete anchor, as part of the one-piece extrusion.

(3) All access doors shall be mounted in such a way that concrete (or other material used for the basin) completely supports the bottom face of the frame, and the basin material shall be designed to support the hatch support loading. The frame shall be a self-draining channel with a 1-1/2 inch draining coupling located in the channel frame. The doors shall be provided with tamperproof fasteners. The doors shall open to 90 degrees and lock automatically in that position with a positive locking arm and a release handle. Doors shall close flush with the top of the frame, resting on a 1/2-inch minimum wide lip around the entire inside of the frame.

(4) All accessory components of access hatches (hinges, handles, locking arms, etc.) shall be of manufacturer's recommendations and specifications to meet the required loadings and serviceability. All nuts, bolts, washers, and miscellaneous hardware shall be stainless steel Type 316 or other approved material. In no case shall carbon steel components be allowed that will present a rusting or sparking condition.

(5) Any aluminum embedded in concrete shall be coated with bitumastic where directed by Engineer.

(6) The minimum dimension of any access door or hatch shall be 30"x30".

(7) All access doors for a duplex pump station shall be made to be lockable.

8. 01-16 Controls, General.

(1) Controls for operation of any pump system shall be furnished by the supplier to meet the Engineer's requirements and specifications. All controls and accessories shall be effective with the pump manufacturer's pump model and type specified and approved by the Engineer. All controls shall be intrinsically safe.

8. 01-17 Pump and Control Panel.

(1) Each pump system shall be furnished with a control panel and pump controls, including level control devices and alarms.

(2) The control panel shall be designed to operate from a single- or three-phase external power supply, be intrinsically safe and weather resistant or waterproof, as specified by the Engineer.

8. 01-18 Wiring.

(1) All internal device wiring shall be as normally furnished by the manufacturer. All interconnecting wiring and wiring to terminals for external connections shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C. All wiring shall be in accordance with the National Electrical Code.

(2) Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Indicating light circuits shall be minimum 16 AWG. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on the system supplier's panel wiring diagrams.

(3) Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits. All wiring shall be grouped or cabled and firmly supported to the panel. Not less than 5 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided.

(4) The panel fabricator shall provide such additional circuits as required for proper, safe operation of the pumps.

8. 01-19 Nameplates.

(1) Nameplates shall be provided on the face of the control panel or on the individual device as required by the Engineer. Panel nameplates shall have approximate dimensions and legends consistent with the control descriptions for each device, and shall be made of laminated phenolic material having engraved letters. Nameplates shall be secured firmly to the panel.

8. 01-20 Enclosure.

(1) The control panel shall be a custom-engineered enclosure, suitable for mounting as indicated on the Drawings. The panel shall contain all system components indicated on the Drawings and be intrinsically safe. In all applications, unless specifically approved by the Engineer, all controls, meters, and devices associated with the pump control system, shall be placed within the interior of this enclosure. All circuits which are routed between backplate-mounted components within the enclosure shall be physically protected in flexible non-metallic conduit. The enclosure size and dimensions shall be NEMA rated as specified by the Engineer.

8. 01-21 Motor Starters.

(1) The pump supplier shall match the sizes of control power transformers, overload devices, heaters, and starters to the equipment furnished, as they may differ from the values indicated on the Drawings. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.

(2) Each pump motor starter shall be provided with an external, manually reset push button for resetting the thermal overload relays. The external reset push buttons shall be accessible by opening the outer door of the control panel enclosure, and mounted on hinged interior panel front within the enclosure.

(3) Each starter shall include auxiliary "RUNNING" status contacts wired to terminals for external connection by others for remote indication.

(4) Each starter shall be provided with interlocking mechanism which, when the disconnect handle is moved to the "OFF" position, disconnects all external sources of power from the terminal blocks within the starter, such as external power across motor auxiliary status contacts.

8. 01-22 Three Phase Starters.

(1) Unless otherwise approved by the Engineer, three-phase starters shall be circuit breaker combination type consisting of three-phase, 60 Hz contactors with electronic adjustable overloads, a 120-volt ac coil, a dry type control power transformer where required, and a circuit breaker disconnect. Overload relay shall be provided with one normally open dry contact. The contact shall close on motor overload and open when manually reset. Control power transformers shall be sized to handle all simultaneous loads.

(2) Circuit breakers shall be 600-volt magnetic motor circuit protectors. If an inverse time thermal magnetic circuit breaker is used, the thermal characteristic shall be externally adjustable from the face of the breaker. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism.

(3) The complete three-phase starter shall have an interrupting rating of at least 14,000 amperes at 208 volts, and 25,000 amperes at 480 volts.

(4) Three-phase motors 15HP and greater shall be provided with a reduced voltage electric soft start in lieu of a full voltage starter, unless approved by the Engineer.

8. 01-23 Single Phase Starters.

(1) Unless otherwise approved by the Engineer, single-phase starters shall consist of single-phase, 60 Hz contactors with solid state overloads and an integral or separately enclosed short-circuit protection device.

(2) Integral short-circuit protection devices for single-phase starters shall be 120/240 volt, magnetic motor circuit protectors.

(4) The short-circuit protection devices shall have an interrupting rating of at least 10,000 amperes at 120 volts, and 18,000 amperes at 240 volts.

8. 01-24 Convenience Receptacle.

(1) A single 120-volt, 20-ampere, ground fault interrupting convenience receptacle shall be provided with the control panel enclosure. A step-down transformer to provide 120-volt AC power to the receptacle shall be provided as necessary. If the receptacle cannot be located within the control panel enclosure, then it shall be located on one exterior side of the control panel enclosure, within its own lockable access receptacle box, which shall be waterproof, dustproof, and weatherproof. The placement of an exterior receptacle shall be approved by the Engineer.

8. 01-25 Area Light Control.

(1) A snap action switch to operate an external area light at the pump station shall be furnished and installed on the interior panel within the control panel enclosure for convenience and safety. The switch shall be connected to a branch power circuit of minimum 15 amperes at either of 120- or 240-volt single phase, supplied from the control power transformer within the control panel enclosure.

8. 01-26 Control Operation (emphasis placed on duplex stations).

(1) Control operation shall correspond to the Drawings and as specified herein. Pumps in a duplex station shall be controlled in a typical duplex lead-lag manner. This includes automatic alternation on successive starts to include the standby pump, automatic failover in the event of a pump failure to start the standby pump and override to start two pumps if the liquid level in the wet well continues to rise.

(2) "HAND-OFF-AUTO" pump mode selector switches shall be connected to allow manual start or stop of each pump in a duplex station and to select automatic operation of each pump under control of the level control system. Pump alternator shall be capable of being manually selected to alternate between pumps or individually select a pump to perform pumping duty in response to the level switch contacts of the level control system. In AUTO, pump controls shall also allow for an external RUN command, via telemetry system, to initiate pump operation, if required by the Engineer.

(3) Each pump rated 5 horsepower or greater in a duplex pump station shall be provided with seal leakage and high temperature detection alarm systems for protection of each pump motor. A moisture-sensing device shall be provided in the stator housing for seal-leakage protection and, if necessary, a monitoring module shall be provided within the control panel for motor shutdown. The monitoring unit shall be equipped with the necessary auxiliary relays and terminals for wiring of sensor leads and external alarm/control functions. Operating voltage power supply requirements required to interrogate the moisture sensing device within each motor shall be provided as necessary within the control panel enclosure.

(4) Unless otherwise approved by the Engineer, each three-phase motor, rated 5 horsepower or greater, shall be protected by a microprocessor-based motor protection relay. The relay shall protect against phase loss, phase reversal, voltage unbalance, and low voltage on any one or more phases, causing a shutdown of the pump if any such abnormality is detected. The relay shall re-activate after power line conditions return to an acceptable level. Trip and reset delays shall prevent nuisance

tripping due to rapidly fluctuating power line conditions. A motor protection relay shutdown alarm shall be connected to a separate detection indicator light on the control panel. A dry, resistive contact shall also be provided and wired by others for remote notification.

(5) The pump station level control system may consist of an approved ultrasonic level transmitter and one (1) high water level sensing float switch with cable and cable supports provided. The controller for the ultrasonic level detection system shall be housed in a NEMA 4X stainless steel and polycarbonate enclosure or equal.

(6) An alternate to the ultrasonic level control system shall use level or float control switches that shall be the direct-acting type, designed and constructed for long life in severe applications. The float switches shall be weighted, pear-shaped, hermetically sealed enclosures containing a single-pole mercury switch. The cable for the float switch shall be SO cord for resistance to immersion, corrosion, and abrasion. The cable length for each float switch shall be sufficient to extend into the control panel or a separate, intermediary junction box outside the pumping station wet well.

(7) Either the ultrasonic or float level control systems shall control the pump off, lead on and lag on pump operations and provide a high level alarm. A separate float switch may be specified by the Engineer for a low water level that will actuate a low level alarm circuit and de-energize the pumps.

(8) The level of the float switches in the wet well shall be set as shown on the Drawings.

(9) Voltage used for the level sensing float switches shall be 24 volts maximum to ensure compliance with intrinsically safe, explosion-proof requirements. A control power transformer with 24-volt secondary voltage shall be furnished and installed within the control panel to interface with the level sensing switches.

(10) Each control panel shall be equipped with heavy-duty “ON-OFF-AUTO” selector switches, pilot lights, reset buttons and a common alarm acknowledge push button at a minimum, as specified by the Engineer. The Engineer may specify elapsed time meters for each pump. All switches, lights, push or reset buttons and elapsed time meters shall be mounted on the face of an interior hinged panel door within the control panel enclosure. All operating controls and instruments shall be securely mounted and arranged in a logical manner such that any standard options offered by pump manufacturer and recommended by the Engineer may be added in the field. All controls, pilot lights, selector switches shall be clearly labeled to indicate function.

(11) Any elapsed time meters required by the Engineer shall be six digit, non-reset type meters shall be provided to indicate running time of each pump in “hours” and “tenths of hours”. Green “Pump Running” indicator lights and individual alarm lights mounted on the hinged interior panel within the control panel shall be provided for the following alarms:

ALARM	COLOR
Pump No. 1 Overload	Red
Pump No. 2 Overload	Red
Pump No. 1 Moisture Detected	Amber
Pump No. 2 Moisture Detected	Amber
Pump No. 1 Over Temperature	Red
Pump No. 2 Over Temperature	Red
Pump No. 1 Phase Protection Trip	Red
Pump No. 2 Phase Protection Trip	Red
Wetwell High-Water Level	Blue

(12) Any of the above alarms shall close a single-pole, double-throw relay with a dry, 120VAC rated resistive contact, wired to terminals for connection by others, for remote indication. In addition, any pump station alarm shall illuminate a flashing red vapor-tight alarm beacon and alarm horn. The alarm beacon shall be furnished with a minimum 60-watt lamp, located on the top of the control panel so as to be readily visible from the main road/street. The alarm horn shall be side-mounted to the control panel enclosure and shall have minimum 103 dB rating at 10 feet distance from the panel.

8. 01-27 Electrical.

(1) Motor rated voltage shall be as follows unless indicated otherwise by the Engineer:

A. All single-phase and three phase pump motors shall be designed in such a way as to be able to operate with voltage levels 10 percent above or 10 percent below the nameplate rating indicated above.

B. Pumps requiring horsepower and voltage levels other than those specified above shall be approved by the Engineer on a case by case basis.

(2) The Contractor shall coordinate with the electric utility to provide power to any duplex pump station. The Contractor or Developer shall bear the burden of the cost for supplying single phase and/or three-phase power to the pump station site.

(3) A lightning arrestor shall be furnished and installed within the service disconnect enclosure at a duplex pump station and connected to the incoming service conductors for surge protection of control panel components and motors.

(4) If required by the Engineer, an area light shall be furnished and installed on a 30 foot, Class 5 Southern Yellow Pine wood pole. The light shall be a minimum 100-watt, HPS lamp, with multi-tap ballast. The pole shall be installed at a location as indicated on the Drawing. The power supply to the light shall originate within the pump control panel and shall be operated by a photocell integral to light, as specified by the Engineer. Conduit and branch power circuit conductors shall be

routed from the pump control panel underground in approved conduit to a riser conduit attached to the exterior of the wood pole.

(5) Auxiliary Pump or Power. This Section describes a back-up power system for a duplex pump station but the Engineer and Management Entity may select a portable pump during power outages or control panel failures. The need of emergency or stand-by power or a portable pumping system should be evaluated by the Engineer and the Management Entity. The size or service area of the pump station, the accessibility or location of the pump station, the proximity to service personnel and any special environmental considerations will dictate the necessity of a portable pump or emergency power and/or remote telemetry. A portable pump system can be sized and specified by the Engineer. The following focuses on a back-up power supply system:

A. A complete stand-by generator system with automatic transfer switch shall be furnished and installed. The unit shall provide output to drive the load of the duplex pump station with 20% maximum voltage dip and be 80% loaded. The unit shall be driven by an engine using natural gas, propane or diesel fuel, as specified by the Engineer. The unit shall have a permanent magnet exciter, and electronic engine governor to provide 0.5% frequency regulation and no load to full lead and 0.25% regulation steady state.

B. The Engineer shall specify the electronic monitoring and control system, noise attenuating, weather-proof and safety features for the generator-engine set. If the unit will use diesel fuel or propane, the fuel tank shall contain enough fuel for 36 hours of run time at 80% load.

C. The automatic transfer switch shall be the same capacity as the utility service and be rated for continuous operation. The transfer switch shall be open transition type operation, contained in an enclosure and be provided with instrumentation and auxiliary controls, as specified by the Engineer.

D. The standby generator unit shall be installed on a reinforced concrete pad, and connected to the incoming power and the pump station control panels in accordance with all local and NEC requirements.

E. Unless otherwise approved by the Engineer, the generator unit and automatic transfer switch have a 5-year warranty and the supplier shall provide factory-trained personnel for system start-up, training on operation and maintenance for the Management Entity and three sets of Owner's Manuals. The Contractor shall warrant the installation for 1 year from the date of acceptance. Acceptance of the generator unit shall include a full fuel tank of diesel or propane or an approved connection of natural gas, if supplied to the Development and specified by the Engineer.

8. 01-28 Monitoring Equipment, Sensing and Alarms.

(1) The monitoring and accessory equipment, including but not limited to a flow meter, radio communication and back-up battery system for pump stations alarms shall be specified by the Engineer with approval by the Management Entity.

(2) All monitoring and sensing equipment and alarms shall be complete and successfully tested at start-up as a condition of acceptance by the Engineer and Management Entity.

8. 01-29 Pump Station Lot and Miscellaneous Requirements.

(1) Sewage pump stations shall be located on a deeded lots or on recorded Easements or Right-of-Ways having a usable area of not less than 3,000 square feet, unless otherwise approved by the Management Entity.

(2) Security fencing and vehicle or pedestrian gates for the pump station shall be specified by the Engineer.

(3) The entire site inside the fence shall be covered with an "anti-weed" fabric that prohibits the growth of vegetation yet allows rainwater to pass through. Covering shall be with 2 inches of crushed stone (ASTM C33, Gradation 67). This covering shall extend to 1 foot outside the fenced area.

(4) If required by the Engineer, a yard hydrant (lockable) supplying potable water for wash-down shall be supplied by the Contractor inside the security fencing. The water service line shall be a minimum 3/4-inch with a double check valve assembly backflow preventer per Engineer's specifications.

(5) All portions of the lot surface and access road to the pump station shall be above the 100-year flood (FEMA and local) elevation, when possible. Provisions shall be made to protect side slopes from flood erosion and wave action during heavy rainfall or flood events.

(6) The access service road to a pump station shall have a minimum width of 12 feet and an all-weather travel surface, as specified by the Engineer.

(7) Backfill materials shall be deposited in layers and compaction of backfill around the pump station wet well and valve vault shall meet Engineer's specifications.

(8) Erosion control measures shall be installed and maintained by the Contractor at the site during construction. At the completion of construction and at such time that Engineer determines that adequate permanent erosion control measures have been established, the Contractor shall remove the temporary erosion control measures and dispose of them off site.

8.02 Grinder Pump Stations

8.02-1 General.

(1) Unless otherwise approved by the Engineer, the standard simplex grinder pump station for a low pressure Sanitary Sewer System in a Cluster or Community System shall be designed with a 2 horsepower pump, a pump control panel and a high density polyethylene (HDPE) or fiberglass basin with an anti-floatation ring at the base and a bolted cover with cover seal. The basin and cover shall be made of fiberglass reinforced polyester resin or HDPE. Fiberglass basins for a Residential Pump Station for an outdoor installation shall be a minimum 2 feet in diameter and 4 feet deep. Larger basins may be required by a local governmental agency with jurisdictions. Prefabricated, packaged fiberglass basins may also installed inside a building in the floor at the lowest floor level, however this practice is discouraged. In addition to the pump and basin, the simplex station requires discharge piping, valves and fittings installed inside the basin, one (1) wet well liquid level on/off float control switch and an alarm float control switch, a waterproof

junction box if the electrical service and alarm wiring terminates inside the basin, and other items necessary as required to provide a complete, safe, operational pump station. Simplex stations shall be furnished by the manufacturer as a complete factory-built and tested grinder pump station with the electrical control/alarm panel and all the necessary valves, fittings, and internal wiring. Installation directions shall also accompany the station for a licensed installer.

8.02-2 Acceptable Manufacturers.

(1) Engineer and Management Entity shall approve simplex grinder pump station suppliers according to these Standards.

8.02-3 Submittals.

(1) Shop drawings shall be submitted detailing the equipment to be furnished, including dimensional data and materials of construction in three (3) copies.

8.02-4 Substitutions.

(1) The requirements set forth herein may be modified at the discretion of the Engineer with Management Entity approval. All simplex grinder pump stations shall, at a minimum, meet all applicable regulations and specifications set forth by the governing county or municipality with jurisdiction. Contractor shall defer to the highest quality specification should any contradictory language exist between the municipal and/or county specification and the standards contained herein.

8.02-5 Experience Clause.

(1) The pump manufacturer shall have a minimum of 1000 units of similar type pumps installed in the United States.

8.02-6 Pump Station Warranty.

(1) The manufacturer shall warrant the pump station being supplied against defects in materials and workmanship. The pump warranty shall be for a period of five (5) years or 10,000 hours in permanently installed wastewater pump station service. The warranty shall be non-prorated throughout the five (5) year or 10,000 hours period. The warranty shall cover parts and labor. Pumps having warranty policies wherein the coverage decreases or is pro-rated during the warranty period or wherein parts only are covered shall not be acceptable.

8.02-7 Pump Requirements.

(1) Grinder pumps shall be intermittent-duty pumps designed to macerate sewage solids and accommodate anticipated peak flows at the total discharge head requirements. The grinder unit or cutter mechanism shall be on the suction side of the impeller and incorporate a rotating cutter and stationary cutter plate made of hardened stainless steel. Grinder pumps may use a vortex impeller or a progressive cavity design to create flow and discharge pressure. The progressive cavity pump that uses a rotor and stator pumping assembly is capable of generating higher discharge pressures but at lower flows compared to the centrifugal grinder pumps.

(2) Grinder Pumps shall be designed and manufactured so they can operate completely submerged in the liquid being pumped. The electrical power cord shall be properly sealed at the motor housing entrance to provide a completely watertight connection that can be removed for service and repair.

(3) Centrifugal grinder pumps for simplex stations shall be supplied with an integral float control switch for automatic on/off operation. A high water level shall be detected by a separate float control switch and energize an alarm circuit. Progressive cavity pump models may utilize pressure sensing devices integral to the pump body for pump operation and alarm activation.

(4) Grinder pump motor windings and rotor shall be open type with Class B insulation, mounted in a sealed, submersible type housing filled with clean high dielectric oil for bearing lubrication and to transmit heat from the motor winding to the outer housing.

(5) Grinder pumps shall be wired for 1 phase, 230 VAC power supply.

8.02-8 Basin Requirements.

(1) The basin diameter of a simplex pump station shall be no less than 2 feet and the depth shall be no less than 4 feet. The 2 foot diameter basin shall not store less than 90 gallons. Larger basins may be specified by the Engineer.

(2) The basin shall be constructed of molded fiberglass reinforced polyester resin containing a minimum of 25% glass fiber. The wall thickness shall not be less than 3/16" for basins that are 2 ft in diameter and increase in wall thickness for larger basins. The basin may also be constructed of heavy-duty polyethylene (HDPE).

(3) The base of the basin shall have a anti-flotation lip.

(4) The basin cover shall be constructed of the same fiberglass reinforced polyester resin or high density polyethylene as the basin and rated for a minimum loading of 300 PSI.

(5) The inlet sanitary pipe shall enter the basin at a level where the pipe invert is a minimum of 36" above the base of the basin or a deeper basin must be submitted for approval by the Engineer. The hole for the inlet pipe shall be properly cut with a hole saw, if the basin does not have an factory installed inlet hub, and the gasket, provided by the basin supplier, shall used to ensure a watertight fit.

(6) The basin outlet pipe fitting shall be pre-mounted by the basin manufacturer or supplier of the grinder pump station.

8.02-9 Interior Valves and Fittings.

(1) A shutoff valve and check valve shall be provided by the supplier of the grinder pump station specified by the Engineer and mounted on the discharge pipe inside the basin according to the manufacturer's installation instructions. The shutoff valve shall be placed nearest the basin wall to enable removal of the grinder pump for servicing.

(2) Only pipe and fittings supplied with the pre-packaged grinder pump station shall be used unless approved by the Engineer. The piping and valving inside and outside the basin shall be arranged according to manufacturer's installation instructions.

8.02-10 Basin Location and Installation.

(1) The grinder pump station basin shall be located at a minimum distance of 5 feet from the exterior of the building unless a greater distance is specified by the county or municipality with jurisdiction.

(2) The top of the grinder pump station basin shall set below the floor elevation of the first or ground floor. Basements with fixtures that will not discharge to the grinder pump station by gravity will require a separate grinder pump station outside the building or a pre-packaged ejector pump system inside the building by a licensed plumber. (Note: The decision to install a pump station inside a building shall be made independent from the Management Entity). All pumping basins must be set at an elevation to accept gravity flow from the lowest sanitary fixture in the building and must comply with the general specifications set forth herein, except where local codes and the Engineer have established higher standards. All customers with the potential for future sanitary fixtures that will not flow by gravity to the existing exterior grinder pump station shall be advised that basement fixtures must be handled by a separate pumping system. The installation of an indoor prepackaged system or a separate exterior pump station that delivers Sewage to an Infiltrator or grinder pump station that pumps to the Collector Line must be performed by a licensed plumber with the knowledge of the Management Entity.

(3) The installer of grinder pump basins shall use sufficient concrete mix, as specified by the basin manufacturer, to achieve the anti-flotation requirements of an empty basin under the worst ground water conditions at the specific site.

(4) Unless approved by the Engineer, extra storage basins or gravel-less pipe overflows shall not be permitted.

8.02-11 Controls.

(1) Controls for operation of the simplex grinder pump system shall be furnished by the manufacturer and supplied with the pump station. All controls and accessories shall be compatible with the manufacturer's pump model and type specified as approved by the Engineer. All controls shall be intrinsically safe.

8.02-12 Pump Control/Alarm Panel.

(1) The control/alarm panel shall be a custom-engineered thermoplastic enclosure with a 4X rating, suitable for mounting as indicated on the Drawings. The panel shall be assembled and tested by the manufacturer meeting UL standards and intrinsically safe. In all applications, unless specifically approved by the Engineer, all pump controls and alarm wiring shall be placed within the interior of the enclosure. The enclosure size and dimensions shall be approved by the Engineer.

(2) The control/alarm panel shall be wired for 1 phase, 230 VAC power supply from the main breaker panel inside the building or residence. The control/alarm panel shall be lockable.

(3) The control/alarm panel shall be located on the exterior of the building in close proximity to the grinder pump station basin and at a level that can be readily visible by the service technician when at the property.

8.02-13 Wiring.

(1) All internal panel wiring shall be furnished by the manufacturer. All interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C. All wiring shall be in accordance with the National Electrical Code.

(2) Power for the grinder pump station shall be supplied from the main breaker panel in the building and served by a dedicated breaker. The service to the control/alarm panel shall be installed to the designated panel location by a licensed electrician and in accordance with all applicable codes.

(3) Electrical connections between the control/alarm panel and the grinder pump basin required to power the pump shall be installed within gas-tight, buried conduit and according to code. The conduit shall be sized to accommodate the pump power cord and the alarm cable.

(4) The panel fabricator shall provide such additional circuits as specified by the Engineer.

8.03 Interceptor Tank Pump Stations for STEP Systems

8.03-1 General.

(1) The Interceptor Tank in this discussion is a Septic Tank that contains an effluent pump or a Septic Tank and a separate tank with an effluent pump to deliver partially treated Sewage to a low pressure Cluster or Community Wastewater System. The effluent pumps shall be submersible centrifugal or submersible turbine type pumps and sized appropriately for the head/capacity conditions. All the Sewage from the building including kitchen, laundry and bath wastes shall enter the first chamber of the Interceptor Tank and then flow to the second, effluent pump chamber contiguous to the first chamber or to the separate pump tank. Regardless of the Interceptor Tank configuration, all such STEP system designs must be submitted to and approved by the Engineer before construction commences.

8.03-2 Acceptable Manufacturers.

(1) Engineer and Management Entity shall approve STEP system suppliers according to the Standards herein. To assure proper operation, installation and compatibility of pump and control equipment, a single supplier or manufacturer shall supply the complete system including pumps, controls and appurtenances.

8.03-3 Submittals

(1) (1) Shop drawings shall be submitted from the manufacturer detailing the design of the tank and any appurtenances, including dimensional data, materials of construction, electrical components, etc., in three (3) copies.

8.03-4 Substitutions

(1) Refer to Section 8.01-4 Substitutions for details.

8.03-5 Experience Clause

(1) The pump manufacturer shall have a minimum of 1000 units of similar type pumps installed in the United States.

8.03-6 Pump Warranty

(1) The pump manufacturer shall warrant the pumps being supplied against defects in materials and workmanship for a period of five (5) years or 10,000 hours in permanently installed wastewater pump station service. The warranty shall be non-prorated throughout the five (5) year or 10,000 hours period. The warranty shall cover parts and labor. Pumps having warranty policies wherein the coverage decreases or is pro-rated during the warranty period or wherein parts only are covered shall not be acceptable.

8.03-7 Pump Requirements

(1) Interceptor Tank effluent pumps shall be designed to handle peak flow and pressure requirements of the low pressure collection system.

(2) Interceptor Tank effluent pumps shall be designed and manufactured so they can operate submerged in the liquid being pumped and in a corrosive environment.

(3) Interceptor Tank effluent pumps shall operate intermittently by an on/off float control switch or an approved equal and wired for 1 phase, 115 or 230 VAC power supply from the building being served, depending on the pump horsepower or specified by the Engineer.

8.03-8 Pump Basin and Vault Requirements

(1) If the Interceptor Tank is configured as one tank with two chambers or two tanks, it shall meet the design and construction requirements for a Septic Tank and any separate pump tank shall meet the specifications of the Engineer.

(2) Pump vaults shall consist of a 12-inch diameter, minimum 54-inch deep PVC vault with sufficient number and diameter holes spaced around the perimeter, of the vault to allow maximum sludge and scum accumulation in the pump chamber to draw effluent from the clear zone of the tank or as specified by the Engineer. The Engineer shall approve the area of the screen assembly that is housed inside the PVC vault.

(3) Vault shall be removable through the septic tank outlet riser and shall be a locking design so vault will not turn once it is in position inside the tank.

(4) Vault shall have a drain port at bottom with a neoprene flap check.

8.03-9 Discharge Valves and Assembly

(1) The discharge assembly shall consist of PVC flex hose with fittings, Schedule 40 PVC pipe, a PVC ball-type check valve and a PVC ball valve. When pumping downhill, install anti-siphon assembly.

(2) Pump discharge hose shall be PVC flex hose with a working pressure rating of 100 psig.

(3) PVC ball value shall be a true union, rated at 150 psig working pressure. The ball type check valve shall be designed so that the ball check will be completely out of the sewage flow at the rated flow and will drop back on its seat to prevent flow reversing back through the pump from the Service Line when the flow stops.

(4) The discharge assembly, including valves, and location shall be specified and approved by the Engineer.

8.03-10 Effluent Pumps

(1) Effluent pumps shall be rated for the flow and discharge head conditions shown on the Engineer's Drawings.

(2) The pump shall be single phase, 115/230 VAC, 60 Hz, UL listed and CSA certified for use in screened effluent applications after partial treatment in a septic tank and shall be constructed to pass 1/8 inch solids particles. Effluent pumps may be corrosion resistant submersible, centrifugal or turbine pumps.

(3) Effluent pump motors shall be constructed of corrosion resistant stainless steel and have constant lubrication in oil-filled motor housings. The motor shall be hermetically sealed and be rated for continuous duty. Motors shall be protected against thermal overload and equipped with surge arrestors for added protection.

(4) Effluent pumps shall have impellers constructed of thermoplastic, stainless or steel.

(5) The effluent pump motor power cord shall be 16/3 SO electrical cord and cord shall be sealed at the motor entrance with use of a rubber compression washer and nut or other connection and cord type approved by the Engineer. A molded rubber tube filled with epoxy shall create a watertight seal.

8.03-11 Pump Controls

(1) The Interceptor Tank control system shall consist of a control panel, a liquid level indicator system as per Engineer design, water tight junction box outside of the tank riser and fittings and approved appurtenances. The control panel shall be UL-listed and shall be fully assembled and tested at the factory and contain sufficient underground, heavy-duty SO feeder cord for each Interceptor Tank. The SO cord shall be direct burial type as approved by the Engineer.

(2) The control panel shall be supplied 115/230V single phase VAC electricity from the main breaker panel in the building and shall be energized through a dedicated circuit breaker in the breaker panel.)

(3) Where liquid level indicators employ a float switch assembly, the assembly shall utilize single pole mercury switches to provide on/off control of the effluent pump. A separate float switch assembly shall activate a high/low level alarm. The control float switch assembly shall consist of four (4) polyurethane mercury switch floats securely mounted on an approved rigid pipe section. The rigid pipe shall be properly mounted inside the screened pump vault in a vertical, stable position and be removable for servicing. The position of the individual float switches shall be adjustable and removable without removing the pump vault. The liquid level indicators or pump control and high/low alarm level functions shall be installed as shown on the Drawings. The mercury switch floats shall be UL or CSA-listed. All wiring shall be assembled and individually insulated and to be watertight and intrinsically safe.

(4) The control panel shall meet the following minimum requirements:

(A) Enclosure: NEMA 4X, stainless steel with stainless steel or non-metallic hinges, stainless steel screws and a padlockable latch.

(B) Pump Circuit Breaker: Rated for 20 amps, ON/OFF switch, DIN rail mounting with thermal magnetic tripping capabilities.

(C) Fuse Disconnect: DIN rail mounted socket base with 5 amp, 10,000 AIC fuses.

(D) Redundant Off Relay: 115VAC, automatic single pole.

(E) Alarm System: The alarm circuit wiring shall be separate from the pump control circuit so that if the pump internal overload switch or pump circuit breaker is tripped, the alarm system remains functional. The panel shall have a panel mounted audible alarm with a minimum 80 db sound pressure at 24 inches and push-to-silence and alarm reset relay capability. The panel shall also have a visual alarm. Alarms shall be energized due to high/low water level in the STEP tank, as specified by the Engineer.

(F) Toggle Switch: The panel shall have a single-pole, double-throw three (3) position switch for Manual (On), Off and Automatic (On) pump control.

(5) The Engineer may require the control panel to have a green pump run light and an elapsed time meter.

(6) The Engineer may require the Contractor to install a separate pad-lockable, 20 amp-rated disconnect to be mounted adjacent to the exterior-mounted control panel.

8.03-11 Installation

(1) The pumps, controls and wiring shall be installed by a qualified Contractor in accordance with state and local electrical codes and manufacturer's instructions.

(2) The underground wiring marked by locator wire between the control panel and the Interceptor Tank shall be of the size and type approved by the Engineer and installed in a water tight conduit approved by the Engineer.

(3) The pump control panel shall be located on the exterior of the building being served by the Interceptor Tank. A panel alarm light shall be within a distance of 50 feet of the effluent pump and at an elevation approved by the Engineer to be readily seen when on the property. An auxiliary alarm may be mounted inside or on the building as specified by the Engineer.

SECTION 9 Interceptor, Tanks and Pump Tanks

9.01 Tank Requirements

9.01-1 Interceptor and Septic Tank Standards and Specifications

(1) General. An Interceptor Tank (e.g. a two chamber Septic Tank with the second chamber being a pump chamber or a single chamber Septic Tank with a separate pump tank) shall meet the standards and specifications of this section and the design and manufacturer preapproved by the Engineer and Management Entity.

(2) Concrete Tanks. A new, replacement, or repaired concrete Septic Tank or pump tank for a Cluster or Community Wastewater System shall be designed and constructed, in accordance with the following specifications and standards:

A. A Septic Tank or pump tank shall be designed to maintain structural integrity and remain watertight when either full or empty under the following conditions.

1. Cover: Maximum 2.4 feet over tank or as specified by the Engineer.

2. Water Table: Occasionally equal to or less than three feet (3') from the ground surface. Tanks shall be of sufficient weight to overcome buoyancy conditions at the site or other provisions shall be made according to the Engineer's specifications to prevent movement of the tank once set.

3. Loading Conditions: Top – 400 pounds per square foot; Lateral – 62.4 pounds per cubic feet.

B. Both Septic Tanks and pump tanks shall have components that are corrosion resistant and resist the effect of sewage, sewer gases, household chemicals and burial in soil.

C. The Interceptor Tank with two compartments shall have a baffle wall to form the two compartments. The baffle wall shall be located so that the inlet compartment comprises approximately two thirds (2/3) of the effective liquid capacity of the tank. When using two tanks in series rather than one large tank with a baffle wall, a baffle wall is not required in the second pump tank.

D. The baffle wall forming the two compartments in concrete Interceptor Tank shall be permanently fastened to the tank and shall be one of the following types:

1. Type 1: A baffle wall with a continuous opening four inches wide extending at least 75% of the width of the baffle, with the top of the opening located 12 inches below the effective liquid surface. A space of two inches shall be provided between the top of the baffle and the opposing underside surface of the tank cover or top.

2. Type 2: A baffle wall designed and specified by the Engineer.

E. Concrete tanks may be precast or poured in place. Both types shall comply with these specifications and meet all the quality assurance and testing requirements described herein. All precast tanks shall conform to the appropriate provisions of the American Society for Testing and Materials (ASTM) Standard.

F. Except as otherwise specified by the Engineer, the minimum hydraulic detention time for a septic tank shall be 2 days (48 hours), based on average design flow. In no case shall the tank effective liquid capacity be less than 1,000 gallons.

G. The inside length of a Interceptor or Septic Tank shall be at least one and one half (1½) times the inside width. The inside width of a tank shall not be less than three feet.

H. The minimum effective liquid depth of a tank shall be three feet, and the maximum effective liquid depth shall be six 6 feet.

I. A minimum air space of eight) inches shall be provided between the effective liquid surface and the lowest point on either the underside of the lid or the underside of the tank top.

J. The inlet to a tank shall be a sanitary or vent tee extending below the effective liquid level.

K. The invert of the Septic Tank inlet tee shall be a minimum of two inches above the invert of a Septic Tank outlet tee.

L. For Interceptor Tanks with a separate pump tank, a tee shall be used for the outlet of the Septic Tank, and the tee shall extend at least six inches above and 18 inches below the effective water level.

M. The inlet tee and the Septic Tank outlet structure shall be centered and aligned with the access inspection openings in the lid or top so as to provide unrestricted access to the inlet and outlet structures. Inlet piping shall comply with the International Plumbing code. Septic Tank outlet piping shall be specified by the Engineer. The inlet and outlet structures shall penetrate the tank wall. A watertight flexible joint (e.g. rubber boot molded into the tank side) shall be used to accommodate installation and reduce leaks due to post-installation tank movement.

N. Interceptor Tanks with an integral pump chamber shall meet all design and testing requirements for Septic Tanks in this document. The tank wall separating the septic tank and pump chamber compartment shall be poured monolithically with the tank walls and bottom, and shall contain, at a minimum the same reinforcing and the same thickness as the sidewalls of the septic tank.

O. Cast in-place tanks shall have minimum wall, bottom and lid thickness of four inches.

P. Precast concrete Interceptor Tanks with capacities of less than 1,200 gallons shall have minimum lid thickness of three inches, and tanks with capacities of 1,200 gallons or more shall have minimum lid thickness of four (4) inches. Concrete shall have a minimum compression strength of 4, 000 psi at 28 days.

Q. Reinforcing steel for Septic Tanks shall be ASTM A-615 Grade 60. Details and placement shall be in accordance with ACI 315 and ACI 318.

R. A lid for a tank may be monolithically poured. The lid for a tank with an effective liquid capacity of less than 1,200 gallons shall have only one section. A larger tank lid may have more than one section. In no case shall it be necessary to remove a lid or lid section in order to gain access to a tank for inspection or maintenance purposes. Where more than one lid section is used, joints between sections shall be sealed to form a watertight seal. Except for a monolithic pour or a proprietary product design, an approved water stop shall be used to affix the lid to the tank body or to seal multiple-part tank bodies. The Engineer shall specify the design and installation of tanks, lids and risers for tanks that will experience traffic.

S. Access inspection openings with a minimum 18-inch diameter or equivalent area opening shall be provided in the tank lid or top over the area of the inlet and outlet structures.

T. Risers for Interceptor Tanks shall be cast directly into tank lids or tops. Risers shall be manufactured of materials that are compatible with the expansion and contraction of tank material and form a mechanical bond with the tank material, ensuring a watertight seal over an extended period. All risers and components shall have watertight covers/lids. The cover/lid shall be designed, constructed, and maintained to prevent unauthorized access. A plastic or fiberglass access riser and cover/lid shall have third-party documentation that ultra-violet (UV) protection is molded into all components.

(2) Polyethylene and Fiberglass Tanks. Polyethylene and fiberglass Septic Tanks and pump tanks shall meet the requirements of the appropriate sections of the International Association of Plumbing and Mechanical Officials (IAPMO). If the requirements of this code conflict with the standards in this document, the standards in this document shall apply.

A. Polyethylene and fiberglass tanks shall meet all the specifications of the Engineer and be approved by the Management Entity before being used as an Septic Tank or pump tank and shall be constructed in accordance with good construction practices

B. Non-concrete tanks shall be watertight and satisfy the requirements for structural integrity and anti-flotation of concrete tanks.

(3) Metal Tanks. The use of metal tanks, drums, barrels or pipes as septic tanks is prohibited.

9.02 Tank Installation

9.02-1 Tank Installation

(1) A new, replacement, or repaired Interceptor Tank, Septic tank or pump tank shall be installed by individuals who are appropriately licensed under current Alabama law and regulation.

(2) Tanks shall be installed on a level, firm, and compacted surface such that the tank is level both longitudinally and laterally.

(3) Installation instructions from the manufacturer of concrete tanks shall be followed. All poly and fiberglass tanks must be accompanied by clear, concise instructions from the manufacturer for the proper installation of the tank. A minimum layer of 2" of sand or gravel placed level in the tank hole is recommended before setting the tank to facilitate leveling.

(4) Tank risers for a dwelling shall not be placed greater than 6 inches below final grade.

(5) Risers on a tank for a commercial establishment shall be brought to a minimum of established finished grade.

(6) When two Septic Tanks are connected in series to obtain the required capacity for an Interceptor Tank, a baffle wall shall not be used in the inlet tank but a baffle wall shall remain in the second tank if the second tank is built with a pump chamber. No more than one (1) two-tank series may be used per building sewer.

(7) Tanks shall be designed and installed so as to not float under all of the following conditions with a minimum recommended cover of one foot (1'):

A. Earth backfill to top of tank

B. Water table at ground surface

C. No water in the tank

(8) Unless approved by the Engineer, the Contractor shall avoid backfilling Interceptor Tanks with gravel that will accumulate groundwater around the tank and increase the risk of infiltration or floating the tank.

9.03 Tank Testing

9.03-1 Tank Testing and Quality Control

(1) All tank manufacturers proposing to sell Interceptor Tanks, Septic tanks or pump tanks to a Cluster or Community Wastewater System shall demonstrate that the design and construction technique employed are sufficient to ensure that each such product meets or exceeds the structural, water-tightness and concrete specimen testing protocols outlined below. The manufacturer shall first demonstrate this to the Engineer for each model it proposes to use in the Cluster or Community Wastewater System by submitting a request for tank consideration and the design and performance details associated with each tank model.

A. Structural integrity shall be verified by actual vacuum load or hydrostatic test in accordance with Table 1.

Table 1

TEST REQUIREMENT FOR STRUCTURAL PROOFING

	Effective Depth*	**30**	**40**	**50**	**60**	**70**	**80**	**90**
Vacuum Test	***Inches of Water***	**33.4**	**40.8**	**48.2**	**55.6**	**63.0**	**70.4**	**77.8**
	Inches of Mercury	**2.5**	**3**	**3.6**	**4.1**	**4.7**	**5.2**	**5.7**
Hydrostatic Test	***Inches of Water In Standpipe*** measured from the invert of the outlet up into the standpipe	**15.9**	**18.1**	**20.3**	**22.6**	**24.8**	**27.1**	**29.3**

*Effective Depth is the depth between the bottom of the tank and the invert of the outlet

B. Water tightness shall be verified by ASTM C1227 00b, "Standard Specification for Precast Concrete Septic Tanks" paragraph 9.2., herein incorporated by reference. ASTM C1227 98, paragraph 9.2.2, shall be modified to read as follows: Water-pressure testing – Plug the inlet and outlet of the tank and fill the tank with water and let stand for 24 hours. Refill the tank. The tank is approved as watertight if the water level is held for one hour. Tanks that pass the vacuum or pressure test and also pass the water tightness test shall be approved for consideration by the Engineer.

C. Structural and water tightness testing of tanks shall be specified by the Engineer and conducted in the presence of and certified by the Engineer or Inspector.

D. Pre-approved Interceptor or Septic Tanks to be used in Cluster or Community Wastewater Systems are subject to financial viability requirements of the Wastewater Management Entities Act [§22-25B-1 *et seq.,* Ala. Code (1975)] shall be randomly tested for watertightness, as described in (1)B above, according to a schedule specified by the Engineer and approved by the Management Entity. Interceptor and Septic Tanks shall be field tested for watertightness after installation and before backfilling. The Management Entity may specify that all tanks for a Cluster or Community Wastewater System must be tested for watertightnes after installation. The following outlines the minimum random testing that should be required:

1. Random watertightness testing shall include no less than 25% of the pre-approved Interceptor and Septic Tanks installed. In the event of a failure of the watertightness test, the Engineer and Management Entity shall agree to increase the percentage of tanks subject to field testing for watertightness from 25% to 50%. In the event of a second tank fails the watertightness test at a Cluster or Community Wastewater System, the Engineer and Management Entity shall have the option to require every new Interceptor and Septic Tank be tested for watertightness. In addition, the Engineer and Management Entity shall take whatever measures are necessary and appropriate, including the rejection of the preapproved model Interceptor or Septic Tank for use in the Cluster and Community Wastewater System in order to assure watertightness of new tanks.

2. All tanks that fail the field watertightness test shall be inspected and repaired by the contract installer, at contract installers expense, and retested. If the same tank fails the field watertightness test twice, the tank must be removed and replaced at contract installer's expense.

3. In the event that the Engineer determines that the cause of watertightness test failures are being cause by the contract installer, the Engineer with the approval of the Management Entity shall take appropriate measures, including but not limited to the requirement of new, properly licensed contract installer be retained by the Contractor, at Contractor's expense to supervise the installation of new Interceptor and Septic Tanks at the Cluster or Community Wastewater System.

4. After the watertightness of the tank has been demonstrated, the Contractor shall check the riser for watertightness, as specified by the Engineer.

(2) Concrete used in Interceptor or Septic Tanks shall have a 28-day compressive strength of at least 4,000 psi. The concrete tank manufacturer shall submit to the Engineer for approval the materials proportion for the concrete mix design and test data showing that such a mix meets the 4,000 psi requirements.

A. Concrete tank manufacturers shall cast at least four compressive-strength specimens every week in which a tank is manufactured, or every 100 cubic yards, or increment thereof, of concrete mix used**,** whichever is more frequent. Two of the specimens shall be tested at 7 days and the other 2 shall be tested at 28 days. Specimens shall be tested in accordance with the appropriate ASTM standard covering testing method for compressive strength of cylindrical concrete specimens."

1. If the 7-day specimen tests at 4,000 psi or greater, the 28-day test is not required.

B. Specimens shall be 6-inch diameter by 12-inch high cylinders unless the maximum aggregate size is ¾ inch or smaller, in which case 4-inch diameter by 8-inch high cylinders may be used. Specimens shall be made in accordance with the appropriate ASTM standard having to do with methods of making and curing concrete test specimens in the field. Specimens shall be cured in a manner similar to the curing of concrete products represented by the specimens.

C. Persons conducting quality control (QC) tests shall hold either a American Concrete Institute (ACI) level 1 certification or a National Precast Concrete Association's (NPCA) certification, "QC personnel training course (Fundamentals of Quality Precast)". If testing is performed by an outside testing agency, the agency must maintain records to demonstrate that the personnel performing the tests are either ACI or NPCA certified.

D. If a tank manufacturer can provide documentation, to the Engineer that the concrete used in the tanks came from an Alabama Department of Transportation (ALDOT) approved concrete plant and the concrete mix is an A1-C ALDOT approved concrete mix, the manufacturer shall not have to meet the requirements of paragraph (2) of this Section for Tank Testing.

(3) Once the watertightness of the tank and riser have been checked and verified and the tank backfilled and compacted, as specified by the Engineer, the Contractor shall demonstrate all the electrical controls and alarms work to the satisfaction of the Engineer or Engineer's Inspector.

(4) Complete logs and/or records of all watertightness testing, equipment testing, including alarms, shall be provided to the Management Entity in a form approved by the Engineer for review for acceptance of each tank by the Management Entity.

SECTION 10 General Design Guidelines for Treatment Systems

All treatment systems shall be capable of meeting the requirements of the Performance Permits issued by ADPH and ADEM.

SECTION 11 General Design Guidelines for Effluent Dispersal Fields

(1) Effluent Dispersal Fields for Cluster Wastewater Systems permitted by ADPH shall meet the requirements of the appropriate sections of Rules of The State Board of Health Chapter 420-3-1.

(2) Effluent Dispersal Fields for Community Wastewater Systems shall meet the requirements of a permit issued by ADEM .