CITY OF LEBANON, TENNESSEE
UTILITIES DEPARTMENT

STANDARD SEWER SPECIFICATIONS
FOR SUBDIVISIONS AND
GENERAL SYSTEM ADDITIONS
CITY PROJECT NO. CL. 23004

SEPTEMBER 2023

City of Lebanon Tennessee

WPN 23.0604

APPROVED FOR CONSTRUCTION

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

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

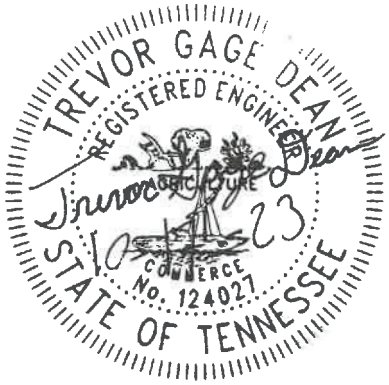
AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

Adnan Bahou

11/2/2023

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

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE



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STANDARD SEWER SYSTEM SPECIFICATIONS

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INTRODUCTION

PURPOSE OF THE STANDARDS MANUAL

These Standards are guidelines for Developers, their Engineers and Contractors for the planning, design and construction of sanitary sewers, small wastewater pumping stations, and associated appurtenances within the City of Lebanon, Tennessee, Utilities Department, hereinafter identified as the "City of Lebanon", service areas.

These Standards shall govern the construction materials and installation of wastewater collections systems that are, or will become, the responsibility of the City of Lebanon to operate and maintain as part of their system.

These standards are intended to meet or exceed the requirements of the State of Tennessee's Department of Environment and Conservation (TDEC) and to aid the Engineer in his design of wastewater collection systems and wastewater pump stations. This design should incorporate the highest level of standards of practice and specify materials of highest quality identified in the technical specifications.

The Standards identify a single set of standards, criteria, submittal requirements and approval procedures to be used in the planning, design, and construction of projects within the City of Lebanon service area.

These Standards are not intended to serve as a step-by-step design and construction method, nor can this manual address every situation that may arise. The application of sound engineering/surveying principles combined with the information contained herein is necessary to complete the planning, design, and construction for wastewater collection projects.

SECTION 1 – GENERAL

1. DEFINITIONS

City of Lebanon - Lebanon, Tennessee, Wilson County

Utilities Department – City of Lebanon Utilities Department, which oversees plan reviews, approval, and installation of sanitary sewer facilities.

Utility Engineer – Employed by the City of Lebanon, registered as a Professional Engineer or Engineer in Training in Tennessee and who is responsible for review and approval of all proposed sewer, water, and/or improvements.

Utility Inspector – City of Lebanon Utilities Department staff who is an authorized representative of the Utilities Department. Inspector is responsible for visiting job sites, monitoring testing, etc.

Utility GIS Technician – City of Lebanon Utilities Department staff who visits job sites to collect GPS data and pictures of newly installed sewer facilities as listed in these specifications.

Project Administrator – City Engineer or Utility Engineer who is responsible for overseeing the plan review in the IDT Submittal portal and who shall be the main contact for questions regarding the project.

Planning Commission – City of Lebanon Planning Commission

Developer – Individual or organization involved in the procurement of land and construction of buildings on that land.

Contractor – Contractor who is installing sewer facilities in a proposed development.

Design Engineer – One who has prepared the construction plans and specifications for the installation of sewer facilities in a proposed development. As provided by the laws of Tennessee, he or she must be a registered professional engineer and plans and specifications must bear his or her official seal.

Surveyor – Party responsible for establishment of building lines, property lines, benchmarks, etc. on a construction project. As provided by the laws of Tennessee, he or she must be a registered Surveyor.

State Regulatory Authority – Tennessee Department of Environment and Conservation (TDEC); Division of Water Pollution Control

Plans – Drawings, details, specifications, survey, plats and any other documents used to communicate design information to a Contractor or regulator necessary to construct improvements, extensions or modifications to the City of Lebanon wastewater system.

Final Record Drawings "As-Built" – Final updated set of Plans, updated upon completion of the project showing the final, field accurate locations, inverts, materials, etc. for all newly installed and existing structures that were connected to.

2. SCOPE OF REGULATIONS

2.1. These regulations shall apply to any person, Developer, firm, business, or entity interested in and desiring to construct additional sewer facilities or to extend sewer mains within the city limits, or to construct sewer facilities or extend sewer lines in a way that affects the sewer service provided by the Utilities Department.

3. PLAN REVIEW PROCEDURE

3.1. Before any connection is made to a sewer line of the Utilities Department, the Developer or other party through his engineer shall submit and receive approval of his proposed plans. Plans will not be deemed approved until the Utilities Department's stamp of approval has been affixed to each sheet of the drawings and specifications.

3.2. The approval of the Utilities Department must be obtained before submittal of the plans and specifications to the State Regulatory Authority, and both approvals must be obtained before construction is started. Evidence of State Regulatory Authority approval must be furnished to the Utilities Department before beginning construction. A copy of the City & State approved plans must be present at the project site during construction.

3.3. Approval of plans for proposed sewer line construction for new subdivisions and other developments must be obtained from the Utilities Department before final approval for such developments will be granted. Approval of plans shall be valid for one (1) year from the date of approval.

3.4. Plan submittal procedure shall be as follows:

3.5. All plans and other required documents shall be submitted to the Utilities Department through the City's electronic plan review portal – IDT Plans. Submissions shall include, as a minimum:

- Transmittal letter
- Plans including vicinity map.
- Preliminary plat showing the plan development if applicable.
- Engineering reports including design criteria used in sizing mains and/or pumping stations, as required.
- All current plan review fees must be paid in full.

3.6. The Utilities Engineering Department will review the plans and specifications. Should the proposed sewer line plan(s) need corrections, a comment list will be generated and sent through the IDT Portal to the Design Engineer for applicable changes.

3.7. Once the proposed sewer plan meets the City of Lebanon's current specifications, they will be stamped approved through the IDT Portal and sent to the Design Engineer electronically. The Design Engineer is responsible for submitting the City Approved Plans to the Tennessee State Regulatory Authority for their approval. The Design Engineer will revise the plans, if necessary, until State Approval has been secured.

3.8. If, after original approval of Plans, substantial changes occur as a result of TDEC review, changes in scope of the project, realignment or updates to the sewer main, or for any other reason(s) not listed, the Design Engineer will be required to resubmit drawings for review and approval by the Utilities Department. Resubmissions shall include a summary sheet with a description of changes made on each sheet. All revisions to the drawings shall be encircled with a cloud and shall be numbered to indicate which resubmission the changes are in reference to. If required, the Utilities Department may request that revised drawings be submitted to TDEC for reapproval, depending on the severity of the changes.

4. PLAN SHEET REQUIREMENTS

4.1. General Requirements

4.1.1. All plans shall be stamped by a Tennessee Licensed Professional Engineer.

4.1.2. Plans shall be drawn on a standard 24" x 36" sheet.

4.1.3. A cover sheet shall be made a part of all plans and shall incorporate a location map on an approximate scale not less than 1" = 1000', the name of the project, and the names, address, telephone numbers, and fax numbers of the Developer and the Design Engineer.

4.1.4. Acceptable plan scales shall be 1" = 50' for detailed drawings and 1" = 100' for overall drawings. Profiles shall have a horizontal scale of 1" = 50' and a vertical scale of 1" = 5' or 1" = 10'. Show profiles of all wastewater lines (for all force mains and gravity lines). Profiles shall be included on the same sheet as the corresponding plan view.

4.1.5. An overall Utilities Sheet is to be included and shall show all proposed underground utilities such as water mains, sewer mains, stormwater systems, and gas mains.

4.1.6. The direction of North shall be clearly shown on all sheets.

4.1.7. Show all existing and proposed utilities, including septic drain fields, wastewater, water, gas, electric, telephone, cable TV, and storm sewers on the plans and profiles with measurements and/or details of proposed clearances of same.

4.1.8. The Design Engineer shall include any elevations associated with existing utilities shown on plans if possible, including but not limited to top of castings, invert elevations, service line depths, etc. These elevations shall be acquired by the Design Engineer or his Surveyor. The source of the data shall be noted on the plans.

4.1.9. Show all topographic features such as driveways, pavements, rights-of-ways, property lines, storm drainage, structures, etc., especially those which may conflict with the proposed wastewater system.

4.1.10. Submitted plans shall include both plan and profile views of gravity sewer and force mains, and the Design Engineer shall label all pipe on the plans, including but not limited to the sizing, material and class, contents being carried, and flow direction, along with labeling proposed and existing structures such as manholes, wet wells, pumping stations, etc.

4.1.11. Profile views shall show all known existing and proposed crossings of utilities and approximate or actual depths, including but not limited to water mains, sewer mains, gas mains, electrical lines, culverts, underground structures, etc.

4.1.12. Plan and profile views shall include a delineation of public and private sewer facilities at or near the property line or existing sewer easement.

4.1.13. Submitted plans shall include, besides the sewer system plans, plans showing finished grades for the roadways, curbs, gutters, sidewalks, and ground as well as the location, size and invert elevation of other utilities and drainage structures. See Paragraph 4.1.8 for elevation collection information.

4.1.14. Provide detailed drawings for unusual conditions such as stream crossing(s), railroad crossing(s), highway crossing(s), etc.

4.1.15. Show the limits of all existing and proposed easements.

4.1.16. The plans shall also include the latest revision date and revisions are to be clouded, if applicable.

4.1.17. The Utilities Department reserves the right to have wastewater lines relocated on the construction plans to facilitate maintenance and to provide service for adjacent properties.

4.1.18. All final construction plans shall be based on field run survey information and shall include the name and stamp of the registered surveyor.

4.1.19. All sewer plans must include one (1) onsite benchmark based on U.S.G.S. North American Datum 1983 (NAD 83) for Horizontal data and North American Vertical Datum 1988 (NAVD 1988) for vertical data. Additional benchmarks shall be shown at approximately 1,500-foot intervals. The use of manhole invert elevation or assumed invert elevation will not be acceptable.

4.2. Sewer Pump Station Submittal Requirements

4.2.1. All influent lines penetrating the wet well walls shall be shown in plan views and sections. The plans shall identify the pipe size, material, and elevations for each line.

4.2.2. Hydraulic calculations and data shall be submitted for the proposed system including an estimation of total SFUs and supporting criteria, average design flow, peaking factor, peak design flow, hydraulic profile, system curves, system's static and total dynamic head calculations, proposed pump curves, wet well calculations, cycle time calculation, force main surge pressure analysis, and all other requirements in accordance with the State design criteria.

4.2.3. Wet wells shall have both plan and profile views, including the below ground valve pits or above ground valve boxes, etc.

4.2.4. A detailed site plan layout for the pump station area including, piping arrangements, valves, bypass connection, backup power facilities, electrical panels, site lighting, access road, fencing, and associated landscaping, along with all other appurtenances for the construction of the facilities.

4.3. Private Developments

4.3.1. Private Developments, who's sewer system will not be owned and maintained by the City of Lebanon Utilities Department shall be required to submit plans and meet or surpass the City of Lebanon's Standard Sewer Specifications and Standard Details before the development is allowed to connect to the City's sewer system.

4.3.2. Private Development sewer systems must be wholly owned (including pumping stations, force mains, gravity sewer and alternative sewer designs) by a single responsible party for operation and maintenance. Ownership must include utility easements to allow complete access to all infrastructure components, or equivalent, to pumps, pump controls, and alarms in order to provide an operable and maintainable system for all force main designs.

4.3.3. Prior to the approval of final plans and specifications for sewerage facilities that are not owned and operated by The City of Lebanon Utilities Department, the Utilities Department must receive evidence of the ownership of the system by a satisfactory organization that will be responsible for the operation and maintenance (such organization as a corporation set up under the General Corporation Act of 1969, an organization that has a charter from the Tennessee Public Service Commission, or a title deed on FHA insured loans) of the system. (TN Rule 0400-40-16-.02)

4.3.4. Plans for sewer systems including domestic wastewater treatment systems will not be approved unless ownership and responsibility for operation are by a municipality, publicly owned utility, or a privately-owned public utility regulated by the Tennessee Regulatory Authority (TRA). The owner is defined as the entity responsible for the operation of the system. The property being served is defined as the user.

4.3.5. Legal title to tanks, pumps, or other components should be vested with the owner. The objective of having title invested to the owner rather than the user is to avoid potential for cost disputes over equipment selection and repair methods. Regardless of where title is vested, the owner should completely control all tanks, pumps, service lines and other components of the system on private property. This requirement is essential to assure

operable hydraulics and overall system reliability.

4.3.6. The owner shall possess a recorded general easement or deed restriction to enter the private property being served, and to access the system and its components. Access must be guaranteed to operate, maintain, repair, restore service and remove sludge.

4.3.7. Owners should operate and maintain facilities without interruption, sewage spills on the grounds, sewage backup into buildings, or other unhealthy conditions.

5. DESIGN FEATURES

5.1. Sewer System Design Criteria

5.1.1. Sewer system design features shall generally conform to good municipal practice and to requirements of the Tennessee Department of Environment and Conservation. The following criteria will generally apply:

Per Capita Wastewater Flow (PE) 100 GPCD

Peak Flow Factors (PFF)

Population Served	PFF
0 – 500	5
500 – 1000	4
1000 – 10000	3.25
10000 – 50000	2.5
Over 50000	2

	GRAVITY	PRESSURE
Minimum velocity at design flow	2.0 fps	3.0 fps
Maximum velocity at design flow	15.0 fps	5.0 fps
Basis of Hydraulic Design: Manning's Formula with "n" =	0.013	Hazen-Williams w/C=140
Minimum Size		
Collector	8"	1 ½"
Service *	4" or 6"	1 ¼"

5.1.2. The minimum size service line (lateral line running from the collector sewer to the point at which the sewer customer is to tie in at the first cleanout) shall be 6" diameter.

5.1.3. Distances between manholes shall not be greater than 400 LF.

5.1.4. All conventional gravity sewers shall be designed and constructed to give mean velocities when flowing full of not less than 2.0 feet per second. The following minimum slopes shall be provided; however, slopes greater than these are desirable:

Sewer Size (inches)	Minimum Slope (Feet per 100 feet)
8	0.45
10	0.30
12	0.25
14	0.20
15	0.18
16	0.16
18	0.14
21	0.12
24	0.09
27	0.08
30	0.07
36	0.06

5.1.5. Sewer system design shall allow a drop in elevation through each manhole of at least 0.1 feet unless approved otherwise by the Utilities Department.

5.1.6. An outside drop connection shall be provided for a sewer entering a manhole at an elevation of more than 1.9 feet above the manhole invert. Where the difference in elevation between the incoming sewer and manhole invert is 1.9 feet or less, the invert shall be filleted to prevent solids deposition. Drop assemblies shall be built in manholes at the locations and in conformance with the details shown on the Standard Detail Drawing. The drop pipe shall be the same diameter and of the same material as the incoming sewer main and shall be encased in concrete.

5.1.7. Generally, the following locations should be utilized for location of new wastewater lines unless field conditions such as other utilities, etc. make it impractical to do so:

A. New Subdivisions – New mains to be in the center of the roadway where practical unless otherwise approved by the Utilities Department and shall not be located under sidewalks.

B. Along older roads in existing subdivisions that have open ditches, the mains shall be located in easements unless otherwise approved by the Utilities Department.

C. Service lines shall be generally located 5’ from the downstream property line and/or out of the way of driveways, sidewalks, landscaping, headwalls, drainage swales, etc. and shall have a cleanout.

D. Cleanouts for service lines shall be installed no more than 3' behind the property line and shall not be located in driveways, sidewalks, landscaping, or near headwalls, drainage swales, etc.

- Separation of sewer, water, stormwater, and gas shall be maintained in accordance with the following guidelines:

- For parallel installations with water, gas, electric or stormwater mains, line separation is to be at least 10 feet edge to edge. If this cannot be obtained, the bottom of the water line shall be at least 18 inches above the top of the sewer. If this condition is also unobtainable, the sewer line is to be constructed of materials and have a joint design equivalent to water main standards as approved by the Water Department and shall be pressure tested to 50 psi to assure watertightness and shall be concrete encased.

- Where the sewer main **crosses under** water, storm sewers, or gas lines, a separation of at least 18 inches shall be provided between the bottom of the water line and the top of the sewer. If this separation cannot be obtained, sewers, for a distance of 10 feet on either side of the crossing, shall be constructed of materials and have a joint design equivalent to water main standards as approved by the Water Department and shall be concrete encased. Such sewer mains shall be pressure tested to 50 psi to assure watertightness.

- When sewer mains do have to **pass over** water lines, the sewer main shall be sleeved to a point of 10' on each side of the water. The water main(s) under sewers shall be protected (in addition to the sewer line construction noted above) by providing: at least 18 inches between the bottom of the sewer and the top of the water line; adequate structural support of the sewer to prevent excessive joint deflection or damage to the water line; centering of the water line section to result in the water line joints being as far from the sewer line as reasonably possible.

- Sewer mains and manholes shall be installed such that a water line would not pass through or come into contact with any part of a sewer or sewer manhole.

5.1.8. In dedicated wastewater easements other utilities, structures, grading, drainage, detention/retention ponds, landscaping, trees, roads, parking lots, fences, walls, construction of any type or any other improvements or obstructions are not allowed. In public utility and drainage easements (PUDEs), proposed tress will not be allowed to be planted on top of existing or proposed wastewater pipes and within the clearance requirements listed in this document. Any proposed landscaping will need approval by the Utilities Department.

5.1.9. Pipe Material shall be as designated on approved plans and shall conform to applicable specifications included in Section 2 of these Standard Specifications. The Design

Engineer shall specify pipe materials on all plans.

5.1.10. Provide concrete cap or ductile iron pipe for mains that, when completed, have less than 2 ½ feet of cover in non-traffic areas and 4 feet of cover in traffic areas.

5.1.11. Sanitary Sewer Services – Sewer services shall not enter manholes except in the cases of terminal manholes or where force mains connect to the gravity system. Manholes which have force mains discharging into them must have a protective coating against hydrogen sulfide attack (H2S) installed and shall utilize non-corrosive composite materials for manhole frames and covers, vent pipes, etc. Composite covers can utilize vents and be watertight if needed. If the force main is a major line with extended run times the next **four** downstream manholes must also be coated.

5.1.12. New doghouse manholes shall be epoxy coated. Dielectric testing (spark testing) shall be completed following the application of the epoxy coating, prior to cutting the pipe, with Utilities Inspector present to witness the testing.

5.1.13. For private gravity sewer systems, a manhole shall be installed at or near the property line, on the subject property, and shall denote on the profile a change from a public to private system.

5.2. Wastewater Pump Station Design Criteria

5.2.1. Generally, sewage pumping facilities shall be designed to maintain the quality of the waters of Tennessee and shall conform to good municipal practice and to the "Design Criteria for Municipal Facilities Section" as established by the Tennessee Department of Environment and Conservation, Division of Water Pollution Control. No pump station shall be subject to flooding. Top of slab to be a minimum of six (6") inches above finished grade.

5.2.2. Pump stations shall be located so that the site will meet the requirements for sanitary protection of the water quality as well as the hydraulics of the system. All stations shall be located within a landscaped and fenced area and shall be provided with a permanent asphalt drive and turnaround that is accessible at all times. The site must also be equipped with a switch operated security light. Grading shall provide for positive drainage away from the pump station.

5.2.3. For sewage pumping installations, suction lift pump stations are generally preferred for depths no greater than 20 feet. The following pumps are generally approved for use in the System (subject to detailed design review of each project):

- Gorman-Rupp
- Smith and Loveless

5.2.4. For sewage pumping installations at depths greater than 20 feet, submersible pumps may be used. The following pumps are generally approved for use in the system (subject to detailed design review of each project):

- ABS
- Flygt
- Fairbanks Morse
- Gorman-Rupp
- KSB

5.2.5. Pumping stations shall, where possible, be designed to utilize equipment similar to that already utilized by the Utilities Department. At least 2 pumping units shall be provided for each station with each pumping unit having the capability of pumping the peak demand. Design discharge velocities shall be such as to create self-cleansing conditions in the force main. Suitable combination air release valves shall be utilized at all points in the force main that are susceptible to an accumulation of air or gases released from the sewage, or the creation of a vacuum condition.

5.2.6. Pumping facilities will be required to have full standby pumping capacity, high water and power failure alarm system, either dual power source or generator (when directed by the City), flow meters in some cases and elapsed time meters for all pumps in all cases, water supply for maintenance and other items as determined in reviews for individual installations.

5.2.7. Pump operation shall be accomplished by the use of a bubbler system. The bubbler system shall consist of dual air compressors.

5.2.8. All wet well mounted pump enclosures shall be insulated fiberglass enclosures and supports, including heat, ventilation, and locking hasp. All wet well mounted pump station enclosures shall be hinged on one end or clam shell type hinged on both ends; or fully sliding type on a concrete slab such that the enclosure opens or slides completely out of the way for easy access to facilitate maintenance by the Utilities Department.

5.2.9. Provide electrical phase monitoring for the power supply to the wastewater pumps utilizing 3-phase power. All electrical conduits and wiring for the pump station shall be placed underground.

5.2.10. All pumping stations shall include an effluent force main cut-off valve outside the pumping station. The cut-off valve shall be contained within a lockable valve pit or lockable valve box to prevent tampering by unauthorized personnel.

5.2.11. In some pumping stations odor control facilities will be required. The method for odor control shall be approved by the Utilities Department.

5.2.12. In general, the combined weight of the pump and motor shall not exceed 1000 pounds; suitable lifting devices (jib crane) with electric hoist must be furnished with the pump station; and all items inside the pump chamber shall be made of corrosion resistant

material or shall be specially coated.

5.2.13. Preliminary discussions with the Utilities Engineer concerning pump station design are required before preparation of preliminary plans so specific design requirements can be established.

5.2.14. A Mission M-800 series SCADA Real Time Monitoring and Control System is required on all pump stations.

5.2.15. All pump stations are required to have an emergency pumping connection per standard detail. Wet well mounted pumping stations should be equipped with an integral emergency pumping connection inside the pump enclosure. Stations with submersible pumps shall have a bypass connection with valving built into the force main, near the wet well. Additionally, a manhole shall be installed within the pump station's fenced area, upstream of the wet well to allow for emergency pumping without disturbing roadways, sidewalks, streams, etc.

5.2.16. For private force mains, where public sewer extensions cannot be completed, the force main shall connect to the nearest public gravity sewer manhole. Any easements required to make a connection to public utilities will be the sole responsibility of the developer to obtain and maintain.

6. EASEMENTS

6.1.1. When sanitary sewers are constructed outside a public right-of-way, easements must be provided using the following:

- 0' –10' depth requires 20' easement.
- 10' – 20' depth requires a 30' easement.

6.1.2. No sewer allowed deeper than 20 feet without special approval by the Utilities Engineer and Utilities Director. All sewer mains and sewer service lines shall be constructed using SDR-26 PVC. In addition, Epoxy Lined Ductile Iron Pipe shall be required for sewer mains in engineered fill sections unless otherwise approved by the Utilities Department.

6.1.3. Easements for sewer infrastructure may be provided in either of two ways:

- Easement Document on forms provided by the Utilities Department, which must include legal description of the easement(s), exhibit map, legal Owner's name, map, and parcel, and must be signed by the Owner; and then notarized and recorded; or

- Record with the Subdivision Plat.

6.1.4. All easements for work on property not owned by the Developer must be obtained and recorded before final plans are approved.

7. PERMITS

7.1. Before beginning any construction, the Contractor shall obtain all necessary permits as required by law. Such permits include, but are not limited to, those from State and County Highway Departments and the City Roadway Department, Tennessee Department of Environment & Conservation, Tennessee Wildlife Resource Agency, US Army Corps of Engineers, Railroads, Cross Country Gas Pipeline owners, etc.

7.2. Special permits such Aquatic Resource Alteration, Railroad crossings, T.V.A. crossings and State Highway crossings must be prepared by the Developer's Engineer and must be in hand, with a copy submitted to the City of Lebanon, prior to final plan approval by the City of Lebanon. Any costs associated with these permits will be paid by the Developer.

8. PRECONSTRUCTION CONFERENCE

8.1. Before beginning any construction, and after the plan approval process is complete, the Developer or his Design Engineer shall schedule a Pre-construction Conference to be held between the Contractor, Developer, Design Engineer, and the City of Lebanon personnel. At this meeting, the contractor will be informed of the City's policies and any special requirements. The following is a list of items relating to the pre-construction conference:

8.2. After fulfilling the requirements noted below the Developer, or Design Engineer, is to schedule and coordinate the conference with the project administrator at least 3 days prior to the requested conference date.

8.2.1. Developer, or Design Engineer, is to have project plans and permits approved by all necessary agencies prior to the conference.

8.2.2. When submitting plans to the Utilities Department, the Design Engineer will provide three (3) hard copies of the plans that have been approved by the Department and the Tennessee Department of Environment and Conservation, and the State's approval letter. These must all be submitted to the Utilities Department prior to scheduling the preconstruction meeting. Additionally, the Design Engineer is responsible for providing three (3) copies of any revised drawings to the Utilities Department once revisions to the plans are approved by the Utilities Department and TDEC (if reapproval of plans is required by the State).

8.2.3. All outstanding fees (plan review, inspection, etc.) must be paid prior to scheduling the preconstruction meeting.

9. SUBMITTALS AND SHOP DRAWINGS

9.1. An electronic copy of each construction submittal (shop drawings, product data, etc. for items including but not limited to, pipe, manholes, castings, service pipe and other major appurtenances) shall be provided for the City of Lebanon Utilities Department for review and approval prior to start of construction and fabrication of and parts, structures, etc. Construction submittals shall be thoroughly checked by the Design Engineer and

Contractor, then dated and stamped with both their approval. Use of clouds, boxes, arrows, highlighting, etc. is required to clearly mark all proposed options and part numbers intended for use on the project. List any proposed deviations on the submittal cover sheet. Allow 14 calendar days for Utilities Department Review. Review of shop drawings by a Utilities Engineer does not relieve the contractor from responsibility for any errors within the documents or for furnishing the materials and equipment of proper dimensions, size, quantity, quality, and all performance characteristics to meet the requirements and intent of the design documents and these specifications.

9.2. Upon request by the Department, laboratory test reports shall be provided on all pipe to assure that it meets the requirements of these specifications.

10. ABILITY TO PERFORM

10.1. The Developer may be asked to establish, to the satisfaction of the Department, that the Contractor proposed to be used on any project, is to be approved by the Department as one who has the ability to perform the Contract and meets at least the minimum standards set forth below. Such factors as judgment, skill, and integrity will play an important part in the overall determination. Although additional criteria may be used, a responsible Contractor must at least:

10.2. Have adequate financial resources or the ability to secure such resources to successfully perform the proposed Contract safely, with minimum impact on the general public in a reasonable time frame.

10.3. Have the necessary experience, organization, and technical qualifications and have or show proof that he can acquire the necessary equipment to perform the proposed Contract.

10.4. Be able to comply with all required performance schedules or completion dates, taking into account Contractor's existing commitments.

10.5. Have a satisfactory record of performance, integrity, judgment, and skills.

10.6. Be otherwise qualified and eligible to receive an award under applicable laws and regulations.

10.7. Maintain a permanent place of business.

10.8. The Developer may be required to furnish the Utilities Department information sufficient to show that the proposed Contractor and its subcontractors and equipment currently meet these minimum standards.

11. INSPECTION

11.1. The Utilities Engineer and Inspector should be notified at least 48 hours before construction is to begin. The contractor must coordinate with the Utilities Department (Office 615-444-0825, ext. 5108, 5141, or 5147).

11.2. Forty-eight (48) hours advanced notice required for all inspection and testing.

11.3. All projects shall be subject to inspection during and upon completion of construction by an authorized representative of the Utilities Department. Inspection may consist of full-time resident inspection or part-time inspection at the sole discretion of the Utilities Department. The presence or absence of the inspector during construction does not relieve the Developer and/or Contractor from adherence to approved plans and specifications.

11.4. The City Utilities Inspector shall be present before a new tap to an existing sewer main can be made, and throughout the entire process.

11.5. The contractor must coordinate with the Utilities GIS Technician and Utilities Department (Office 615-444-0825 ext. 2312 or one of the above-listed extensions) to collect the data points. A minimum of 1-hour notice is required. Notice does not guarantee the ability of staff to be on site within 1-hour.

11.5.1. Any features listed below or noted at the time of the preconstruction conference that are covered before the Utilities GIS Technician records will be required to be uncovered at the Contractor's expense:

A. Every manhole, clean out, and valve needs to be collected.

B. On force mains, every bell, joint, bend, and fitting needs to remain exposed to be collected. The ditch can be filled, as long as these points are still exposed.

C. Every tap, tee, bend, fittings, and cleanouts on sewer services need to be collected along with the end of the services line.

D. If the force main runs underneath any structure, the main needs to be exposed underneath the structure so it can be located and photographed.

E. Concrete check dams need to be GPSed and photographed after completion. Top of all check dams must be exposed.

F. For casing pipes, each end of the casing needs to be exposed for the GIS technician to GPS and photograph before backfilling.

G. For creek crossings, each end of the concrete cap needs to be GPSed and photographed before removal of temporary dewatering measures are removed and backfilling is completed..

11.5.2. If, during construction, any gas mains are excavated, the contractor shall contact and coordinate with the City of Lebanon Gas Department (Office 615-443-2835, ext. 3001 or 3027) so they may collect GPS data on the existing main.

11.5.3. The work shall, at all times, be subject to the inspection of authorized representatives of the Utilities Department. Materials and/or workmanship found not meeting requirements of approved plans and specifications shall be immediately brought into conformity with said plans and specifications.

11.6. When the installation of the sewer facilities is complete, in place, tested, and ready for use, the Design Engineer or a licensed surveyor will prepare and submit as-built drawings through the IDT portal for review by the Utilities Department. When the as-built drawings have been approved, the Design Engineer will receive notification and he/she can schedule an as-built inspection with the Utilities Inspector(s).

11.7. The Developer must pay the cost of the inspection provided by the Utilities Department in the approval letter, which is sent after City approval in the IDT system. Upon completion of the project, the Utilities Department shall refigure the inspection fee based on sewer mains constructed and shall make whatever adjustment is necessary to correct the amount of the original deposit.

11.8. Inspection fees will be charged at their current rate and are due prior to scheduling the preconstruction meeting.

11.9. Authorized representatives of the Tennessee Department of Environment and Conservation shall have the right to inspect the construction work and shall be notified of the final inspection date on the work.

12. WORKMANSHIP

12.1. The work shall always be subject to inspection by authorized representatives of the Utilities Department. Materials and/or workmanship found not meeting requirements of approved plans and specifications shall be immediately brought into conformity with said plans and specifications.

12.2. All wastewater construction shall be in accordance with the latest specifications of the Utilities Department.

12.3. Contractor shall provide competent, suitably qualified personnel to survey, layout and construct the work. The contractor shall, at all times, maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons, the work or property at the site or adjacent thereto, shall be performed during regular working hours. Regular working hours shall be considered to be 7:30 a.m. to 4:30 p.m., Monday through Friday. Contractor will not permit overtime work or the performance of work on Saturday, Sunday, or any legal holiday without the Utilities Department's approval. A request to work outside regular working hours must be made two (2) working days prior to the time proposed to do the work. The contractor shall also follow any permit requirements for working hours or days, such as the restrictions set forth by the Tennessee Department of Transportation (TDOT), which limits work in Highways and Interstates to non-rush hour times and restricts work during federal holidays to outside of the TDOT right-of-way.

12.4. The Contractor shall be responsible for locating and verifying the elevations of existing utilities prior to construction. The Design Engineer is required to locate and verify existing utilities during the design process. Relocation of existing utilities will be done only with prior approval of the Utilities Department and shall be at the expense of the developer(s). All elevations of existing utilities shown on the plans are required to have been field verified by the Design Engineer or a licensed Surveyor.

12.5. The Developer and his contractors shall protect all utilities whether existing or new from damage by other utility installers. The Developers shall replace any water service/wastewater service in its entirety, (for water lines from the main to the meter and for wastewater lines, from the main to the easement line/right-of-way) should it be damaged.

12.6. The City, at its discretion, may require additional surveys by a licensed surveyor or engineer to verify placement of lines or other facilities within the easement.

12.7. The Contractor shall maintain service to existing wastewater systems at all times during construction. All necessary temporary power, bypass pumping, pump and haul, temporary plugs, etc., shall be furnished and maintained by the contractor. Coordinate and schedule any such activities with the Utilities Department at least two (2) weeks in advance.

13. RECORD DRAWINGS

13.1. A record of all deviations from the construction plans shall be recorded in the field by the project's superintendent, and submitted to the Design Engineer who shall, upon completion of the project, generate Final Record Drawings (As-Builts). As-Builts are generated by revising the original design information and adding the corrected data. Therefore, the Final As-Builts will depict the constructed information.

13.2. The Design Engineer shall provide a complete set of As-Builts (including private developments) using the IDT Plan Review system. This shall include a pdf set of As-Built drawings along with the GPS survey files in a format compatible with the City's geographic information system (GIS) software.

13.3. As-Builts drawings shall include actual field angles between lines and all actual service lines and cleanout locations. These As-Builts must be completed and submitted prior to acceptance of any facilities into the public system and any connections being made thereto.

13.4. The completed As-Builts shall be submitted to and reviewed by the Utilities Department for verification of information. The plans will be either accepted as As-Builts or rejected and the above process is repeated.

13.6. The drawings shall depict the Design Engineer's verification of the pipe sizes, lengths, slopes and angles, inverts, manhole covers, flow lines, changes in offset distances of structures, and location and elevation of existing utilities. Each drawing shall have the following shown on each sheet:

13.7. The Design Engineer and a licensed Surveyor shall stamp and sign **ALL SHEETS** of the As-Builts.

13.8. The Design Engineer shall affix a note on each sheet identifying the Drawings as As-Builts.

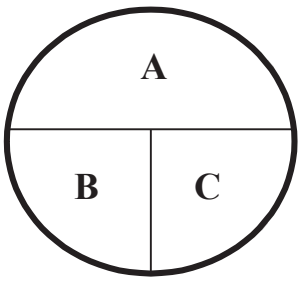
13.9. A statement affixed on the lower right-hand corner stating: In accordance with the Information provided by the field survey conducted by (licensed surveyor) on (date), information provided to (certifying engineer) by (contractor) on (date), and based on separate field reviews, I hereby certify that these plans represent a true and accurate depiction of the as-built conditions to the best of my knowledge.

13.10. Any unverified data shall show +/-, thereby indicating that information has not been verified. This shall only apply to information that could not be field verified by reasonable methods as approved by the Utilities Engineer.

13.11. As-Built drawings of the sewer improvements shall be complete and shall provide the following information:

- final surveyed location of sewer mains, services, and force mains.
- surveyed locations of all fittings, cleanouts, service connections, etc. along with the northing and easting coordinates for each.
- final surveyed manhole locations and invert elevations. along with the northing and easting coordinates for each.
- final surveyed top of casting elevations.
- identify pipe material, size, length, and final sewer slopes for gravity sewers.
- Changes in pipe lengths, angles, invert elevations, manhole rim elevations, etc. that deviate from the Design Drawings are to have the original text struck through, and revised numbers shown in a larger text size and in a red color.

13.12. Property Service Connections for sanitary sewer laterals shall be shown in a red font as follows:



Whereas:

A = The north easting coordinate of the service connection.

B = The horizontal distance from the center of the wye or tee to the end of the lateral.

C = The vertical distance from the top of the ground to the top of the lateral at the plug or property line.

13.13. Pump station as-builts shall identify the following to provide an accurate representation of installed facilities: all pipe sizes and materials, valves, abandoned piping and structures, bypass connection with detail, backflow preventor with detail, electrical controls, ventilation systems, pumps, elevation set for level controls, equipment layout, building modifications, location, and elevation of existing utilities, etc.

13.14. Provide the field verified operating conditions for the pump, summarized hydraulic calculations, specs for the supplied pump on the final pump station plan sheet and a copy of the startup report.

13.15. Show all other utilities.

13.16. Show abandonments and sewer utility removals.

13.17. Show all public and private easements along with building setbacks to verify that easements do not encroach on buildable portions of the lots.

13.18. Differentiate between private and public sewers. All sewers shall be shown on the as-builts.

13.19. Standard As-built drawing shown in the appendix.

14. FINAL INSPECTION

14.1. The Utilities Department shall make a final inspection of the project after completion to determine the acceptability of the work.

14.2. Before a final inspection is scheduled, the following must take place:

14.2.1. Record Drawings/As-builts have been reviewed and approved by the Utilities Engineer.

14.2.2. When the Developer completes the installation of the sewer infrastructure, a semi-final inspection will be held by the Utilities Department and the Contractor. A “punch list” will be generated during the inspection by the Utilities Department. When the punch list items have been addressed by the contractor, a final inspection with the Developer or his representative, the Contractor, and the Utilities Department will be held.

14.2.3. Binder pavement must be in place in road sections where water and/or wastewater lines are installed.

14.2.4. The Contractor will arrange for the T.V. inspection of all new gravity sewer facilities and provide the videos for review to the Utilities Department before the final inspection is scheduled, at the Developer's expense.

14.2.5. When the list of deficiencies, if any, is corrected, the Contractor will arrange for a final inspection.

15. FINAL ACCEPTANCE

15.1. When facilities qualify as public facilities, the Utilities Department will accept ownership of the completed facilities when the work has passed the final inspection and when record drawings are submitted to the Utilities Department reflecting actual "As-Built" conditions. The Utilities Department will review the drawings and, if acceptable, will begin the one (1) year warranty period.

15.2. Final acceptance by the Utilities Department will be made in writing, upon satisfactory completion of the project including final inspection, submittal of "As Built" drawings and payment of all fees due. The Developer shall guarantee the work for a period of one year from the date of final acceptance. When the Utilities Department has acknowledged final acceptance of the sewer facilities, the Developer may request that the Utilities Department reducer the Letter of Credit for Utilities to an amount equal to ten precent (10%) of the total value for utilities. Any deficiencies in the work due to materials and/or workmanship, which occur during the guarantee period shall be immediately corrected by the contractor.

PROCESS

STEP 1: The Developer shall submit a formal Utility Availability Request to the Utilities Department for review and approval if required.

STEP2: The Developer shall obtain approval from the Planning Commission for any preliminary plans or site plans prior to submitting related Construction Drawings.

STEP 3: The Developer will contract with a Design Engineer to design the proposed wastewater extension.

STEP 4: Developer and Design Engineer prepare plans.

STEP 5: Initial plan submittal of Construction Drawings via the IDT portal for review by the City of Lebanon. Initial submittal should include all necessary permits and easements needed from any agency and/or person having jurisdiction in the project area.

STEP 6: City of Lebanon Utilities Department reviews the drawings and includes comments for corrections to be made to the Design Engineer.

STEP 7: The Design Engineer revises the plans as necessary and resubmits them for review by the City of Lebanon. (Steps 6 & 7 repeat until all outstanding comments have been addressed and the City of Lebanon sends an approval letter).

STEP 8: The Design Engineer submits approved copies of the plans and specs to TDEC for approval.

STEP 9: The Design Engineer submits three (3) copies of the TDEC and City approved plans to the Utilities Department.

STEP 10: Developer and/or his contractor requests a PRECONSTRUCTION CONFERENCE with City representatives (Project Admin) after paying all fees and posting a Letter of Credit.

STEP 11: BEGIN CONSTRUCTION: Provide minimum 48-hour notification.

STEP 12: Developer's Engineer submits "As-Builts" and TV inspection video (for gravity sewer mains) and log of the sewer system.

STEP 13: Developer and Contractor set up final inspection by the Utilities Department.

STEP 14: City issues letter of Acceptance, Letter of Credit is reduced to 10% of the original, and the 1-year warranty period starts.

STEP 15: City of Lebanon Utilities Department TV's gravity sewer mains approximately 6 months after the start of the warranty period. Any issues will be addressed by the Developer during the 1-year warranty period.

STEP 16: Upon completion of the 1-year warranty period and after addressing any outstanding issues or paying outstanding fees, the Developer requests, in writing, the end of the 1-year warranty period and return of the Letter of Credit or Cash.

* * * *

SECTION 2 – MATERIALS

1. GENERAL MATERIALS

1.1. GENERAL

1.1.1. All materials to be incorporated in the project shall be first quality, new and undamaged material conforming to all applicable portions of these Specifications.

1.2. CONCRETE

1.2.1. Cement – Cement shall be Portland cement of a brand approved by the Utilities Department and shall conform to "Standard Specifications for Portland Cement", Type 1, ASTM Designation C150, latest revision. Cement shall be furnished in undamaged 94-pound, one cubic foot sacks, and shall show no evidence of lumping.

1.2.2. Concrete Fine Aggregate – Fine aggregate shall be clean, hard uncoated natural sand conforming to ASTM Designation C33, latest revision, "Standard Specifications for Concrete Aggregate".

1.2.3. Concrete Coarse Aggregate – Coarse aggregate shall consist of clean, hard, dense particles of stone or gravel conforming to ASTM Designation C33, latest revision, "Standard Specifications for Concrete Aggregate". Aggregate shall be well graded between 1 ½" and #4 sieve sizes.

1.2.4. Water – Water used in mixing concrete shall be clean and free from organic matter, pollutants, and other foreign materials.

1.2.5. Ready Mix Concrete – Ready Mix concrete shall be secured only from a source approved by the Utilities Department, and shall conform to ASTM Designation C94, latest revision, "Specifications for Ready Mix Concrete". Before any concrete is delivered to the job site, the supplier must furnish a statement of the proportions of cement, fine aggregate and coarse aggregate to be used for each mix ordered and must receive the Design Engineer's approval of such proportions.

1.2.6. Class "A" Concrete – Class A concrete shall have a minimum compressive strength of 4,500 pounds per square inch in 28 days and shall contain not less than 6 sacks of cement per cubic yard.

1.2.7. Class "B" Concrete – Class B Concrete shall have a minimum compressive strength of 3,000 pounds per square inch in 28 days and shall contain not less than 4 ½ sacks of cement per cubic yard.

1.2.8. Metal Reinforcing – Reinforcing bars shall be intermediate grade steel conforming to ASTM Designation A 15, latest revision, "Standard Specifications for Billet Steel Bars for Concrete Reinforcement". Bars shall be deformed with a cross sectional area at all points equal to that of plain bars of equal nominal size.

1.3. CRUSHED STONE

1.3.1. Crushed stone for bedding or backfill shall be Tennessee Department of Transportation (TDOT), Bureau of Highways, Standard Size No. 67 and shall meet TDOT Standards for road surfacing.

1.4. PEA GRAVEL

1.4.1. Pea gravel for shaping cradle bedding shall be #4 to ½" size Ohio River or approved local gravel of similar character.

1.5. EXTERNAL JOINT WRAP

1.5.1. External joint wrap shall consist of a minimum 9" width wrap with an outer layer of polyethylene, having a minimum tensile strength of 3,000 psi. Joint wrap may utilize either an under layer of rubberized mastic that is reinforced with a woven polypropylene fabric, or a heat-shrinkable sleeve of polyethylene. The joint wrap shall be installed on all manhole joints prior to backfilling. Joint wrap shall be RUBR-NEK, ConWrap CS-212, Wrapid Seal or approved equal.

1.6. RESILIENT CONNECTORS

1.6.1. All connections of pipes to manhole sidewalls shall be made with resilient connectors. Openings in the manhole sidewall shall be so constructed as to include the resilient connector such that it is an integral part of the sidewall and to provide for the required size and location of the pipe to connect to the manhole. The sidewall opening shall be manufactured to allow for lateral and vertical movement, as well as angular adjustments through 20°. The resilient connector shall be the Kor-N-Seal or approved equal. The resilient connector shall meet all physical and performance requirements as set forth by ASTM C-923.

1.6.2. The Contractor shall install a flexible annular space filler around the entire pipe with "Cavity-O-Ring" as manufactured by NPC Systems, Inc. of Milford, NH or approved equal.

1.7. DUCTILE IRON SEWER PIPE AND FORCE MAIN

1.7.1. Ductile iron sewer pipe shall conform to ASA Spec. A21.51 for ductile iron pipe centrifugally cast in metal or sand lined molds. Laying lengths shall be 16 feet or longer, except for special construction conditions. Buried piping shall have bituminous coating outside and an internal epoxy coating. Pipe shall be made with 60-42-10 grade ductile iron, or stronger. Thickness Class 52 shall be used for force mains and Class 50 for gravity sewers unless noted otherwise on the Plans.

1.7.2. Ductile iron pipe, where designated on the Plans for gravity lines and force mains, shall conform to USA Standard A21.51 for centrifugally cast pipe. The pipe shall be manufactured of iron having acceptance values of 60-42-10.

1.7.3. Pipe shall be furnished in lengths of 18 feet to 20 feet and unless otherwise indicated shall be provided with a compression type slip joint equal to Fastite joint as manufactured by American. Gaskets and lubricants shall be furnished with the pipe. Ductile iron pipe shall be at least Thickness Class 51, unless shown otherwise on the Drawings. Ductile iron pipe on piers or in tunnels or bores shall be at least Thickness Class 52, unless shown otherwise on the Drawings.

Diameter	Class 51	Class 52
8"	.30	.33
10"	.32	.35
12"	.34	.37
16"	.36	.39
18"	.37	.40
20"	.39	.42
24"	.41	.44
30"	.43	.47
36"	.48	.53

1.7.4. The buried pipe shall be furnished with an internal coating of Protecto 401 Ceramic Epoxy, Series 431 Perma-Shield PL Ceramic Epoxy, or an engineer-approved equal ceramic epoxy lining. The exterior of the pipe shall have a bituminous seal coat and a bituminous casting on the outside. The exterior of the pipe shall be clearly marked to indicate the manufacturer, date of manufacture, the pipe class and weight. Exterior markings shall also positively identify the pipe as being Ductile Iron.

1.7.5. Ductile iron pipe installed in pump station wet wells shall be provided with 3M Scotchkote fusion bonded epoxy coating 134 or approved equal material on the exterior of the pipe to protect against corrosion.

1.7.6. Joints shall be push-on type compression joints unless otherwise indicated and shall confirm to ANSI/AWWA/C111.A21.11, latest revision. Gaskets and lubricant shall be furnished with the pipe. Where shown on the Plans or required, joints shall be designed, and factory fabricated for extra deflection to the maximum for various pipe sizes as shown in published tables supplied by the pipe manufacturer.

1.7.7. Where indicated on the Plans, restrained joint pipe shall be provided. Such restrained joints shall be American Flex-Ring, U.S. Pipe Lok-Tyton, or equal.

1.7.8. All fittings shall be compact ductile iron, lined with Protecto 401 Ceramic Epoxy, Series 431 Perma-Shield PL Ceramic Epoxy, or an engineer-approved equal epoxy lining, manufactured in accordance with USA Standards A21.53-19, latest revision, unless otherwise indicated or directed. Minimum pressure rating shall be 350 psi. Unless indicated otherwise on the Drawings, mechanical joint fittings shall be used.

1.7.9. The fitting manufacturer shall furnish certificates that fittings were manufactured in compliance with ANSI A21.53-19, latest revision.

1.7.10. Pipe manufacturer shall furnish, upon request, the test data for quality control during the manufacturing period for pipe furnished on the project. Testing and inspection shall be accomplished at the factory in accordance with ASA A21.51. An independent testing laboratory approved by the Utilities Department or authorized representative shall perform tests and furnish the Utilities Department or his authorized representative with three copies of all test reports. Tests include hydrostatic test (500 psi – 10 sec); tensile test and impact test with one sample to be taken during each casting period of approximately 3 hours.

1.7.11. All ductile iron pipe shall be of first quality, with the weight, class, manufacturer's mark, year of manufacture and letters "DI" or "DUCTILE" shall be cast or stamped on each section of pipe.

1.8. FITTINGS AND COUPLINGS

1.8.1. Unless otherwise indicated on the Plans or directed by the Utilities Department or his authorized representative, fittings shall be of the same material as the pipeline in which they are to be installed. Fittings shall be ductile iron or stainless steel with mechanical joints for 3" or greater diameter lines. Fittings shall have interior and exterior coatings as specified for the pipe material and the application. Fittings shall be furnished with joints of the same type used throughout the rest of the pipeline unless such joint shall not be available and the Utilities Department or his authorized representative should approve a substitute type joint. Fittings shall be of the type indicated on the drawings and shall be to the manufacturer's standard conforming to all applicable standard specifications and dimensional tolerances appropriate for the material of construction.

1.8.2. Approved type commercial couplings shall be used in making transitions from one type of material to another. For gravity sewer applications couplings for transitions between clay and cast iron, concrete, and cast iron or between concrete and clay pipe shall be a heavy-duty reinforced rubber coupling with stainless steel clamps as manufactured by Tex-Vit, Fernco Strongback. or approved equal.

1.8.3. **Special coupling adapters for point repairs on sewer lines and/or joining sewer lines shall provide for shear / differential settlement protection and shall be Mission Flex-Seal ARC sewer couplings as manufactured by Mission Rubber Company or Utilities Department approved equal.**

1.9. PIPELINE DETECTION TAPE AND TRACER WIRE

1.9.1. Detectable tape shall be 3 inches wide and shall be an inert, bonded layer plastic with a metalized foil core and shall be highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The tape shall be green in color, 5.0 mils thickness, and shall bear the imprint "CAUTION -- SEWER LINE BURIED BELOW." Tape shall be Terra-Tape as manufactured by Reef Industries, Inc. or approved equal. Pipeline detection tape shall be used as directed by the Utilities Engineer.

1.9.2. In addition to the detectable tape described above, a tracer wire shall also be installed by taping to the top of the sewer main. This tracer wire shall be single strand of 12-gauge insulated copper clad steel tracer wire. All splices shall be by the solder or compression fitting methods. Wire nuts are not permitted.

1.9.3. Tracer wire and detection tape are to be installed on **ALL** gravity lines, pressure sewers and force mains not constructed of ferrous material. Tracer wire stub up boxes shall be required at a maximum distance of every five hundred (500) feet if air releases valves or other stub up locations are not in relatively close proximity.

1.9.4. **Note: The Contractor shall stub-up trace wires in all valve boxes, air release assemblies, clean-outs, etc.**

1.10. SEWER SERVICE CLEAN-OUTS, WYES, BOXES, AND COVERS

1.10.1. Typical sewer service clean-outs (6-inch or 4-inch) shall be installed as per Standard Details. The clean-out shall consist of a clean-out wye (no tees) along with a 45° bend. The 6-inch or 4-inch plug or cap shall be contained in a plastic (meter type) box.

1.10.2. The box shall be a minimum of 16" x 10-3/4" x 12" and 6-inch extensions made of injection molded plastic meeting ASTM D-2853-70, Class 1212, as manufactured by Brooks Products, Inc. or approved equal. The cover shall be green with "SEWER" imprinted on the top. The box and lid shall have UV stabilizer additive to assure resistance to material degradation from ultraviolet light. A 2-1/2-inch diameter, 16-gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection.

1.10.3. If the valve box must be located in a roadway or roadway shoulder subject to traffic, then valve box shall be constructed of pre-cast concrete or cast iron in accordance with the following:

A. Valve Boxes - Valve boxes are to be made of pre-cast concrete sections measuring 11" x 13-1/4" inside dimensions and 17" x 19-1/4" outside dimensions with a height of 12 to 15 inches. Reinforcement shall be placed and shall conform to the requirements of ASTM A-15 and ASTM A-305 for intermediate grade.

Footing blocks for standard concrete valve boxes are to be pre-cast in blocks measuring 12" x 12" x 4". No reinforcing steel is required in footing blocks.

B. Valve Box Frames and Covers shall be made of heavy cast iron and shall meet the requirements of ASTM A-48, Class 40.

All casting shall be made accurately to the required dimensions and shall be sound, smooth, clear, and free of blemishes of other defects. Defective castings which have been plugged in or otherwise treated to remedy defects shall be rejected. Contact surfaces of frames and covers to be machined so that the covers rest securely in the frames with no rocking. The cover shall be in contact with the frames for the entire perimeter of the contact surface.

The cast iron valve box frames and covers shall be manufactured by Bouchard No. 8006, Roadway Type, Nashville Standard or equal. The cover shall be marked "SEWER."

1.11. TUNNEL LINER PLATE

1.11.1. The steel lining shall consist of 8-gauge steel plates conforming to ASTM A-569 not to exceed 18 inches wide. Each circumferential ring shall be composed of the number and length of plates to complete the required diameter. The Contractor shall submit details of the lining for approval.

1.11.2. The strength of the casing or tunnel lining will be determined by its section modulus. The thickness of the metal for these steel plates shall not be less than 8 gauge allowing for standard mill tolerance conforming to AASHTO M-167.

1.11.3. All plates shall be punched for bolting on both longitudinal and circumferential seams, shall be of the lap type with offset equal to gauge of metal for full width of plates including flanges and shall have staggered-bolt construction so fabricated as to allow the cross- section of the plate to be continuous through the seam. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

1.11.4. The new material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first class in every respect.

1.11.5. After the plates are formed to shape and after all holes are punched, the plates shall be galvanized conforming to ASTM A-123. Plates shall then be bituminous coated conforming to AASHTO M-190.

1.11.6. All nuts and bolts shall be galvanized and conform to ASTM A-307, Grade A and ASTM A-153.

1.11.7. Plates shall be fabricated with grout holes to facilitate grouting above and around the tunnel liner. These grout openings shall be 2-inch I.P.T. half couplings welded into a hole in the center corrugation of a plate, and a galvanized C.I. plug shall be provided for each opening to permit tight closure after grout holes so that the spacing of holes will be on a maximum spacing of 18-inch centers at the top of the tunnel and at the top quarter points, staggered with holes at the top.

1.11.8. Field coating material shall be asphaltic mastic, Trumball 5X or approved equal, and shall be applied with hydraulic spray equipment using a minimum of 2,400 pounds pressure at the nozzle tip. The material shall be supplied at spraying consistency and shall be applied both to the outside and inside of the liner plates. Plates may be hot-dipped to produce a similar coating.

1.12. TUNNEL LINER GROUT

1.12.1. The grout shall consist of Portland cement, water, sand and 2% approved additive (Bentorite, Septamine Seax, Hydrocide liquid, etc.). One part Portland cement with additive shall be combined to four parts clean sand and sufficient water added to provide a grout having the consistency of thick cream when well mixed.

1.13. TUNNEL BACKFILL

1.13.1. Material used to backfill the tunnel/bore shall be pea gravel or grout along with stainless

steel anchors to secure carrier pipe submitted to and reviewed by the Utilities Department.

1.14. MANHOLE/VALVE/FORCE MAIN MARKERS

1.14.1. Manhole/valve markers, if required, shall be Carsonite Markers or approved equal.

1.15. CASING PIPE

1.15.1. Where noted on the Drawings or required by these Specifications, roadway, railroad, or other crossings shall be made utilizing carrier pipe within a casing pipe. Sizes of carrier pipe and casing pipe shall be as noted on the Drawings or described in these Specifications. **The minimum size of the steel casing pipe shall be large enough to allow the use of casing chocks described below. The Contractor may utilize a larger casing pipe size, if desired, as long as the carrier is properly secured to the satisfaction of the Utilities Department.**

1.15.2. Casing pipe joints shall be steel, of leakproof construction (in accordance with the following table), unless specifically shown otherwise on the Drawings or in the Specifications describing construction requirements at a particular casing location.

TABLE OF MINIMUM WALL THICKNESS FOR
STEEL CASING PIPE (COOPER E-80 LOADING)

Casing Diameter, inches	Wall Thickness with approved protective coating, inches	Wall thickness without approved protective coating, inches
Under 14	0.188	0.251
14 & 16	0.219	0.282
18	0.250	0.313
20	0.281	0.344
22	0.312	0.375
24	0.344	0.407
30	0.406	0.469
36	0.469	0.532
42	0.500	0.563

1.15.3. The Contractor shall provide all materials to properly secure carrier pipe inside casing pipe in a manner approved by the Utilities Department.

1.15.4. The casing pipe shall extend to the points indicated on the Drawings. The ends of the casing shall be protected against the entrance of foreign material but not tightly sealed, in a manner approved by the Utilities Department.

1.15.5. Note: In situations where the bore method is utilized with a steel casing pipe, the carrier pipe shall be secured inside the steel casing pipe with casing chocks (minimum three per joint) as manufactured by Power seal Pipeline Products Corporation of Wichita Falls, Texas, or Engineer approved equal. Where casing chocks are used inside steel casing pipes, the requirement for sand or pea gravel backfill can be eliminated. Additionally, the end of the steel casing pipe shall be sealed with casing pipe "End Seals", "Link-seal" or Engineer approved equal."

1.16. RIP-RAP

1.16.1. Rip-Rap stone material shall be sound, durable, free from cracks, pyrite intrusion and other structural defects. Wear shall not exceed sixty by the Los Angeles Method. When crushed aggregate is subjected to five alterations of the sodium sulfate soundness test, the weighted percentage of loss shall not be more than fifteen. At least 90 percent of the stone shall not be less than 8 inches wide by 12 inches long by 12 inches deep and shall be approximately rectangular in shape.

1.17. SEALING AND PROTECTIVE COATING FOR INTERIOR MANHOLE SURFACES

1.17.1. Sealing and epoxy coating of manholes is required for all new and existing manholes that have a potential for elevated hydrogen sulfide levels. This includes manholes that receive discharge from a force main or are equipped with watertight frame and covers that prevent release of the hydrogen sulfide. A Utilities Department representative shall inspect any existing manholes that will be connected to by the installation of the project to determine coating requirements for existing infrastructure.

1.17.2. Furnish materials of quality required by ASTM standards and specifications. Coating products shall be capable of being installed and cured properly within the specified environments. Coating products shall be resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems and capable of adhering to the substrates and repair products.

1.17.3. The contractor shall utilize equipment for the application of the coating products which has been approved by the coating product manufacturer. The contractor shall have received training in the operation and maintenance of said equipment from the coating product manufacturer. Contractors shall be trained by, or have their training approved and certified by, the coating product manufacturer for the handling, mixing, application, and inspection of the coating products to be used as specified herein. The contractor shall be trained in the use of testing or inspection instrumentation and knowledgeable of the proper use, preparation and installation of the coating products to be used as specified herein. Provide guarantee against defective materials and workmanship in accordance with the requirements of these specifications.

1.17.4. Manhole sealing involves materials to be used for sealing existing manhole sidewalls and/or inverts. For voids, brickwork joints, leaks, and/or invert work required, a Portland cement based hydraulic cement, Thoroc™ Plug and Thoroc™ Patch as manufactured by Thoroc / ChemRex, Inc. (formally Preco Industries Ltd.), Shakopee, Minnesota or Engineer-approved equal shall be used.

1.17.5. Materials for sealant applications shall be Durpal, Drycon Grey, Drycon White, Brush-Bond, SP15 Spray Mortar as manufactured by Thoroc / ChemRex, Inc., or Engineer-approved equal. This material shall be a Portland cement slurry which consists of Portland cement and finely graded mineral fillers and inorganic co-polymer additives which prevents seepage of water through the manhole inverts, benches, and sidewalls under a hydrostatic pressure.

1.17.6. For manholes needing protective coating for resistance to sulfide corrosion, the Contractor shall furnish and apply to the interior of manholes a multi-layer protective lining system consisting of a polyurea adhesion coating, polymer surface layer and final polyurea armor layer. The material shall consist of OBIC Polyurea System, SpectraShield® Liner Systems, or Warren Environmental® epoxy liner to the required thickness specified in the design documents but not less than 150 mils. The finished liner shall conform to the minimum requirements listed below:

1.17.7. The liner system armor layer shall provide 100% solids, no volatile organic compound (VOC), moisture tolerant, elastomeric polyurea coating to provide infiltration and corrosion protection. Material shall be capable of curing properly given the project site conditions and temperatures conforming to the following minimum physical requirements:

Property	Value
Hardness	D-48
Tensile Strength, D-412	3315 psi
100% Modulus, D-412	1668 psi
200% Modulus, D-412	1960 psi
300% Modulus, D-412	2650 psi
Tear strength, DIE-C, D-624	417 pli
Ultimate elongation, D-412	395%
Abrasion Resistance (cs17 wheels, 1000g, 1000 cycles, D-4060	15 mg loss
ASTM G210-13 Severe Wastewater Analysis Testing	Pass

1.17.8. The liner system surface layer shall provide 100% solids, no volatile organic compound (VOC), moisture tolerant, elastomeric polyurethane coating to provide infiltration and corrosion protection. Material shall be capable of curing properly given the project site conditions and temperatures conforming to the following minimum physical requirements:

Polyurethane		
Core Density	6 lb. ft^3	ASTM D 1622
Compressive Strength	130-180 psi	ASTM 1621
Closed Cell Content	>94%	
S.W.A.T.		ASTM G210-13

1.17.9. Manufacturer and Applicator warrant the liner system against failure for a period of 10 years. "Failure" will be deemed to have occurred if the protective lining fails to prevent the internal deterioration or corrosion of the structure or prevent groundwater infiltration. If any such failure occurs within 10 years of initial completion of work on a structure, the damage will be repaired at no cost to the Utilities Department. "Failure" does not include damage

resulting from mechanical or chemical abuse occurring from abnormal operational conditions. Mechanical or chemical abuse means exposing the lined surfaces of the structure to any mechanical force or chemical substance not customarily present.

1.17.10. ***Note: All sealing and coating of interior manhole and invert surfaces shall be by the spray applied method only.***

1.18. STRUCTURAL REPAIR AND SEALING OF MANHOLES AND STRUCTURES

1.18.1. Furnish materials of quality required by ASTM standards and specifications. Coating products shall be capable of being installed and cured properly within the specified environments. Coating products shall be resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems and capable of adhering to the substrates and repair products. The coating system shall provide for the structural enhancement of the existing structures.

1.18.2. For manholes requiring a protective coating for structural integrity and resistant to sulfide corrosion, the material shall consist of Sprayroq 100% structural polyurethane or approved equal to the required thickness as calculated by the manufacturer based on partially or fully deteriorated conditions of the existing structures but shall not be less than 250 mils. The following design conditions shall be assumed for structures being rehabilitated for structural repairs.

Parameter	Design Requirement
Structure Condition	Partially/Fully Deteriorated, based on condition of the existing structure.
Design Thickness	ASTM 1216-09 or Two Way Flat Wall Beam Analysis
Ovality	Not greater than 5%
Soil Load	120 lbs./cu. ft.
Traffic Load	AASHTO-HS-20-44 Highway
Soil Modulus	>500 psi. <1000 psi.
Safety Factor	2.0
Soil Cover	Distance from grade to crown of conduit
Water Table	Distance from invert to water table

1.18.3. Resin based material shall be used to form the sprayed structurally enhanced monolithic liner covering all interior surfaces of the structure, including benches and inverts of manholes. The finished liner shall be 100% solids polyurethane and conform to the minimum physical requirements listed below.

Compressive strength	ASTM D 695	> 16,000 psi
Tensile strength	ASTM D 638	> 7,450 psi
Bond (Concrete) Or Substrate Failure	ASTM D7234	> 200 psi
Bond (Steel)	ASTM D4541	> 1,000 psi
Flexural Modulus (Initial)	ASTM D 790	> 600,000 psi
Flexural Modulus (Long Term)	ASTM D 2990	> 500,000 psi
Density		87 ± pcf

Chemical Resistance: ASTM D543

1.18.4. The resin based liner is to be structurally designed to withstand the hydraulic load generated by the groundwater table with the long term (50 yr) value of the flexural modulus of elasticity will be utilized to calculate the thickness of the structural liner. The initial flexural modulus of elasticity (short term) of the submitted resin material will be utilized with the long term deformation percentage as determined by ASTM D2990 in the design equations outlined in ASTM 1216-09, Appendix X1-X7 (Circular Geometries) or Flat Wall Beam Analysis for walled structures. No adhesion to the substrate shall be assumed in structural calculations. The value of the long term flexural modulus of the proposed product will be certified by an independent, certified, third party testing lab, independent of the Manufacturer. All design submittals will include this certified third party DMA testing (ASTM D2990) value in their respective design calculations for each structure being rehabilitated.

1.18.5. ***Note: All sealing and coating of interior manhole and invert surfaces shall be by the spray applied method only.***

1.19. CHIMNEY SEALS

1.19.1. The chimney seal shall utilize either a flexible rubber frame seal or a heat-shrinkable sleeve to seal joints and prevent groundwater from entering the collection system.

1.19.2. When utilizing a flexible rubber frame seal, where necessary, an interlocking extension to extension or extensions, to seal the entire chimney of all sanitary manholes. The seal and extension(s) or sleeve shall extend from the lower base flange of the frame down to the top of the cone. The frame seal shall be capable of repeated vertical movement of the frame of not less than 2 inches and/or repeated horizontal movement of not less than 1/2 inch after installation and throughout its design life.

1.19.3. The bands used to compress the sleeve against the manhole shall be integrally formed from 16-gauge stainless steel conforming to the applicable material requirements of ASTM C-923, Type 304, with no welded attachments and shall have a minimum width of 1 inch. The top compression band shall have a shape and width sufficient to, when tightened, will mechanically lock the sleeve to the manhole frame's base flange. The lower compression band shall be a flat strip to allow placement into the lower band recess of the seal and or extension. The tightening mechanism on both bands shall have the capacity to develop the pressures necessary to make a watertight seal and shall have a minimum adjustment range of 2 diameter inches. Screws, bolts, and nuts used on the bands shall be 304 stainless-steel.

1.19.4. When utilizing a heat shrinkable frame wrap, the wrap shall completely encompass the manhole chimney, risers, and the bottom section of the manhole casting. Wrap shall have a minimum peel strength of 8.6 pli, and a minimum tensile strength of 3,000 psi.

2. GRAVITY SEWER MATERIALS

2.1. MANHOLE FRAMES AND COVERS

2.1.1. Manhole castings shall conform to ASTM Designation A48, latest revision, Class 20 and shall be free from scale, lumps, blisters, sand holes and defects of every nature which would impair their use. The castings shall be well cleaned, with a smooth tough asphaltic coating. Covers shall be of the solid indented type with the words "SANITARY SEWER" cast in raised letters thereon. The bearing surfaces of frames and covers shall be machined to provide a solid bearing and prevent rocking. Pattern drawings and weights of castings shall be submitted for the approval of the Utilities Department.

2.1.2. Vented lids shall be furnished and installed at ends and at approximately 1400 feet along line segments. Locations of all vented lids shall be at locations determined by the Design Engineer.

2.1.3. Manhole frames and covers (minimum clear openings to be 24 inches) shall be equal to those listed below for particular applications.

TRAFFIC & NON- TRAFFIC	John Bouchard & Sons No. 1155 Composite Access Products Model Cap One
WATERTIGHT	To be used where manhole casting is subject to flood or submergence by surface runoff. John Bouchard & Sons No. 1123 Composite Access Products Model Cap One
WATERTIGHT INSERT*	To be used as directed by Design Engineer. Manhole frame and cover to be same as non-traffic type as specified above. Insert to be "The Rainstopper" as manufactured by Southwestern Packaging & Seals, Inc., or approved equal.

2.1.4. Watertight Inserts shall be provided for 15% of the total number of Manholes installed for every project. This number shall be denoted during the preconstruction meeting and inserts are to be delivered to the Utilities Department Office at 200 Carver Lane, Lebanon, TN 37087.

2.1.5. Exceptions to the above shall be noted on Plans.

2.1.6. Traffic Rated Composite or HDPE manhole frames and covers may be used in place of cast iron manholes with approval from Utilities Department. All marking and submittal requirements for cast iron shall be required for Composite or HDPE.

2.2. MANHOLE STEPS

2.2.1. Steps shall be (1) aluminum, equal to #15295 by Alcoa, (2) ductile iron equal to Neenah No. R-1981-Q, or (3) plastic encapsulated steel equal to No. PS 1-45 as manufactured by M.A. Industries, Inc., East Point, Georgia.

2.3. MONOLITHIC POURED-IN-PLACE MANHOLES

2.3.1. The concrete shall be Class A design mix and shall be submitted to the Utilities Department for approval. Also, for each day's pour, two test cylinders should be made and tested in compliance with ASTM 172, ASTM C-31 and ASTM C-39. These tests shall be done by a testing laboratory selected, employed, and paid for by the Contractor after approval of the laboratory by the Utilities Department.

2.3.2. The Contractor shall submit to the Sewer Department his choice of a testing laboratory for their approval. The Contractor shall instruct the testing laboratory to forward copies of the test reports to the Utilities Department.

2.3.3. All manholes constructed and installed shall be cast with XYPEX® Admix C-1000 RED, or approved equal, in the concrete for waterproofing protection. The minimum required addition rate for Concentrate C-1000 RED is 3.5% by weight of cement. Alternative waterproofing additives may be submitted for review and approval. Design engineer must provide documentation that proposed substitutes for XYPEX® Admix C-1000 RED are equal in protection and manufacturer warranty.

2.3.4. The maximum depth of manholes shall not exceed twenty feet. The minimum wall thickness for 4'-0" inside diameter manholes shall be 6 inches. The minimum wall thickness for 5' and 6' inside diameter manholes shall be 8 inches.

2.3.5. The base concrete shall be Class A as stated above, vibrated on firm subgrade foundation or suitable crushed stone bedding. The base shall have a minimum diameter 8 inches greater than the outside diameter of the manhole and a minimum thickness, including the area under the pipe, as follows:

0' to 8' Manhole	8"
8' to 12' Manhole	10"
12' to 20' Manhole	12"

2.3.6. All water shall be removed from the form before and during the placement of the concrete. The first placement of base concrete shall consist of approximately 1/2 cubic yard of concrete deposited evenly around the walls and vibrated until there is a minimum slope of 60 degrees from the bottom of the forms to the bearing surface both inside and outside of the manhole. When this is complete and before additional concrete is added, the concrete must be carefully vibrated on each side of each pipe.

2.3.7. Additional concrete must be deposited in evenly distributed layers of 18 inches with each layer vibrated to bond to the preceding layer. The wall spacers must be raised as the placements are made with the area from which the spacer is withdrawn being carefully vibrated.

2.3.8. Should a cold joint become necessary, a formed groove and reinforcing dowels (#5 bars 36 inches long at 12-inch centers) will be required in the top of the first placement for shear protection. Immediately before the second placement is made, the surface of the cold joint shall be thoroughly cleaned and wetted with a layer of mortar being deposited on the

surface.

2.3.9. Felt adjustment rings will be formed and/or poured into the top section of the manhole to provide future manhole casting adjustments equal to two courses of brick.

2.3.10. The forms may be removed 24 hours after placement. At this time a membrane curing compound with a fugitive dye included will be applied by power spraying to the outside of the manhole. The Contractor must submit the manufacturer's descriptive details for curing compounds for approval.

2.3.11. The monolithic manholes shall be backfilled to same level simultaneously all around. The manholes shall not be backfilled until they reach 75% of the specified design strength. A select gravel backfill material shall be placed adjacent to the manholes in areas where swelling clays exist.

2.3.12. A resilient pipe connector shall be utilized to connect pipe to manhole sidewall.

2.3.13. Eccentric manhole cones shall be furnished and installed for 5-foot and 6-foot diameter manholes on precast or poured-in-place manholes. Concentric manhole cones may be installed on 5-foot and 6-foot diameter manholes if transition sections are used from 5-foot or 6-foot diameter to 4-foot diameter at approximately 60 inches above pipes. Details of proposed manhole construction shall be submitted to Utilities Department for approval.

2.4. PRECAST MANHOLES

2.4.1. Precast manholes shall conform to the latest revision of ASTM C-478. Drawings of manhole sections proposed for use on this project must be submitted to the Utilities Department or authorized representative for approval prior to use. Steps shall be furnished in accordance with Paragraph 2.2, and care must be taken to assure a firmly embedded step with no cracks from mortar shrinkage, which will allow leakage. Aluminum in contact with concrete shall be coated with heavy bitumastic paint. Loose steps and shrinkage cracks passing through manhole walls shall be cause for rejection.

2.4.2. All manholes constructed and installed shall be cast with XYPEX® Admix C-1000 RED, or approved equal, in the concrete for waterproofing protection. The minimum required addition rate for Concentrate C-1000 RED is 3.5% by weight of cement. Alternative waterproofing additives may be submitted for review and approval. Design engineer must provide documentation that proposed substitutes for XYPEX® Admix C-1000 RED are equal in protection and manufacturer warranty.

2.4.3. Manhole sections showing evidence of cracking, crazing, honeycombing, crumbling or excessive roughness will not be acceptable. Sections with improper cut-outs, misalignments or other defects shall not be utilized in the project.

2.4.4. Precast manhole panel (monolithic) bases may be used. Drawings of the monolithic bases proposed for use on this project must be submitted to the Utilities Department for approval prior to use. Bases shall have a minimum thickness of 8 inches with a minimum thickness of 2 inches allowed at the invert of the downstream pipe for the construction of the invert.

2.4.5. Manhole sections shall be steam or water cured and shall not be delivered to job site until at least 7 days old. Each section shall be marked with date of manufacture and manufacturer's mark in a permanent manner.

2.4.6. Testing and Inspection of precast manhole sections shall be done at the site of manufacture in accordance with ASTM C- 478 by the Manufacturer. Compression tests shall be run on specimens obtained from each day's production: a minimum of 2 cylinders or cores per day's run but no less than the maximum number designated by ASTM C-478. The absorption test shall be run on a minimum of 2 randomly selected manhole sections per each day's production. Certified test reports shall be submitted in three (3) copies to the Design Engineer.

2.4.7. In addition to testing required of the manufacturer as described above, the Utilities Department may provide an independent testing laboratory to make visual inspections of manhole sections produced from selected sections. The random samples will be selected by the Utilities Department's testing laboratory and will be taken from stock on the manufacturer's yard intended for use on this project. Core samples shall be cut from designated sections amounting to no more than 4% of the total production in order to run compressive strength and absorption tests. The manufacturer shall cut the cores and seal the holes, but this testing shall be done by the Utilities Department's testing laboratory and paid for by the Utilities Department. In the event the samples fail to conform to the Specifications, the manufacturer may furnish additional test specimens to the extent permitted by the Specifications. Testing done by the Utilities Department's testing laboratory shall be in accordance with ASTM C-478, latest revision.

2.4.8. In the event of a discrepancy between the results of tests run by the manufacturer and tests run by the Utilities Department's testing laboratory, the Utilities Department shall determine the test results which will be applicable.

2.5. DROP PIPE ASSEMBLIES

2.5.1. Precast manholes designed for the installation of an external drop pipe assemblies shall be cast with resilient connectors to allow for the connection of the sewer main and the drop pipe. Drop pipe assemblies shall utilize pipes of the same type as the sewer main and shall be coupled to prevent separation.

2.6. POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

2.6.1. All Gravity PVC sewer pipe shall be **SDR 26** or heavier including mains and service line piping to the clean out. Pipe shall be manufactured in accordance with ASTM D3034, latest revision, for type PSM sewer pipe and fittings, for 4" through 15", and ASTM F679 (wall thickness T-1), for 18" through 36". Pipe shall be furnished in lengths not exceeding 14-feet. Pipe shall be furnished with integral bells: gaskets and lubricants shall be furnished by the pipe manufacturer. Pipe fittings shall be made of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D 1784.Pipe manufacturer shall be approved by the Utilities Department or authorized representative before use on any project.

2.6.2. Joints shall be compression type utilizing an elastomeric gasket providing a positive seal against ground water and root intrusion as well as sewage leakage and shall be in accordance with ASTM D3212. Gaskets shall comply with physical requirements specified in ASTM F477, latest revision. Lubricant shall be furnished with the gaskets and entirely compatible with gasket and pipe material.

2.6.3. Joints shall show no signs of leakage when tested as follows (supersedes ASTM D3034): Typical joint assembly shall be subjected to internal hydrostatic pressure of 10.8 psig for 10 minutes without leakage; assembly shall also be subjected to internal vacuum of 22 inches of mercury or external pressure of 10.8 psig for 10 minutes without leakage. The above internal pressure and vacuum (or external pressure) tests shall be run on a typical joint assembly in concentric alignment and in a position of angular deflection to at least 3 degrees.

2.6.4. Joint design shall be approved by the Utilities Department or authorized representative before use on any project.

2.6.5. Testing and inspection of all pipes shall be done at the factory with a certified copy of the test results furnished to the Utilities Department or an authorized representative before any pipe is installed.

2.6.6. For projects using less than 2,000 feet of sewers (not including service lines) such testing shall be done by the manufacturer. For larger projects testing shall be done by an independent testing laboratory approved by the Utilities Department or authorized representative (unless this requirement is waived in writing by the Utilities Department or authorized representative in which case testing shall be done as if for projects using less than 2,000 feet of sewers).

2.6.7. Tests shall be done in accordance with ASTM D3034 or ASTM F679 and shall include Pipe and Fitting Dimensions; Pipe Flattening; Impact Resistance; Pipe Stiffness; Joint Tightness (see Part 2); and Extrusion Quality. At least 1% of the production of each size furnished for this project shall be tested.

2.6.8. Each pipe section shall be marked with the following information:

- 4” to 15”:
  Manufacturer’s name or trademark; nominal pipe size; PVC cell classification; Legend “Type PSM DR 26 PVC Sewer Pipe”; ASTM D3034.

- 18” to 36”:
  Manufacturer’s name or trademark; nominal pipe size; PVC cell classification; Legend “PS 115 PVC Sewer Pipe”; ASTM F679.

2.6.9. Fittings shall be clearly and permanently marked to show manufacturer’s name or trademark; nominal size; material designation “PVC”; designation PSM or PS 46; ASTM designation D3034 or F679.

2.6.10. Installation of PVC sewer pipe shall follow requirements of Section 3.

2.7. POLYVINYL CHLORIDE (PVC) LARGE DIA. GRAVITY SEWER (CLOSED PROFILE)

2.7.1. Large diameter PVC sewer pipe (42" to 60”) may be "closed profile pipe" manufactured in accordance with ASTM F-1803, latest revision, for PVC; PS 46 42-inch through 60-inch. Pipe shall be furnished in lengths not exceeding 14 feet. Pipe shall be furnished with integral bells: gaskets and lubricants shall be furnished by the pipe manufacturer. Pipe and fittings shall be made of PVC plastic having a cell classification of 12364 as defined in ASTM D-1784.

2.7.2. Joints shall be compression type utilizing an elastomeric gasket providing a positive seal against groundwater and root intrusion as well as sewage leakage and shall be in accordance with ASTM D-3212. Gaskets shall comply with physical requirements specified in ASTM F-477, latest revision. Lubricant shall be furnished with the gaskets and shall be entirely compatible with gasket and pipe material.

2.7.3. Joints shall show no signs of leakage when tested in accordance with Specification D-3212). Typical joint assembly and each pipe shall be subjected tests in full compliance with ASTM F-1830, latest revision.

2.7.4. Testing and inspection of all pipe shall be done at the factory with a certified copy of the test results furnished to the Design Engineer prior to any pipe being installed. Tests shall be done in accordance with ASTM F-1803, latest revision, and shall include Pipe and Fitting Dimensions; Pipe Flattening; Impact Resistance; Pipe Stiffness; Joint Tightness; and Extrusion Quality. At least 1% of the production of each size furnished for this project shall be tested.

2.7.5. Each pipe section shall be marked with the following information:

42-inch to 60-inch:
Manufacturer's name or trademark; nominal pipe size; PVC cell classification D-1784; Legend "PS 46 PVC Sewer Pipe"; ASTM F-1803.
Extreme care shall be taken by the Contractor when hand laying PVC closed profile pipe and when bedding. Bedding for PVC pipe shall be #67 compacted crushed stone under and over the pipe (Type 5 trench condition).

2.7.6. For sewers exceeding 12 feet deep, the PS rating shall be PS 115.

3. PRESSURE SEWER MATERIALS

3.1. POLYVINYL CHLORIDE (PVC) FORCE MAIN

3.1.1. The Polyvinyl chloride (PVC) force main shall conform to ASTM D-2241, latest revision, and shall be no less than Class 200 (SDR 21). Cell classifications shall be 12454-B, unless otherwise approved. Type 1, Grade 1 (PVC 1120) resin shall be used. Pipe shall be produced by a continuous extrusion with joint lengths of at least 16 feet. In all cases the pipe must be “GREEN” in color.

3.1.2. In addition to the above, the pipe manufacturer shall furnish a certificate stating that he is fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these Specifications and further stating that he has manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these Specifications. All pipes shall be manufactured in the United States of America. All pipes for any one project shall be made by the same manufacturer.

3.1.3. The pipe may be furnished in the manufacturer's standard laying lengths of 20 feet, 38 feet, or 40 feet. The Contractor's methods of storing and handling the pipe shall be approved by the Design Engineer. All pipes shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed sewer line routes will not be allowed.

3.1.4. Service pipe shall be 2-inch Class 200 PVC pressure pipe made from Type C, Grade I, polyvinyl chloride plastic as defined in ASTM D- 1784, "Specifications for Project Poly (vinyl chloride) Compounds."

3.1.5. Services shall be installed in the best workmanlike manner. Service lines shall run at a 90-degree angle to the main and shall terminate at or near the property line of the served property. The cover shall be as much as practical but in no case less than 18 inches. Installation shall be in accordance with Standard Detail Drawings.

3.1.6. Joints shall be of the bell and spigot or similar type utilizing a rubber gasket. Joints shall be in accordance with ASTM D-3139, approved by the Utilities Department or authorized representative and equal to Clow Bell-Tite, Certain-teed Fluid-Tite, or approved equal. Rubber gasket shall conform to ASTM F477, latest revision.

3.1.7. Fittings in pipelines shall be firmly secured to prevent the fitting from being blown off the line when under pressure. When connections are made between the new work and existing mains, the connections shall be made using specials and fittings to suit the actual conditions.

3.1.8. All tees, caps, plugs, bends or other fittings subjected to unbalanced forces tending to pull the joints apart shall be protected with concrete thrust blocks. Thrust blocks shall be provided in accordance with details shown on Drawings and must bear against an undisturbed trench face. Thrust blocks must be used unless written permission is obtained from the Utilities Department to use special locked-joint fittings, anchoring fittings, or pipe clamps with tie rods.

3.1.9. Fittings shall be placed in locations indicated on Drawings or designated by the Utilities Department and shall be installed in accordance with provisions of these Specifications dealing with laying of pipe. Joints shall be compatible with pipe material and shall be as described in Section 2 of these Specifications.

3.1.10. Before being placed in trench, all fittings shall be subjected to inspection by the Utilities Department, and any defective, unsound or damaged fittings shall be rejected, and Contractor shall remove at once from work area.

3.1.11. Testing and inspection shall be accomplished at the factory in accordance with ASTM D-2241, latest revision, by an independent laboratory approved by the Utilities Department or authorized representative. The laboratory shall furnish the Utilities Department with three copies of all test reports. Tests are to include:

- Quick Burst Test – hydrostatic strength shall meet the following based on ASTM D1599, taken once per 24-hour period:

SDR	Pressure Rating	Pressure, PSI
13.5	315	1000
17	250	800
21	200	630

- Sustained Pressure Test – Sample shall withstand without failure for 1,000 hours in accordance with ASTM D1598: 340 psi hydrostatic pressure-4,200 psi hoop stress.
- Tensile Strength – Shall be conducted in accordance with ASTM D-638. The minimum tensile strength shall be 7,400 psi.
- Chemical Resistance – Sample shall be completely immersed in anhydrous acetone for a 60-minute period with examination at 20-minute intervals. The test shall meet requirements of ASTM D-2152.
- Tests shall be run on the maximum of specimens called for under ASTM D-2241 for all pipe manufactured in each size and strength classification.

3.1.12. Each length of pipe is to be permanently marked with manufacturer's name, nominal size, Class pressure rating or SDR number, material designation and ASTM D-2241.

3.2. AUTOMATIC WASTEWATER AIR RELEASE VALVE FOR SMALL DIA. PRESSURE SEWER / FORCE MAINS (SMALLER THAN 4-INCH)

3.2.1. The automatic wastewater air release valve shall be designed to be installed on a wastewater force main, pump, or system. After the air escapes out of the air release valve, the valve shall shut off until more air accumulates in it and the opening cycle repeats automatically. The wastewater air release valve shall be ARI Model #D-020 or H-TEC Models #986-01, #989, or #990 or approved equal in stainless steel material or approved equal.

3.2.2. The stainless-steel float must withstand a minimum pressure of 1,000 psi. Each valve shall be complete with hose, two quick disconnect couplings, blowoff, and shutoff valves to permit backflushing without dismantling the valve. The valve shall be short body and the height (including the backflushing attachments) shall be not more than 24 inches. The valves shall be 2-inch size complete with shutoff valve unless otherwise noted on the Drawings.

3.3. COMBINATION AIR AND VACUUM RELIEF VALVES FOR 4-INCH AND LARGER FORCE MAINS

3.3.1. Automatic combination air and vacuum valves shall be H-Tec Models 986-01 or 988-00 F4”r, or approved equal as per special detail on the Plans.

3.4. VALVE BOXES FOR PRESSURE SEWER SERVICE CONNECTION ASSEMBLIES

3.4.1. Valve boxes for pressure sewer valves, cleanout and service connections shall be as indicated on the Plans or a standard plastic meter box with a nominal size of 16" x 10-3/4" x 12" and 6" extensions. The meter box shall be injection molded meeting ASTM D-2853-70, Class 1212. It shall be a rigid combination of polyolefin with inorganic component reinforcing and UV stabilizer additive to assure resistance to material degradation from ultraviolet light. The cover shall be molded of the same material and design with no molded protrusions for latching. **A 2-1/2-inch diameter 16 - gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection.** The cover shall be green with the words "SEWER" imprinted on the top. **If valve box is located in a roadway or roadway shoulder subject to traffic, then valve box shall be constructed of cast iron.**

3.5. LOW PRESSURE SEWER PIPELINE

3.5.1. Pipe material for this project shall be as described below. Material and size shall be as shown on the Drawings or as directed by the Engineer.

3.5.2. PVC (Polyvinyl Chloride) Plastic Pipe (1-1/2 inch to 4 inch) - PVC pipe 1-1/2 inch to 4 inches shall be pressure rated, gasket joint pipe manufactured in accordance with ASTM D-2241 for water service, Pressure Class 200, SDR 21, unless noted otherwise on the Drawings or as directed by the Engineer.

A. The pipe shall be manufactured of clean virgin Type 1 Grade 1 (PVC 1120) resin compound with cell classification 12454-B and shall conform to ASTM D-1784 for PVC compounds.

B. Testing and inspection shall be accomplished at the factory in accordance with ASTM D-2241. Tests are to include:

- Sustained Pressure Test: 420 psi for 1000 hours in accordance with ASTM D-1598.
- Quick Burst Test: 600 psi for 60 to 70 seconds in accordance with ASTM D-1599.
- Flattening Test: In accordance with ASTM D-2241.
- Extrusion Quality: In accordance with ASTM D-2152, using acetone immersion.
- Dimensions: Wall thickness and outside dimensions shall meet applicable portions of ASTM D-2122.

C. Tests shall be run on the maximum number of specimens called for under ASTM D-2241 for all pipe manufactured in each size and strength classification. If any specimen fails to meet any of the above stated test requirement, all pipe of that size and type between successful tests shall be excluded from use on this project.

D. The manufacturer shall provide the Utilities Department with three (3) certified copies of statements verifying that all required tests have been performed on the pipe provided for this project and that the pipe provided passed all tests. Such statements shall be submitted to the Utilities Department for review before any pipe is shipped to the jobsite.

3.5.3. Pipe joints shall be slip-joint gasket design conforming to ASTM D-3139. Gaskets shall conform to ASTM F-477. Gaskets and lubricants shall be compatible with the pipe material and the intended service and shall be furnished by the pipe manufacturer.

3.5.4. Unless approved otherwise by the Utilities Department, each gasket shall be factory installed in the bell end of the pipe and locked in place. The joint design shall be approved by the Utilities Department before the Contractor will be permitted to install any pipe on this project.

3.5.5. The manufacturer's equipment and quality control facilities must be adequate to ensure that all pipe produced is uniform and meets the requirements of the specifications. All pipes for this project shall be manufactured in the USA by the same manufacturer, unless specifically approved otherwise by the Engineer.

3.5.6. The pipe used on this project shall have been approved by the NSF and the manufacturer shall provide certification to that effect.

3.5.7. The pipe may be furnished in the manufacturer's standard laying lengths from 18 feet to 40 feet.

3.5.8. Shipment and Storage - Shipment packets shall be constructed to protect the pipe, usually with supports not more than 5 feet from the pipe ends and such that unsupported lengths do not exceed 15 feet. While in storage and shipment, pipes shall be protected from excessive heat or cold and shielded from direct sunlight.

3.5.9. Marking - Each length of pipe is to be permanently marked with: manufacturer's name, nominal size, Class pressure rating or SDR number, material designation, ASTM D-2241, and NSF approval.

A. PVC (Polyvinyl Chloride) Plastic Pipe (less than 1-1/2-inch diameter) - PVC pipe less than 1-1/2-inch diameter (for this project, 1-1/4-inch service line) shall meet all the requirements of Part A above except as specifically stated below. The pipe shall be PVC Pressure Pipe, Schedule 40 manufactured in accordance with ASTM D-1785 and D-1784. Joints shall be solvent welded.

B. Material - See above.

C. Testing - See above.

D. Joint Design - Joints shall be solvent weld type. Primer and cement shall be compatible with the pipe material and the intended use, shall be supplied by the pipe manufacturer, and shall conform to ASTM D-2564.

E. The joint design shall be approved by the Utilities Department before the Contractor will be permitted to install any pipe on this project.

F. Manufacturing Standard - See above.

G. Laying Lengths - See above.

H. Shipment and Storage - See above.

I. Marking - See above.

3.6. FITTINGS

3.6.1. Fittings shall be PVC, solvent weld for 1-1/4 inch and smaller PVC pipe and slip joint gasketed for 1-1/2 inch and larger PVC pipe. The fitting shall be designed and fabricated to the same pressure rating as the pipeline in which the fitting will be installed.

3.6.2. Fittings shall be fabricated by the same manufacturer as the pipe used on this project, unless approved otherwise by the Utilities Department.

3.7. VALVES

3.7.1. Valves for use on this project are for flow control such as on/off, directional, pressure regulating, flow rate regulating or special purpose such as air relief or air and vacuum release. The location and designation are as shown on the Drawings. The specifications below describe the valve to be furnished for particular designations.

3.7.2. Gate Valves - For the purpose of controlling flow either on or off or, in some cases, to regulate the rate of flow, gate valves shall be installed at locations shown on the Drawings or designated by the Design Engineer.

A. Gate valves may be used on lines 2 inches in diameter and larger.

B. Gate valves shall be resilient seat type, meeting all the requirements of AWWA C509. Bonnet bolts, studs and nuts shall be stainless steel. Valve gates shall be cast iron with resilient seats. Stem seals shall be "O-ring". Valves shall be furnished with mechanical joint ends in accordance with USA Standard A21.11 unless otherwise shown or directed. Valves shall be suitable for installation in approximately vertical position in buried pipelines. All valves shall be open to the left (counterclockwise) and shall be provided with a 2" operating nut for operation when buried and a hand wheel when above ground.

C. Valves shall be for working pressures up to 200 psi and shall be equal to latest specifications of AWWA C509 in all respects.

D. Valve boxes for gate valves shall be as described below under the heading "Valve Boxes".

3.7.3. Ball Valves - On lines less than 2 inches in diameter, ball valves are to be used (and may be used on lines up to 4 inches in diameter) for controlling flow either on or off or to regulate

the rate of flow. Ball valves shall be installed at locations shown on the Drawings or designated by the Design Engineer.

A. Ball valves shall be true union type with PVC body, high impact ABS operating handle, Teflon seat rings, and elastomer "O-ring" seals. The valves are to open and close with one-quarter turn. Pressure rating at 30^{o} to 120^{o} F shall be no less than 150 psi.

B. Ball valves shall be manufactured by ASAHI/America, Hayward, or approved equal.

C. Valve boxes for ball valves shall be as described below under the heading "Valve Boxes".

3.7.4. Check Valves - A check valve shall be located on each service line in the customer service box to protect against backflow from the collection system to the customer's premises in the event the customer's service line breaks.

A. The valve shall be 1-1/4-inch PVC with an internal flapper designed to swing clear of the flow path during forward flow and to seat tightly against backflow. Valve shall be full- flow design, angle seat, weighted flapper to seat against low pressures while holding up to 50 psi under some operating conditions (Test pressures may be higher - see line testing specification). Seal shall be Buna-N or as approved by Design Engineer.

B. Valve shall be supplied with compression type ends to serve as union connections. Body shall be PVC compatible with intended application (1-1/4 Schedule 40 PVC service piping). Valve shall be manufactured by Flo Control, Inc., or approved equal.

3.7.5. Air and Vacuum Valves - At the locations shown on the Drawings or where directed by the Utilities Department, air and vacuum valves (A/VV) shall be installed to vent large quantities of air or relieve vacuum conditions. Valve size shall be as shown on the Drawings and suitable for system operating pressures of 0 to 50 psi (test pressures will be higher - see specification requirements for line testing, this project). Valve shall be suitable for use in sewage (septic tank effluent). Installation will be in accordance with the detail drawings.

A. Valve shall be APCO No. 445 series, A.R.I. Model D-020 or approved equal.

3.8. REDUNDANT CHECK VALVE

3.8.1. Each service pressure line and/or connection assembly shall include a check valve for installation in the discharge line between the grinder pump and the sewer force main to ensure maximum protection against backflow in the event of sewer service line break.

3.8.2. The valve shall be 1-1/4-inch E-1 (Environment One Corporation) glass line check valve.

3.9. SMALL MISCELLANEOUS VALVES

3.9.1. Unless otherwise shown on the Drawings, gate valves 2-inch and smaller shall be all-

bronze, single wedge disc, non-rising stem, and handwheel operated. Such valves shall be Crane No. 438, Lunkenheimer Figure 2129, or equal, for screwed end valves, and Crane No. 1320, Lunkenheimer Figure 2133, or equal, for solder joint valves. Check valves 2-inch and smaller shall be bronze body, composition disc, with screwed ends, similar to Crane No. 34-1/2, Lunkenheimer Figure 230-70, or equal.

3.9.2. Standard screwed end globe valves 2-inch and smaller shall be bronze valves with plug disc and shall be Crane No. 14-1/2 P, Lunkenheimer Figure 73-PS, or equal. Needlepoint globe valves 3/4-inch and smaller shall be bronze valves similar to Crane No. 88, Jenkins or equal.

3.10. VALVE BOXES

3.10.1. Valve boxes for this project are designated on the drawings as one of the following types:

A. Type "A" Valve Box - For gate valves, nut operated, the valve box shall be heavy roadway type cast iron. Inside diameter shall be not less than 5 inches. The base section shall be enlarged to enclose and protect valve operating nut without being in contact with pipe or valve. The top section shall be adjustable for elevation. The cover shall be heavy cast iron with the word "SEWER" cast in raised letters. Boxes shall be screwing type as manufactured by Clow Corporation or approved equal.

B. Type "B" Valve Box - For cleanout assemblies, ball valves and other lever or handwheel operated valves, air release valves, and air and vacuum valves, the valve box shall be constructed of brick with a cast iron frame and cover in accordance with project detail drawings.

Frame and cover shall be heavy cast iron construction (traffic type) providing an opening of approximately 12 inches by 20 inches. The frame and cover shall be equal to John Bouchard Company No. 8110 with word "SEWER" cast in cover.

C. Type "C" Valve Box - At locations where more room is required than is available in a Type "B" valve box, a Type "C" valve box shall be used. The box shall be constructed of brick with a cast iron frame and cover in accordance with project detail drawings.

The frame and cover shall be heavy cast iron construction (traffic type) providing an opening approximately 13 inches by 30 inches. The frame and cover shall be John Bouchard Company No. 8122, or approved equal, with word "SEWER" cast in cover.

Upon completion of the pressure sewer system, all pressure sewer valve boxes in public rights-of-way or dedicated easements shall be painted with orange paint. The Developer shall submit paint for approval.

D. Type "D" Valve Box - At the customer service connection housing a cleanout connection, cut-off (ball) valve and check valve, a Type "D" valve box shall be installed in accordance with project detail drawings.

Valve box shall be a standard plastic meter box with a nominal size of 15 inches by 21 inches (bottom dimensions) by 12-inch height with (normally) one 6-inch extension piece for an overall (normal) height of 18 inches. Box shall be injection molded meeting the requirements of ASTM D-2853. Material shall be polyolefin with inorganic component reinforcing (or as otherwise approved by Utilities Department) with UV stabilizer additive to provide resistance to material degradation from exposure to sunlight.

The cover shall be molded of the same material as the base section(s). The cover shall contain a corrosion resistant steel plate affixed to the underside to enable a buried cover to be found with electronic detection equipment. The cover shall be imprinted with the word "SEWER".

Valve box including cover shall be green or other color approved by Utilities Department to differentiate from other utility valve boxes.

3.11. PREFABRICATED GRINDER SEWAGE PUMP STATIONS

3.11.1. The Contractor shall furnish and install a factory - built simplex or duplex grinder pump station consisting of either location shown on the Drawings or as directed by the Utilities Department.

3.11.2. The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged on delivery. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective.

3.11.3. The Contractor shall be responsible for the safe storage of material furnished by him until it has been incorporated in the completed project. All motors and electrical and mechanical components shall be stored in a dry environment. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

3.11.4. All guide rails, piping, valves, lifting chain/cables, brackets, conduit, etc. inside the pump station basin shall be made of stainless steel.

A. Grinder Pump

The manufacturer shall furnish a factory built simplex or duplex grinder pump station consisting of either one or two grinder pump units as applicable with mercury switch level controls, discharge piping, pump mounting plates with bottom rail supports, upper rail supports or guide rails, a quick disconnect coupling, lifting chain, reinforced fiberglass pump cover plate, and all necessary parts and equipment installed in a fiberglass reinforced polyester tank as described in the following specifications. The discharge piping and/or check valves shall be so designed as to prevent siphoning of wastewater from the pump basin when conditions of negative pressure exist at the point of connection to the pressure system piping network. The grinder pump station shall be of the same manufacturer as existing equipment being utilized by the City.

B. Operating Conditions

The pumps shall be of centrifugal type. The pumps provided shall be capable of delivering a minimum of 16 GPM against a normal rated total dynamic head of 85' with a maximum shut-off head of 100'. Pump motor shall be a minimum of 2 HP, single phase, 230V, 3,450 rpm, 60 cycle. The pumps shall not overload at any point on the performance curve and shall be free from harmful effects of cavitation at either high or low head.

C. Tank

The tank shall be a minimum of 30" diameter for simplex systems and a minimum of 48" diameter for duplex systems of depth as shown on the Plans.

The tank shall be molded of fiberglass reinforced polyester resin of the lay-up and spray technique to assure that the interior surface is smooth and resin rich.

The tank shall have a minimum wall thickness of 1/4". A heavy rib or flange shall extend around the basin for strength and shall have holes through the rib for anchoring in concrete to prevent flotation.

D. Tank Cover

The cover shall be 7/15-inch-thick fiberglass with reinforcing ribs with high temperature bake epoxy paint. The cover shall be bolted to basin with cap screws. Nuts for screws shall be completely embedded in the fiberglass to prevent turning and for corrosion resistance. Cover to be sealed with caulking compound or a gasket fastened to covers.

A basin inlet flange with "O"-ring for 4-inch Schedule 40 plastic pipe shall be included but not mounted on the basin. Flange to be mounted in the field at inlet height required by the installation. Conduit fittings shall be furnished for sealing cords from control box into conduit entering basin. This is to prevent sewer gases from being carried to the control box.

E. Check Valve

A heavy-duty rubber flapper type check valve or ball check valve shall be an integral part of the lift out discharge seal assembly and shall lift out with the pump assembly.

F. Shut-Off Valve

A 1-1/4" ball valve with extension handle to top of basin shall be installed in the discharge line for closing when pump assembly is removed. Discharge from station shall be through side of basin and shall consist of 1- 1/4" NPT coupling.

G. Pump and Motor

The grinder pump and motor are to be specially designed and manufactured so that

they can operate completely submerged in the liquid being pumped. Electrical power cord is to be sealed by use of a cord grip with individual conductors additionally sealed into the cord cap assembly with epoxy sealing compound, thus eliminating water getting into the motor by following individual conductors inside the insulation. The cord grip shall have a male taper pipe thread which is threaded into a female taper pipe thread in a cord cap. The cord cap shall be sealed into the motor housing with a Buna-N "O-ring", providing an electrical connection which is completely watertight, yet may be easily removed for service.

The combination centrifugal pump impeller and grinder unit shall be attached to a common motor and pump shaft made of stainless steel. The grinder unit shall be on the suction side of the pump impeller and discharges directly into the impeller inlet leaving no exposed shaft to permit packing of ground solids. The grinder shall have two stages or have grinding impeller and shredding ring. Both stationery and rotating cutters shall be made of hardened and ground stainless steel. Pump and motor housings are to be high quality gray iron castings. Impeller shall be bronze and non-clogging. All fasteners shall be of high-grade stainless steel.

The pump motor shaft shall be sealed by two mechanical carbon and ceramic faced seals within an oil filled chamber to provide clean, constant lubrication. The shaft shall be supported by a ball radial and thrust bearing and a lower bronze radial sleeve bearing between the shaft seals to minimize overhang, both running in oil.

The motor winding and rotor are to be mounted in a sealed, submersible type housing which is filled with clean high dielectric oil for bearing lubrication and to transmit heat from motor winding to outer housing. Motor winding shall be securely held in the housing with machine screws, or it shall be pressed into the housing.

Wet wells shall be coated and use Type 316 stainless steel in all components of the pump station.

H. Controls for Simplex Station

Sealed float type mercury switches shall be supplied to control sump level and alarm signal. The mercury tube switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have a heavy Neoprene jacket and a weight shall be attached to the cord above the float to prevent sharp bends in the cord when the float operates under water. The float switches shall hang in the sump supported only by the cord that is held to the NEMA 4 fiberglass junction box. Two float switches shall be used to control levels. One for pump turn-on, one for pump turn-off, and a third switch shall be provided for alarm control.

A red alarm light is to be supplied for mounting on the control box.

The light shall consist of a 40-watt high-intensity bulb and a red polycarbonate lens with a neoprene gasket. The alarm light will flash to indicate a high-water condition and go out when the water level drops.

I. Operation of Simplex System

On sump level rise the lower mercury switch shall first be energized, then upper-level switch shall next energize and start pump. With pump operating, sump level shall lower to low switch turn-off setting and pump shall stop. If the level continues to rise when pump is operating, the alarm switch shall energize. All level switches shall be adjustable for level settings, from the surface.

J. Electrical Control Panel for Simplex Station

Control panel shall have a NEMA 3 R/12 weatherproof enclosure. A lock hasp shall be provided on the door. A circuit breaker shall be provided for the pump and a magnetic starter with one leg overload protection for single phase operation shall be supplied. H-O-A Switches and running lights shall be supplied for the pump. Terminal strip shall be provided for connecting pump and control valves. Additional terminals shall be provided to connect alarms. The control circuit shall be 115V or a transformer shall be supplied to give 24V control circuit. The control panels shall be provided with a disconnect switch that will permit the servicing of the various electrical components without such components being subject to electrical power.

Note: Control panel must be UL listed.

K. Controls for Duplex Station:

Sealed float type mercury switches shall be supplied to control sump level and alarm signal. The mercury tube switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have a heavy Neoprene jacket. A weight shall be attached to cord above the float to hold switch in place in sump. Weight shall be above the float to effectively prevent sharp bends in the cord when the float operates. The float switches shall hang in the sump supported only by the cord that is held to the NEMA 4 cast iron or cast aluminum junction box. Three float switches shall be used to control level: one for pump turn-on, one for pump turn-off, and one for both pumps turn-on. A fourth switch shall be provided for alarm control.

A red alarm light is to be supplied for mounting on the control box.

The light shall consist of a 40-watt high-intensity bulb and a red polycarbonate lens with a neoprene gasket. The alarm light will flash to indicate a high-water condition and go out when the water level drops.

L. Operation of Duplex System

On sump level rise, the lower mercury switch shall first be energized, then upper-level switch shall next energize and start lead pump. With lead pump operating, sump level shall lower to low switch turn-off setting and pump shall stop. Alternating relay shall index on stopping of pump so that lag pump will start on next operation. If the sump level continues to rise when lead pump is operating, override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low level switch turns off both pumps. If the level continues to rise when both pumps are

operating, the alarm switch shall energize and signal the alarm. If one pump should fail for any reason, the second pump shall operate on the override control and if the level continues to rise the alarm switch shall energize and signal the alarm. All level switches shall be adjustable for level setting from the surface.

M. Electrical Control Panel for Duplex Station

Control panel shall have a NEMA 3 R/12 weatherproof enclosure. A lock hasp shall be provided on the door. A circuit breaker shall be provided for each pump and a magnetic starter with one leg overload protection shall be supplied. An alternating relay or solid-state alternator shall be provided to alternate pumps on each successive cycle of operation. Starters shall have auxiliary contact to operate both pumps on override condition. An interlock relay shall be provided to automatically reconnect the control circuit in case of circuit breaker trip on one pump. H-O-A switches and running lights shall be supplied for each pump. Terminal strip shall be provided for connecting pump and control wires. Additional terminals shall be provided to connect alarms. The control circuit shall be 115V or a transformer shall be supplied to give 24V control circuit. The control panels shall be provided with a disconnect switch that will permit the servicing of the various electrical components without such components being subject to electrical power.

Note: Control panel must be UL listed as a complete unit.

N. Wiring

It shall be the responsibility of the electrical contractor to furnish and install, according to the plans and in compliance with appropriate national and local codes, the branch circuit protection and all wiring to the pump leads and to the high alarm indicator lamp.

O. Corrosion Protection

All materials exposed to wastewater shall have inherent corrosion protection, i.e., cast iron, fiberglass, stainless steel, PVC. Any exterior steel surfaces are to be suitably protected against corrosion.

P. Serviceability

The grinder pump unit shall have provisions for lifting to facilitate easy removal of the unit from the tank if necessary.

Q. Manufacturer

The equipment specified shall be the product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product; submit evidence of an established service support program including complete parts and service manuals; and be responsible for maintaining a continuing inventory of grinder pump replacement parts.

R. Warranty

The manufacturer shall warrant its product to be free from defects in material and factory workmanship for a period of one year from the date of acceptance. Repair or parts replacement required as a result of such defects will be made free of charge during this period.

The manufacturer will provide the General Contractor with specific instruction on the assembly and installation of the pump stations and related equipment.

The manufacturer will furnish, at his own expense, the services of a factory trained serviceman to instruct the Utilities Department's personnel in the operation and maintenance of the pumps and related equipment. The individual performing the instruction to the Utilities Department is to be trained and/or certified by the manufacturer as its authorized operation, maintenance, and service specialist.

S. Execution

Install the grinder sewage pump station as shown on the Drawings and in accordance with the manufacturer's recommendations.

Obtain the services of the manufacturer's service engineer to check the installation of each grinder sewage pump station and make any field adjustments necessary to ensure proper operation.

For typical grinder pump installations see Standard Drawings attached hereto.

3.12. ELECTRICAL PANELS

3.12.1. Electrical panels installed for use at pump stations shall only be utilized for the necessary equipment for operation of the pump station and other onsite equipment and housing.

3.12.2. Connections, whether temporary or permanent, shall not be allowed for usages such as retention/detention pond fountains, lighting outside of the pump station site, power for residential or amenities centers, etc. without written approval from the Utilities Director.

3.12.3. Any electrical panels installed outdoors shall be provided with a canopy. The orientation of the canopy shall be such that panels face east or north.

3.13. RESILIENT SEAT GATE VALVES

3.13.1. Resilient seat gate valves shall be iron body, machined surface, modified wedge disc, resilient rubber seat ring type valves with non-rising stems (NRS). Resilient seat gate valves shall have the bronze stem nut cast integrally with the cast iron valve disc. The valve shall have machined seating surface and capable of being installed and open to the left (counterclockwise). Valves shall be furnished with mechanical joint ends in accordance with USA Standard A 21.11 unless otherwise shown or directed. Valves shall be suitable for installation in approximately vertical position in buried pipelines. Stem seal

shall consist of O-ring seals. All valves shall open to the left (counterclockwise) and shall be provided with 2" square operating nut. All underground gate valves which have nuts deeper than 30" below the valve box top shall have extended stems with nuts located within one foot of the valve box cap.

3.13.2. Valves shall be for working pressure up to 200 psi and shall be equal to latest specifications of AWWA C-509 in all respects. Valves shall be equal to Mueller A 2370-20 unless shown otherwise on project drawings. Iron body resilient seat gate valves shall be manufactured as by Mueller, or equal.

3.13.3. Note: if valves are required on sewer mains, plug valves are preferred. Gate valves shall only be utilized if approved by the Utilities Department.

3.14. PLUG VALVES

3.14.1. Plug valves shall be non-lubricated, eccentric type, with seats suitable for 200 PSI water under throttling service and for the 150-psi working pressure. Lengths shall be the same as gate valves. The port area shall be at least 75 percent of full pipe area.

3.14.2. Valves 3-inch and larger shall have cast iron, Type I ni-resist, or bronze bodies; resilient faced plugs; and nickel seats. Smaller valves shall have Type I ni-resist bodies and seats and resilient faced plugs.

3.14.3. Manually operated valves 8-inch and larger shall have worm gear operators and hand or chain wheels. Valves smaller than 8-inch may have nuts for wrench operation or operating handles. One wrench for each three valves shall be furnished for each size of operating nut for wrench operated valves.

3.14.4. Valves in horizontal lines shall be installed with the stem horizontal and the plugs on top when the valves are open. Valves in vertical lines shall be installed with the plug at the top when closed. Valves shall be tagged or marked by the manufacturer to indicate the proper mounting position.

3.14.5. All valves shall open to the left (counterclockwise) and shall be provided with 2-inch square operating nut. All underground plug valves, which have nuts deeper than 30 inches below the valve box top, shall have extended stems with nuts located within one foot of the valve box cap.

3.14.6. Iron body resilient seat plug valves shall be manufactured by Mueller or equal.

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SECTION 3 – CONSTRUCTION

1. GENERAL

1.1. Location of Lines

1.1. The streets, roads, and easements in which lines shall be placed have been indicated on the Plans. Any change from locations approved by the City of Lebanon shall be approved by the Utilities Department before construction.

1.2. Location and Protection of Existing Utilities

1.2.1 Prior to trenching the Contractor shall determine, insofar as possible, the actual location of all underground utilities in the vicinity of this operation and shall clearly mark their locations so that they may be avoided by equipment operators. Where such utility lines or services appear to lie in the path of construction, they shall be uncovered in advance to determine the exact location and depth and to avoid damage due to trenching operations. Existing facilities shall be protected during construction or removed and replaced in equal condition, as necessary.

1.2.2 Should any existing utility line or service be damaged during, or as a result of the Contractor's operations, the Contractor shall take such emergency measures as may be necessary to minimize damage and shall immediately notify the utility involved. The Contractor shall then repair the damage to the satisfaction of the utility or shall pay the utility for making the repairs. In all cases, the restoration and/or repair shall be such that the damaged structure will be in as good or better condition as before the damage occurred.

1.2.3 All shade trees, telephone poles, power poles, etc., along the line of work shall be protected, and sufficient barricades, lanterns, etc., shall be provided for the protection of the public.

1.2.4 The Contractor shall take such precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities or structures through cave-ins, slides, settlement or other soil disturbance resulting from his operations.

1.3 Clearing and Grubbing

1.3.1 The Contractor shall be responsible for cutting, removing and disposing of all trees, brush, stumps, roots and weeds within the construction area. Disposal shall be by means of chippers, landfills, or other approved method and not in conflict with state or local ordinances.

1.3.2 Care shall be taken to avoid unnecessary cutting or damage to trees not in the construction area. The Contractor will be responsible for loss or damage to trees outside the permanent easement or rights-of-ways.

2. TRENCH EXCAVATION

2.1. General

2.1.1. Trenching must be done in a neat and workmanlike manner maintaining proper vertical and horizontal alignment. Alignment shall be maintained by the use of offset hubs and batter boards at maximum 50-foot intervals or with a laser device or with other methods approved by the Utilities Department. The Design Engineer shall check all cut sheets before construction begins.

2.1.2. Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material and appurtenances. Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions, but in general shall not include more than 300 feet of continuous open trench at any time.

2.1.3. No driveways shall be cut or blocked without first notifying the occupant of the property. Every effort shall be made to schedule the blocking of drives to suit the occupant's convenience, and except in case of an emergency, drives shall not be blocked for a period of more than 8 hours. The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for the protection of public safety. Flagmen shall be provided as required on heavily traveled streets to avoid traffic jams or accidents.

2.1.4. Trench width shall be held to a minimum consistent with proper working space for assembly of pipe. Maximum trench width up to point one foot above top of pipe shall be limited to the outside pipe diameter plus 16 inches. Boulders, large stone, shale and rock shall be removed to provide clearance of 6" below and on each side of the pipe. Trench walls shall be in accordance with OSHA Regulations for depth and type of soil. Where unstable soil conditions are encountered at the trench bottom, the Contractor shall remove such additional material as may be directed by the Design Engineer or Utilities Department and replace the excavated material with approved backfill, or otherwise provide stable bedding for pipe as directed by the Design Engineer and approved by the Utilities Department.

2.1.5. The Contractor shall excavate by hand wherever necessary to protect existing structures or utilities from damage or to prevent over-depth excavation in the trench subgrade.

2.1.6. The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill and clean-up, and in event of failure to do so, may be prohibited from opening additional trench until such work is completed. This requirement is particularly applicable to work being done in developed areas.

2.1.7. The Contractor shall plan his operations to cause a minimum of inconvenience to property owners and to traffic. City Streets are to remain open between 7:00 a.m.-8:00 a.m. and 3:00 p.m.-4:00 p.m., unless approved by the Engineering Department. No road, street or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

A. A permit is secured from appropriate State, County, City, or Municipal authorities having jurisdiction.

B. Suitable detours are provided and are clearly marked. Detour plan must be provided to and approved by City of Lebanon Engineering Department.

C. The following offices must be contacted a minimum of 72 hours prior to the cutting or closing of any City Street:

A.	LEBANON PUBLIC SERVICES DEPARTMENT	443-2824 ext. 2325
B.	LEBANON UTILITIES DEPARTMENT	444-0825 ext. 5141
C.	CITY OF LEBANON STREET DEPARTMENT	444-0825 ext. 5101
D.	LEBANON ENGINEERING DEPARTMENT	443-2839 ext. 2334
E.	LEBANON GIS DEPARTMENT	444-3647 ext. 2313
F.	LEBANON POLICE DEPARTMENT	444-2323
G.	FIRE DEPARTMENT	443-2827ext. 3116
H.	WILSON COUNTY SHERIFF'S OFFICE	444-1412
I.	WILSON CO. EMERGENCY MANAGEMENT	444-8799
J.	LEBANON SPECIAL SCHOOL DISTRICT	449-6060
K.	WILSON COUNTY SCHOOLS	453-7296
L.	TDOT	772-3185
M.	LEBANON DEMOCRAT	444-3952 ext. 13
N.	WILSON POST	444-6008
O.	WANT FM	444-9899
P.	WEMA	444-8777

D. Excavated material shall be stored safely away from the edge of trench and in such a way as to avoid encroachment on private property.

E. Where the excavation exceeds the required depth, the Contractor shall bring the excavation to proper grade through the use of an approved incompressible backfill material (generally crushed stone or fill concrete, depending upon the nature of the facility to be placed thereon). In the event unstable soil conditions are encountered at the bottom of the excavation, the Design Engineer will direct the Contractor to continue the excavation to firm soil or to provide pilings or other suitable special foundations, with such action subject to approval by the Utilities Department.

2.2. Rock Excavation

2.2.1. Where rock is encountered, the excavation shall be carried to a depth of 6" below the barrel of the pipe, or the bottom of the structure. The excess excavation shall be backfilled with crushed stone, sand, or other approved bedding material firmly compacted. Boulders and large stones, rock or shale shall be removed to provide a clearance of at least 6" below all parts of the pipe of fittings and to clear width of at least 6" on each side of all pipe and appurtenances.

2.2.2. Where rock is encountered, the Contractor shall "mattress" the trench during blasting operations and shall use all precautions necessary to protect adjacent property against damage resulting from his operations. Rock excavation in proximity to other pipes or structures shall be conducted with the utmost care to prevent damage to the existing

structures and any such damage caused shall be promptly repaired at the Contractor's expense. Blasting operations shall not be conducted within 50' of finished sewer or water pipe and rock excavation shall be completed at least 25' ahead of pipe laying.

2.2.3. Extreme care shall be exercised in blasting with signals of danger given and displayed before the firing of any charge. The Contractor shall, in all his acts, conform to and obey all rules and regulations for the protection of life and property that may be imposed by any public authorities or that may be made from time to time by the Design Engineer relative to the storing and handling of explosives and the blasting operations. No blasting shall be done at any time except by persons experienced in this line of work.

2.2.4. Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas, the Contractor shall remove the rock by means other than blasting. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting.

2.3. Sheeting and Shoring

2.3.1. The Contractor shall provide such bracing, sheeting or shoring as may be necessary for the protection of life and property, or where such protection is specifically required by the Design Engineer because of potential danger to life, property or the completed structure. Sheeting will be required where necessary to restrict the trench width to acceptable limits above the top of pipe.

2.3.2. Sheeting, shoring, or bracing shall conform to applicable safety codes and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above top of pipe. The bracing or sheeting may then be removed in an approved manner unless the Design Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place either at the direction of the Design Engineer or option of the Contractor, the sheeting shall be cut off at least 18" below the finished ground level.

2.3.3. Care shall be taken in removing sheeting to avoid weakening the trench, increasing the backfill load, or endangering adjacent property. Voids left by the removal of sheeting shall be filled in and compacted with suitable material using tamps intended for this purpose.

2.4. Surface Obstructions

2.4.1. All buildings, walls, fences, poles, bridges, railroads, trees, and other property or improvements encountered shall be carefully protected from all injury, and in the event that any of the foregoing are damaged or removed during the process of the work, they shall be repaired or replaced in a satisfactory manner. Special care must be exercised in trenching under or near railroads in order to avoid or minimize delays or injuries resulting therefrom. Where it is necessary to cross beneath railroad tracks, the Contractor shall make such installations in a casing of large diameter as approved by the Railroad Company and the Utilities Department.

2.4.2. As an alternative to sheeting and/or shoring of trenches, trench boxes may be utilized in accordance with OSHA regulations.

2.5. Subsurface Obstructions

2.5.1. In excavating, backfilling, and laying pipe, care must be taken not to remove, disturb, or injure other pipes, conduits, or structures, without the approval of the Utilities Department. If necessary, the Contractor, at his own expense, shall sling, shore up and maintain such structures in operation, and within a reasonable time shall repair any damage done thereto. Repairs to these facilities shall be made to the satisfaction of the Utilities Department.

2.5.2. The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any other pipe, conduit, etc., and shall abide by their regulations governing such work. In the event subsurface structures are broken or damaged in the prosecution of the work, the Contractor shall immediately notify the proper authorities and shall be reasonable for any damage to persons or property caused by such breaks.

2.5.3. When pipes or conduits providing service to adjoining buildings are broken during the progress of the work, the Contractor shall have them repaired at once. Delays, such as would result in buildings being without service overnight or for needlessly long periods during the day will not be tolerated, and the Utilities Department reserves the right to make repairs at the Contractor's expense without prior notification. Should it become necessary to move the position of a pipe, conduit, or structure, it shall be done by the Contractor in strict accordance with instruction given by the Utility Engineer(s) involved.

2.6. Excavation for Structures

2.6.1. Excavation for air release valve installations, metering pits or other appurtenance shall be only as large as may be required for the structure or appurtenance and for working room around the same. In earth, excavation shall generally extend to the outer limits of the structure at the bottom and shall slope outward at such angle as may be required for stability of excavated face. In rock, excavation shall be carried to a point 6 inches outside the structure so that no rock is left within 6 inches of the finished structure or appurtenance.

2.6.2. Care shall be taken as the excavation approaches the desired grade to avoid overdepth excavation and provide a firm and undisturbed soil surface on which footings, slabs or foundations are to be placed. Should the Contractor excavate below the desired grade level, the excavation shall be brought to grade by the use of Class B concrete at the expense of the Contractor. The use of tamped earth backfill under foundations, footings or slabs will not be acceptable.

2.6.3. Where structures rest partially upon rock, the rock shall be excavated to a point 6" below bottom of structure and compacted crushed stone shall be used to bring the excavation back to grade. Where the structure will rest completely on sound solid rock, the rock shall be excavated to a point 4" below bottom of structure and compacted crushed stone shall be used to bring the excavation back to grade.

2.6.4. Should the material found at the desired subgrade appear to be unstable or otherwise unsuitable for support of the structure, such condition shall be immediately called to the

attention of the Utilities Department and Design Engineer. The Utilities Department may direct that such unsuitable material be removed and replaced with concrete, and may require the modification of the foundation design to suit the condition, or may determine that the bearing capacity of the material for the load to be supported; but in any case, shall provide written instructions to the Contractor as to the procedure to be followed.

3. INSTALLATION OF SEWER PIPE AND ACCESSORIES

3.1. General

3.1.1. The Contractor shall use only experienced men in the final assembly of pipe in the trench, and all pipe shall be laid in accordance with these Specifications and the recommended practice of the pipe manufacturer. Trench bottoms shall be carefully prepared, shall be free of water and bedding as specified shall be in place.

3.1.2. Care shall be exercised to ensure that pipe of the proper strength or classification meeting the specifications in every respect is provided at the site of pipe laying operations. Recommended tools, equipment, lubricant and other accessories needed for proper assembly or installation of the pipe shall be provided at the site of the work. Any damaged or defective pipe discovered during the pipe laying operations shall be discarded and removed from the site of the pipe laying operations.

3.1.3. Alignment and grade shall be carefully maintained during the laying operations. The method used for maintaining grade and alignment must be acceptable to the Design Engineer and the Utilities Department and must produce the desired results. The top of the bedding material must be brought to the exact grade and must be shaped so as to provide effective support for the bottom quadrant of the pipe except at the bells.

3.1.4. The Contractor shall exercise care in the storage and handling of pipe, both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be inspected for defects and for dirt or other foreign material immediately before placing them in the trench. Suitable swabs shall be available at the site of laying operations, and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench.

3.2. Bedding

3.2.1. Trench widths from a point one (1) foot above the top of the pipe down to the bottom of the trench be held to a minimum consistent with the provisions of necessary space for proper assembly of the pipe. In general, the trench width shall not exceed the nominal pipe diameter plus 16 inches.

3.2.2. A minimum of 6” of crushed stone bedding shall be placed in the bottom of the trench to provide continuous support of the bottom quadrant of the pipe. The Contractor shall bring the crushed stone bedding up to the required level to provide support to the bottom quadrant and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe. Bedding material shall be compacted.

3.2.3. After the bedding has been shaped and the pipe has been installed, crushed stone backfill

shall be carefully placed by hand and compacted on both sides of the pipe and up to level 12" above the top of the pipe.

3.2.4. In addition to maximum trench width, the selection of pipe has been based on the use of 6" of crushed stone bedding to provide continuous support of the bottom quadrant of the pipe plus crushed stone backfill carefully placed and compacted on both sides of the pipe and up to a level 12" above the top of the pipe. It is therefore essential that these conditions be observed in the installation of the pipe.

3.3. Pipe Laying

3.3.1. After the pipe has been cleaned and inspected for defects and lowered into the trench, the mating surfaces of the compression joint shall be wiped clean and coated with lubricant of a type supplied by the pipe manufacturer. The pipe shall then be assembled with due care being taken to ensure that the spigot end of the pipe is shoved home and that the pipe is left in proper grade and alignment.

3.3.2. Whenever pipe laying operations are to be discontinued for a period of time exceeding 2 hours, the end of the pipe shall be carefully secured to avoid displacement or misalignment and a tight-fitting plug or stopper shall be placed in the line. Upon resumption of laying operations, the plug or stopper shall not be removed from the line until any water, mud or other debris has been removed to avoid entry into the completed section of the sewer.

3.3.3. Installation of sewer pipe including force mains shall conform to provisions of these Specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

3.3.4. The proper gaskets and lubricants shall be furnished by the pipe manufacturer and lubricants shall be delivered to the job site in properly labeled, unopened containers.

3.3.5. Wye branches or tees and other fittings shall be placed in the sewer line as shown on the Drawings or as directed by the Design Engineer as pipe laying progresses. The Contractor shall keep accurate records of their location.

3.3.6. All gravity piping and force mains not constructed of ferrous material shall have tracer wire and detection tape installed during installation of the new pipe.

3.3.7 Installation of Polyvinyl Chloride Pipe (PVC) shall be in accordance with the following.

A. Installation of polyvinyl chloride pipe shall conform to ASTM 2321, latest revision. PVC pipe shall be laid on crushed stone bedding and shall be backfilled with compacted crushed stone around and above the pipe as shown in standard detail S1. The bedding material shall be shaped to provide continuous support for the PVC pipe throughout its length except at bells. Blocking shall not be used to bring the pipe to grade.

B. Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions,

the cutting may be made with either hand or mechanical saws or plastic pipe cutters. The cut shall be square and perpendicular to the pipe axis. The cut end shall be beveled to as closely resemble the factory bevels as possible.

C. Unless otherwise indicated or directed by the Utilities Department, fittings shall be of the same material as the pipeline in which they are to be installed. Fittings shall be furnished with joints of the same type used throughout the rest of the pipeline unless such joint shall not be available, and the Utilities Department should approve a substitute type joint. Fittings shall be of the type indicated on the Drawings and shall be the manufacturer's standard conforming to all applicable standard specifications and dimensional tolerances appropriate for the material of construction.

D. Assemble all joints in accordance with recommendations of the manufacturer.

3.3.8 Installation of Ductile Iron Pipe shall be in accordance with the following.

A. Where ductile iron pipe is shown, specified or directed by the Design Engineer the pipe shall be of the type and class as indicated. Ductile iron pipe to be installed in trenches shall be laid on crushed stone bedding and shall be backfilled with compacted crushed stone around and above the pipe as specified for other pipe materials. The bedding material shall be shaped to provide continuous support for the ductile iron pipe throughout its length except at bells.

B. Whenever it is necessary to cut a joint in order to fit the trench conditions, the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave a smooth end at right angles to the axis of the bore and the end shall be beveled or finished as required to make the joint without risk of damage to the gasket.

C. Unless otherwise indicated ductile iron pipe shall be laid with slip type compression joints equal to the manufacturer's standard for pressure water pipe, and assembly of the joints shall be in accordance with the manufacturer's recommendations using lubricant and accessories as provided by the pipe manufacturer.

D. In stream crossings, ravines, shallow cuts and other locations where the pipe will not be laid on bedding placed on original subgrade the pipe shall be supported on concrete piers as detailed on the Drawings or as directed by the Design Engineer.

E. Piers shall be of Class A concrete with reinforcing as shown. The tops of piers shall be carefully set at the exact elevation and shall be shaped so as to provide support for the bottom half of the pipe with allowance being made for the outside diameter of the pipe plus the thickness of a layer of tarred felt around the outside of the pipe. After the concrete has obtained satisfactory strength the ductile iron pipe may be installed across the piers using one or more layers of tarred felt between the surface of the concrete and the outside diameter of the pipe. The Contractor may, at his option, install the pipe to exact grade and alignment using temporary supports and then construct the permanent piers for the pipe, provided suitable

precautions are taken to avoid any misalignment during the construction of the piers. The Design Engineer will need to oversee construction and inspection of aerial segments and provide written approval to the Utilities Department upon completion.

3.3.9 Installation of Pressure Sewer shall be in accordance with the following.

A. Lay the pressure sewer at the lines and grades required by the Drawings. All fittings shall be at the required locations and spigots well centered in the bells.

B. Unless otherwise indicated by the Drawings, all pressure sewers shall have at least 30 inches of cover. No departure from this policy shall be made except at the order of the Utilities Department.

C. Provide and use tools and facilities that are satisfactory to the Utilities Department and that will allow the work to be done in a safe and convenient manner. Use a derrick, ropes, or other suitable equipment to lower all pipe fittings into the trench one piece at a time. Carefully lower each piece so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances, drop or dump pressure sewer materials into the trench.

D. Lower no pipes and fittings into the trench until they have been swabbed to remove any mud, debris, etc. that may have accumulated within them. After the pipe has been lowered, remove all unnecessary materials from it. Before any pipe is laid, brush and wipe clean the outside of its spigot end and the inside of its bell and ensure that the pipe is dry and oil-free.

E. Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside it, then place a heavy, tightly woven canvas bag of suitable size over each end of the pipe and leave it there until it is time to connect that pipe to the one adjacent to it.

F. Place no debris, tools, clothing, or other materials in the pipe during laying operations. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.

G. Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

H. Whenever pipe laying is not in progress, the pipe shall be carefully secured to avoid displacement or misalignment and a tight-fitting plug or stopper shall be placed in the line. This shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench, this seal shall remain in place until the trench has been pumped completely dry.

I. The cutting of pipe so that fittings or closure pieces can be inserted shall be done in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

J. The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.

K. Unless otherwise directed by the Design Engineer, lay pipe with the bell ends facing in the direction of laying.

L. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions of plumb stems or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by the Design Engineer.

M. Lay no pipe in water or when it is the Design Engineer's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, this shall be considered incidental to the project.

N. Install thrust blocks wherever the force main changes direction (e.g., at tees and bends), at dead ends, or at any other point where the manufacturer recommends and/or the Design Engineer indicates that they are to be used.

O. Make all joints, whether standard mechanical or push-on joints, in conformance with the recommendations of the joint manufacturer as approved by the Design Engineer.

P. The detectable tape and 12-gauge insulated copper tracer wire shall be buried in the utility line trench directly above the installation to be identified. The tracer wire shall be placed directly on top of the pressure sewer and the marking tape shall be placed 15- inches from finish grade of the trench. The tape shall be placed in the trench with the printed side up and be essentially parallel to the finished surface. The Contractor will take necessary precautions to ensure that the tape and tracer wire are not pulled, distorted, or otherwise misplaced in completing the trench backfill. Tape and wire shall be placed in all trenches.

3.3.10 Pressure Sewer Valves and Fittings

A. Ball Valve: The valve on the service line that connects to the main shall be a PVC ball valve of true union design with permanently lubricated Teflon seats and elastomer "O"-ring seals. The valves are to open and close with a quarter turn. Working pressure at 70 degrees F shall be 150 pounds per square inch..

B. Redundant Check Valve (E-1 Glass Line): Each service line shall include a check valve for installation in the discharge line between the grinder pump and the pressure sewer to ensure maximum protection against backflow in the event of sewer service line break.

C. Air Release Valves: At the locations shown on the Plans and in accordance with these Specifications, install an air release valve. The valve shall have a body and float of stainless-steel construction and a Buna-N seat. The valve shall have a 2-inch inlet.

D. Fittings: Fittings shall be of the solvent welded type for use in conjunction with valves. Fittings shall be fabricated by the manufacturer of the pipe used.

E. Valve Boxes: Unless otherwise shown, valve boxes shall be a standard plastic meter box with a nominal size of 16" x 10-3/4" x 12" and a 6" extension. The valve box shall be injection molded meeting ASTM D- 2853-70, Class 1212. It shall be a rigid combination of polyolefin with inorganic component reinforcing and UV stabilizer additive to assure resistance to material degradation for ultraviolet light. The valve box shall bear on appropriately sized solid concrete blocks and shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finish pavement or centered over the valve and cleanout or approximately 1/2-inch above the ground surface or such other level as may be directed.

F. The cover shall be molded of the same material and designed with no molded protrusions for latching. A 2-1/2-inch diameter 16-gauge steel reflector with dichromate coating shall be applied to the underside of the plastic cover for electronic detection. The cover shall be green with the words "CONTROL VALVE" imprinted on the top.

3.4 Sewer Connections

3.4.1 Connections of pipes to manholes or other large structures shall be made using short lengths of pipe to avoid stressing the pipe at the point where it is placed in the wall of the structure. Pipes entering or leaving masonry or concrete walls shall have one flexible joint located not more than 6” outside the structure wall followed by a length of pipe not more than 2’ in length with another flexible joint at the end of the 2’ pipe length in such a way as to provide for limited lateral or vertical movement of the pipeline as well as limited deflection. Ordinary compression type joints of the types specified for gravity sewers shall be considered as having sufficient flexibility for this purpose. The supplier of the pipe for the sewer lines shall furnish with the pipe order the required number of specials and short lengths of pipe for the Contractor to install the required flexible connections without improvising.

3.4.2 **For all situations where connections are made to existing manholes, the connections shall be accomplished by resilient connectors and shall be Kor-N-Seal or approved equal. Where grouting is required around piping entering and exiting manholes, the grout shall be non-shrink hydraulic cement grout.**

3.4.3 **Contractors are required to vacuum test existing manholes prior to making any new connection and shall have Utilities Inspector on site during testing. Any deficiencies found in the existing manhole must be addressed prior to making the connection.**

Contractor shall coordinate with Utilities Department on how to address issues. Utility Engineer shall determine the required method to address any issues found, which may include, but are not limited, to epoxy coating or replacing the existing manhole.

3.4.4 No pipe shall be connected to the existing sewage system until all new upstream construction has been completed, tested, and is free of foreign materials and obvious defects have been corrected. In addition, approval must be given by the Utilities Department for connection. New lines, then, must remain disconnected from the existing system by actual physical separation by brick-and-mortar bulkheads/plugs of a type approved by the Utilities Department, by plugs of a type approved by the Utilities Department, or by other means approved by the Utilities Department. A note on the construction plans stating this requirement shall be required for the approval of the plans.

3.4.5 The Contractor shall make connections to existing sewers in accordance with details as shown on the Drawings or as directed by the Utilities Department.

3.4.6 In all cases the Contractor shall locate and uncover existing sewers and shall verify invert elevations before laying the connecting sewer so as to allow opportunity for making adjustments to compensate for discrepancies.

3.4.7 Work shall include any required stopping or diversion of flow in existing lines or structures and the necessary rebuilding of any manhole inverts to the lines shown generally on the Standard Detail sheet.

3.4.8 For all situations where main to be tapped has been lined with Cured in Place Pipe (CIPP), saddle must be epoxied in place.

4 MANHOLES

4.1 The Contractor shall submit details of the proposed manholes together with the name of the supplier to the Utilities Department or authorized representative for approval before any of the precast manholes are shipped to the job site. Precast manholes shall be used consisting of precast monolithic bases with resilient connectors for all pipes entering or leaving the manhole. Precast risers shall be furnished with resilient connector openings for pipes entering and leaving the manhole. Individual riser sections shall be furnished for the exact conditions to be encountered in the field and shall be constructed so as to suit field conditions and to line up properly with the pipes and manhole steps in other riser sections. Misalignment of steps or improperly located holes for incoming pipes shall be cause for rejection of the manhole sections. Precast manhole sections shall be joined together in such a way as to present a smooth uniform joint, which shall be structurally sound and watertight.

4.2 All connections of pipes to manhole sidewalls shall be made with resilient connectors. Openings in the manhole sidewall shall be so constructed as to include the resilient connector such that it is an integral part of the sidewall and to provide for the manhole. The sidewall opening shall be manufactured to allow for lateral and vertical movement, as well as angular adjustments through 20º. The resilient connector shall be the Kor-N-Seal as manufactured by NPC, Inc. or approved equal. The resilient connector shall meet all

physical and performance requirements as set forth by ASTM C-923.

4.3 See materials section regarding the requirement for concrete admix for water proofing and corrosive protection for all manholes.

4.4 Flow channels shall consist of smooth uniform cross sections conforming to the cross section of the pipe so as to provide a minimum of turbulence and avoid deposition of solids.

4.5 Flow channels shall have a depth at least equal to ½ the pipe diameter. The finished flow of the manhole shall have a slope of approximately ½" from wall to channel to provide for proper drainage, but at the same time offer a safe footing for workmen.

4.6 Brick or pieces of brick may be used for filler material in forming the flow channel and finished floor in the manholes provided that no brick shall be left within 1" of the finished surface. A minimum fall of 0.1' shall be maintained across the manhole.

4.7 Temporary covers, preferably a cone and casting, must be placed on manholes that have been installed in the undeveloped areas that are not to final grade. Care shall be taken not to let water stormwater or foreign material enter the sewer system.

5 SERVICE CONNECTIONS

5.1 PVC Services shall be SDR-26. Sewer service lines shall be provided as shown on the plans or as directed by the Design Engineer. Service connections shall consist of a tee or wye with 6" branch connection, 6" bends, and piping as required to complete the sewer service connection. Pipe and fitting joints shall be compression type as used on the main sewer. Service pipe and fittings shall be of the same material as used for the main sewer. Service pipe shall be laid on a slope of ¼" per foot, where this grade is not available and the Utilities Department specifically approves, 1/8" per foot may be used. Sewer service lines shall conform to details as shown on the Standard Detail Drawings and shall terminate at the property line with a tight compression plug braced to withstand pressure of air pressure test.

5.2 The property line clean-out shall be installed as per Standard Detail Drawing contained in the back of these specifications. Cleanouts shall be located no more than 3' behind the property line unless prior approval from the Utilities Department is given.

5.3 In the event that it should be necessary to install a service connection where a tee has not been provided, saddles must be used and shall be attached to the main sewer utilizing a Romac Saddle or, if required and with approval from Utilities Department, by installation of an epoxy saddle to create a permanent watertight joint.

5.4 Excavation, laying and backfilling for service lines shall conform to the applicable specifications.

5.5 "As-Built" drawings submitted to the Utilities Department shall indicate the service line locations in such a manner that they can be accurately located in the field using information shown on the drawings.

5.6 Service lines shall be generally located 5’ from the downstream property line and/or out of the way of driveways, sidewalks, landscaping, headwalls, drainage swales, etc and shall have a cleanout.

5.7 A 3/8” to ½” steel rod shall be driven at the end of each stub out. The rod shall be 24” long and be covered/backfilled 4” to 6”.

5.8 All service taps shall have a tracer wire attached to the pipe the same as gravity line, one foot of bedding and then location tape installed above pipe.

6 BACKFILL

6.1 Above the pipe zone as defined below may be suitable excavated material or, where called for on approved plans, crushed stone, placed in layers generally not exceeding 12” and vibrated in place.

6.2 Bedding backfill shall be crushed stone for PVC, DIP, and HDPE pipes.

6.3 Where crushed stone backfill is required the crushed stone shall be No. 67 size as designated by Tennessee Department of Transportation (TDOT) Standards and shall meet all requirements of the TDOT Standards for crushed stone used in road surfacing.

6.4 Where crushed stone is not required but the excavated material is unsuitable for use in the backfill, the Contractor may use fine dry selected earth or clay as backfill material. Material containing excessive organic matter, stumps, roots, refuse or foreign matter or hard clay lumps that cannot readily be compacted will not be acceptable for use as backfill.

6.4.1 Backfill for Trenches

A. Backfill up to the spring line of the pipe shall be placed as pipe laying progresses in order to maintain proper grade and alignment. Additional backfill shall not be placed until after the pipe has been inspected by the Engineer and approved for backfill.

B. Backfill to a depth of 12” above the top of pipe (pipe zone) shall be crushed stone, placed by hand to avoid damage or misalignment of the pipe. Additional backfill may be placed by means of front-end loaders, bulldozers or other suitable mechanical equipment subject to a 12” limitation of maximum thickness of layers placed before compaction. Each lift shall be compacted to 98% STD proctor (ASTM) prior to placement of the next lift.

C. Note: All sewer trenches in existing roadways and proposed roadways or street shall be backfilled with #67 crushed stone from a point 6 inches below the sewer pipe to the roadway or proposed roadway subgrade.

D. In highways, streets, drives or other paved or traveled areas, backfill above pipe zone as described above shall be entirely No. 67 size crushed stone to within one

(1) foot of subgrade. The remaining one (1) foot shall be backfilled with compacted mineral aggregate Class "A" Grading "D" as designated by Tennessee Department of Transportation (TDOT) Standards.

E. Where trench is located in open country or on public right-of-way outside the ditch lines where not subject to traffic, the backfill up to a point 12" above the top of the pipe shall be placed as specified in the preceding paragraphs. Above this point the backfill may consist of excavated material placed so as to avoid excessive settlement of the trench provided such material is selected to exclude rocks larger than 6" in any dimension. No rocks larger than 1 ½" may be used in the top 6" of backfill material.

F. With Approval from Utilities Department, in wide deep trenches the Utilities Engineer(s) may, at their discretion, permit the use of rock larger than 12"in the backfill, provided such rock is carefully placed in such a manner that the final position of the rock will not be within the vertical prism lying directly over the pipe or within 9" on either side of the pipe.

G. In all instances, sufficient care must be exercised to avoid leaving any holes or voids over, around or under stones, boulders, or other backfill material which may later be filled by leaching or settlement of surrounding material thereby causing future trench settlement. Where the Contractor desires to use excavated rock for backfill material and such rock meets the dimensional requirements as specified herein, the Contractor shall provide additional backfill material of a suitable nature to fill the voids as required.

H. In locations not subject to traffic where excavated material is permitted in the backfill such material shall be brought up to the original ground level and shall then be mounded over to provide additional settlements. Compaction of this backfill material will not be required, however, if the Contractor shall exercise care to confine the mound to the area immediately over the trench and shall be responsible for bringing in such additional fill material as may be required from time to time during the one-year warranty period to fill in areas where excessive settlement has occurred.

I. The Contractor shall be responsible for and shall protect all sewers, storm sewers and electric, telephone, water or other pipes or conduits against danger or damage while the trenches are being backfilled and from future settlement of the backfill. Where such damage should occur as a result of the Contractor's operations, he shall repair such damage promptly.

J. The Contractor's attention is called to the fact that he will be held completely responsible for any damage to pavement, sidewalks, curbs, gutters, meter or valve boxes, street inlets, or other structure or appurtenances as a result of the Contractor's operations. It should be specifically noted that the Contractor shall be responsible for damage even though the character or nature of the original pavement or structure was such that it was not capable of carrying the load of the construction equipment regardless of the construction methods used.

6.4.2 Backfill at Manholes and Other Structures

A. Backfill around manholes located in highways, streets, or other traveled areas shall consist of carefully placed granular material as specified under "Backfill for Trenches". Backfill around manholes, piers or other structures in locations not subject to traffic may consist of excavated material subject to the following restrictions.

- No rock larger than 6" in any dimension shall be place within 12" of the manhole walls, or pipes entering or leaving the manhole.
- No rock larger than 6" in any dimension shall be placed in the vertical prism above and extending 9" outside of the pipelines.
- Crushed stone shall be a minimum of 6" deep under and 12" thick around the manhole encasing the barrel sections in ¾" stone. To a point 12" below finish grade in unpaved areas.
- Excavated material used for backfill outside of the required stone envelope shall be carefully placed in layers and compacted in such a manner as to fill voids and prevent excessive settlement.

6.4.3 Backfill for Force Mains

A. Backfill around sewage force mains of ductile iron areas shall consist of selected excavated material or fine, dry earth placed by hand around both sides of the pipe and tamped to eliminate voids and provide firm support for the pipe. The selected backfill shall be compacted in 4-inch layers and shall be continued in this manner until the backfill has been placed to a finished depth of 12 inches over the top of the pipe. No rocks or stone larger than 2 inches shall be included in the selected backfill around the pipe. Where PVC pipe is permitted by the Sewer Department, backfill shall consist of hand-placed crushed stone placed in 4-inch to 6-inch layers and worked into place around pipe to a finished depth of 12 inches over the top of the pipe.

B. After the backfill has been placed and compacted in layers to a depth of 12" above the top of the pipe the remainder of the backfill may be placed by machine and compacted by running suitable wheel type construction equipment along the ditch provided, however, that no rock larger than 6" in any dimension is included within the backfill and no rock larger than 1 ½" is included in the top 6". Should the Contractor fail, refuse, or neglect to systematically exclude or remove oversize rock from the backfill material, he may be required to place and compact the backfill by other suitable methods, which will permit the rocks to be detected and removed.

C. In areas subject to light traffic or under temporary type pavement, the backfill shall be the same as provided above, except that the backfill must be placed and compacted in 12-inch layers all the way to the top of the trench.

D. Under highways, roadways, streets or parking areas having permanent type pavement or heavy traffic, when indicated on approved plans, the backfill shall consist of crushed stone placed in 4" to 6" layers and thoroughly compacted up to the top of the trench.

7 PAVEMENT REMOVAL

7.1 Where existing paved streets, roads, parking lots, drives or sidewalks must be disturbed during construction of the project the Contractor shall take the necessary steps to minimize damage. Permanent type pavement shall be saw cut in a straight line before removal and care shall be taken during excavation to avoid damage to adjacent pavement. Where trucks or other heavy equipment must cross curbs or sidewalks, such areas shall be suitably protected.

7.2 A ROAD EXCAVATION PERMIT must be obtained before excavating in any city street.

8 PAVEMENT REPLACEMENT

8.1 In paved or improved roads, or where sidewalks, curbs, gutters or driveways have been damaged by Contractor, and where replacement of surfaces or damaged items is required, items shall be repaired or replaced without any needless delay in the best workmanlike manner with same kind of materials as were removed or damaged in the construction operation. Underlying foundation courses of roads, etc., finished surface, etc., shall conform to undisturbed portions of damaged items and shall in every respect be equal to quality, materials and workmanship in original, undisturbed item. Decision of Engineer shall be final as to classification of any form of pavement or surfacing not specified on project plans or of any forms of pavement or surfacing where classification is at all doubtful. Should Contractor fail or refuse to repair any damage after receiving directions of the Utilities Department or Design Engineer, the Utilities Department may, after 24 hours written notice, employ such force and furnish such materials as may be necessary to do the work with cost to be billed to the Contractor.

8.2 Contractor shall refer to Department of Public Services Standard Street Details for repair and replacement of roadways, curbs, gutters, sidewalks, etc.

9 CLEAN-UP PROCEDURES AND REQUIREMENTS

9.1 The Contractor shall not, without the permission of the Engineer, remove from the line of work any earth excavated until the excavation has been refilled and surfaced.

9.2 As soon as the backfilling of any excavation is completed and when in areas of existing development, the Contractor must at once begin the removal of all surplus dirt except that necessary to provide for the settlement of the filling unless otherwise provided in the special specifications. He shall also remove all the pipe and other material placed or left on the street by him except material needed for the replacement of paving, and the street shall be opened and made passable for traffic. Following the above work, the repairing and complete restoration of the street surfaces, bridges, crossings and all places affected by the work shall be done as promptly as possible.

9.3 All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable conditions. Contractor will be required to re-grass lawns or neutral grounds where trenches are excavated in these locations or where Contractor has damaged lawns or neutral ground by his operations.

9.4 The Engineer shall be the sole authority in determining the time in which rough and final clean up shall be prosecuted. Rough clean-up shall consist of removal of rocks larger than 1 foot in any dimension, grading of excess backfill material over pipeline or removal of said material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or roadway, restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same.

9.5 Rough, clean up shall, in general, be prosecuted no later than 1 day after pipe laying and backfilling or no farther behind pipe laying operations than 1000 feet, whichever time limit is shortest shall govern. Final clean up consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking with seeding, strawing, etc., of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items shall, in general, be prosecuted no later than 2 weeks after pipe has been laid and backfilled.

10 SLOPE PROTECTION AND EROSION CONTROL

10.1 This section shall consist of temporary control measures as shown in the Drawings or directed by the Engineer or as required by the State of Tennessee – Water Pollution Control Division during the life of the Contract to control erosion and water pollution through the use approved control devices.

10.2 Note: The Developer/Contractor's attention is directed to the fact that a permit from the Division of Water Pollution Control might be required for aquatic resource alteration for work in and/or around streams. In addition, a Notice of Intent (NOI) might be required on this project. The Contractor/Developer shall fully comply with all requirements of the State of Tennessee and all other Agencies.

10.3 The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features, to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

A. Silt Fencing or Erosion Wattle – Silt Fencing or erosion wattles shall be installed and securely embedded in the ground with staking a minimum of 4 to 6 inches to prevent water flowing under them.

B. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Contractor.

C. Erosion Control Outside Project Area - Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads and equipment storage sites.

11 MANHOLE SEALING AND PROTECTIVE COATING

11.1 Manhole sidewall, invert, and bench sealing, and rehabilitation shall be performed on existing manholes as required by the Sewer Department. The sealing of sidewalls and inverts in the manhole shall conform to the following specifications and Section 2 - Materials. The manhole coating and sealing materials as allowed in Section 2 - Materials shall be applied in strict accordance with manufacturer's recommendations.

11.2 All safety regulations and precautions set out by the manufacturer and OSHA shall be strictly observed.

11.3 Manholes to be waterproofed and sealed must first be cleaned by high-velocity cleaning equipment to remove all foreign matter from the walls and base. This cleaning shall remove oil, grease, loose mortar, paints, protective coatings, efflorescence, laitance and curing compounds.

11.4 Cleaning shall use a spray of a 10 percent solution of muriatic acid, which shall be washed off and the manhole allowed to dry. The manhole and invert shall then be gone over by patching with a quick setting Portland Cement based hydraulic cement to seal all cracks, etc.

11.5 Application of the epoxy resin shall be as per the manufacturer's recommendations. The first coat shall be applied by vertical brush strokes so that all brick joints in the direction receive an adequate coating of material. The first coat will be white in color to ease inspection and make the second coat visually simple to apply. After the first coat has cured, the surface is ready for the second coat. This second coat will be gray in color and should be applied with horizontal brush strokes to insure complete coverage of joints.

11.6 The sealant coatings shall be applied and be capable of withstanding a hydrostatic pressure of 7 psi (16 feet of water).

11.7 This sealing and waterproofing procedure shall be applied to the sidewalls, base, invert, and benches. As necessary to accomplish this work, the Contractor shall control the sewage flow through the manhole.

11.8 After all sealing, the Sewer Department shall inspect the sealed manholes after rainfall events have sufficiently raised the ground water table. See Section 4 - Testing and Acceptance for other requirements. Manholes that do not pass this inspection / testing shall be resealed.

12 CONCRETE CHECK DAMS (TRENCH PLUGS)

12.1 Check dams (trench plugs) are barriers placed within an open pipeline excavation in order to slow flow and reduce erosion in the trench and also to prevent the trench from becoming a subsurface drainage path. Since the bedding and embedment are constructed using cohesionless, free-draining soils, a path is created for water to flow easily (French drain effect) alongside the pipe.

12.2 Check dams shall be installed in all areas that have the potential for the drainage of water though the sewer bedding material. In areas where there is high groundwater flow, where

the pipeline crosses streams or aquifers, or where the natural groundwater flow would be affected or even diverted by the select materials, trench plugs of compacted, cohesive, soils or impervious materials should be utilized. This includes, but is no limited to sections of sewer main installed within 50-feet of or running through streams, wetlands, wet weather conveyances, intermittent streams, etc.

12.3 Check dams shall have a bedding of compacted, cohesive soils or impervious materials (such as concrete or controlled low strength materials a.k.a. flowable fill), whereas bedding on both sides of the check dam will have a bedding of uncompacted, cohesionless soil. Trench plugs must have lower permeability than the surrounding native soil.

12.4 Location and Spacing:

A. A minimum of one (1) check dam between manholes is required. Earthen or Concrete may be utilized.

B. One (1) concrete check dam is required at each end of a stream crossing and wetland. See standard details for typical stream crossing information.

C. Checkdams shall not be installed under roadways or sidewalks unless a stream crossing is required.

12.5 Concrete and Earthen check dams shall be constructed in accordance with the standard detail.

13 TUNNEL/BORE

13.1 Sewer Main In Tunnel/Bore The carrier pipe in the tunnel/bore shall be as specified in the Materials section of this specification. All work performed beneath existing structures, across railroad rights-of-way, and under pavements shall be performed in accordance with the requirements of the parties or agencies having jurisdiction over these locations. The Contractor shall contact the parties or agencies prior to starting work and shall meet all requirements of the parties or agencies in regard to methods of construction and the safety precautions to be taken in performing the tunnel work. All costs involved in meeting these requirements shall be paid for by the Contractor and no additional compensation allowed.

13.2 At the Contractor's option and with consent of the parties or agencies having jurisdiction, steel pipe may be jacked or bored into place in lieu of a liner plate tunnel provided the Contractor be responsible for all approvals from the parties and/or agencies having jurisdiction including, but not limited to, furnishing complete details of the methods to be employed for approval.

13.3 The sewer main pipe shall be adequately secured in the tunnel/bore casing by a method approved by the Design Engineer and Utilities Department. At a minimum, the carrier pipe must be secured, and non-compressible sand or pea gravel shall be placed in the space between the liner/casing and the carrier pipe by a method approved by the Design Engineer and Utilities Department. Concrete bulkheads will be placed at the end of the tunnel, thickness, and placement of which shall be subject to the Design Engineer and Utilities Department approval. Excavation shall be unclassified, and no distinction made between

rock and other materials excavated, with the cost of excavation merged in the unit price per foot of pipe sewer.

13.4 Note: In situations where the bore method is utilized with a steel casing pipe, the carrier pipe shall be secured inside the steel casing pipe with casing chocks (minimum three per joint) as manufactured by or Engineer approved equal. Where casing chocks are used inside steel casing pipes, the requirement for sand or pea gravel backfill can be eliminated. Additionally, the ends of the steel casing pipe shall be sealed with casing pipe "End Seals", "Link-seals", or Engineer approved equal.

13.5 Construction of the tunnel/bore shall be carried on in such a manner that settlement of the ground surface above the tunnel/bore shall be held to an absolute minimum. Where ground conditions are unstable, poling plates or poling boards shall be used to prevent caving of material above the tunnel before the liner plates can be installed. Steel liner plates shall be installed as soon after the excavation is removed as possible, and excavation shall not be removed more than 24 inches ahead of the installed liner plates.

13.6 Excavation shall be carried on in such a manner that voids behind the liner plates will be held to a minimum. However, should any boulders larger than one (1') foot in diameter be encountered, they shall be removed so that none are closer than 6 inches to the outer face of the liner plates. Should piling be encountered, each pile shall be cut out so that no portion remaining shall be closer than one (1') foot to the outer face of the liner. Where boulders or piling are excavated, the holes shall be backfilled by tamped material.

13.7 The steel lining shall consist of plates not to exceed 18 inches wide. Each circumferential ring shall be composed of the number and length of plates to complete the required diameter. The Contractor shall submit details of the lining for approval.

13.8 The strength of the casing or tunnel lining will be determined by its section modulus. The thickness of the metal for these steel plates shall not be less than 8 gauge allowing for standard mill tolerance.

13.9 All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be so fabricated as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type with offset equal to gauge of metal for full width of plates including flanges and shall have staggered bolt construction so fabricated as to allow the cross-section of the plate to be continuous through the seam. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

13.10 The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first-class in every respect.

13.11 After the plates are formed to shape and after all holes are punched, the plates shall be galvanized on all surfaces by the hot-dip process. A coating of prime western spelter, or equal, shall be applied at the rate of not less than three (3) ounces per foot of double exposed surface. If the average spelter coating as determined from the required samples is less than the amount specified above, or if any one specimen shows a deficiency of 0.2 ounce, the lot shall be rejected. Spelter coating shall be of first-class commercial quality

free from injurious defects such as blisters, flux and uncoated spots.

13.12 All nuts and bolts shall be galvanized.

13.13 Plates shall be fabricated with grout holes to facilitate grouting above and around the tunnel liner. These grout openings shall be 2-inch I.P.T. half couplings welded into a hole in the center corrugation couplings welded into a hole in the center corrugation of a plate and a galvanized C.I. plug shall be provided for each opening to permit tight closure after grout holes so that the spacing of 18-inch centers at the top of the tunnel and at the top quarter points, staggered with the holes at the top.

13.14 Field coating material shall be asphaltic mastic, Trumbull 5X, or approved equal, and shall be applied with hydraulic spray equipment using a minimum of 2,400 pounds of pressure at the nozzle tip. The material shall be supplied at spraying consistency and shall be applied both the outside and inside of the liner plates. Plates may be hot dipped to produce a similar coating.

13.15 When installing liner plate by the tunneling method, the excavation shall be performed in such a manner that voids between the undisturbed earth and the liner plate shall be maintained at a minimum. Any void occurring shall be filled with Portland cement and sand grout pumped under pressure through grouting openings in the liner plate.

13.16 The minimum provision for grouting openings shall be one (1) opening in a top plate of the tunnel or conduit at locations not to exceed 54 inches apart. Additional plates with grouting openings are to be installed at the top quarter points on each side between the top openings. The opening shall be staggered but shall not exceed 54 inches in any one line. Grout vent pipes will be required at a minimum of one per monolithic pour.

13.17 The grout shall consist of Portland cement, water, sand and 2% approved additive (Bentorite, Septamine Seax, Hydrocide liquid, etc.). One part Portland cement with additive shall be combined to four parts clean sand and sufficient water added to provide a grout having the consistency of thick cream when well mixed.

13.18 A pump shall be provided for placing the grout which shall be capable of exerting sufficient pressure to assure the filling of all voids between the liner plate/ casing and the undisturbed ground. The minimum acceptable pressure will be five (5) pounds per square inch.

13.19 Pumping of grout shall be done (1) at the completion of the installation of approximately each 9 feet of liner plate, (2) at more frequent intervals than 9 feet if conditions indicate the necessity, and (3) at the end of a workday or when there is work stoppage for any reason.

13.20 The carrier pipe shall be furnished by the Contractor. Upon acceptance of the liner/casing, install the carrier pipe in the casing by jacking it through the casing. A concrete invert may be poured if necessary to achieve proper line and grade on the carrier pipe to offset any minor variations in the alignment of the casing.

* * * *

SECTION 4 – TESTING

1. GENERAL

1.1. Testing and inspection of the completed work shall be accomplished by the following methods:

A. Visual Inspection
B. Infiltration Testing (Leakage Tests)
C. Air Pressure Testing of Lines
D. Roundness Testing
E. Vacuum Testing of Manholes
F. Spark/Holiday Testing of Epoxy Coatings
G. Gravity Sewer Video Inspection
H. Testing Force Mains
I. Testing Valves
J. Private Development Testing

1.2. Upon completion of construction the Contractor shall remove all sand, dirt, brick and other foreign materials from the sewers and shall conduct his own inspection to locate any defects and determine when the sewers are ready for testing and final inspection by the Utilities Department. All apparent defects shall be corrected by the Contractor before testing or final inspection are requested.

1.3. No sewer line shall be allowed to discharge into the existing sewage system until said line is free of foreign materials and obvious defects have been corrected. New lines, then, must remain disconnected from the existing system by actual physical separation, by plugs of type approved by the Utilities Department, or by other means approved by the Utilities Department.

1.4. Testing of the system before final inspection by the Utilities Department shall consist of visual observation and leakage tests conducted and observed by the Utilities Department. The Utilities Department will not conduct a final inspection until receiving written notification from the Design Engineer that the construction is complete in accordance with approved drawings and specifications. This notification shall include a report of the results of the visual observation and leakage tests.

1.5. If, after completion of any testing, portions of the sewer system are excavated and reinstalled, such as if a sag is found in a section of gravity sewer main by TV inspection after a roundness test is completed or manholes must be excavated and re-set to reach TDEC minimum slopes, complete retesting of the affected lines and structures will be required. This will include a minimum 28-day settling period to for the reinstalled lines and structures. This requirement of repair and retesting will be in effect until completion of the warranty period for the newly installed sewer lines and structures.

2. VISUAL INSPECTION

2.1. The Design Engineer will make the necessary visual inspections to verify the quality of workmanship. Such inspections shall include examination of manholes, “lamping”, “flashing” or “televising” sewer mains and observation of clean-up, pavement replacement.

2.2. Any defects such as misalignment of sewers, visible leaks, obstructions, cracked or broken pipe, or failure to restore the surface to a satisfactory condition must be corrected before acceptance.

3. LEAKAGE TESTS (GRAVITY SEWER)

3.1. In addition to the visual inspections, leakage tests may be made to ensure compliance with the infiltration limitations. Infiltration shall not exceed 25 GPD per inch diameter per mile of sewer. However, in view of the fact that the ground water table fluctuates and likely will not be at a maximum when the test needs to be made, tests may be based on exfiltration with a head of one foot above the invert at the upstream manhole.

3.2. Time and method for any exfiltration test must be approved by the Utilities Department before running the test. Exfiltration tests shall have a duration of one hour and the permissible limits for exfiltration shall be 25 gallons per day per inch diameter per mile of sewer. Water required for the exfiltration test must be furnished by the Contractor.

4. AIR PRESSURE TEST (GRAVITY SEWER)

4.1. Air pressure tests shall be required for all lines and shall be completed before binder or concrete are placed for vehicle or pedestrian uses. Equipment shall be top quality, in good condition, and approved by the Design Engineer and Utilities Department for use on this project. Plugs should have a sealing length equal to or greater than the diameter of the pipe being tested. External bracing of the plugs should not be required in order for the plug to hold against internal air pressure. The test equipment shall include accurate pressure gages to monitor test pressure, safety relief valve(s), and quick-release air bleed valve(s).

4.2. Air pressure testing shall occur no sooner than 30 days after installation of sewer infrastructure and all other utilities and stormwater infrastructure is placed and backfilled.

4.3. After cleaning the line (including flushing, if necessary) making sure all service plugs are adequately braced against internal pipe pressure and checking air test equipment including pipe plugs (suitably braced against internal pipe pressure, if necessary), the sewer line section to be tested shall be pressurized to 5 psig (pounds per square inch-gage). At least 2 minutes shall be allowed for air pressure to stabilize. After the stabilization period and with 5.0 psig minimum pressure in pipeline, air supply shall be disconnected, and the time observed which results in a 0.5 psig pressure drop.

4.4. The portion of line, including services that are connected to mains 8” or larger, being tested shall be termed “Acceptable” if after five (5) minutes, the pressure decreased from 5.0 psig to no less than 4.5 psig.

4.5. If the pipe is tested in a “dry” condition and fails to meet the test, specifications allow for the pipe to be wetted and tested in that condition. Initial testing may be in the “dry” or “wet” condition at the Contractor’s option.

4.6. Observe safety precautions during the test. Caution all workers to remain clear of test plugs, which can blow out under considerable force at any time the line is pressurized.

4.7. Air tests will not be utilized on pipes larger than 24” diameter.

4.8. Tests shall be made upon completion of the sewer, after visual inspection, but before any service connections have been made. The Developer, through his Contractor or Design Engineer shall furnish all labor, tools, equipment, and materials for the tests. The tests must be scheduled at a time acceptable to the Utilities Inspector and shall be witnessed by the Design Engineer’s representative.

5. ROUNDNESS TEST (GRAVITY SEWER)

5.1. Roundness testing shall occur no sooner than 30 days after installation of sewer infrastructure and all other utilities and stormwater infrastructure is placed and backfilled. Additionally, roundness test shall be required for all lines and shall be completed before binder or concrete are placed for vehicle or pedestrian uses.

5.2. Sewer constructed of PVC pipe shall pass a go/no-go mandrel sized to 95% of the actual pipe diameter with the pipe in place and backfill completed.

5.3. Contractor shall provide a suitable ball or mandrel having a diameter equal to 95% of the actual inside pipe while the Utilities Department or authorized representative observes the test. Any section of sewer showing a deflection of more than 5% of the actual inside diameter shall be considered to have failed and shall be re-laid to correct the condition. Mandrel shall be pulled without mechanical pulling devices and shall not be performed until a minimum of 7 days after backfilling operations.

6. VACUUM TESTING OF MANHOLES (GRAVITY SEWER)

6.1. This test shall be considered acceptable if the vacuum remains at 10" Hg. or drops to no less than 9" Hg. within one (1) minute. If the manhole fails the initial test, the Contractor shall locate the leak and make appropriate repairs acceptable to the Design Engineer and Utilities Department in preparation for additional tests. Use of Hydraulic Cement in an attempt to allow the manhole to temporarily pass the vacuum test is prohibited.

6.2. It is also called to the Contractor's attention that he will be required to furnish all equipment necessary for this test including the manhole sealing apparatus, gauges, pump, plugs, and operating personnel.

6.3. **The vacuum testing of manholes shall include plugging all inlet and outlet CIPP lined or pipe bursted pipes in the manhole and vacuum testing of annular space seals at the same time as manholes which have been rehabilitated. The manhole shall be sealed at the top of the cone for the test.**

6.4. Before making any new connections to an existing manhole, the contractor is required to perform a vacuum test on the manhole using the same guidelines mentioned above and may be required to repair or replace the existing manhole at the direction of the Utilities Department.

6.5. The Developer, through his Contractor or Engineer, shall furnish all labor, tools, equipment, materials, apparatus, gauges, etc. for the tests.

7. SPARK/HOLIDAY TESTING

7.1 The purpose of the test is to determine the presence of pinhole leaks, punctures, cuts, etc. Testing shall be in accordance with ASTM D-4787.

7.2 The surface of the applied lining shall be clean, dry, free of oil, grease, dirt, or other contaminants and be sufficiently cured in accordance with the manufacturer's latest published instructions at the time the testing is performed.

7.3 Testing to be completed using a High Voltage Spark Tester with a voltage rating in excess of 800 V. The detector is to consist of an electrical energy source, an exploring electrode, a ground connection, and ground wire. The detector shall be equipped with a visual or audible indicator, or both.

7.4 Utilize visual or audible indicators, or both, to signal a closed electrical circuit. Such signals shall be essential for testing the underlayment for electrical conductivity and for exposing discontinuities in the lining after it has been applied.

7.5 Completely test the lining and repair any defects found in the lining prior to retesting. After repairs are completed, retest the repaired areas.

8. GRAVITY SEWER VIDEO INSPECTION

8.1. After the installation and backfill of the proposed sewer main and a 28-day minimum settlement period, but prior to the binder being placed on the roadway, the contractor shall conduct a video inspection and log of the gravity sewer main for the development. The contractor shall deliver a copy of the log and video to the Utilities Department for review. Any defects caused by workmanship or materials, including settlement, detected shall be corrected to the satisfaction of the Utilities Department before the final inspection walkthrough can be completed and the warranty period can start. Any repairs to the sewer main will also require reinspection and retesting of any mains, manholes, or other apparatuses as required by the Utility Department. Reinspection and retesting may not occur sooner than 28 days after repairs are completed and any required backfill is placed, unless otherwise directed by the Utilities Engineer or Utilities Director.

8.2. Prior to the end of the warranty period, the Utilities Department and/or a third party contracted by the Utilities Department will conduct a secondary video inspection and log of the gravity sewer main. The Utilities Department reserves the right to re-inspect the lines at any time during the warranty period and will not accept any defects discovered during that period. Any defects in workmanship or materials, including settlement, detected in any video inspection shall be corrected to the satisfaction of the Utilities Department. The warranty period cannot end until all repairs are made and any retesting and reinspection of the sewer has been completed. The cost of the initial video inspection shall be included in the existing Gravity Sewer Inspection Fee listed in Section 1 of these specifications.

8.3. Should repairs be required, the Utilities Department may, at its discretion, require a video re- inspection of the repaired line. If so, the Developer will be charged a setup fee at the

current rate. The Developer will be informed of this amount by the Utilities Department and the specified amount shall be paid in full before the re-inspection will be scheduled. The Developer or designated contractor shall request the inspection/re-inspection at least one week in advance and the Utilities Inspector will then coordinate the best available time based upon availability of Utilities Department resources and personnel. The Utilities Department reserves the right to cancel or reschedule the inspection/re-inspection should an emergency require those same resources. If it is necessary to clean the line before any inspection, initial or follow-up, the currently hourly rate will be charged to the Developer. This fee will be paid in full before the sewer system is accepted by the Utilities Department. The flooding and flushing of lines will be performed by others prior to the video inspection.

8.4. Any repairs made after passing the initial testing and acceptance of the utility line will result in the line being retested at the Utilities Department's discretion. A 30-day waiting period before retesting is required.

9. TESTING FORCE MAINS

9.1. Before final acceptance, force mains shall be pressure tested by suitably closing the end of the main with a test plug of approved design suitably braced against the internal pressure to prevent blowout and possible injury to personnel. Contractor shall furnish all labor, materials, and equipment for testing the force main including, but not limited to, water for testing, test pump, pressure gauges, test plugs, etc. Test shall be performed by the Contractor and witnessed by the Engineer.

9.2. The force main shall be filled with water taking care to eliminate air from the high points. A positive displacement test pump shall be used to pump clean water into the main to build up a test pressure equal to the normal system pressure plus 50 psi. Test pressure will be determined by the Engineer. The test pump shall then be valved off from the system, and the pressure shall be observed over a period of one hour. A drop in pressure of 5 psi or more during the one-hour test period shall be taken as an indication of leakage. In the event leaks are found and corrected, the Contractor shall repeat the pressure test using the same procedure described above. Should the Contractor be unable to obtain a satisfactory pressure test over a duration of one hour, he shall then be required to perform a leakage test using a water tap and standard water meter to measure the leakage in the test section at system pressure over a period of 24 hours. Leakage during the 24-hour period must not exceed the allowable leakage for mechanical or push-on joints as shown in AWWA C600, latest revision. Leakage shall not exceed the quantity determined by the formula: L = (ND P) divided by 3,750 where L is the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tests; D is the nominal pipe diameter in inches; and P is the average test pressure during the leakage test in pounds per square inch. Should the system fail to pass the leakage test, the Contractor will be required to locate and correct the leaks and to retest the system until satisfactory results can be obtained.

9.3. The Contractor shall provide suitable first quality pressure gauges with 5 lb. or smaller graduations and a standard 3/4 x 5/8-inch water meter in the event the meter is required for the leakage test. Pressure gauges and water meter shall be in good condition and shall be subject to such tests for proof of accuracy as the Engineer may require.

10. TESTING OF VALVES

10.1. Upon completion of the work, the Contractor/Developer shall operate all buried valves in the

presence of the Utilities Inspector to verify proper operation of each valve.

11. TESTING OF GRINDER PUMPS

11.1. Upon completion of the work, the Contractor/Developer shall operate and test all grinder pumps in the presence of the Utilities Inspector to verify proper operation and performance of each pump station. This test shall include operating all valves, measuring amp draw for pumps, and checking all controls.

12. PRIVATE DEVELOPMENT TESTING

12.1. Contractor shall reach out the Utilities Department upon completion of private gravity and force main sewers for testing. Manholes and sewer line shall be tested to the same standards as public mains before the contractor is allowed to connect to the existing public sewer main.

12.2. Contractor is to contact Utilities Department before making connections to existing sewer and force mains. Utilities Department must inspect and GPS the connection and ensure connection is properly installed. If the contractor fails to notify the Utilities Department before a connection backfilled, the contractor will be responsible for excavating any buried facilities for testing, inspection, and GPS data collection along with any additional TV inspection of the facilities as required by the Utilities Department.

12.3. All standard sewer inspection fees charged for public sewer facilities shall also be required for private sewer facilities.

SECTION 5 – SPECIAL INTERCEPTORS

1. GREASE INTERCEPTORS

1.1. A grease interceptor is required for all commercial establishments where food or beverages will be processed, cooked, served, or prepared in any way; Regardless of whether there is a charge for the food. All kitchen and/or food and beverage preparation waste lines will be routed through the grease interceptor. However, no domestic waste will be allowed to enter the grease interceptor. All wastewater flowing from kitchen areas and/or food and beverage preparation areas shall flow through approved grease interceptors prior to entering the public sewer system.

1.2. Grease interceptors shall be located outside of buildings. Interceptors shall be placed where the proposed food waste line will have an adequate slope and be accessible for maintenance and inspection at all times.

1.3. The grease interceptor will be sized as defined in Table 5.1.A below and will have a minimum volume of 1,000 gallons and may not exceed a maximum volume of 2,000 gallons. When interceptors are installed in series, the combined interceptor capacity required may be calculated based on the reduced capacity requirements per seat or per meal as shown in Table 5.1.A. The grease interceptor shall be designed and installed in accordance with the manufacturer's instructions, the requirements of this section, and Appendix Standard Detail Drawing S20.

Table 5.1.A. Sizing Requirements for Grease Interceptors.

Type of Facility	Unit	Grease Interceptor Capacity Single (gallons)	Grease Interceptor Capacity in Series (gallons)
Restaurant, Food, or Beverage Preparation	seat	20	10
Restaurant – Fast Food	seat	10	5
Restaurant – 24-hour	seat	30	15
Convention Center, Catering Facility, or Cafeteria	meal	5	2.5

See Fats, Oils, and Grease Control Program for additional requirements.

2. OIL AND WATER SEPARATORS:

2.1. Oil and water separators are required for all facilities where commercial vehicles or equipment are repaired, maintained, or washed, including vehicle repair garages, car-washing facilities, factories, and all other facilities where oily liquid wastes are produced.

2.2. Oil and water separators shall be individually designed and sized for each site-specific application.

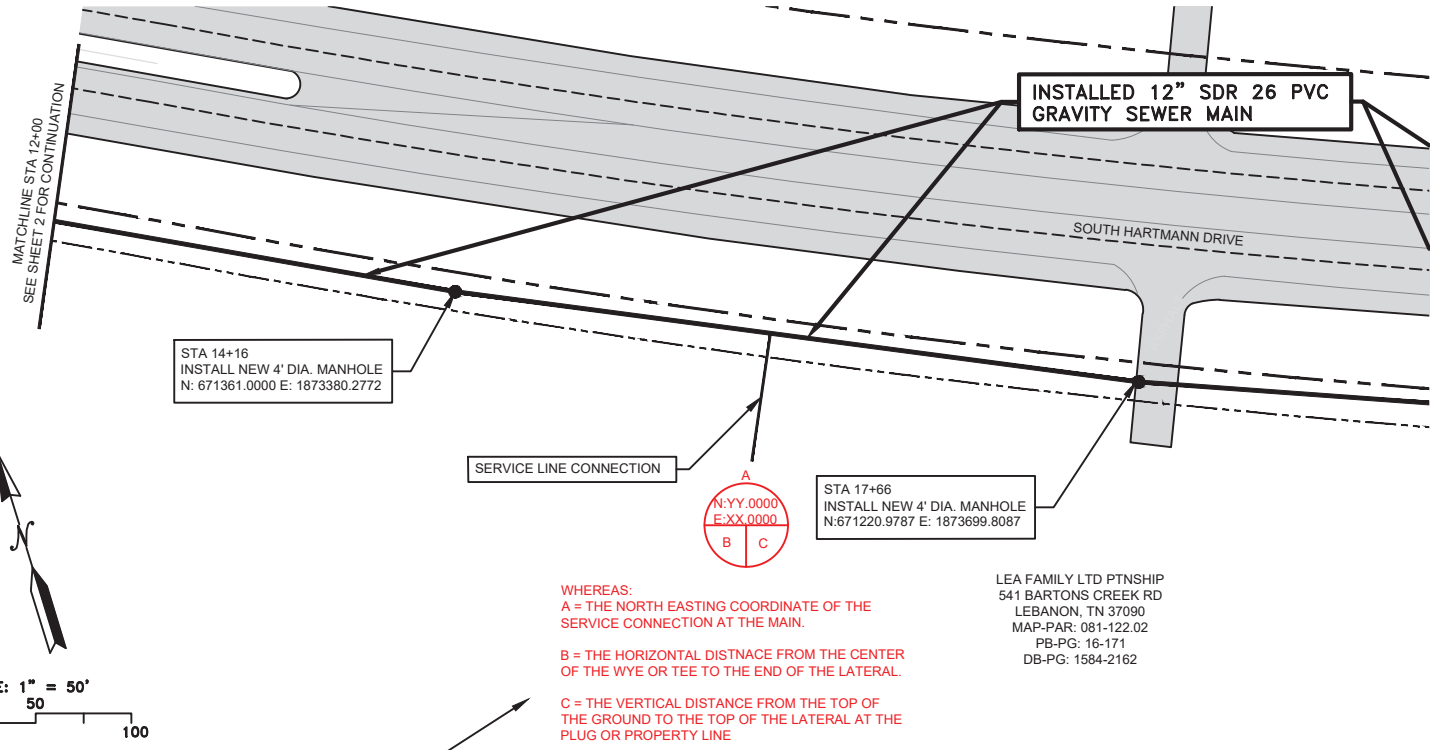
2.3. Where automobiles are serviced, greased, repaired, or washed or where gasoline is dispensed, oil and water separators shall have a minimum capacity of 6 cubic feet for the first 100 square feet of area to be drained, plus 1 cubic foot for each additional 100 square feet of area to be drained into the separator.

2.4. All commercial vehicle-washing systems shall be equipped with a water recycling system that has no connection to the sanitary sewer system with the exception of a single overflow line from the final water holding tank. For the purposes of this Section, commercial vehicle washing systems shall include systems associated with businesses that sell or lease cars, trucks, boats, and other motorized vehicles. Hand-held hoses are exempt from this provision.

3. SAND AND GRIT SEPARATORS/TRAPS:

3.1. Sand and grit separators/traps are required for all commercial facilities discharging fine particles, floatable, or other debris that could cause clogs or blockages in the collection system. Examples include sand, dust, metal shavings, rags, strings, feathers, glass, etc. Sand and grit separators shall be individually designed and sized for each site-specific application.

* * * *



SCALE: 1" = 50'

50

0 100

WHEREAS:
A = THE NORTH EASTING COORDINATE OF THE SERVICE CONNECTION AT THE MAIN.

B = THE HORIZONTAL DISTNACE FROM THE CENTER OF THE WYE OR TEE TO THE END OF THE LATERAL.

C = THE VERTICAL DISTANCE FROM THE TOP OF THE GROUND TO THE TOP OF THE LATERAL AT THE PLUG OR PROPERTY LINE

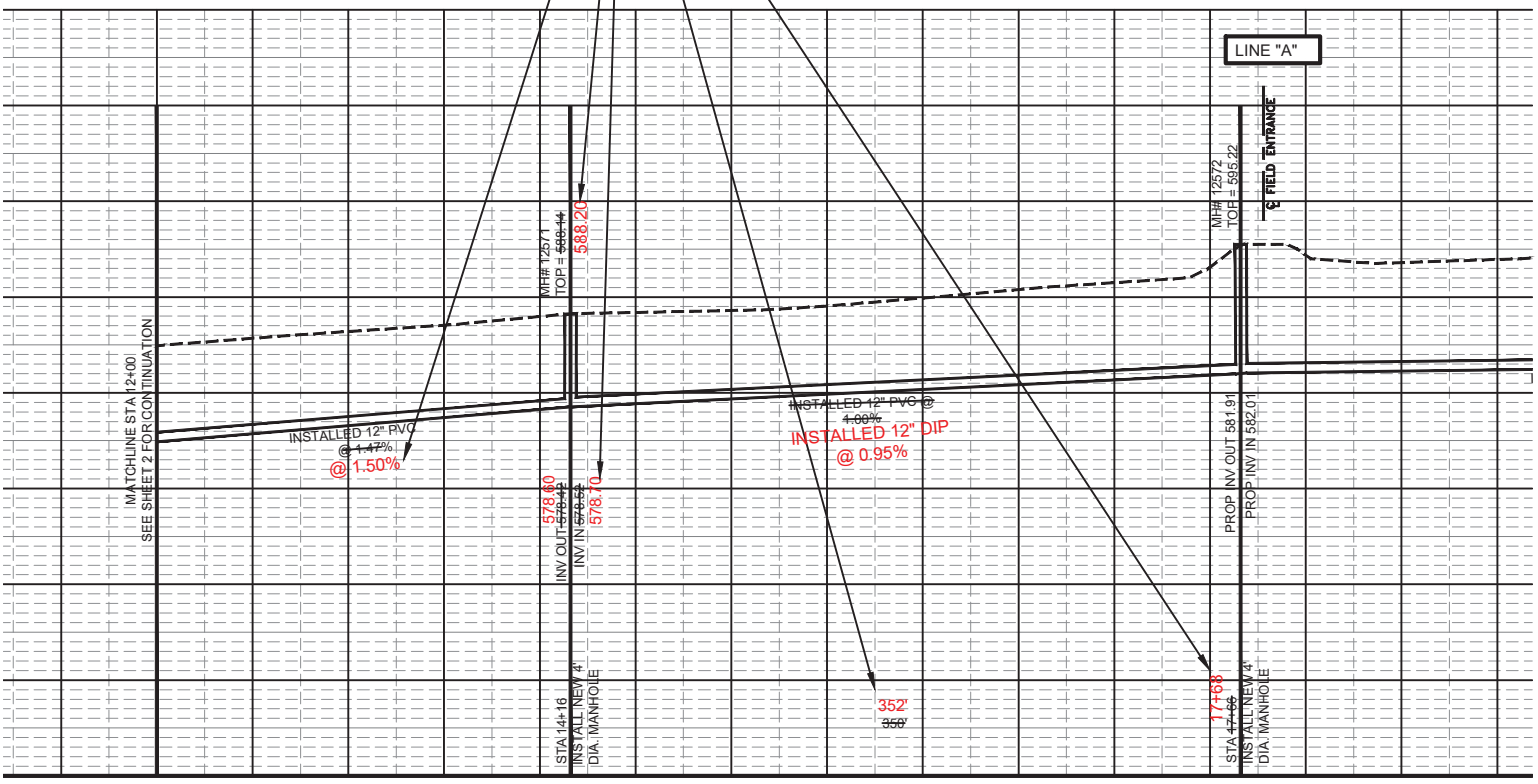
LEA FAMILY LTD PTNSHIP
541 BARTONS CREEK RD
LEBANON, TN 37090
MAP-PAR: 081-122.02
PB-PG: 16-171
DB-PG: 1584-2162

AS-BUILTS INCLUDE:
1. LOCATION MARKER FOR SERVICES
2. UPDATES FOR RELEVANT TEXT, INCLUDING SLOPES, ELEVATIONS, AND LENGTHS BETWEEN MANHOLES. IF CHANGE IS MADE, DESIGN NUMBERS TO BE STRIKETHROUGH TEXT STYLE (~~EXAMPLE~~) AND REVISED NUMBERS TO BE IN RED TEXT AND A LARGER SIZE AS SHOWN BELOW.

RECORD DRAWING

IN ACCORDANCE WITH THE INFORMATION PROVIDED BY THE FIELD SURVEY CONDUCTED BY *(LICENSED SURVEYOR)* ON *(DATE)*, INFORMATION PROVIDED TO *(CERTIFIED ENGINEER)* BY *(CONTRACTOR)* ON *(DATE)*, *AND BASED ON SEPARATE FIELD REVIEWS*, I HEREBY CERTIFY THAT THESE PLANS REPRESENT A TRUE AND ACCURATE DEPICTION OF THE AS-BUILT CONDITIONS TO THE BEST OF MY KNOWLEDGE.

SIGNATURE:_____ DATE:_____

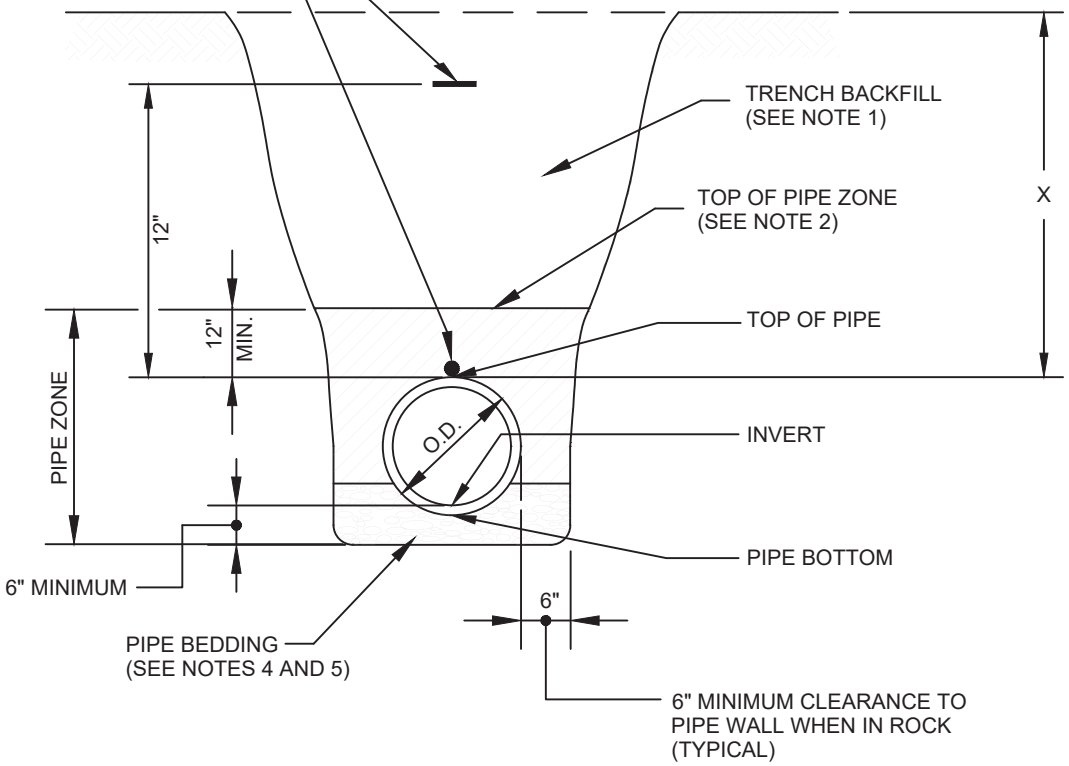


STANDARD SEWER DETAIL APPENDIX

STANDARD #	STANDARD DETAIL DRAWING
S-1	TYPICAL SEWER INSTALLATION
S-2	SEWER SERVICE LINE
S-3	DEEP SEWER SERVICE LINE
S-4	TYPICAL CLEANOUT ASSEMBLY
S-5	STANDARD MANHOLES
S-6	DOG-HOUSE MANHOLE
S-7	MANHOLE FLOOR PLAN
S-8	TYPICAL CAST IRON TRAFFIC & NON-TRAFFIC RATED MANHOLE CASTINGS
S-9	TYPICAL COMPOSITE TRAFFIC & NON TRAFFIC RATED MANHOLE CASTINGS
S-10	TYPICAL MANHOLE CASTING FINISH
S-11	DROP PIPE FOR STANDARD MANHOLES
S-12	CONNECTION TO EXISTING MANHOLE
S-13	SMALL DIA. FORCE MAIN TIE-IN AT MANHOLE
S-14	LARGE FORCE MAIN TIE-IN AT EXISTING MANHOLE
S-15	VENT PIPE ASSEMBLY
S-16	MANHOLE ABANDONMENT
S-17	TYPICAL TRENCHING DETAIL FOR PARALLEL INSTALLATIONS
S-18	METHOD OF CROSSING OBSTRUCTION
S-19	TYPICAL CREEK CROSSING
S-20	TYPICAL BORE CASING DETAIL
S-21	TYPICAL TUNNEL SECTION
S-22	TRENCH REPAIR
S-23	NARROW TRENCH REPAIR
S-24	TYPICAL SIMPLEX GRINDER PUMP STATION
S-25	TYPICAL SIMPLEX GRINDER PUMP CONTROL PANEL
S-26	TYPICAL SUBMERSIBLE PUMP STATION W/ ABOVE GROUND VALVE BOX
S-27	TYPICAL SUCTION LIFT PUMP STATION
S-28	TYPICAL HIGH FLOW PUMP STATION
S-29	TYPICAL ELECTRICAL RACK DETAIL
S-30	ELECTRICAL CANOPY DETAIL
S-31	TYPICAL PUMP STATION SITE LAYOUT
S-32	TYPICAL FENCE & DOUBLE GATE
S-33	EMERGENCY PUMPING CONNECTION DETAIL
S-34	TYPICAL GRINDER PUMP AND SERVICE CONNECTION DETAIL
S-35	TYPICAL PLUG VALVE INSTALLATION
S-36	SMALL/LARGE VALVE BOX AND COVER (TRAFFIC TYPE)
S-37	LOW PRESSURE SEWER AUTOMATIC AIR RELEASE MANHOLE
S-38	AUTOMATIC COMBINATION AIR & VACUUM RELEASE MANHOLE
S-39	OFFSET - AUTOMATIC COMBO AIR /VACUUM MANHOLE W/ 30" CONC. PIPE STRUCTURE FOR SMALL FORCE MAINS
S-40	TYPICAL LOW PRESSURE SEWER SERVICE LINE CONNECTION (1 ¼")
S-41	TYP. LOW PRESSURE SEWER VALVE BOX & CLEANOUT ARRANGEMENT ALONG STRAIGHT RUNS AND AT CHANGES IN DIRECTION
S-42	TYPICAL LOW PRESSURE SEWER SERVICE LINE CONNECTION (1 ¼")
S-43	TYPICAL SHALLOW CLEANOUT ASSEMBLY W/ FORCE MAIN CONNECTION
S-44	TYPICAL DEEP CLEANOUT ASSEMBLY W/ FORCE MAIN CONNECTION*
S-45	CONCRETE THRUST BLOCKING
S-46	CONCRETE CHECK DAM
S-47	CONCRETE ANCHOR
S-48	CONCRETE ENCASEMENT & CONCRETE CAP
S-49	TYPICAL GREASE TRAP
S-50	EROSION CONTROL TYPICAL SILT FENCE INSTALLATION
S-51	EROSION CONTROL SEDIMENT TUBE TYPICAL INSTALLATION

NOTE:

PRESSURE SEWER AND GRAVITY SEWER MAINS SHALL BE INSTALLED WITH BOTH 3-INCH. WIDE; 5.5 MILS THICK DETECTION/ /MARKING TAPE AND #12 GAUGE COPPER CLAD STEEL TRACER WIRE.



NOTES:

1. "PIPE ZONE" EXTENDS TO 12" ABOVE TOP OF PIPE AND BACKFILL IN TO BE CRUSHED STONE, GRAVEL OR OTHER GRANULAR MATERIAL AS APPROVED BY THE ENGINEER.
2. LIMIT TRENCH WIDTH AT TOP OF PIPE ZONE TO O.D. + 16", UNLESS PERMITTED OTHERWISE BY ENGINEER.
3. PIPE BEDDING IS TO BE CRUSHED GRAVEL OR OTHER GRANULAR MATERIAL AS APPROVED BY ENGINEER. DEPTH UNDER BOTTOM OF PIPE IS TO BE 6" MINIMUM.
4. PIPE TO BE CONTINUOUSLY SUPPORTED ALONG LENGTH OF PIPE BARREL EXCEPT AT BELLS. BELL HOLES ARE REQUIRED SUCH THAT NO BEARING LOAD IS TAKEN BY THE BELL.
5. IN AREAS DESIGNATED FOR "CHECK DAM", ENCASE THE PIPE ZONE FOR A MINIMUM OF 4 FEET ALONG THE PIPE CENTERLINE AND SHALL BE CLASS C CONCRETE AS SHOWN IN CONCRETE CHECK DAM DETAIL
6. MINIMUM DEPTH OF PIPE "X" IS EQUAL TO
   - 30" OUTSIDE OF ROADWAY
   - 48" UNDER ROADWAY
8. IF MINIMUM DEPTH "X" CANNOT BE ACHIEVED, CONCRETE CAP WILL BE REQUIRED OUTSIDE OF ROADWAY AND FLOWABLE FILL OR STEEL ENCASEMENT WILL BE REQUIRED UNDER ROADWAY.

BACKFILL REQUIREMENTS:

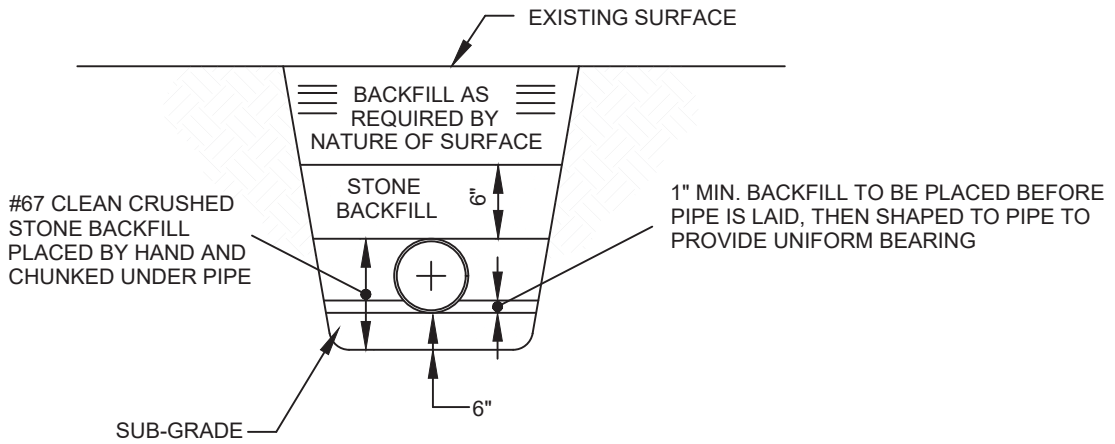
1. ABOVE THE PIPE ZONE, USE SUITABLE EXCAVATED MATERIALS OR CRUSHED STONE PLACED IN LAYERS, GENERALLY NOT EXCEEDING 12", VIBRATED IN PLACE.
2. BEDDING BACKFILL SHALL BE CRUSHED STONE FOR PVC, DIP, AND HDPE PIPES.
3. WHERE CRUSHED STONE BACKFILL IS REQUIRED, NO. 67 STONE AS DESIGNATED BY TDOT SHALL BE REQUIRED.
4. WHERE CRUSHED STONE IS NOT REQUIRED AND EXCAVATED MATERIAL IS NOT SUITABLE, CONTRACTOR MAY USE FINE DRY SELECTED EARTH OR CLAY BACKFILL.
5. UNSUITABLE MATERIAL INCLUDE THOSE CONTAINING EXCESSIVE ORGANIC MATTER, STUMPS, ROOTS, REFUSE, FOREIGN MATTER, HARD CLAY LUMPS THAT ARE NOT EASILY COMPACTABLE, OR LARGER DIAMETER ROCKS.
6. SEE SPECIFICATIONS SECTION 3. CONSTRUCTION FOR MORE DETAILS.

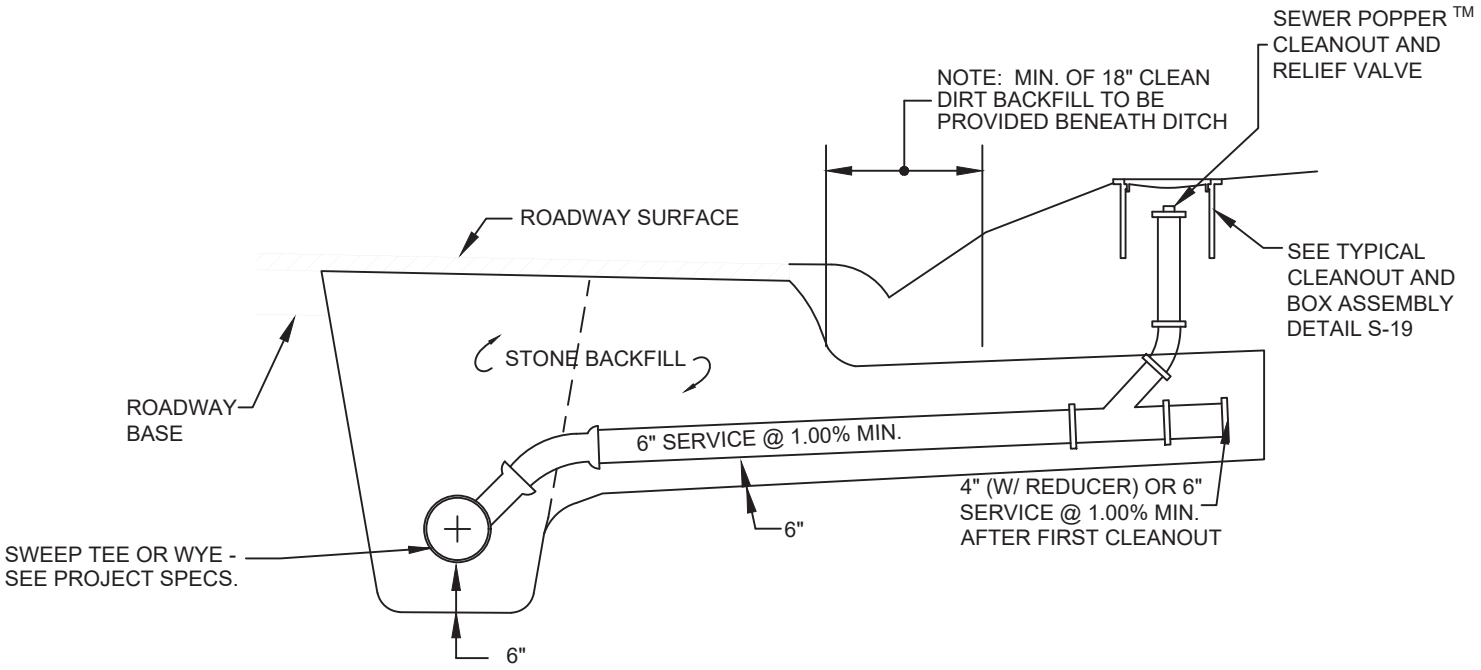
NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL SEWER INSTALLATION
10/18/2023 UTILITIES DIRECTOR DATE		S-1

NOTES:

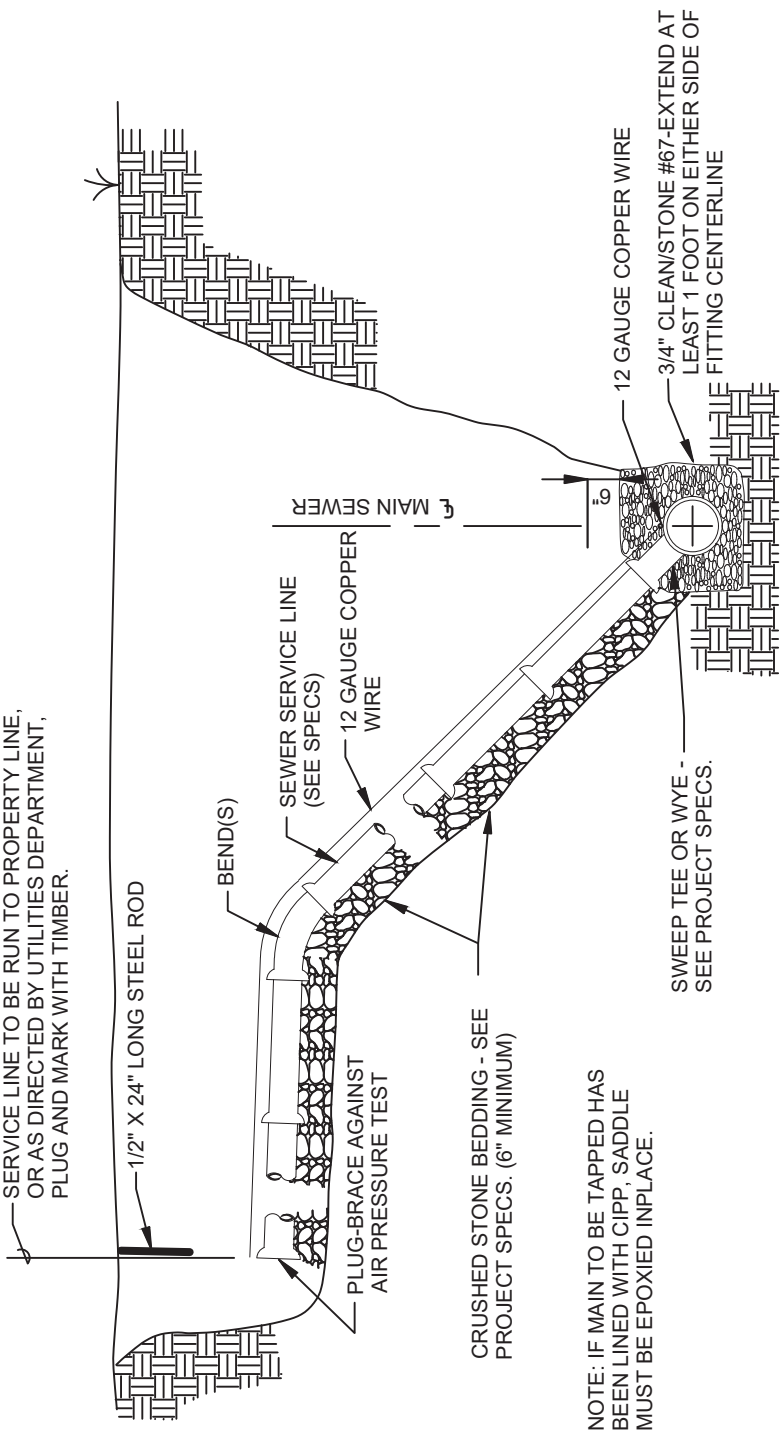
1. FIRST CLEANOUT SHALL BE INSTALLED AT THE PROPERTY LINE.
2. FOR DIRECT SEWER TAPS:
   - PVC/CIPP: USE ROMAC
   - CLAY: FLEXIBLE FERNCO WITH PRESSURE KIT





NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		SEWER SERVICE LINE
10/18/2023		S-2
UTILITIES DIRECTOR DATE		

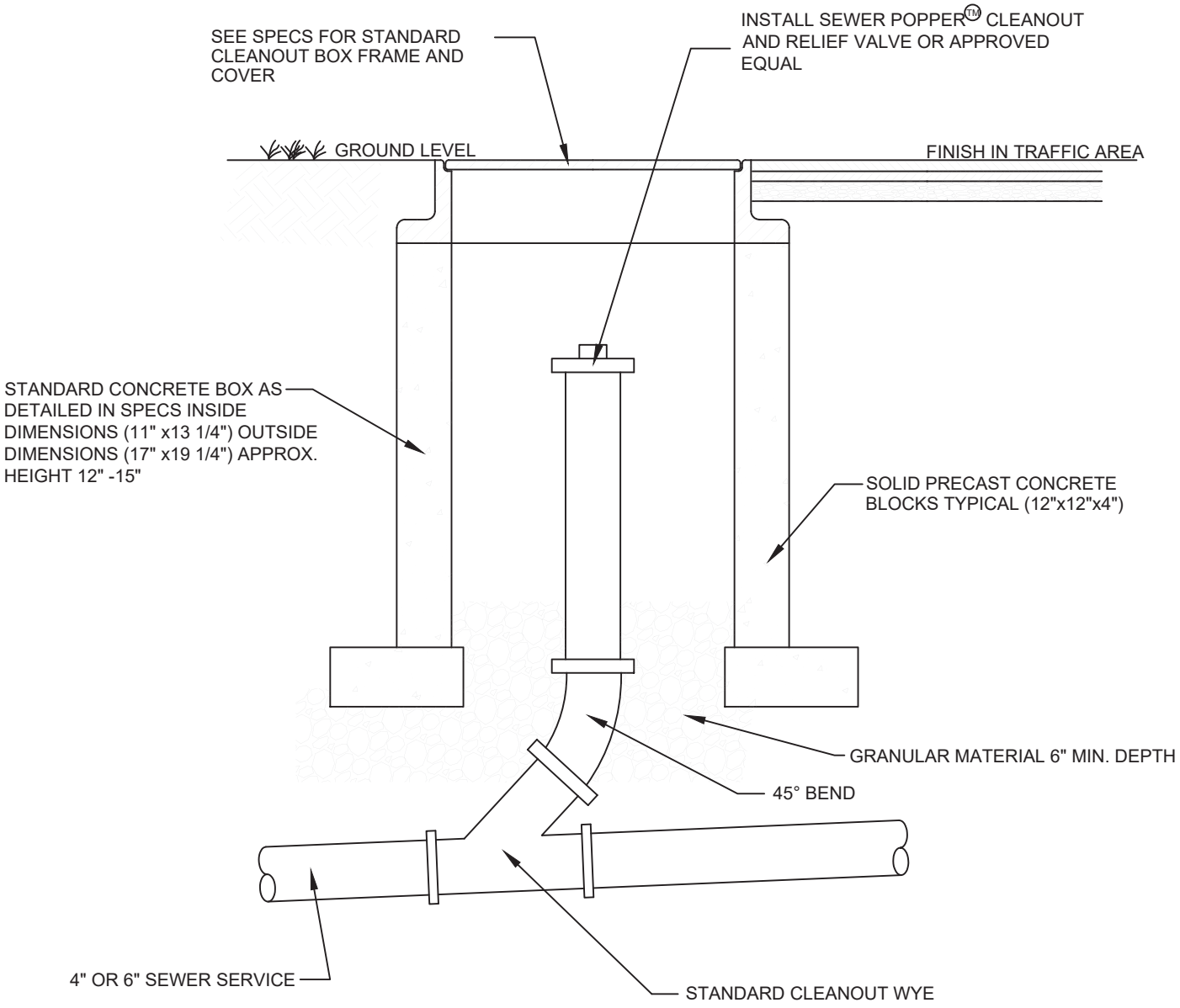


NOTE: IF MAIN TO BE TAPPED HAS BEEN LINED WITH CIPP, SADDLE MUST BE EPOXIED INPLACE.

NOTE:

1. DEEP SEWER SERVICE TO BE USED WHERE DIRECTED BY DESIGN ENGINEER OR UTILITIES DEPARTMENT
2. FOR NEW CONNECTIONS TO EXISTING SEWER MAINS, STAINLESS STEEL MATERIALS ARE TO BE USED
3. FOR DIRECT SEWER TAPS:
   - PVC/CIPP: USE ROMAC
   - CLAY: FLEXIBLE FERNCO WITH PRESSURE KIT

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		DEEP SEWER SERVICE LINE
Regina Santana 10/18/2023		S-3
UTILITIES DIRECTOR DATE		

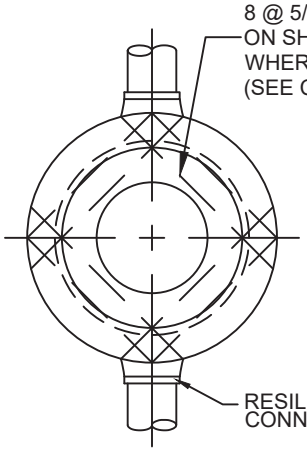


NOT TO SCALE

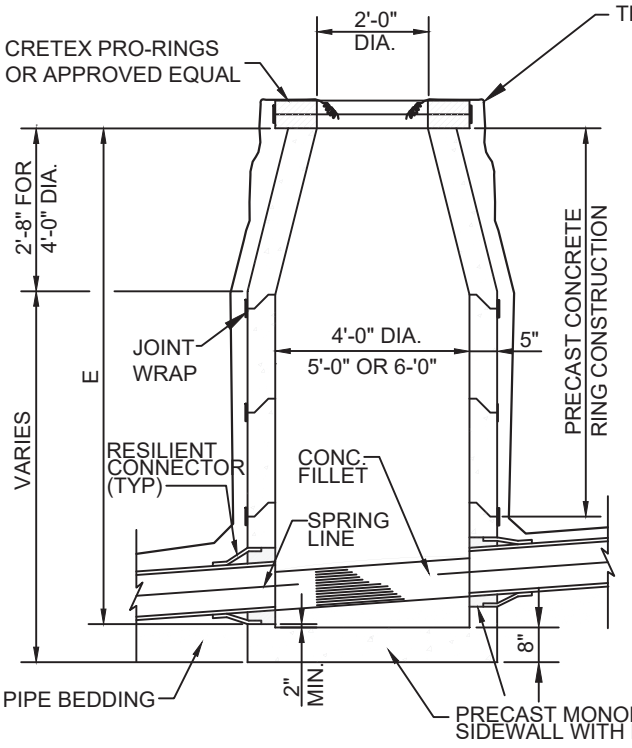
10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL CLEANOUT ASSEMBLY
Regina Santana 10/18/2023		S-4
UTILITIES DIRECTOR DATE		

NOTES:
1. CONTRACTOR SHALL PROVIDE "INFLOW PROTECTOR MANHOLE INSERTS" FOR 15% OF ALL NEW MANHOLES IN EACH DEVELOPMENT
2. GRANULAR BACKFILL MATERIAL SHALL BE PLACED ADJACENT TO MANHOLE IN AREAS WHERE SWELLING CLAY EXIST.

CONSTRUCTION NOTES
1. CYLINDRICAL AND CONICAL SECTIONS OF ALL MANHOLES SHALL BE CONSTRUCTED OF EITHER MONOLITHIC CONCRETE OR PRECAST CONCRETE RINGS AS DESIGNED IN THE PROJECT SPECIFICATIONS OF THE CONTRACT DOCUMENT.
2. CONCENTRIC CONES SHALL BE USED ON PRECAST CONCRETE AND MONOLITHIC CONCRETE UNITS.
3. DIMENSION "E" VARIES. WHEN LESS THAN 5-FEET OMIT CONE AND EXTEND CYLINDRICAL MANHOLE SIDEWALL SECTION TO AN ELEVATION 8-INCHES BELOW BOTTOM OF ADJUSTING BRICK.
4. CONSTRUCT 8-INCH THICK CONCRETE SLAB ON TOP OF CYLINDRICAL SECTION REINFORCED WITH 5/8-INCH DIA. BARS AS SHOWN.
5. PROVIDE 24-INCH DIAMETER OPENING IN SLAB FOR MANHOLE'S FRAME AND ADJUSTMENT RINGS AS ON CONED MANHOLE.
6. BENCH WALLS IN MANHOLES FOR SEWERS 18-INCHES IN DIAMETER AND SMALLER TO BE BUILT UP TO THE THREE-QUARTER POINT ON PIPE. SEWERS 21-INCHES TO 30-INCHES IN DIAMETER - 15-INCHES HIGH. LARGER SEWERS TO SPRING LINE.
7. NO BENCH WALLS REQUIRED IN DEAD END MANHOLES, ALTHOUGH BOTTOM TO BE PROPERLY DISHED.
8. ALL JOINTS TO BE WRAPPED WITH 6" JOINT TAPE.
9. ALL MANHOLES SHALL BE INCLUDE ADMIX FOR WATERPROOFING AND PROTECTION AGAINST HYDROGEN SULFIDE DETERIORATION. SEE SPECIFICATIONS FOR DETAILS.

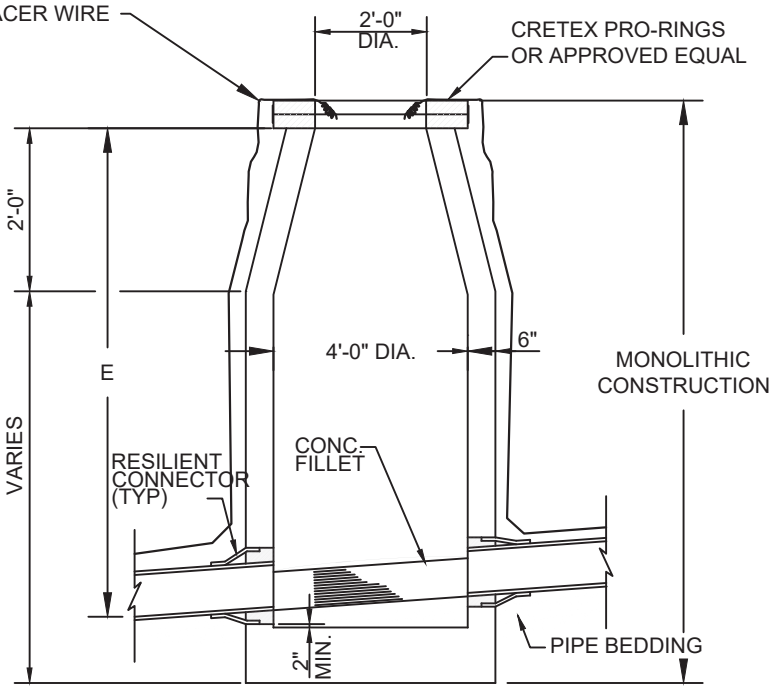


PLAN



SECTION

FOR SEWERS
36" DIAMETER & SMALLER
NOT TO SCALE

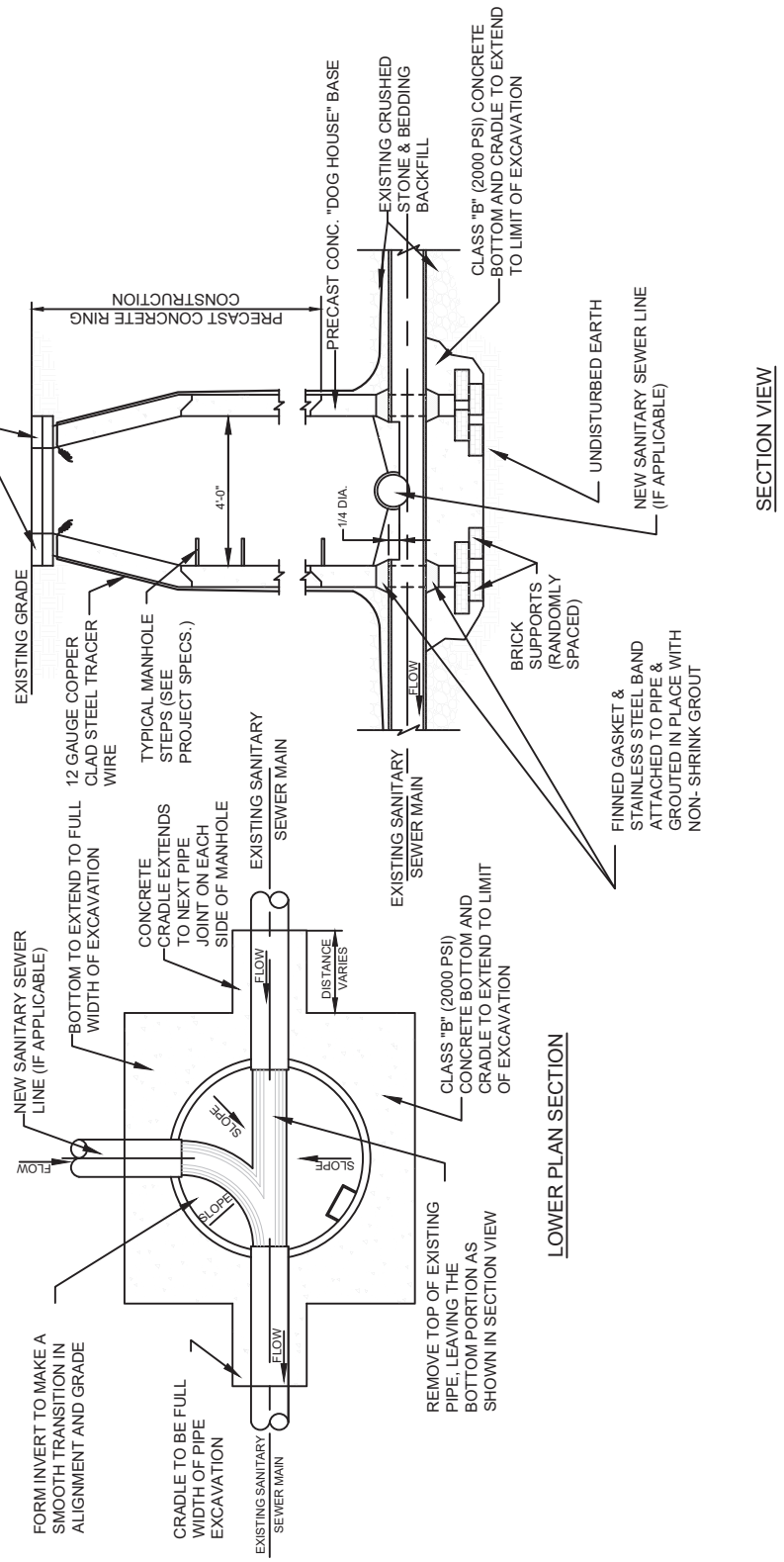


POURED IN PLACE MANHOLE
NOT TO SCALE

INSTALL FLEXIBLE ANNULAR SPACE FILLER AROUND PIPES WITH "CAVITY-O-RING" AS MANUFACTURED BY N.P.C. SYSTEMS, INC. OF MILFORD, NEW HAMPSHIRE, OR APPROVED EQUAL.

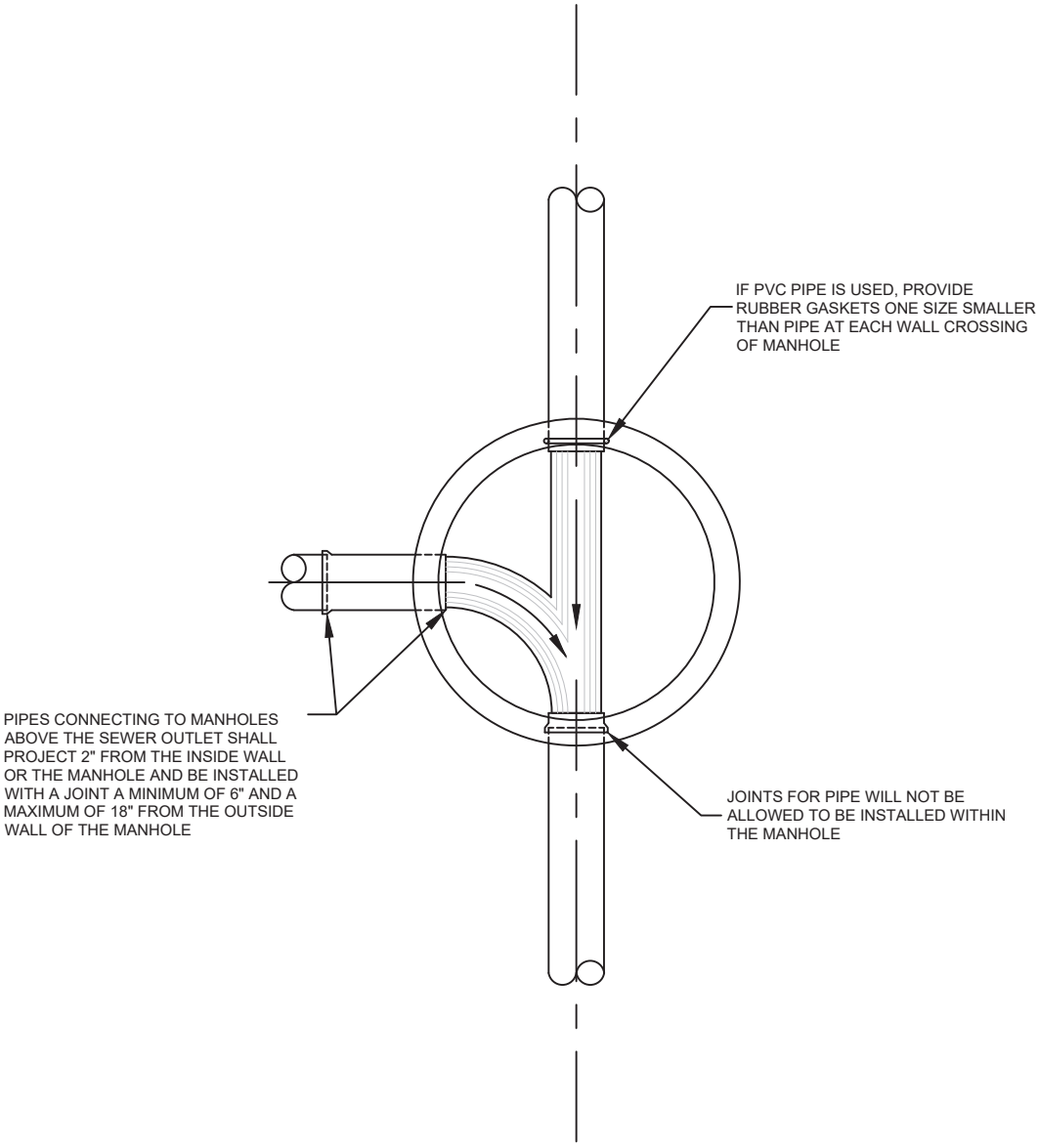
NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	STANDARD MANHOLES
10/18/2023		S-5
UTILITIES DIRECTOR DATE		



NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	DOGHOUSE MANHOLE
10/18/2023		S-6
UTILITIES DIRECTOR DATE		



NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		MANHOLE FLOOR PLAN
Regina Santana 10/18/2023		S-7
UTILITIES DIRECTOR DATE		

STANDARD WATERTIGHT MANHOLE FRAME AND COVER

NOT TO SCALE

SEE SPECS FOR MODEL NUMBERS

STANDARD MANHOLE CASTING NON-TRAFFIC & TRAFFIC

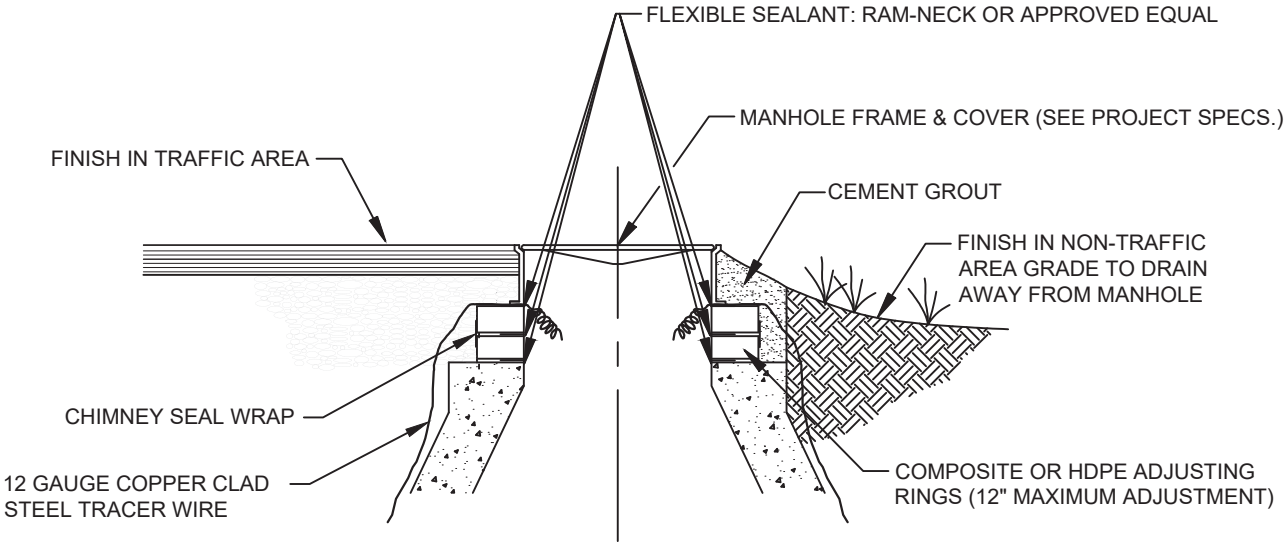
NOT TO SCALE

NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	TYPICAL CAST IRON TRAFFIC & NON-TRAFFIC RATED MANHOLE CASTINGS
10/18/2023		S-8
UTILITIES DIRECTOR DATE		

NOT TO SCALE

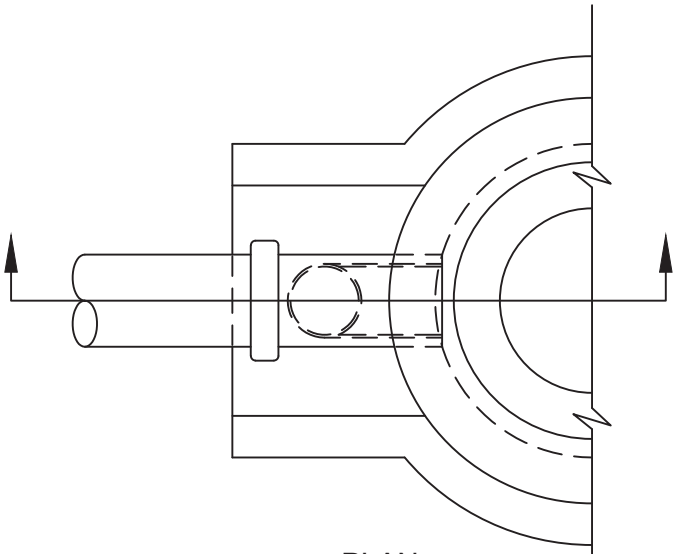
10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	TYPICAL CAST IRON TRAFFIC & NON-TRAFFIC RATED MANHOLE CASTINGS
10/18/2023		S-9
UTILITIES DIRECTOR DATE		



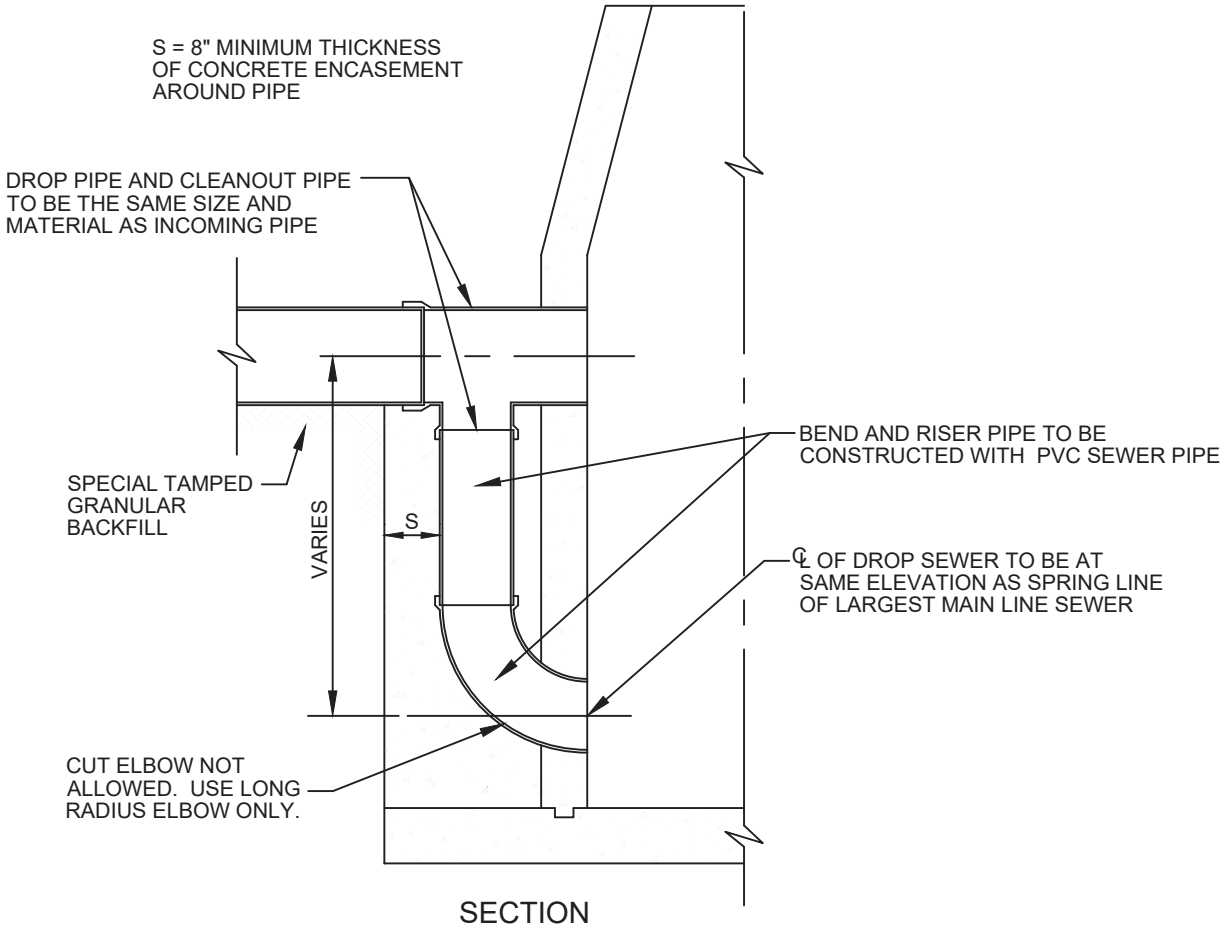
NOTE:
BRICK AND CEMENT ADJUSTMENT OF THE CASTING IS NOT ALLOWED

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL MANHOLE CASTING FINISH
Regina Santana 10/18/2023		S-10
UTILITIES DIRECTOR DATE		



PLAN



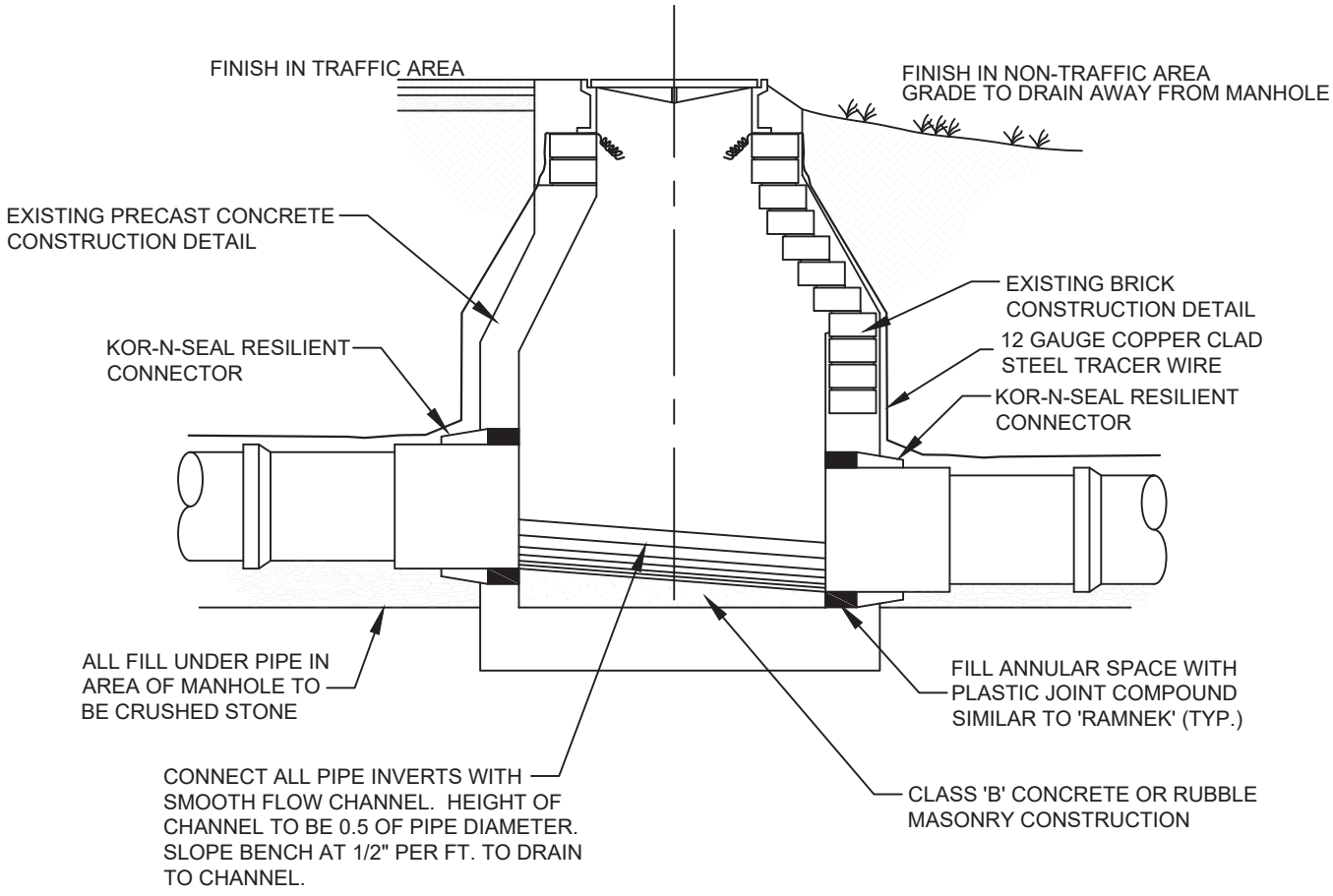
SECTION

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		DROP PIPE FOR STANDARD MANHOLES
Regina Santana 10/18/2023		S-11
UTILITIES DIRECTOR DATE		

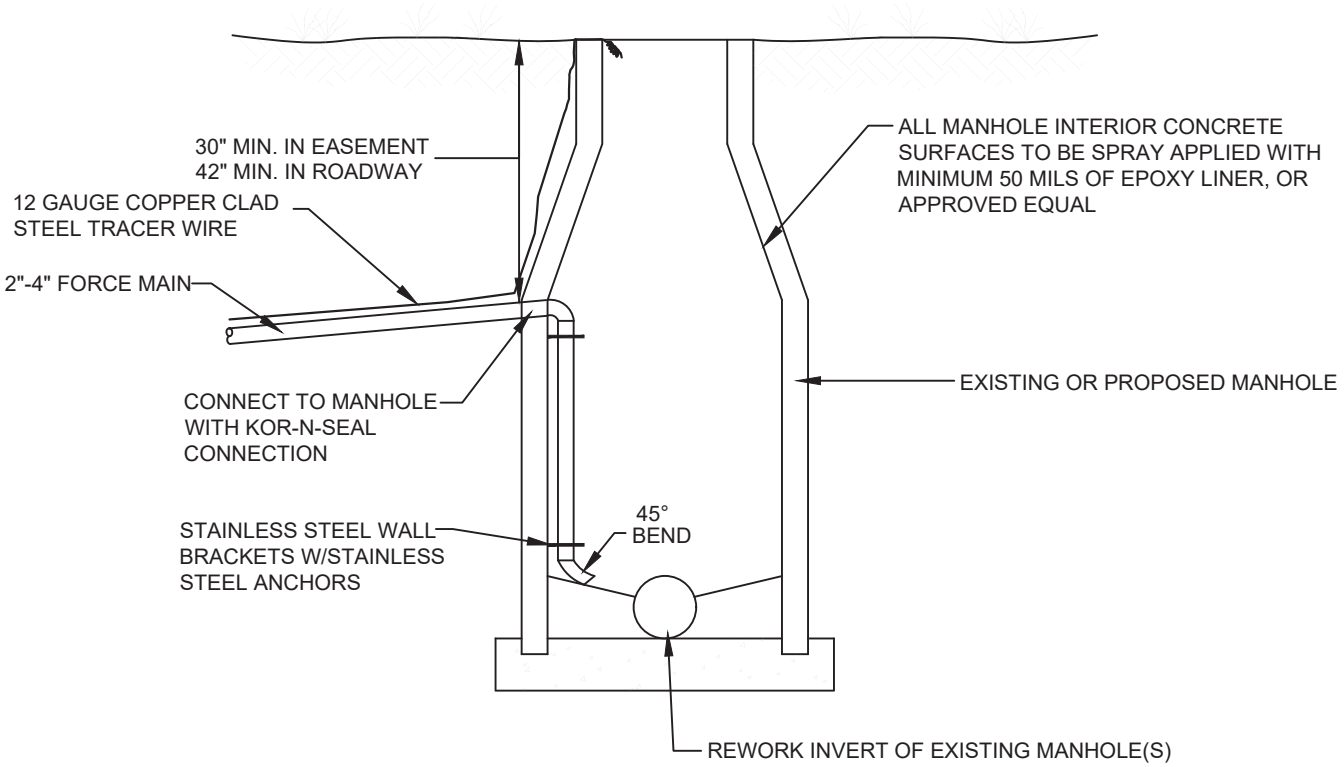
NOTES:

1. THE CONTRACTOR SHALL NOT CONNECT TO EXISTING MANHOLE UNTIL ALL NEW SEWAGE FACILITIES HAVE BEEN INSTALLED, TESTED AND RELEASED FOR SERVICE.
2. CONTRACTOR SHALL UTILIZE COMPOSITE OR HDPE GRADE RINGS TO RAISE MANHOLE CASTINGS IF CASTING ADJUSTMENTS ARE REQUIRED. BRICK IS NOT AN APPROVED MATERIAL.



NOT TO SCALE

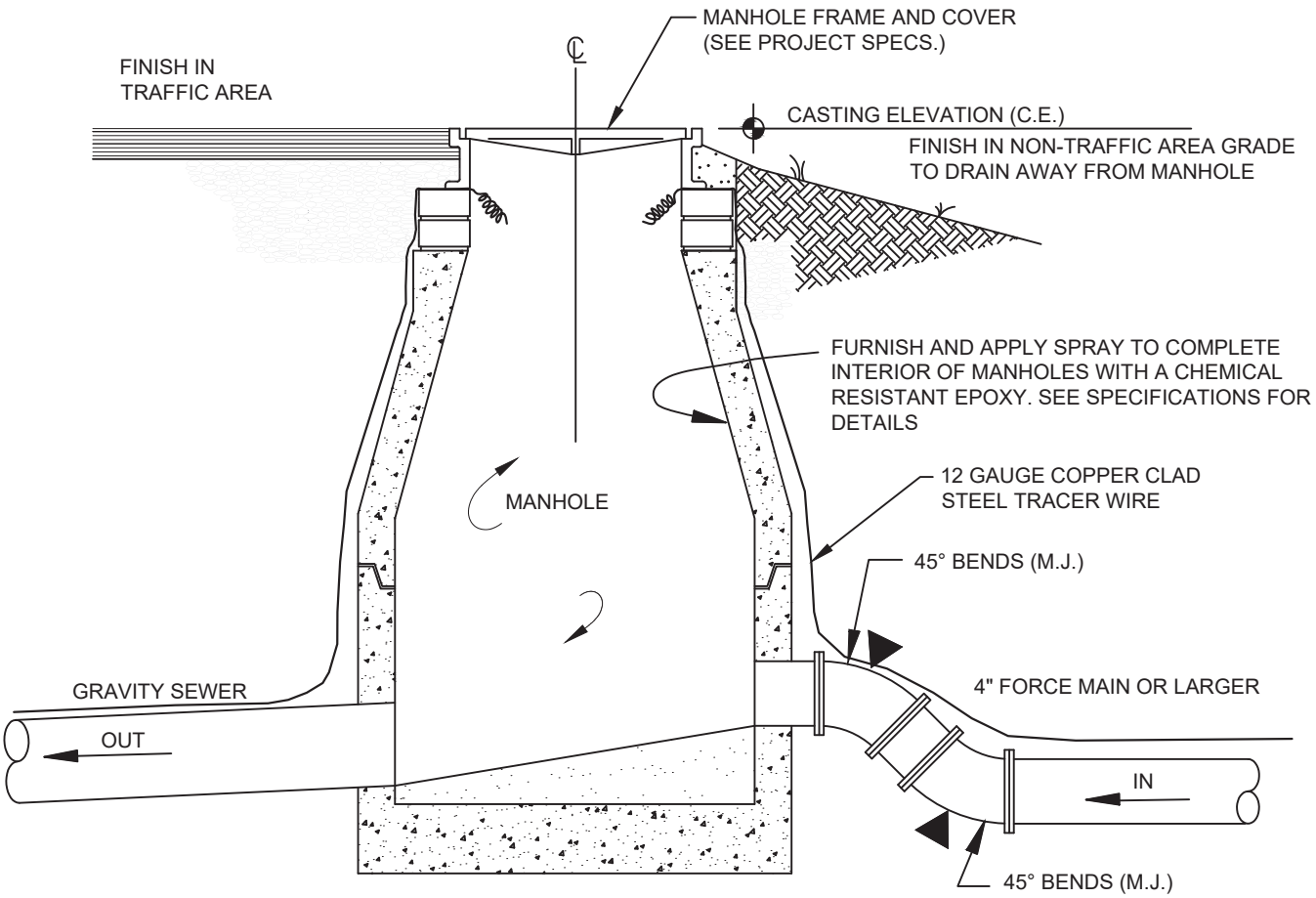
10/18/2023 UTILITIES ENGR. DATE 10/18/2023 UTILITIES DIRECTOR DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT CONNECTION TO EXISTING MANHOLE S-12



NOT TO SCALE

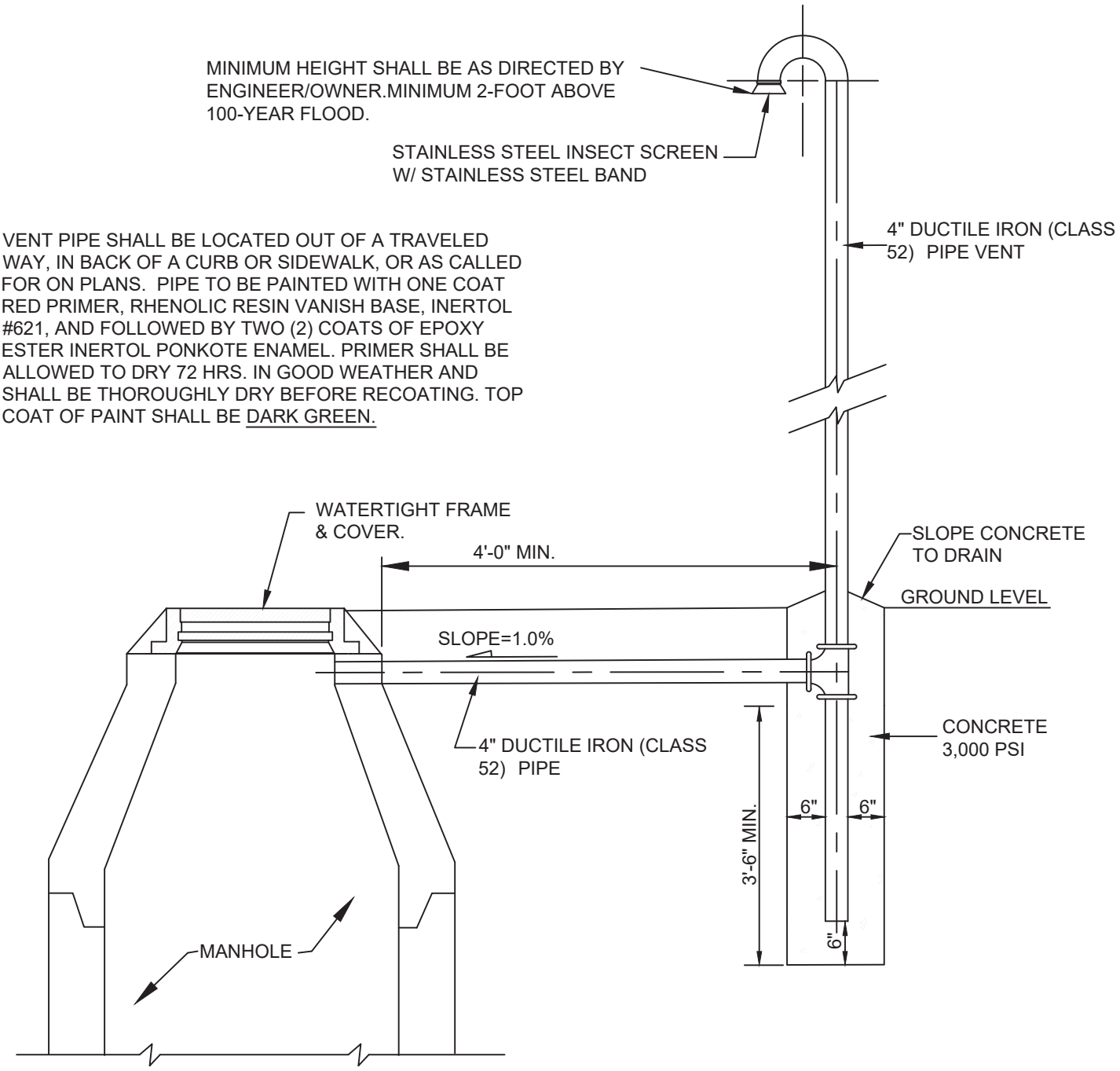
NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		SMALL DIA. FORCE MAIN TIE-IN AT MANHOLE
Regina Santana 10/18/2023		S-13
UTILITIES DIRECTOR DATE		



NOT TO SCALE

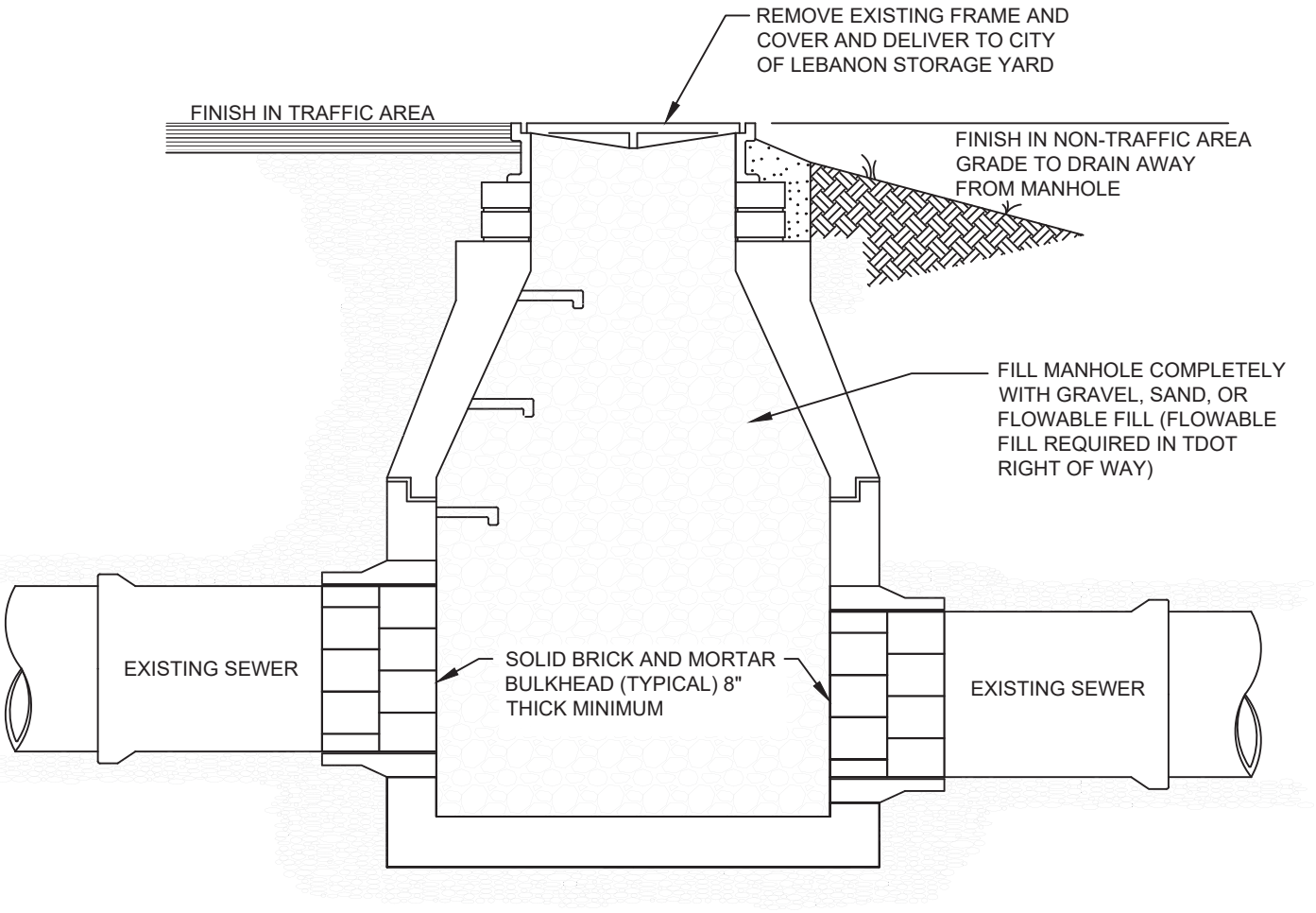
10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		LARGE FORCE MAIN TIE-IN AT EXISTING MANHOLE
Regina Santana 10/18/2023		S-14
UTILITIES DIRECTOR DATE		



VENT PIPE SHALL BE LOCATED OUT OF A TRAVELED WAY, IN BACK OF A CURB OR SIDEWALK, OR AS CALLED FOR ON PLANS. PIPE TO BE PAINTED WITH ONE COAT RED PRIMER, RHENOLIC RESIN VANISH BASE, INERTOL #621, AND FOLLOWED BY TWO (2) COATS OF EPOXY ESTER INERTOL PONKOTE ENAMEL. PRIMER SHALL BE ALLOWED TO DRY 72 HRS. IN GOOD WEATHER AND SHALL BE THOROUGHLY DRY BEFORE RECOATING. TOP COAT OF PAINT SHALL BE DARK GREEN.

NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE 10/18/2023 UTILITIES DIRECTOR DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT VENT PIPE ASSEMBLY S-15

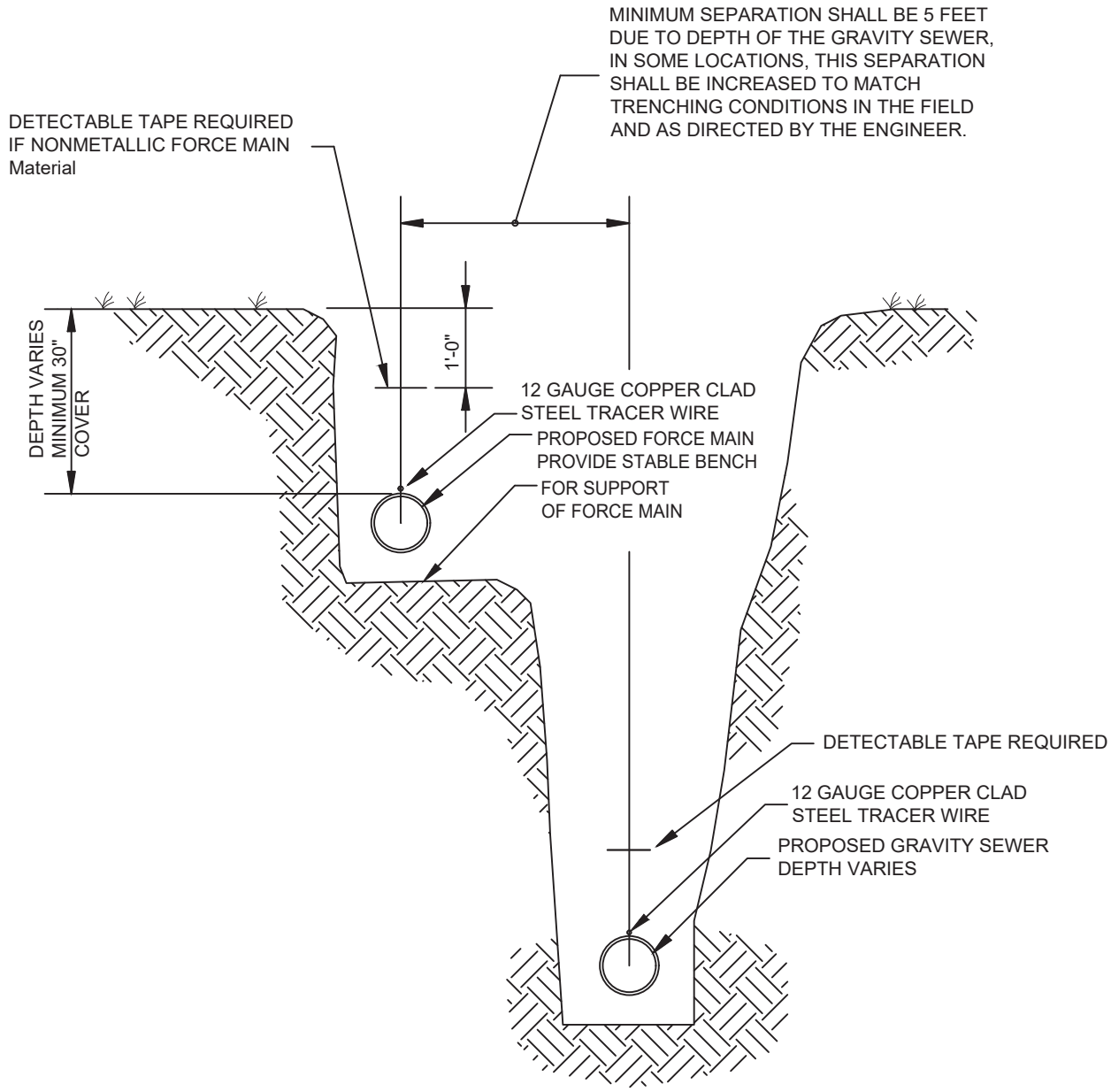


NOTE:
1. ON MANHOLE TO BE ABANDONED, REMOVED AND DELIVERED TO THE CITY OF LEBANON STORAGE YARD. THE STRUCTURES ARE TO BE REMOVED TO A POINT 18-INCHES BELOW EXISTING GROUND. THE IN AND OUT PIPES ARE TO BE CUT, CAPPED AND BULKHEADED. STRUCTURES ARE TO BE FILLED W/CONCRETE TO A POINT 18-INCH ABOVE INVERT AND COMPLETELY FILLED WITH COMPRESSIBLE MATERIAL AND SITE IS TO BE GRADED TO EXISTING CONDITIONS.

2. FILL TO BE FLOWABLE FILL IN ANY AREA UNDER STATE HIGHWAY.

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		MANHOLE ABANDONMENT
Regina Santana 10/18/2023		S-16
UTILITIES DIRECTOR DATE		

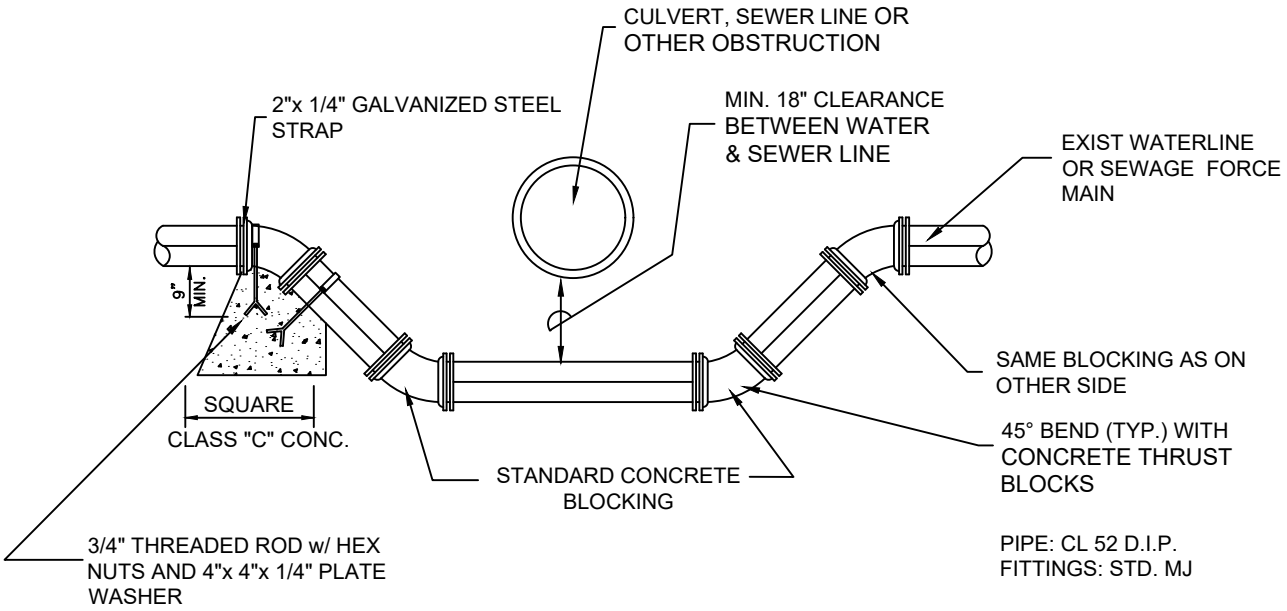


NOTE: MINIMUM COVER FOR FORCE MAIN SHALL BE AS FOLLOWS:

1. ACROSS DRIVEWAYS AND ROADWAYS - 42 INCHES
2. AT AIR RELEASE MANHOLES - 42 INCHES
3. OTHER AREAS - 30 INCHES UNLESS OTHERWISE REQUIRED DUE TO EXISTING UTILITIES OR OTHER FACTORS.

NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE 10/18/2023 UTILITIES DIRECTOR DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT TYPICAL TRENCHING DETAIL FOR PARALLEL INSTALLATIONS S-17

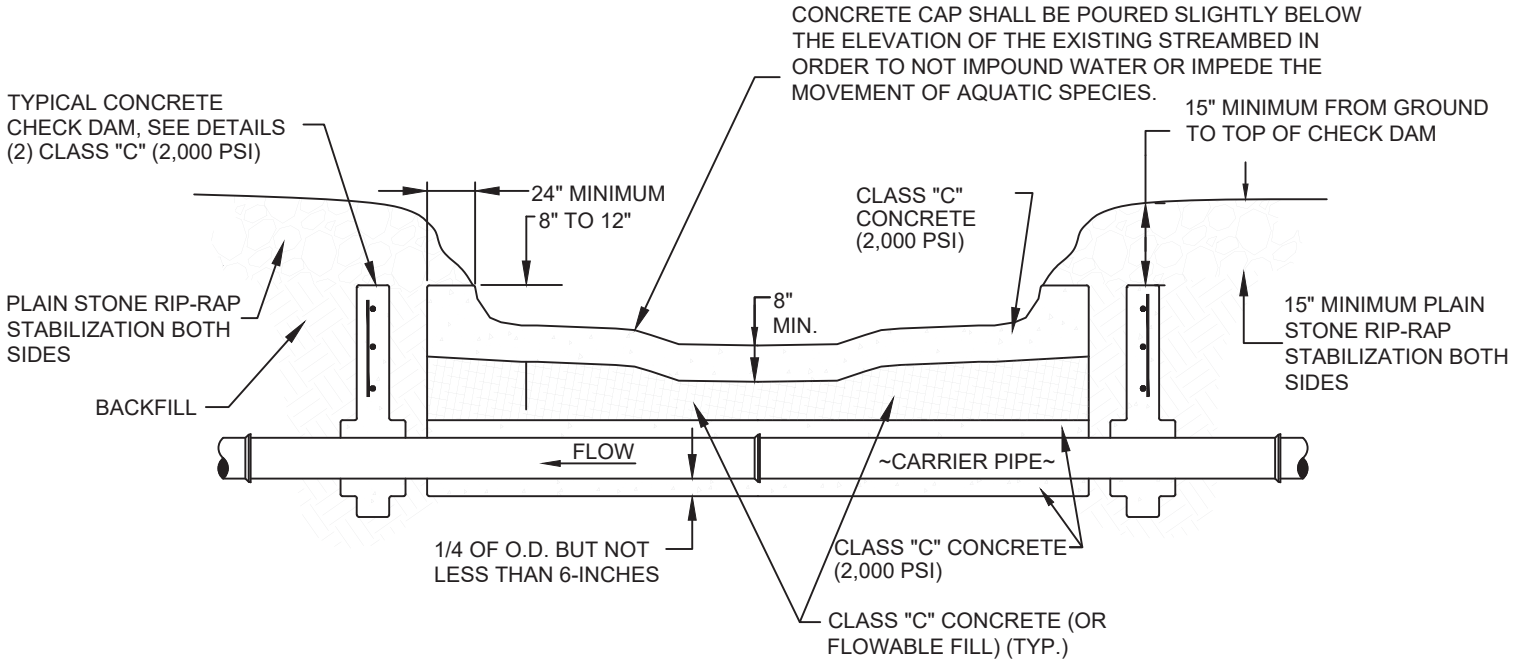


(Pressure Sewer Mains or Main Relocation)

NOTES:
1. FOR UPPER THRUST BLOCK ON A VERTICAL BEND, CONCRETE VOLUME SHALL BE AS APPROVED BY THE ENGINEER. COST OF STEEL STRAP & REBAR TO BE MERGED INTO UNIT PRICE BID FOR CONCRETE BLOCKING.
2. INSTALL STANDARD 3/4" RODDING BETWEEN FITTINGS OR USE MEGALUGS IF THERE ARE NO JOINTS BETWEEN FITTINGS.

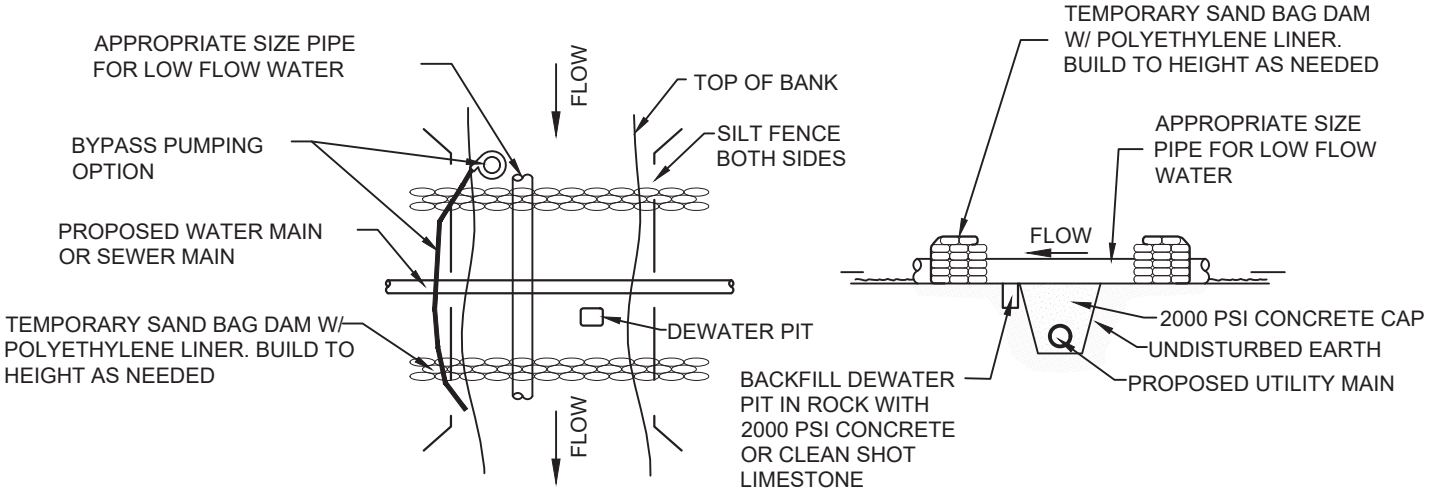
NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		METHOD OF CROSSING OBSTRUCTION
Regina Santana 10/18/2023		S-18
UTILITIES DIRECTOR DATE		



TYPICAL STREAM CROSSING

NOTE:
ALL WORK IN THE STREAM CHANNEL SHALL BE DONE "IN THE DRY".

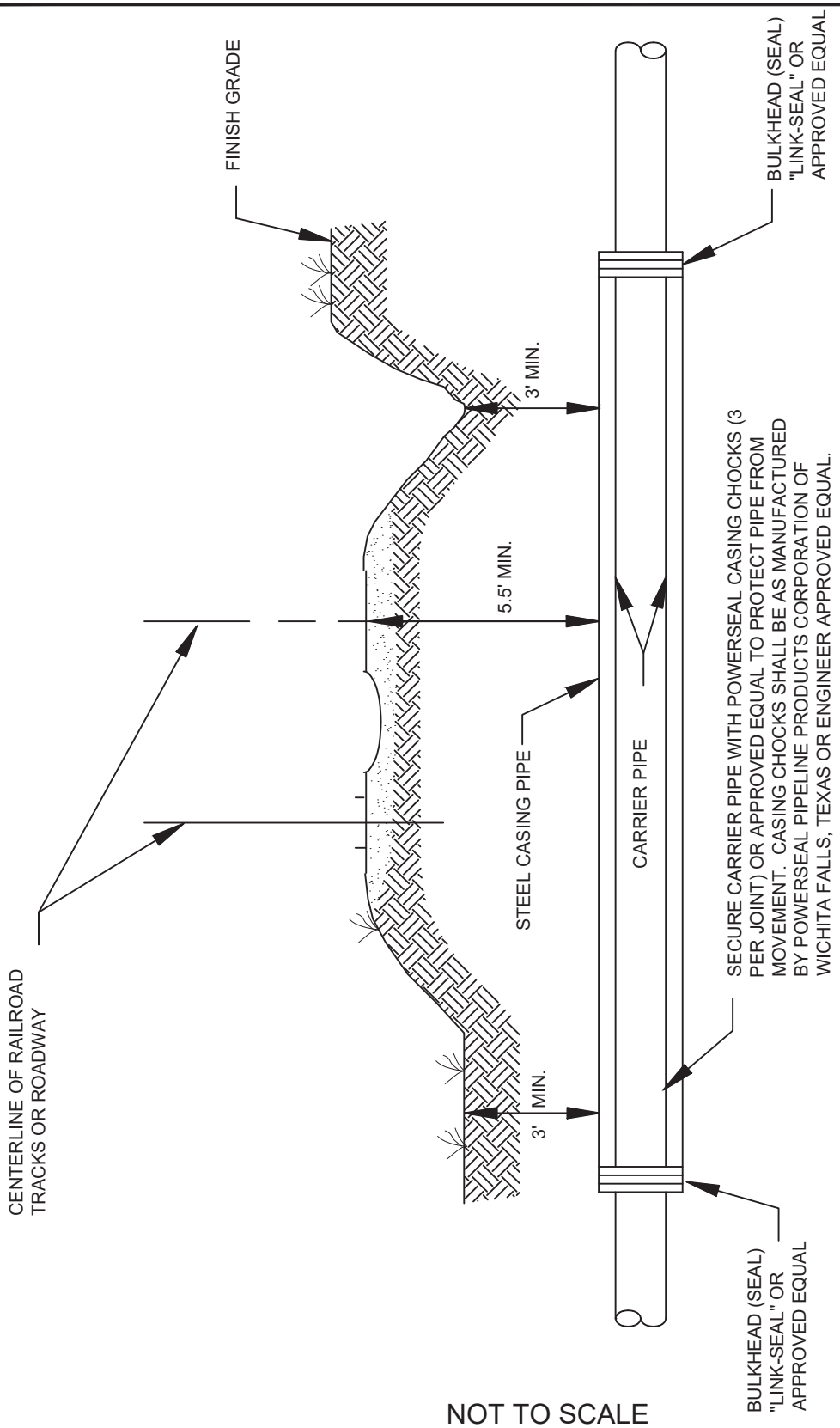


NOTE: ALL CONCRETE POURS SHALL BE DONE "IN THE DRY" WITH NO WET CONCRETE ENTERING STREAMS/FLOWING WATER.

LOW FLOW STREAM CROSSING

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL CREEK CROSSING
Regina Santana 10/18/2023		S-19
UTILITIES DIRECTOR DATE		

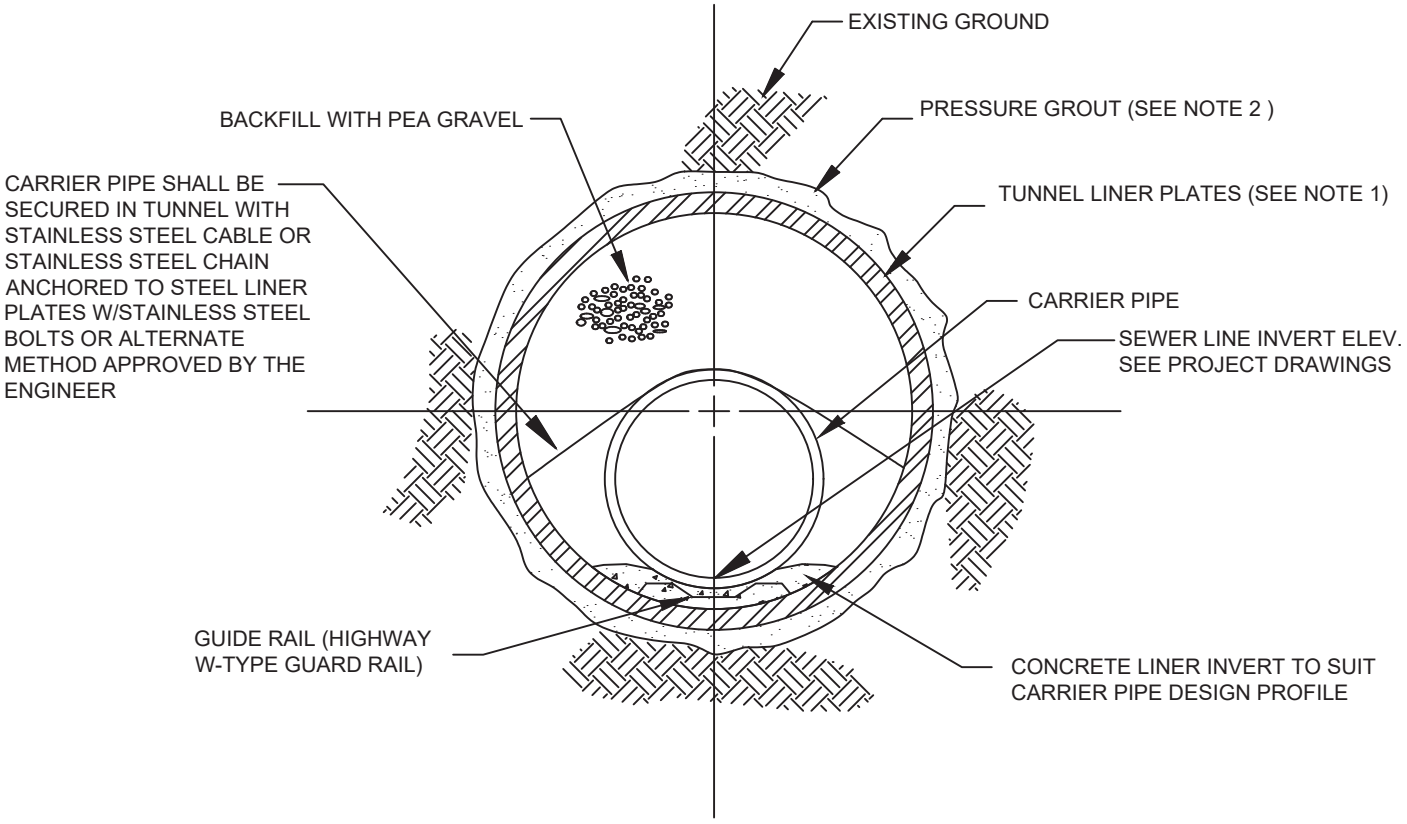


NOTE:
FOR CASING PIPE INSTALLED INSIDE OF TDOT OR RAILROAD RIGHT OF WAY AND REQUIRES A PERMIT, CONTRACTOR IS TO REFER TO MINIMUM DEPTH AND MATERIAL REQUIREMENTS FOR THE PERMITTING ORGANIZATION.

NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL BORE CASING DETAIL
10/18/2023 UTILITIES DIRECTOR DATE		S-20

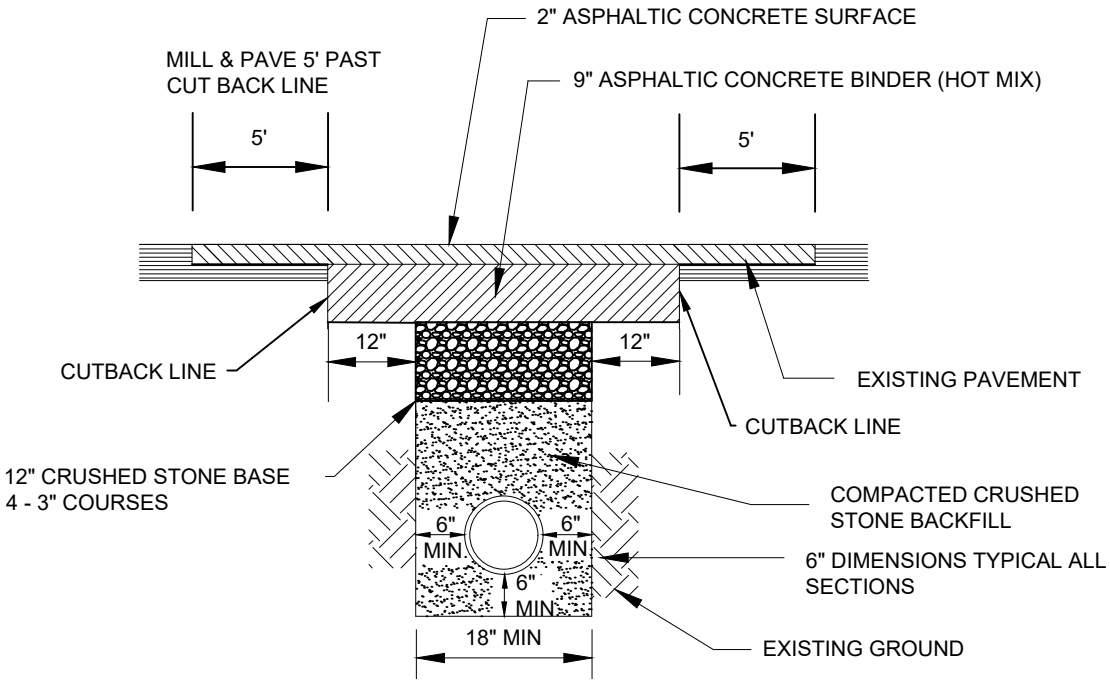
AT THE CONTRACTOR'S OPTION AND WITH CONSENT OF THE PARTIES OR AGENCIES HAVING JURISDICTION, STEEL PIPE OR OTHER ACCEPTABLE MATERIAL MAY BE JACKED OR BORED INTO PLACE IN LIEU OF A LINER PLATE TUNNEL PROVIDED THE CONTRACTOR BE RESPONSIBLE FOR ALL APPROVALS FROM THE PARTIES AND / OR AGENCIES HAVING JURISDICTION INCLUDING, BUT NOT LIMITED TO, FURNISHING COMPLETE DETAILS OF THE METHODS TO BE EMPLOYED FOR APPROVAL.



NOTES:
1. TUNNEL: MINE/EXCAVATE TUNNEL AS NEATLY AS POSSIBLE TO ELIMINATE VOIDS OR OVERBREAKS AND TO MAXIMIZE LINER TO SOIL CONTACT.
2. PRESSURE GROUT: OVERCUT AS SOON AS POSSIBLE AFTER INSTALLATION OF LINER PLATES (9' LENGTH MAX.) TO PREVENT SOIL SHIFTING AND TO MAINTAIN PROPER SHAPE OF TUNNEL.

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL TUNNEL SECTION
Regina Santana 10/18/2023		S-21
UTILITIES DIRECTOR DATE		



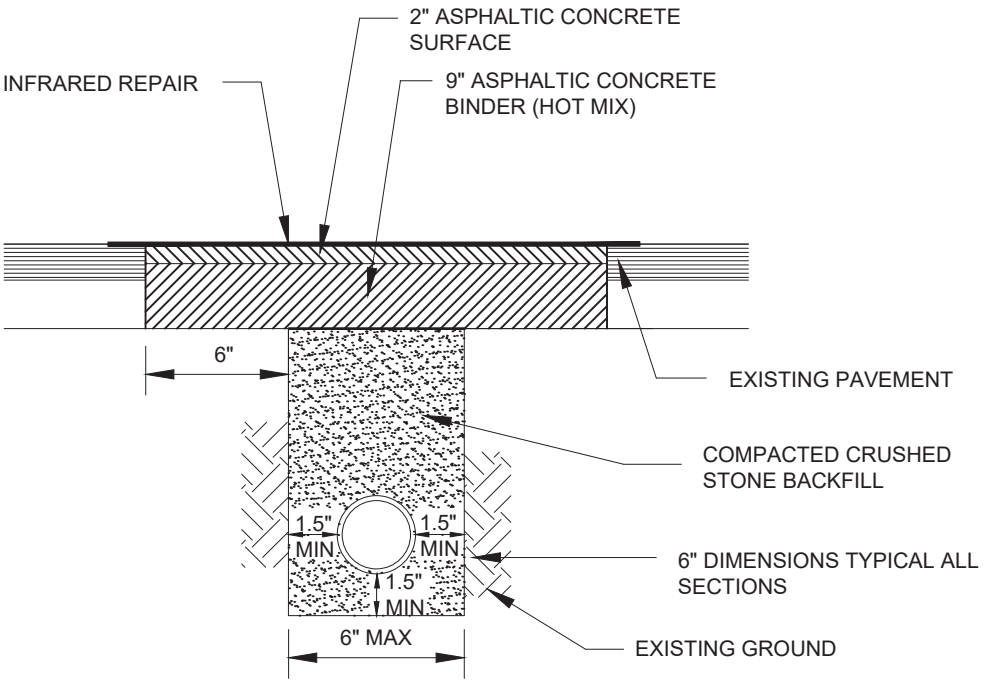
TYPICAL SECTION ASPHALT PAVEMENT - TYPE A

GENERAL NOTES

1. A CITY INSPECTOR IS TO BE PRESENT FOR TRENCH REPAIR INSTALLATION
2. ALL TRENCH REPAIR WORK SHALL HAVE A WARRANTY PERIOD OF 1 YEAR AFTER THE ACCEPTANCE DATE
3. EDGE OF PAVEMENT SHALL BE SAW CUT 12" PAST TRENCH ON ALL SIDES AS NECESSARY TO OBTAIN NEAT LINES
4. MINIMUM TRENCH WIDTH SHALL BE 18" TO ALLOW FOR PLATE COMPACTOR
5. ALL PAVEMENT MARKINGS AFFECTED BY CONSTRUCTIONS MUST BE REPLACED
6. DETAIL IS STANDARD DETAIL ST 402 FROM CITY OF LEBANON STREET DETAILS 2019 DRAWN BY DILLAN JACKSON

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TRENCH REPAIR
Regina Santana 10/18/2023		S-22
UTILITIES DIRECTOR DATE		



TYPICAL SECTION ASPHALT PAVEMENT - TYPE A

GENERAL NOTES

1. A CITY INSPECTOR IS TO BE PRESENT FOR TRENCH REPAIR INSTALLATION
2. ALL TRENCH REPAIR WORK SHALL HAVE A WARRANTY PERIOD OF 1 YEAR AFTER THE ACCEPTANCE DATE
3. EDGE OF PAVEMENT SHALL BE SAW CUT 12" PAST TRENCH ON ALL SIDES AS NECESSARY TO OBTAIN NEAT LINES
4. INFRARED REPAIR SHALL BE REQUIRED ON NARROW TRENCHES
5. ALL PAVEMENT MARKINGS AFFECTED BY CONSTRUCTIONS MUST BE REPLACED
6. DETAIL IS STANDARD DETAIL ST 403 FROM CITY OF LEBANON STREET DETAILS 2019 DRAWN BY DILLAN JACKSON

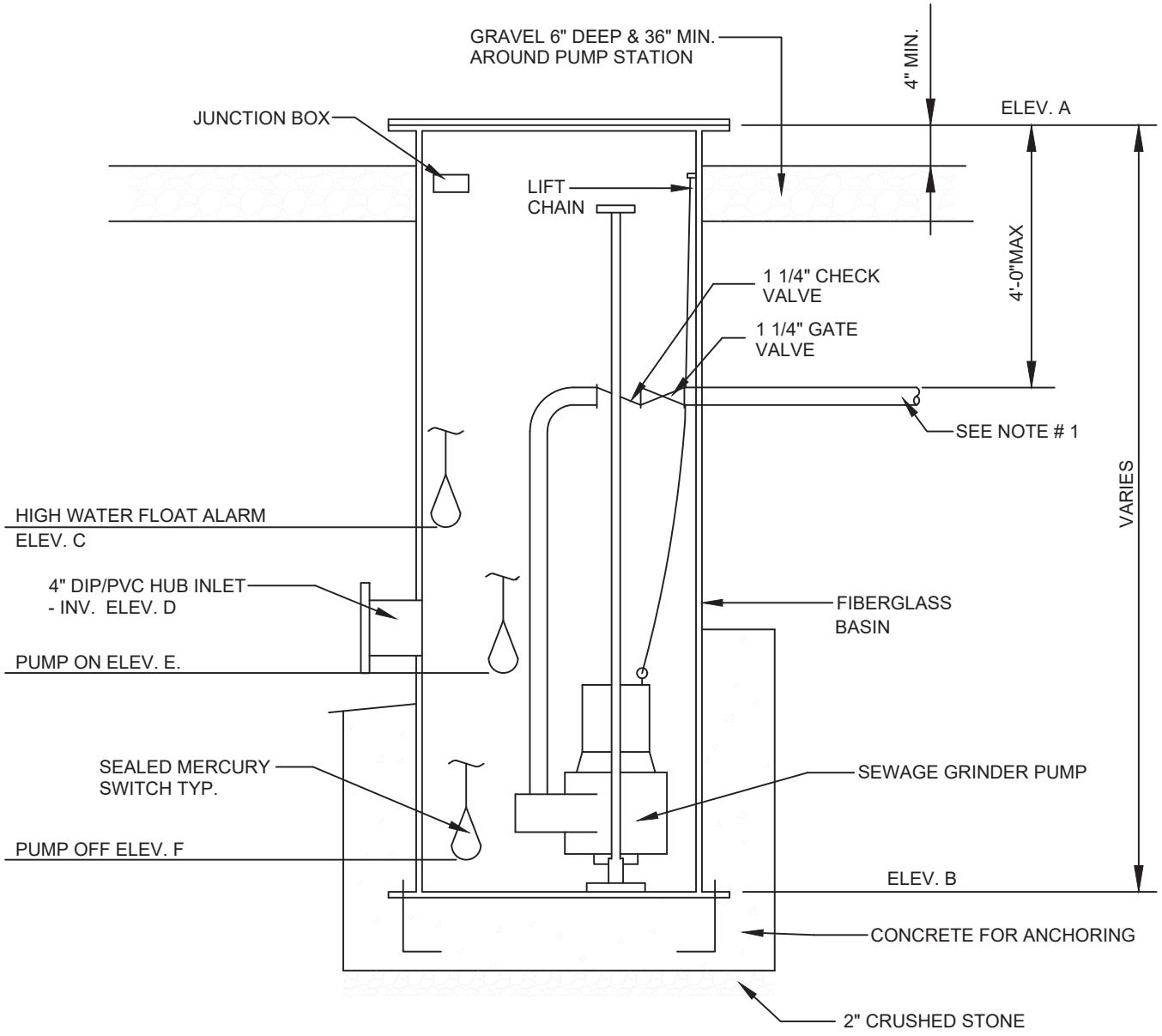
NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		NARROW TRENCH REPAIR
Regina Santana 10/18/2023		S-23
UTILITIES DIRECTOR DATE		

NOTE:

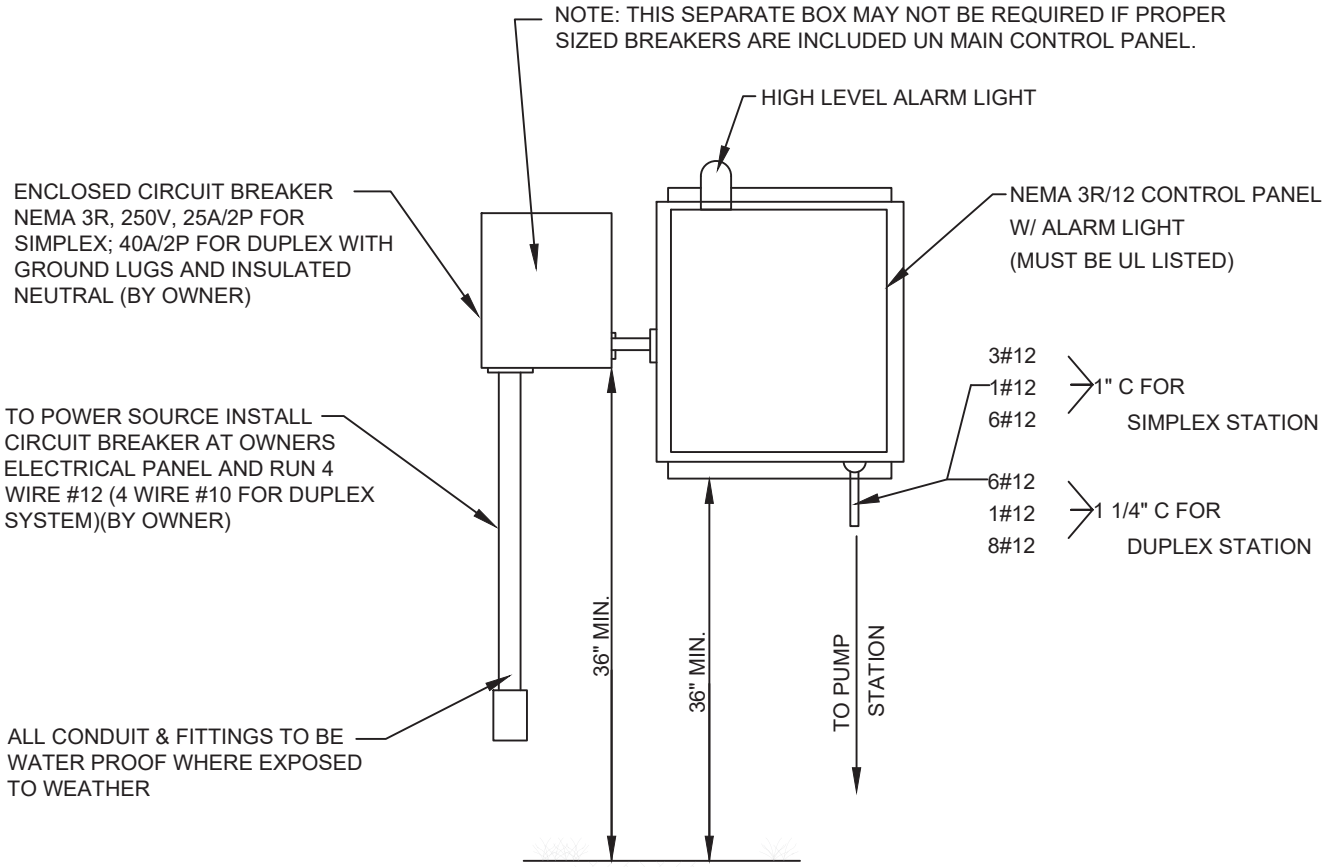
1. INSTALL RIGID 1 1/4"x2" STAINLESS STEEL PIPE NIPPLE & STAINLESS STEEL PIPE FOR MIN. OF 4 L.F. FROM PUMP STATION TO UNDISTURBED EARTH THEN TRANSITION TO 2" CL. 200 PVC.

2. CONTRACTOR SHALL GRADE AND RESHAPE AREA AROUND PUMP STATION FOR PROPER SITE DRAINAGE



NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL SIMPLEX GRINDER PUMP STATION
10/18/2023		S-24
UTILITIES DIRECTOR DATE		

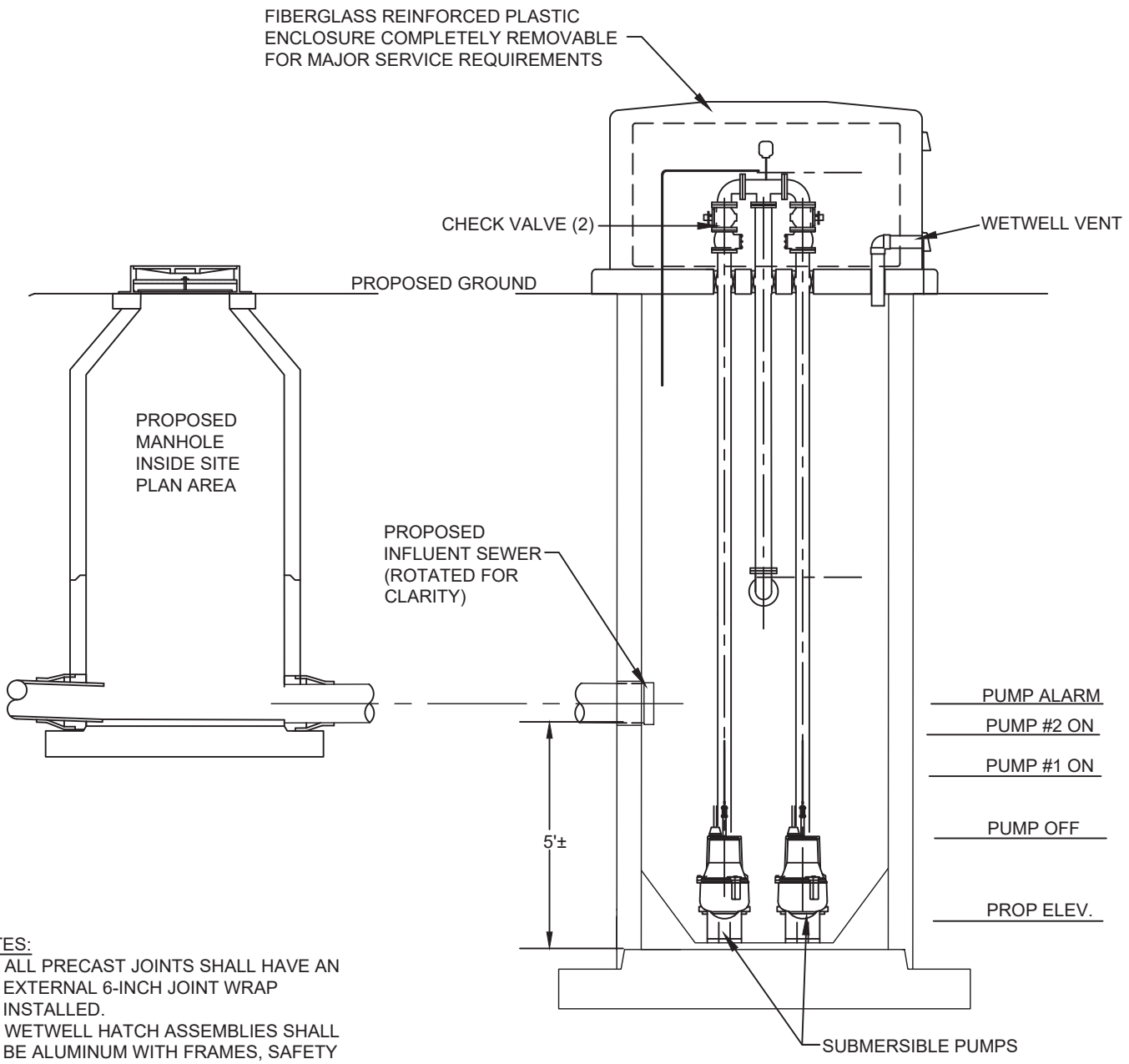


ELECTRICAL NOTES:
1. WIRE: COPPER- THW OR THWN.
2. CONDUIT: PER LOCAL CODES.
3. CODES: CHECK LOCAL AUTHORITY.

NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE 10/18/2023 UTILITIES DIRECTOR DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT TYPICAL SIMPLEX GRINDER PUMP CONTROL PANEL S-25

NOTE:

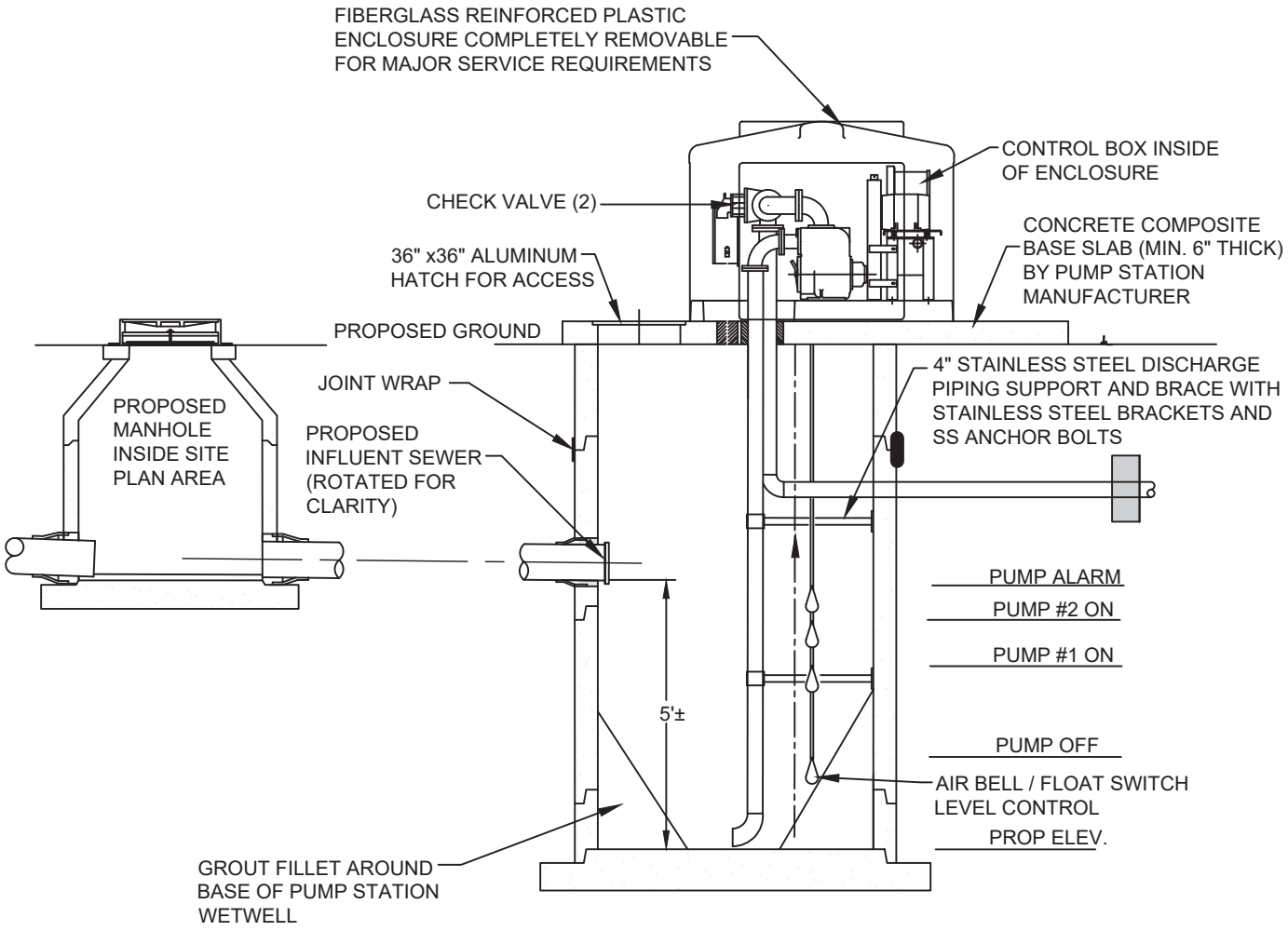


NOTES:
1. ALL PRECAST JOINTS SHALL HAVE AN EXTERNAL 6-INCH JOINT WRAP INSTALLED.
2. WETWELL HATCH ASSEMBLIES SHALL BE ALUMINUM WITH FRAMES, SAFETY GRATES, AND COVERS RATED FOR 300 PSF LIVE LOAD. NO CORRODIBLE PARTS WILL BE ALLOWED FOR THE ACCESS HATCH.

NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL SUBMERSIBLE PUMP STATION W/ ABOVE GROUND VALVE BOX
10/18/2023 UTILITIES DIRECTOR DATE		S-26

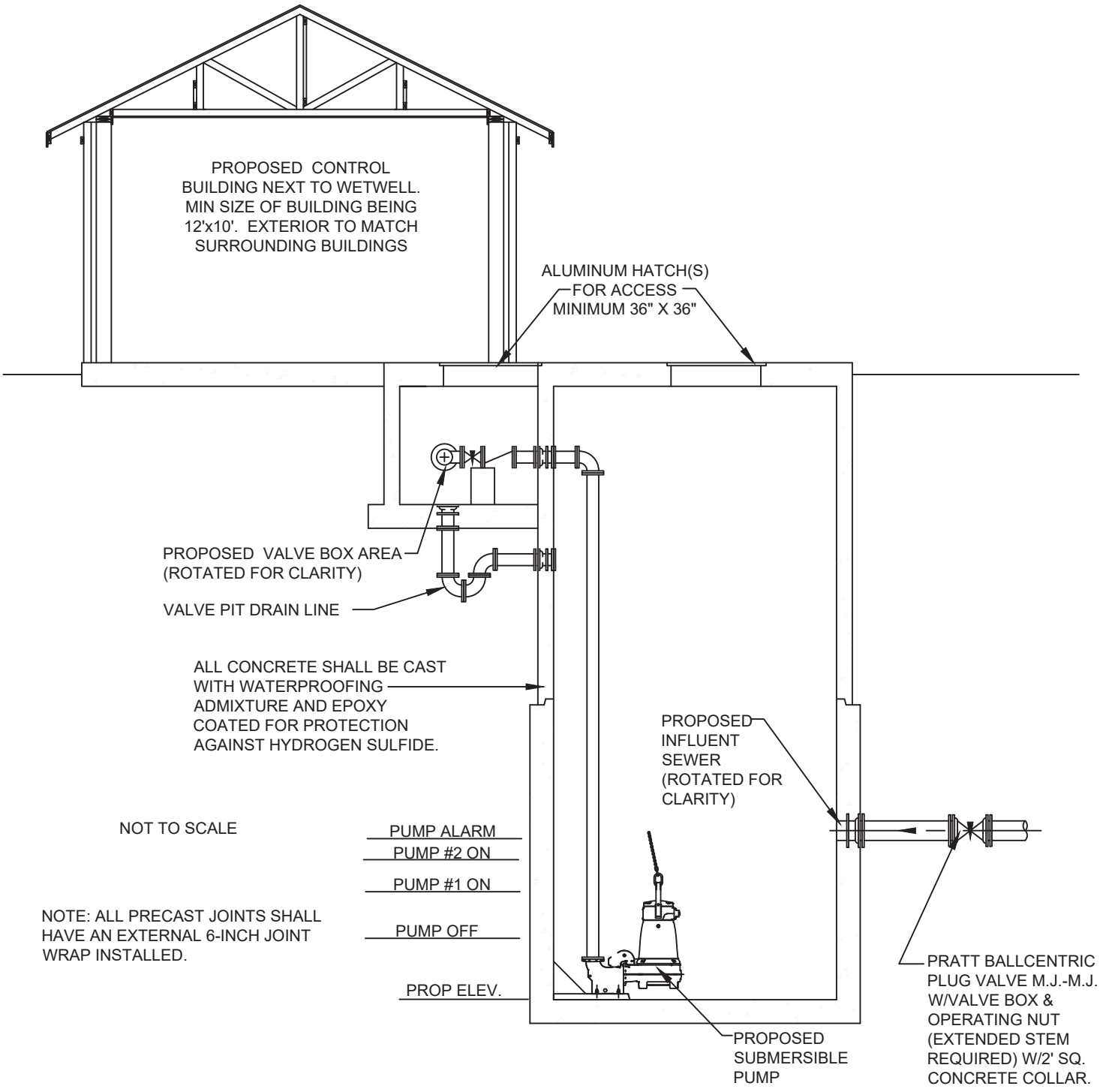
NOTE: WETWELL HATCH ASSEMBLIES SHALL BE ALUMINUM WITH FRAMES, SAFETY GRATES, AND COVERS RATED FOR 300 PSF LIVE LOAD. NO CORRODIBLE PARTS WILL BE ALLOWED FOR THE ACCESS HATCH.



NOTE: ALL PRECAST JOINTS SHALL HAVE AN EXTERNAL 6-INCH JOINT WRAP INSTALLED.

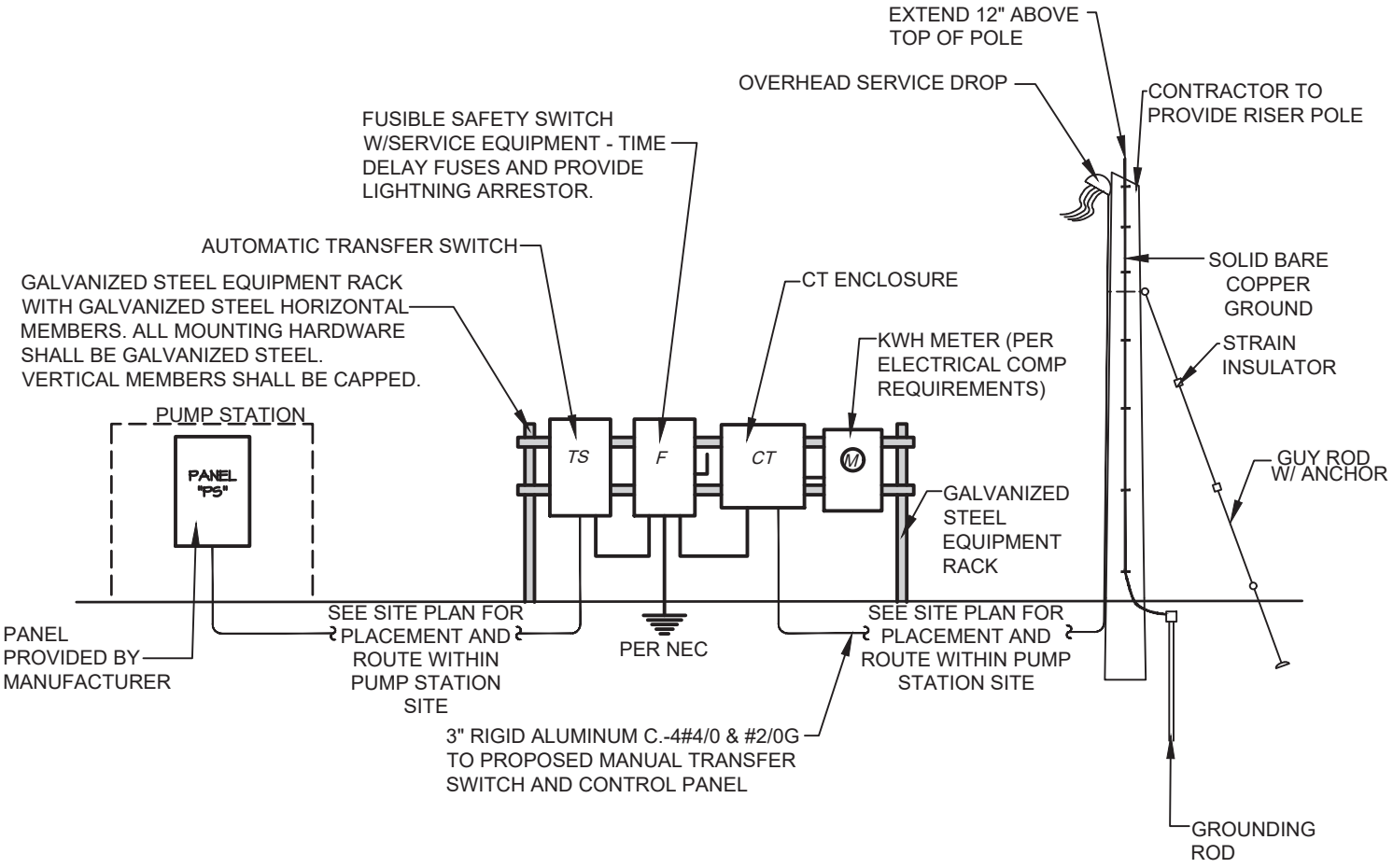
NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE 10/18/2023 UTILITIES DIRECTOR DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT TYPICAL SUCTION LIFT PUMP STATION S-27



NOT TO SCALE

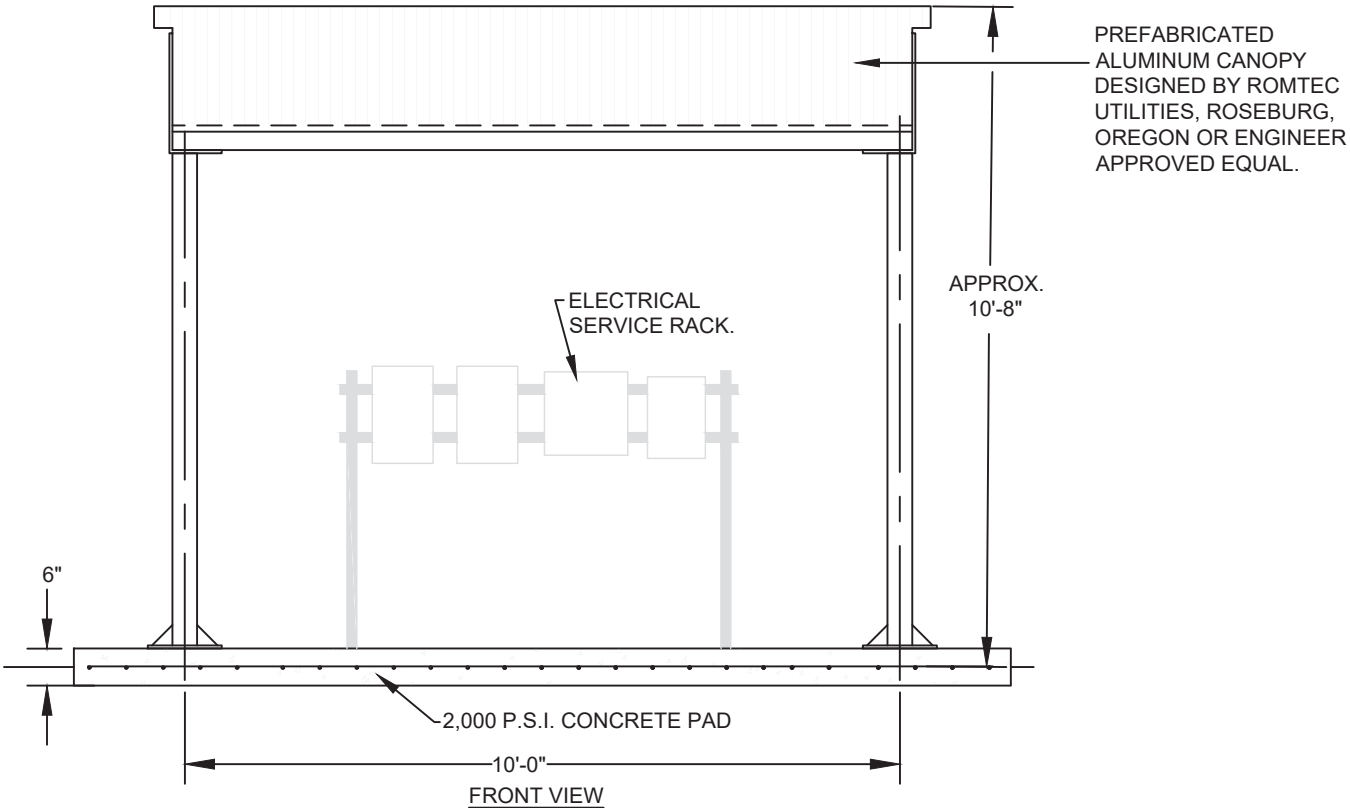
10/18/2023 DATE UTILITIES ENGR.	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL HIGH FLOW PUMP STATION
10/18/2023 DATE UTILITIES DIRECTOR		S-28



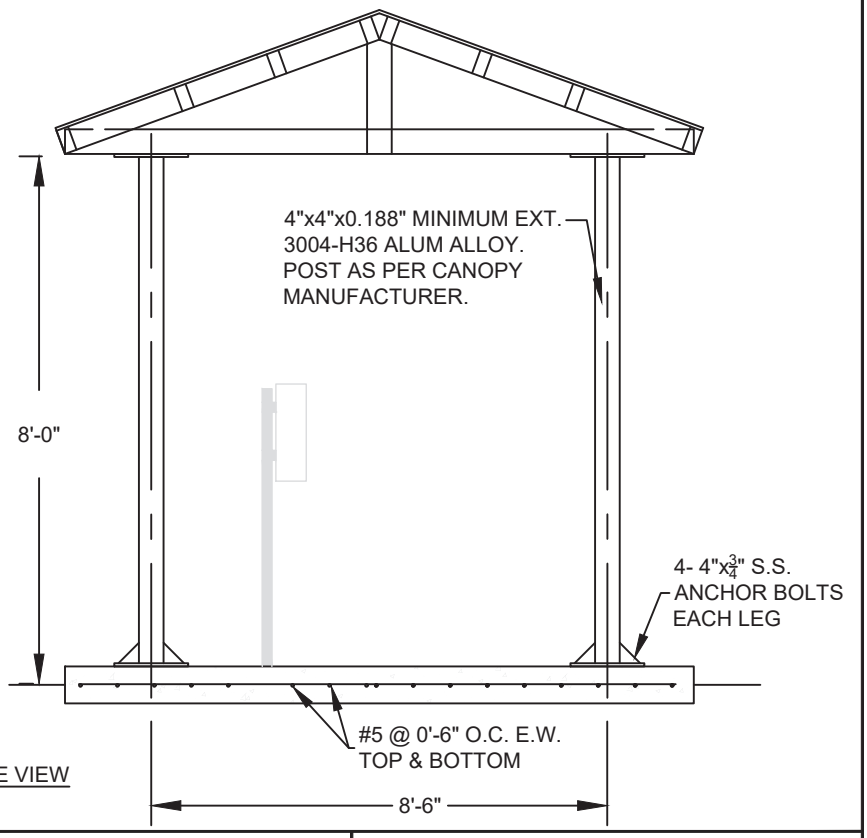
NOTE: IF SERVICE TO SITE IS RAN UNDERGROUND BY THE ELECTRICAL UTILITY CO. TO THE PROPOSED SITE PLAN, THEN A POLE IS NOT NEEDED.

NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL ELECTRICAL RACK DETAIL
10/18/2023 UTILITIES DIRECTOR DATE		S-29



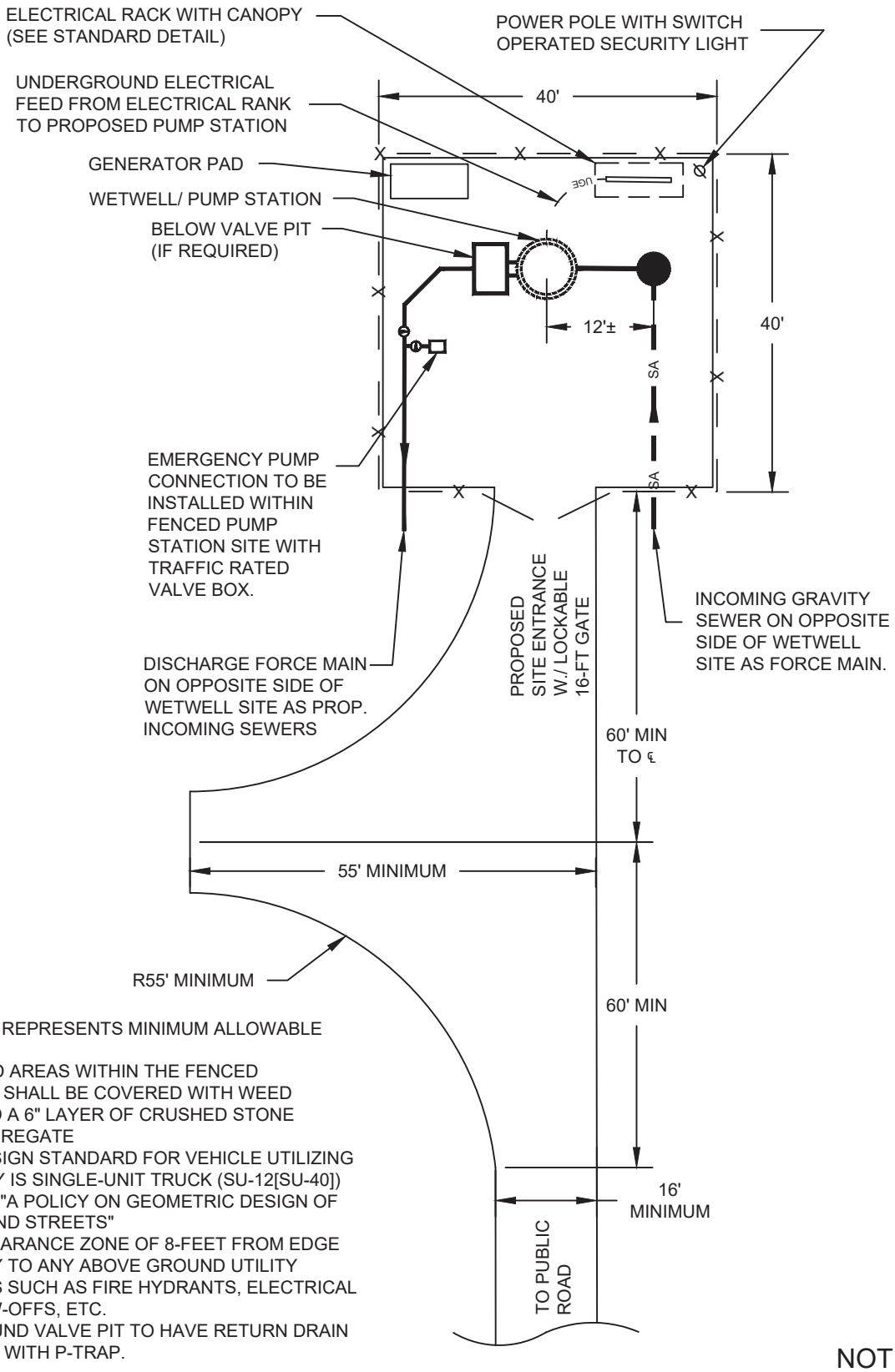
FRONT VIEW



SIDE VIEW

NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	ELECTRICAL CANOPY DETAIL
Regina Santana 10/18/2023		S-30
UTILITIES DIRECTOR DATE		



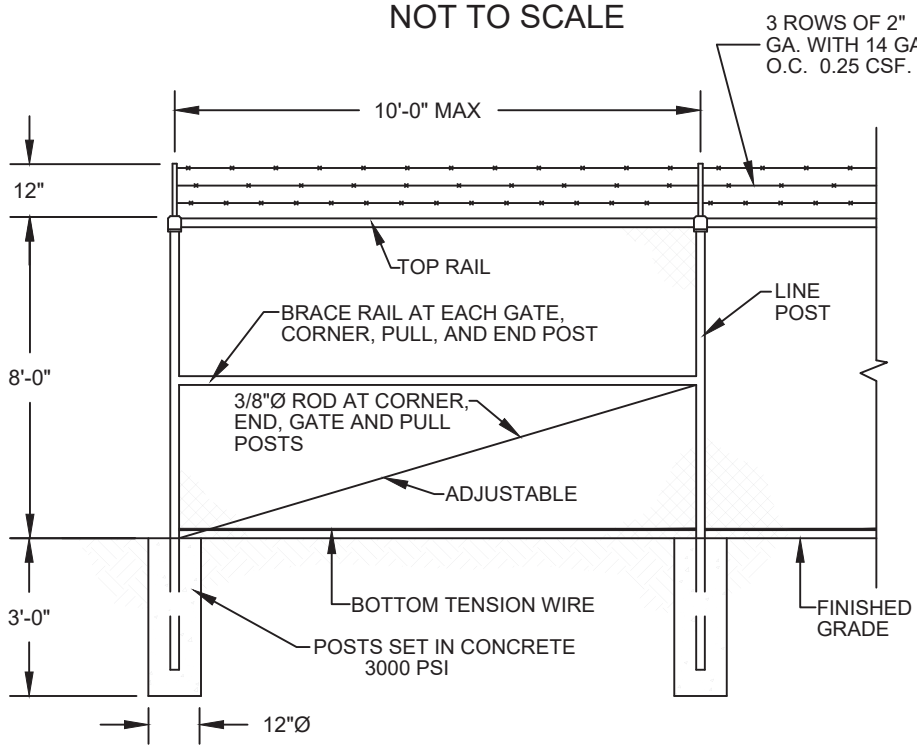
NOTES:

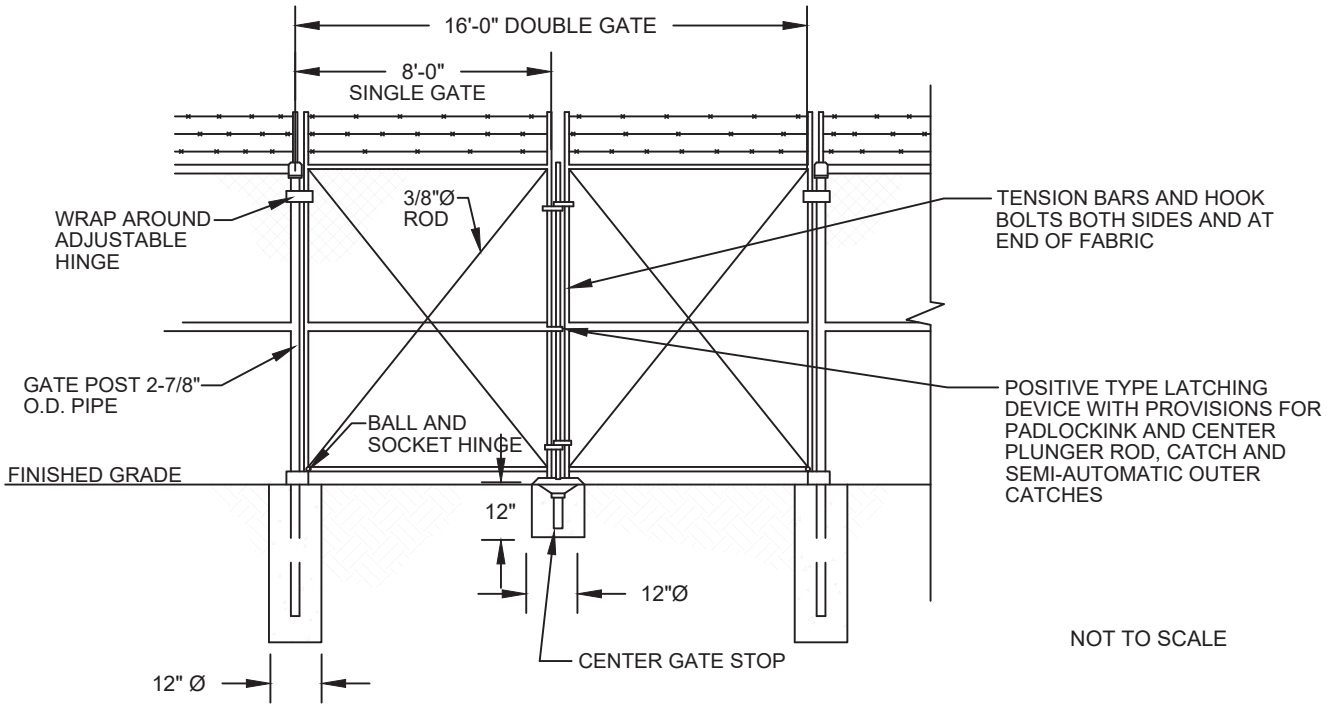
1. SITE LAYOUT REPRESENTS MINIMUM ALLOWABLE DIMENSIONS
2. ALL UNPAVED AREAS WITHIN THE FENCED BOUNDARIES SHALL BE COVERED WITH WEED BARRIER AND A 6" LAYER OF CRUSHED STONE COARSE AGGREGATE
3. MINIMUM DESIGN STANDARD FOR VEHICLE UTILIZING THIS FACILITY IS SINGLE-UNIT TRUCK (SU-12[SU-40]) PER AASHTO "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS"
4. MINIMUM CLEARANCE ZONE OF 8-FEET FROM EDGE OF ROADWAY TO ANY ABOVE GROUND UTILITY STRUCTURES SUCH AS FIRE HYDRANTS, ELECTRICAL POLES, BLOW-OFFS, ETC.
5. BELOW GROUND VALVE PIT TO HAVE RETURN DRAIN TO WETWELL WITH P-TRAP.

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL PUMP STATION SITE LAYOUT
Regina Santana 10/18/2023		S-31
UTILITIES DIRECTOR DATE		

NOT TO SCALE



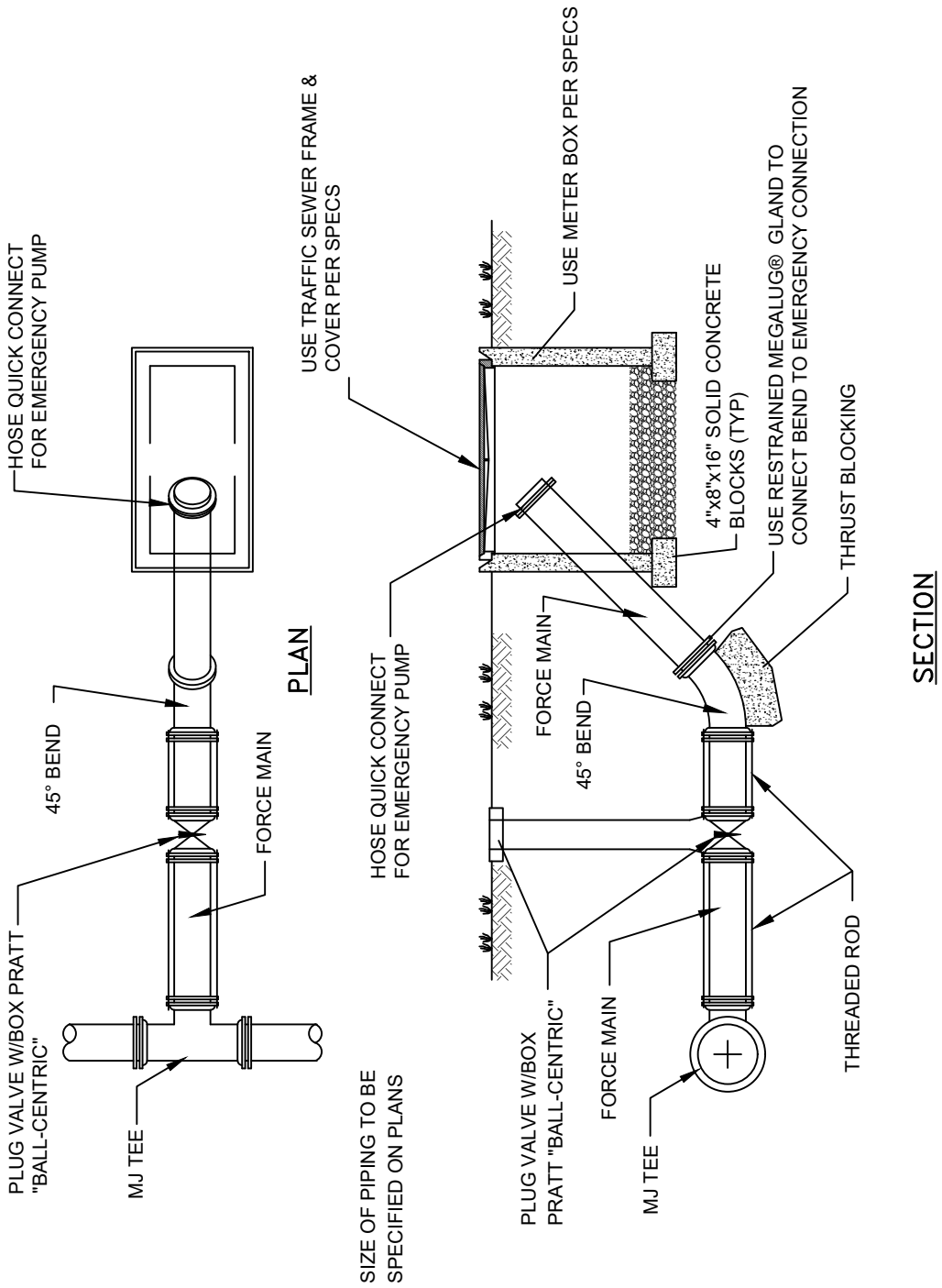


NOT TO SCALE

NOTES:

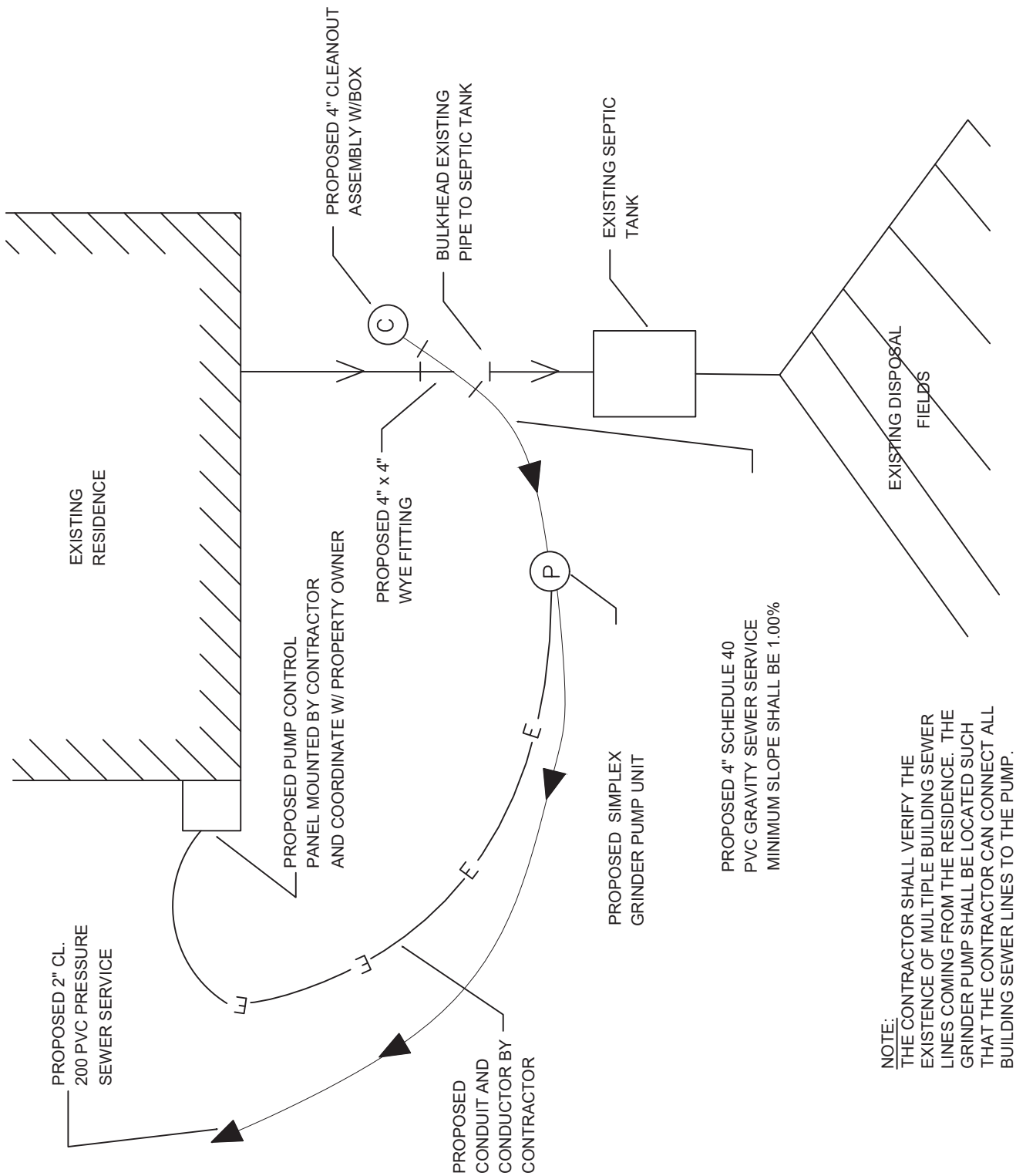
1. FENCING SHALL BE VINYL COATED. COLOR FOR THE COATING SHALL BE BLACK.
2. FABRIC CONNECTIONS: TERMINAL POSTS - 3/16" X 3/4" STRETCHER BAR W/ 1/8" X 7/8" STEEL BANDS 15" O.C. LINE POSTS - 9 GA. WIRE CLIPS 15" O.C. TOP RAIL-9 GA. TIE WIRE 24" O.C.
3. ALL POSTS AND OTHER APPURTENANCES SHALL BE HOT DIP GALVANIZED W/ MIN. 1.2 CSF. ZINC. ALL FITTINGS SHALL BE MALLEABLE OR DUCTILE IRON STEEL.

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL FENCE & DOUBLE GATE
Regina Santana 10/18/2023		S-32
UTILITIES DIRECTOR DATE		



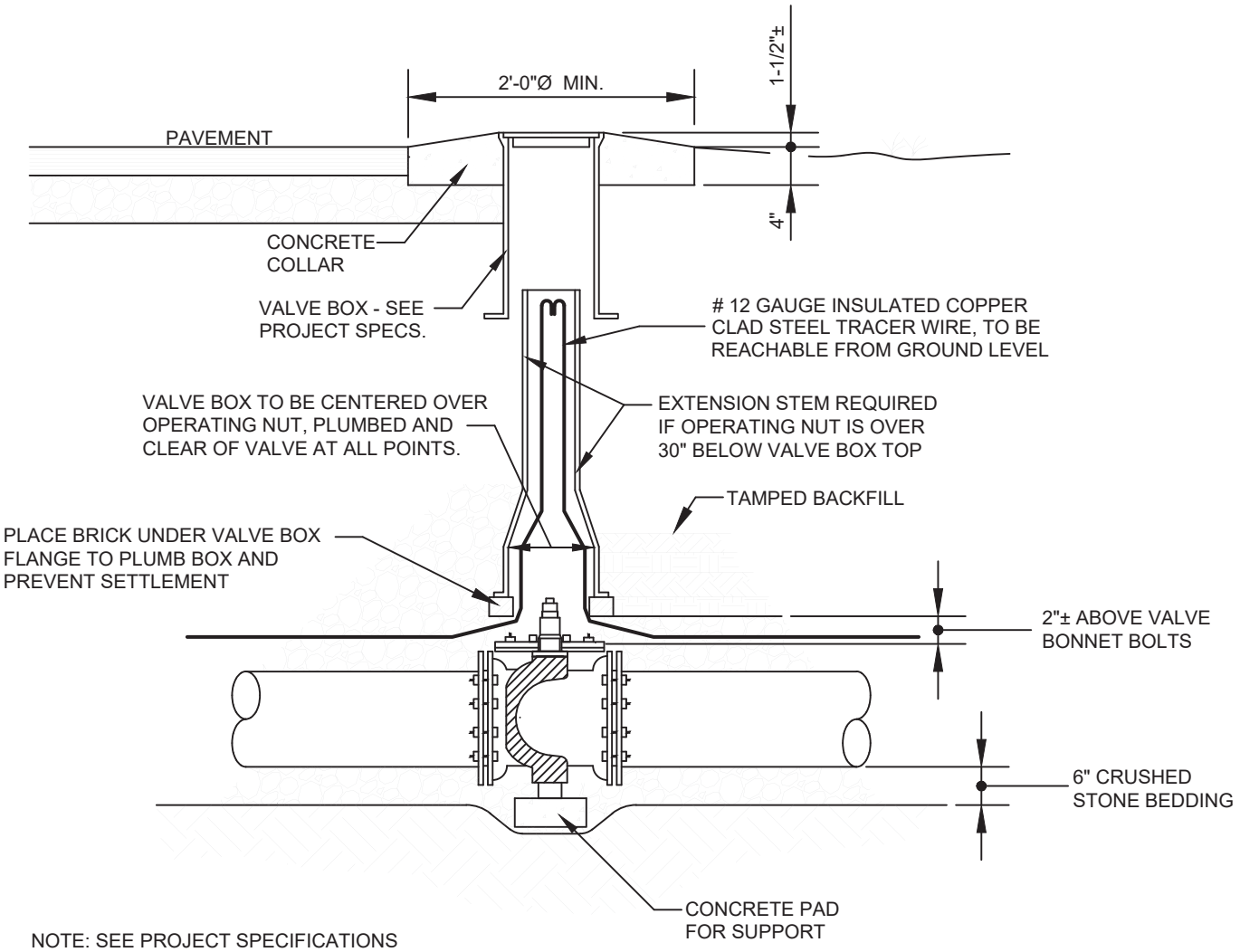
NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	EMERGENCY PUMPING CONNECTION DETAIL
Regina Santana 10/18/2023		S-33
UTILITIES DIRECTOR DATE		



NOT TO SCALE

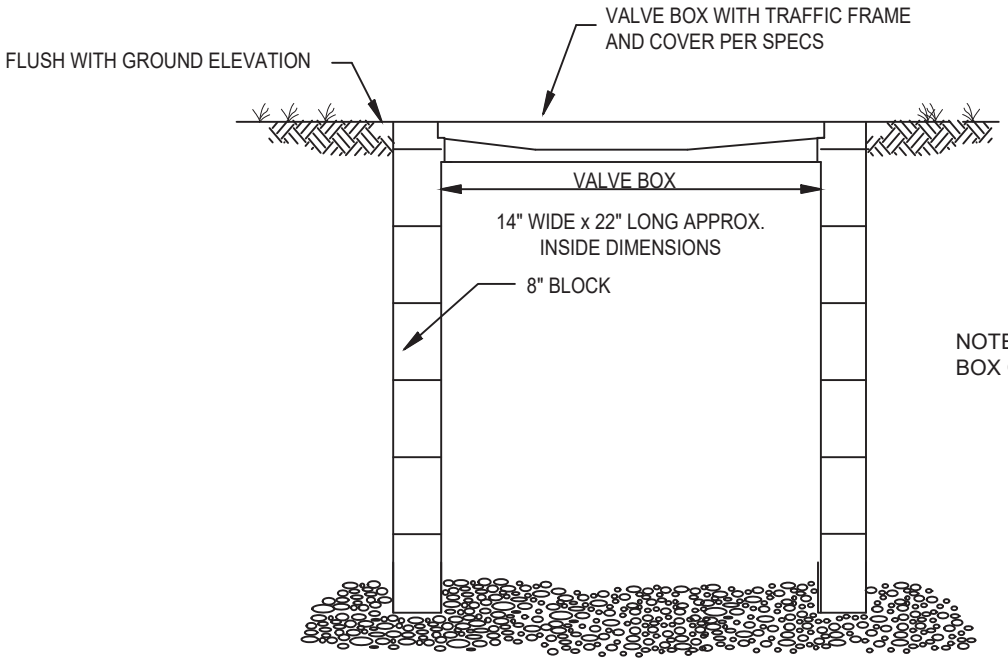
10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL GRINDER PUMP AND SERVICE CONNECTION DETAIL
10/18/2023 UTILITIES DIRECTOR DATE		S-34



NOTE: SEE PROJECT SPECIFICATIONS FOR PLUG VALVE REQUIREMENTS

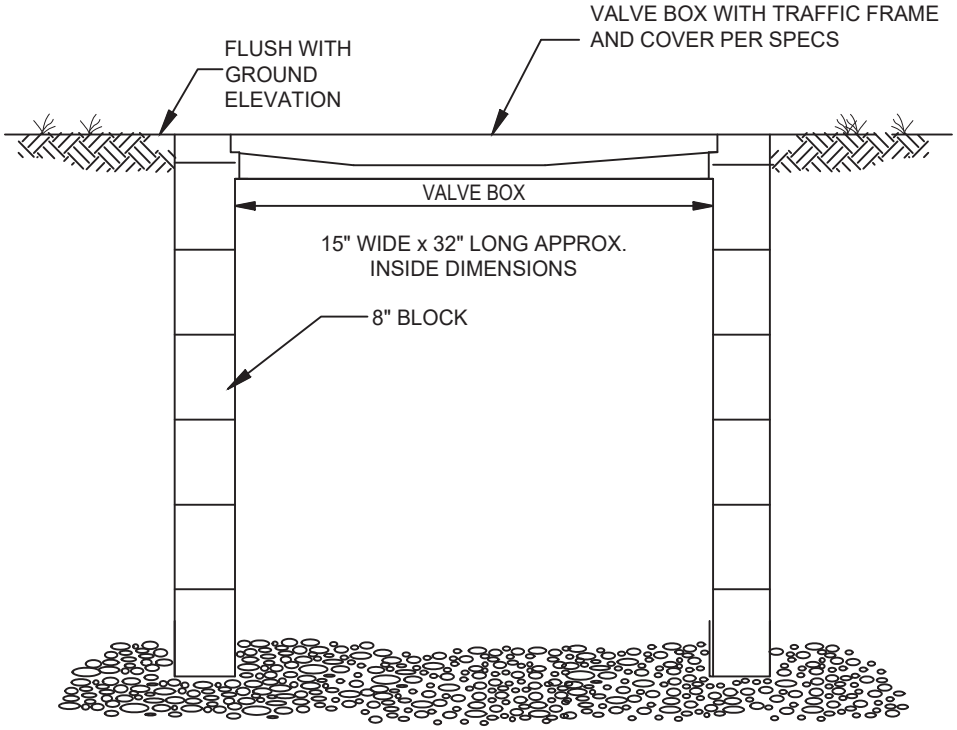
NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL PLUG VALVE INSTALLATION
Regina Santana 10/18/2023		S-35
UTILITIES DIRECTOR DATE		



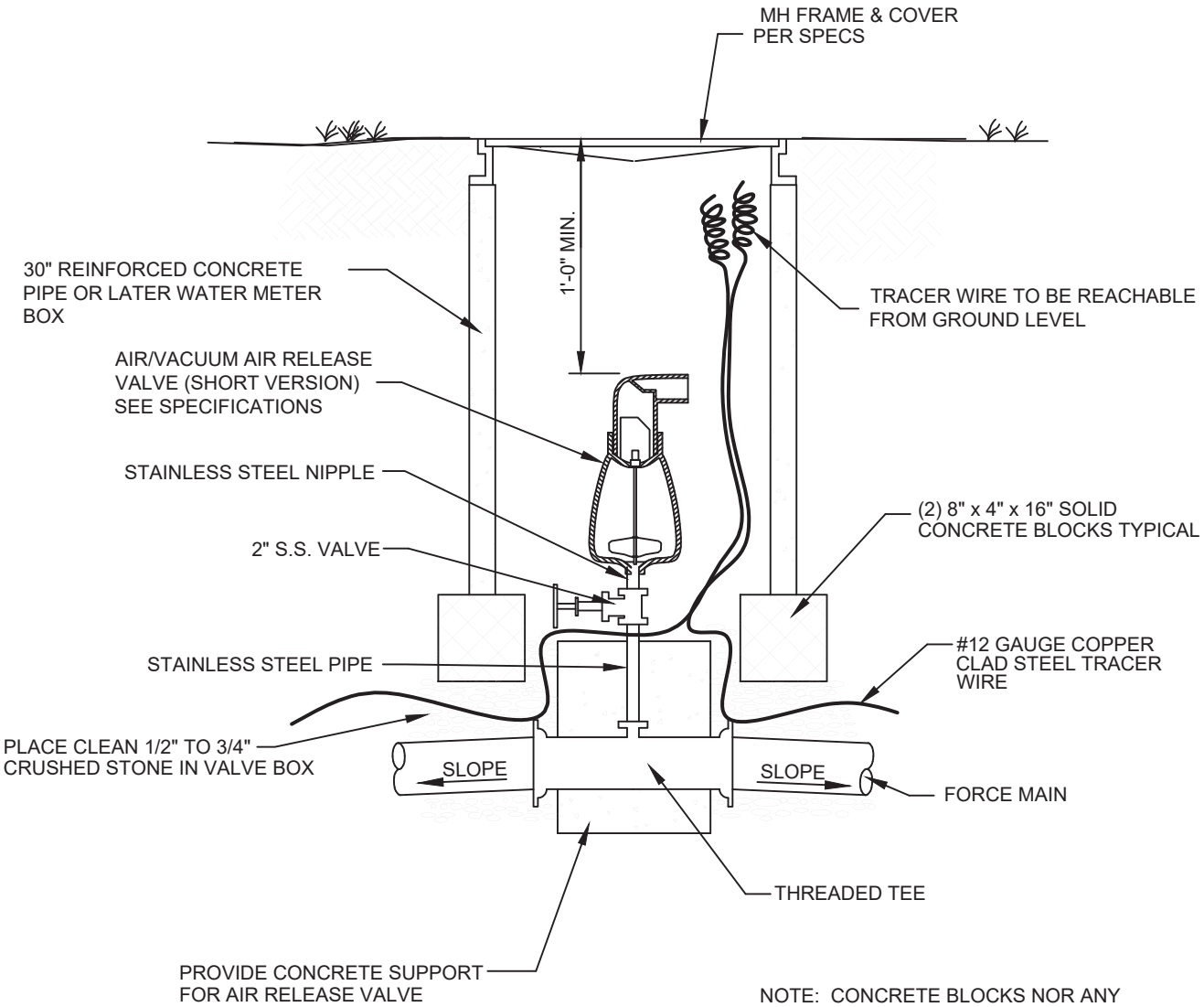
NOTE: THESE DETAILS FOR VALVE BOX CONSTRUCTION ONLY

SMALL VALVE BOX AND COVER (TRAFFIC TYPE)



NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		SMALL/LARGE VALVE BOX AND COVER (TRAFFIC TYPE)
Regina Santana 10/18/2023		S-36
UTILITIES DIRECTOR DATE		

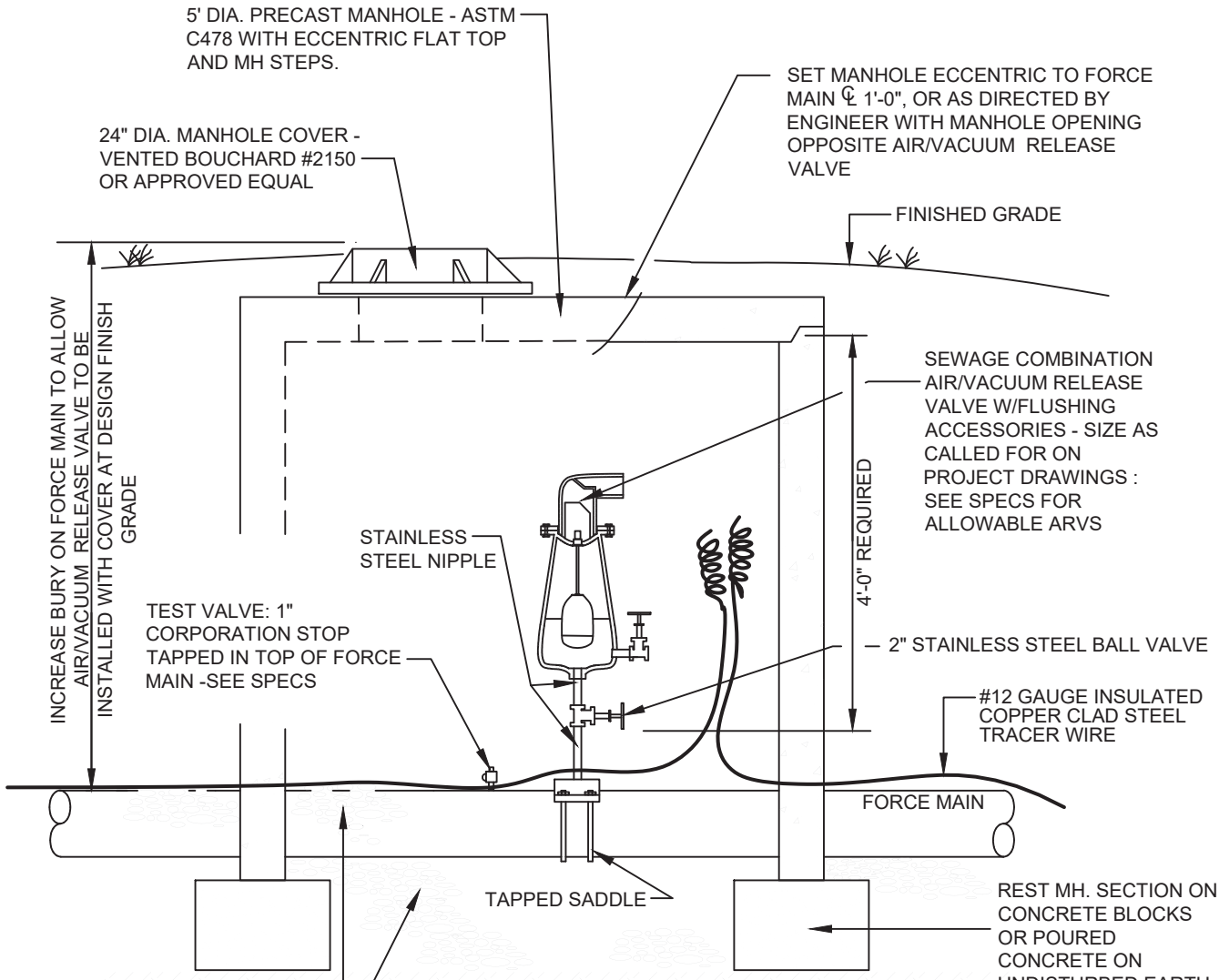


NOTE: CONCRETE BLOCKS NOR ANY PORTION OF 30" CONCRETE PIPE SHALL REST ON PROPOSED FORCE MAIN.

NOTE: THIS ARV IS FOR USE ON SMALL PRESSURE / GRINDER SYSTEMS WITH 3" OR SMALLER FORCE MAINS

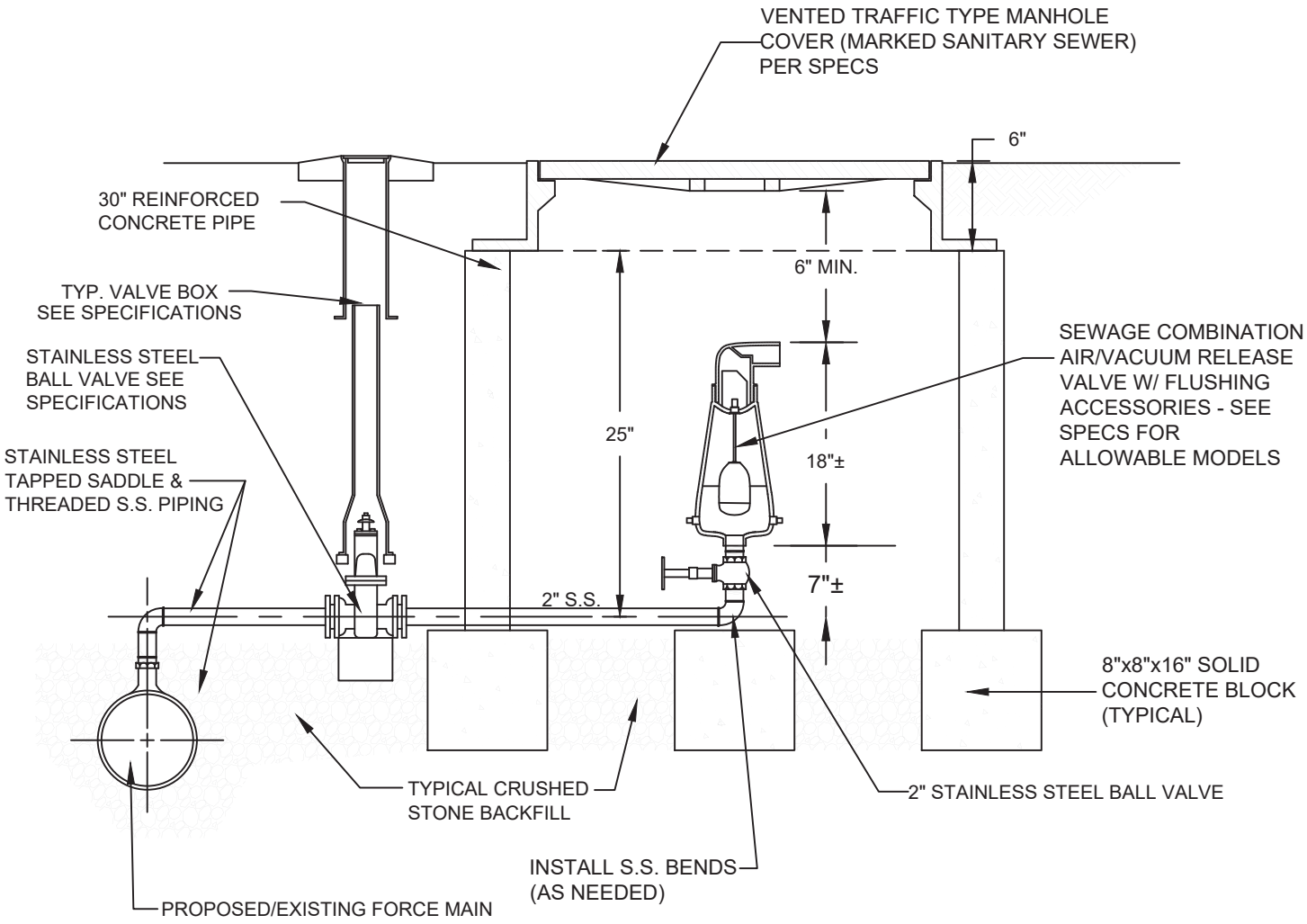
NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		LOW PRESSURE SEWER AUTOMATIC AIR RELEASE MANHOLE
10/18/2023 UTILITIES DIRECTOR DATE		S-37



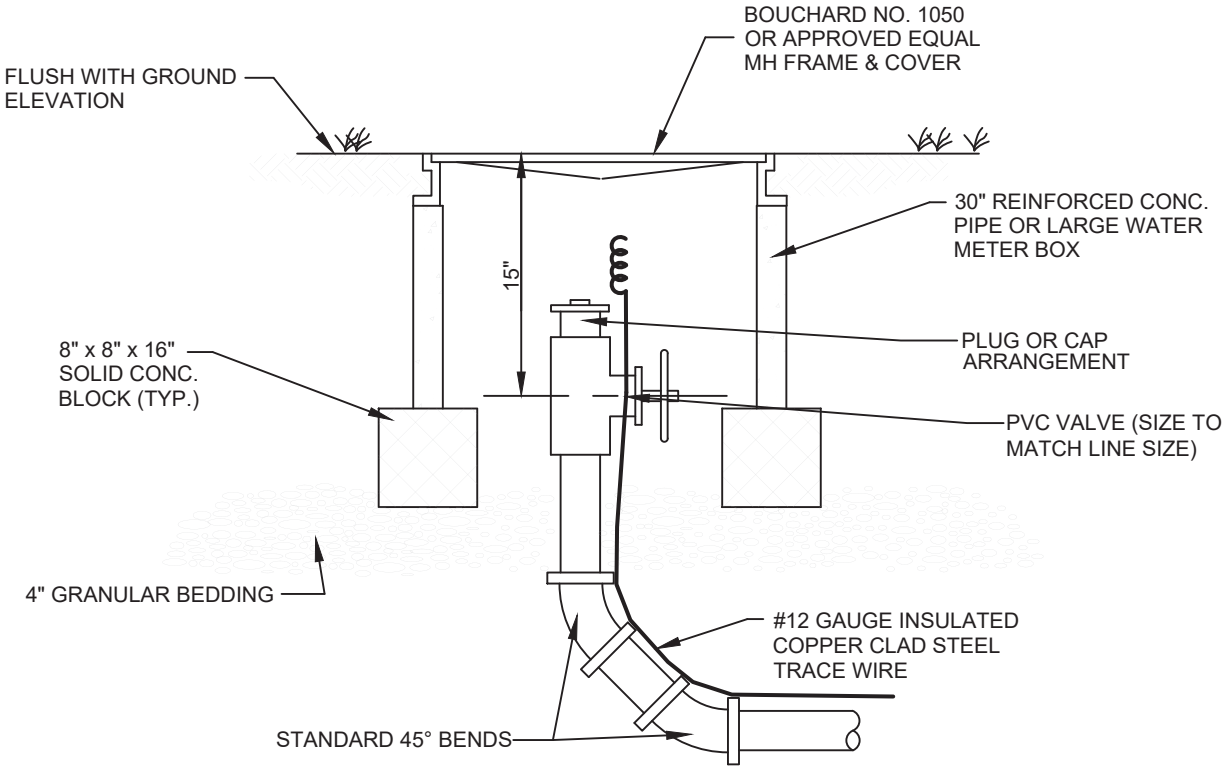
NOT TO SCALE

10/18/2023 UTILITIES ENGR. DATE 10/18/2023 UTILITIES DIRECTOR DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT AUTOMATIC COMBINATION AIR & VACUUM RELEASE MANHOLE S-38



NOT TO SCALE

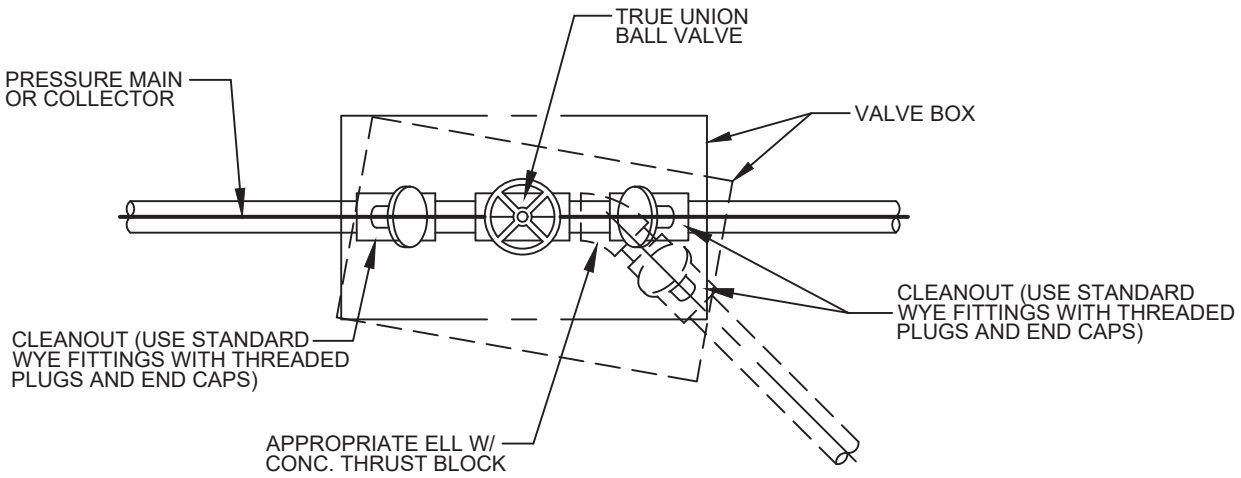
10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		OFFSET - AUTOMATIC COMBO AIR / /VACUUM MANHOLE W/ 30" CONC. PIPE STRUCTURE FOR SMALL FORCE MAINS
Regina Santana 10/18/2023		S-38
UTILITIES DIRECTOR DATE		



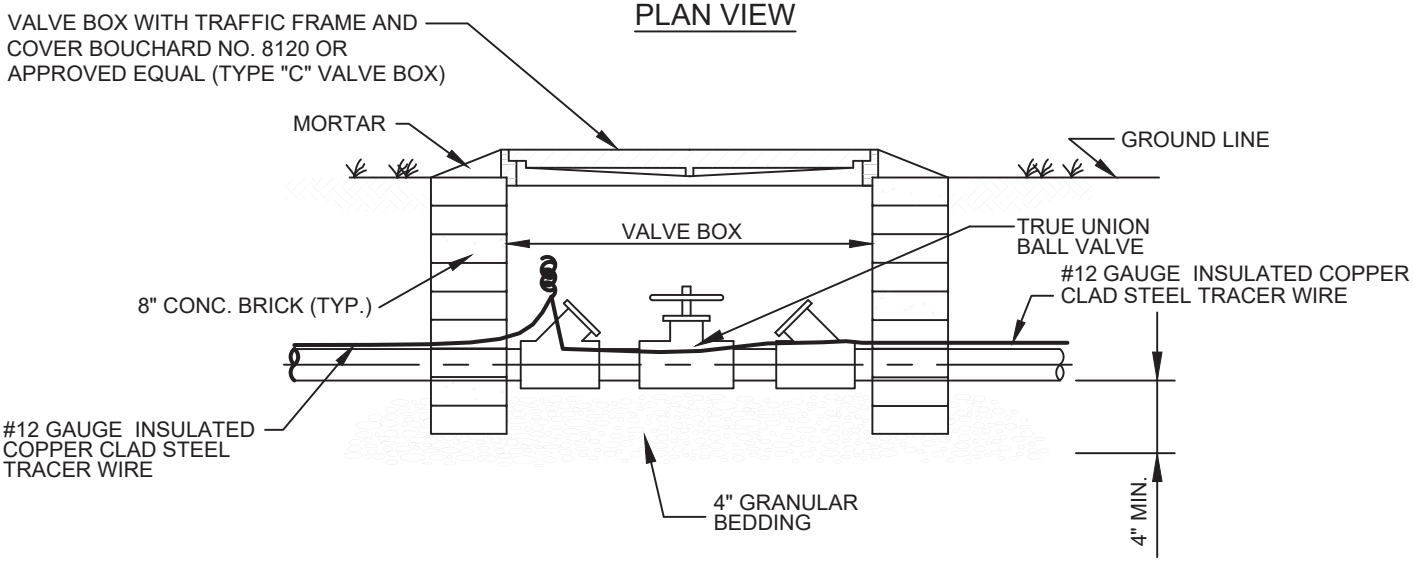
NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	TYPICAL LOW PRESSURE SEWER SERVICE LINE CONNECTION (1 ¼")
Regina Santana 10/18/2023		S-40
UTILITIES DIRECTOR DATE		

NOTE: PROVIDE FOR ENTRANCE AND EXIT OF PRESSURE SEWER THROUGH WALLS OF VALVE BOX AT ANGLES REQUIRED BY CHANGE OF DIRECTION IF ANY.



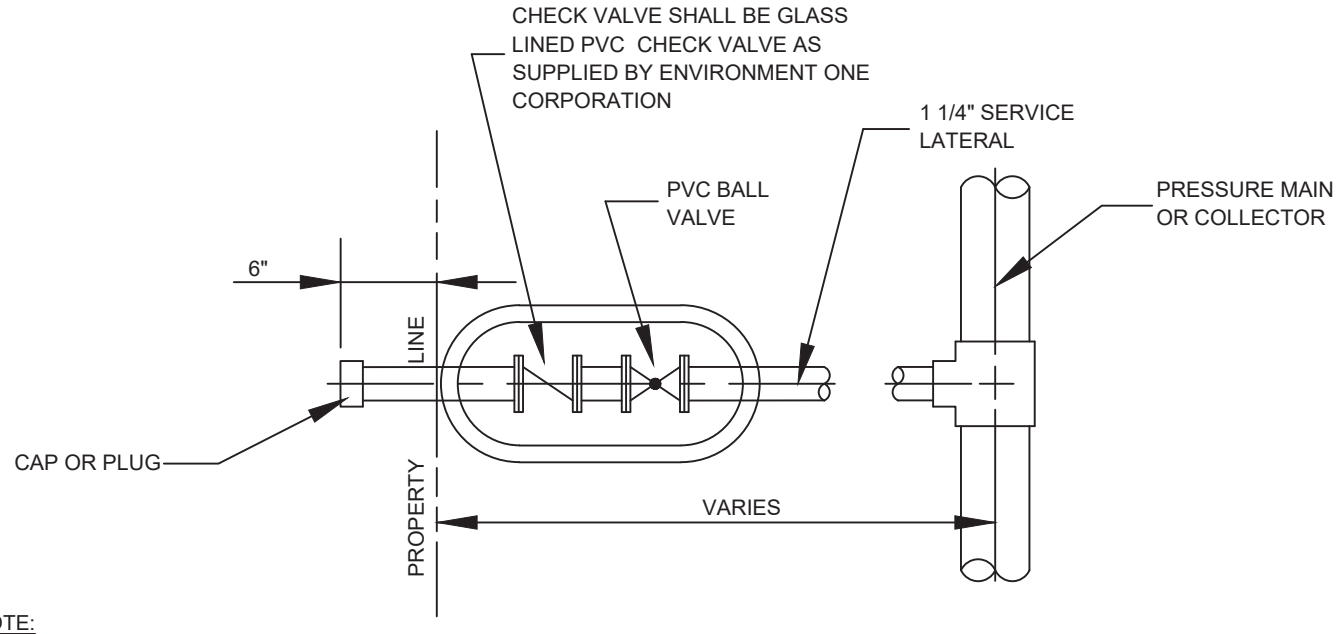
PLAN VIEW



ELEVATION

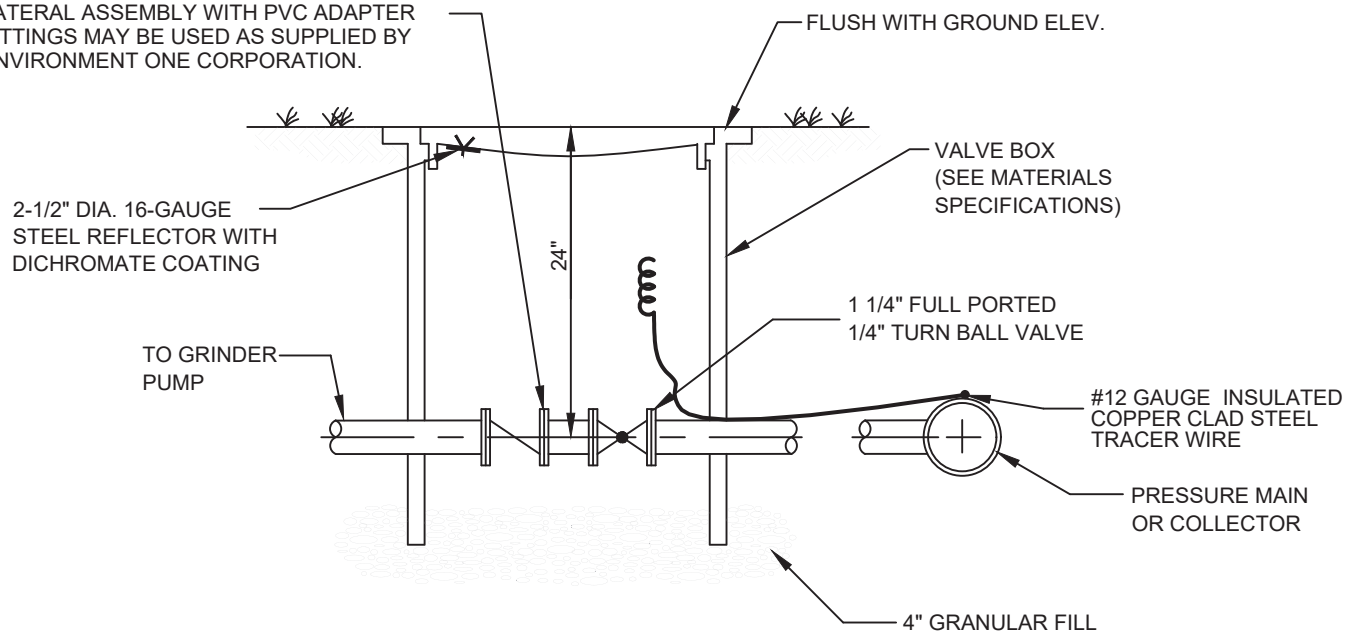
NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	TYP. LOW PRESSURE SEWER VALVE BOX & CLEANOUT ARRANGEMENT ALONG STRAIGHT RUNS AND AT CHANGES IN DIRECTION
10/18/2023		S-41
UTILITIES DIRECTOR DATE		



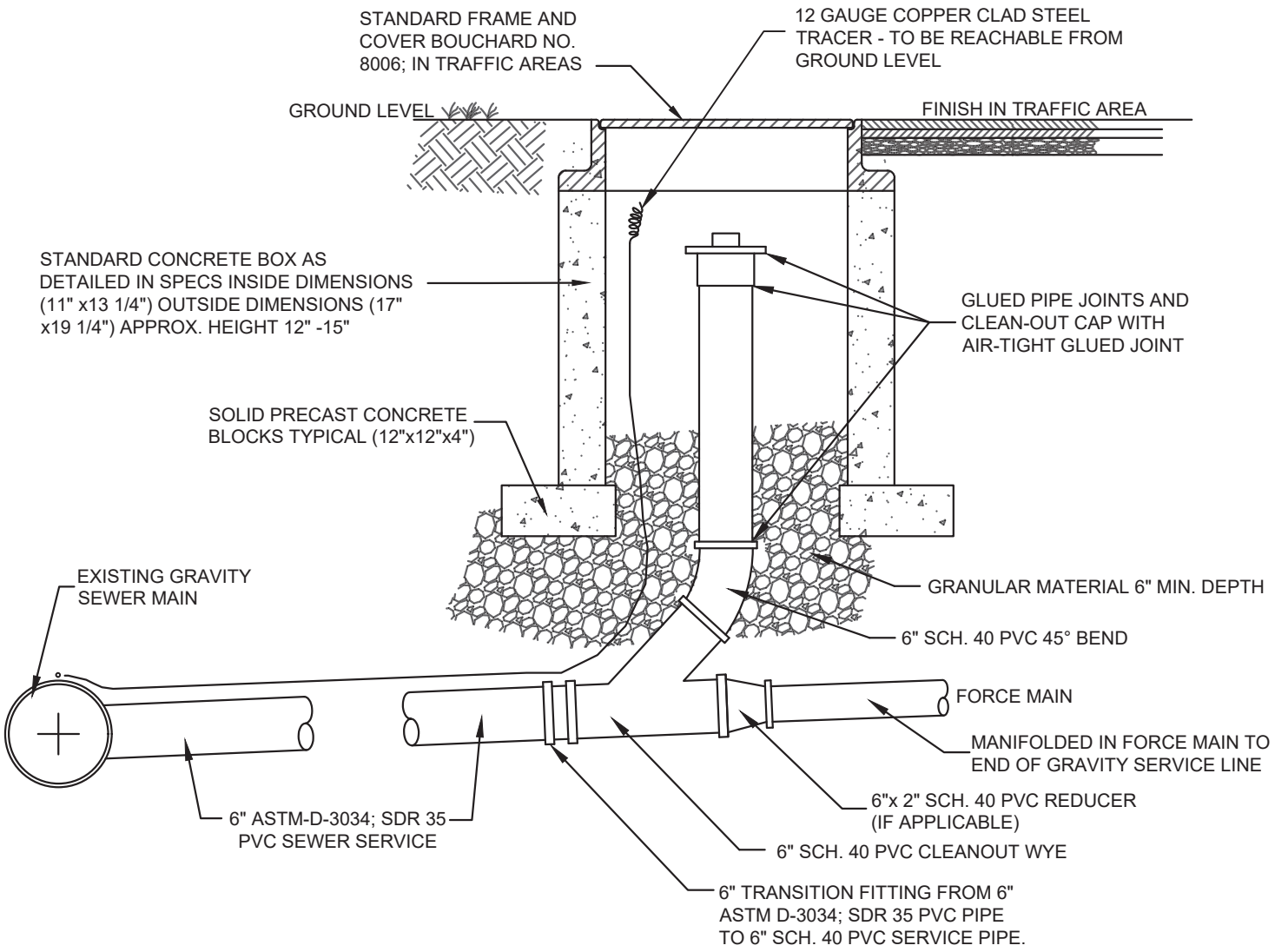
NOTE:

1. AT CONTRACTOR'S OPTION A 1 1/4" PLASTIC LATERAL ASSEMBLY WITH PVC ADAPTER FITTINGS MAY BE USED AS SUPPLIED BY ENVIRONMENT ONE CORPORATION.



NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL LOW PRESSURE SEWER SERVICE LINE CONNECTION (1 ¼")
10/18/2023		S-42
UTILITIES DIRECTOR DATE		



GENERAL NOTES:

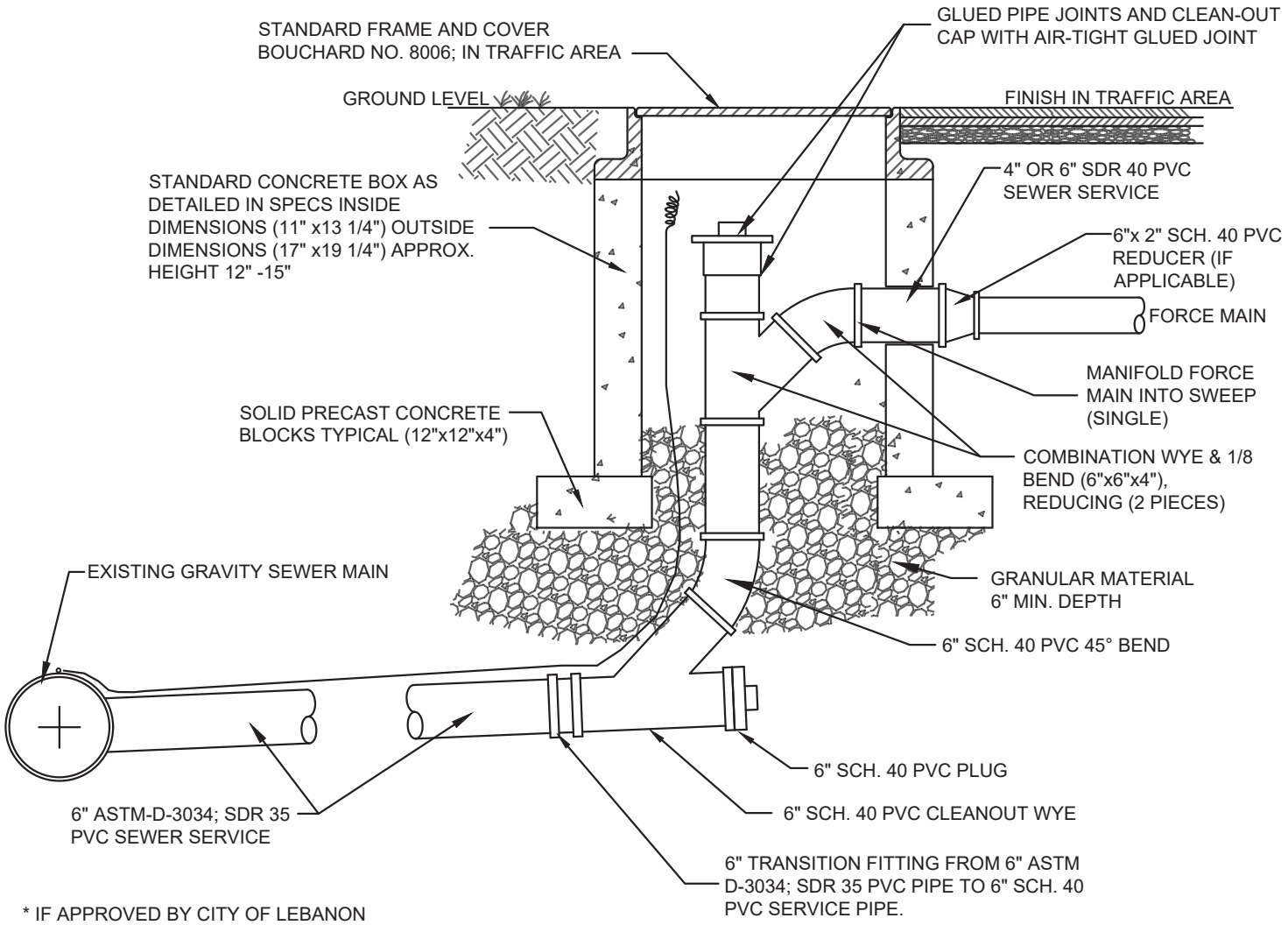
1. TRAFFIC BEARING BOX REQUIRED IN TRAFFIC AREAS.
2. ALL PIPE AND FITTINGS SHALL BE OF SIMILAR MATERIAL.
3. ALL PIPE SHALL BE OF SAME SIZE.
4. NO BENDS ARE ALLOWED IN THE LATERAL FROM THE MAIN TO THE CLEAN-OUT STACK WYE (EXCEPT AS NOTED.)
5. ALL MAIN LINE TAPS ON ACTIVE MAINS SHALL BE SUPERVISED OR PERFORMED BY THE CITY OF LEBANON.
6. MINIMUM COVER FOR ALL SEWER LATERALS SHALL BE THREE (3') FEET.
7. GRAVITY SECTION AND CLEANOUT SHALL BE 6" DIAMETER FOR PUBLIC FORCE MAINS AND 4" DIAMETER FOR PRIVATE FORCE MAINS AS APPROVED.
8. PUBLIC FORCE MAINS SHALL CONNECT TO SEWER MANHOLES.
9. PROPERTY OWNER RESPONSIBLE FOR INSTALLING CLEANOUT ON PROPERTY LINE WHEN MAINTENANCE OCCURS, IN ACCORDANCE WITH THIS STANDARD.

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL SHALLOW CLEANOUT ASSEMBLY W/ FORCE MAIN CONNECTION
Regina Santana 10/18/2023		S-43
UTILITIES DIRECTOR DATE		

GENERAL NOTES:

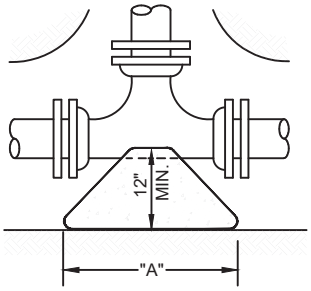
1. TRAFFIC BEARING BOX REQUIRED IN TRAFFIC AREAS.
2. ALL PIPE AND FITTINGS SHALL BE OF SIMILAR MATERIAL.
3. ALL PIPE SHALL BE OF SAME SIZE.
4. NO BENDS ARE ALLOWED IN THE LATERAL FROM THE MAIN TO THE CLEAN-OUT STACK WYE (EXCEPT AS NOTED.)
5. ALL MAIN LINE TAPS ON ACTIVE MAINS SHALL BE SUPERVISED OR PERFORMED BY THE CITY OF LEBANON.
6. MINIMUM COVER FOR ALL SEWER LATERALS SHALL BE THREE (3') FEET.
7. GRAVITY SECTION AND CLEANOUT SHALL BE 6" DIAMETER FOR PUBLIC FORCE MAINS AND 4" DIAMETER FOR PRIVATE FORCE MAINS AS APPROVED.
8. PUBLIC FORCE MAINS SHALL CONNECT TO SEWER MANHOLES.
9. PROPERTY OWNER RESPONSIBLE FOR INSTALLING CLEANOUT ON PROPERTY LINE WHEN MAINTENANCE OCCURS, IN ACCORDANCE WITH THIS STANDARD.



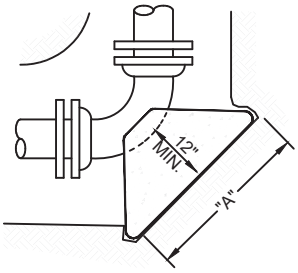
* IF APPROVED BY CITY OF LEBANON ENGINEERING DEPARTMENT FOR DEEP INSTALLATION

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		TYPICAL DEEP CLEANOUT ASSEMBLY W/ FORCE MAIN CONNECTION*
Regina Santana 10/18/2023		S-44
UTILITIES DIRECTOR DATE		



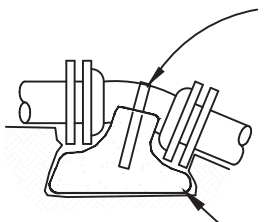
PLAN: TEE



PLAN: 90° BEND

NOTES:

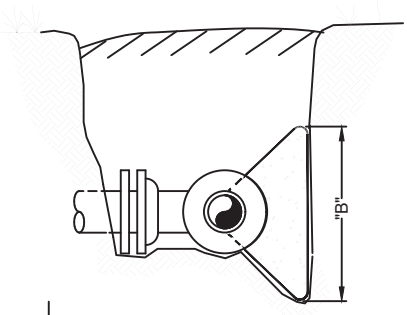
1. CONCRETE TO BE CLASS "B" (2000 P.S.I.) OR STRONGER.
2. DIMENSIONS AS SHOWN ARE APPROXIMATE - SUBJECT TO CHANGE AT DIRECTION OF OR APPROVAL OF ENGINEER.
3. KEEP CONCRETE CLEAR OF ANY PIPE JOINT, GLAND BOLTS, ETC.
4. CONCRETE TO BEAR AGAINST UNDISTURBED EARTH WITH BEARING AREA EQUIVALENT TO AT LEAST AxB.



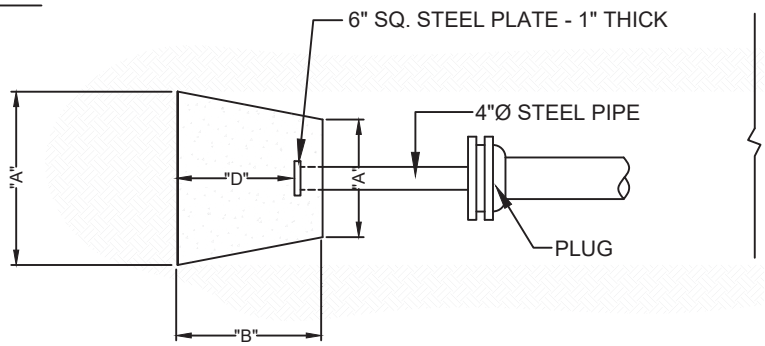
FOR UPPER THRUST BLOCK ON A VERTICAL BEND, CONCRETE VOLUME SHALL BE AS DETERMINED BY ENGINEER. LOWER BLOCK TO HAVE DIMENSIONS ACCORDING TO SCHEDULE BELOW. FITTING TO BE FIXED TO UPPER BLOCK USING 1/4" x 2" STEEL STRAP PROTECTED WITH 2 COATS BITUMASTIC PAINT (OR AS OTHERWISE APPROVED BY ENGINEER).

WEIGHT IS CRITICAL - MUST BE DETERMINED OR APPROVED BY ENGINEER.

GRAVITY-TYPE THRUST BLOCK



SECTION



PLUG

SCHEDULE OF MINIMUM BEARING AREA REQUIRED

BASED ON 200 PSI INTERNAL PRESSURE AND 4000 PSF SOIL BEARING CAPACITY*

PIPE SIZE	TEE OR DEAD END	90° BEND	45° BEND	22 1/2° BEND	11 1/4° BEND
4"	1.0	1.5	1.0	1.0	1.0
6"	2.5	3.0	2.0	1.0	1.0
8"	4.0	5.5	3.0	1.5	1.0
10"	6.0	8.5	4.5	2.5	1.5
12"	8.5	12.0	6.5	3.0	2.0
16"	15.0	21.5	11.5	6.0	3.0
18"	20.0	27.5	15.0	8.0	4.0
20"	24.0	33.5	18.5	9.5	5.0
24"	34.0	48.0	26.0	13.5	7.0
30"	53.0	76.5	41.0	21.5	12.0
36"	76.5	110.0	59.0	30.5	17.5

VALUES ARE TABULATED IN SQUARE FEET

*Engineer to confirm actual required dimensions before construction of the Thrust Block.
Bearing Area (square feet) = A(feet) x B(feet)

NOT TO SCALE

10/18/2023
UTILITIES ENGR. DATE

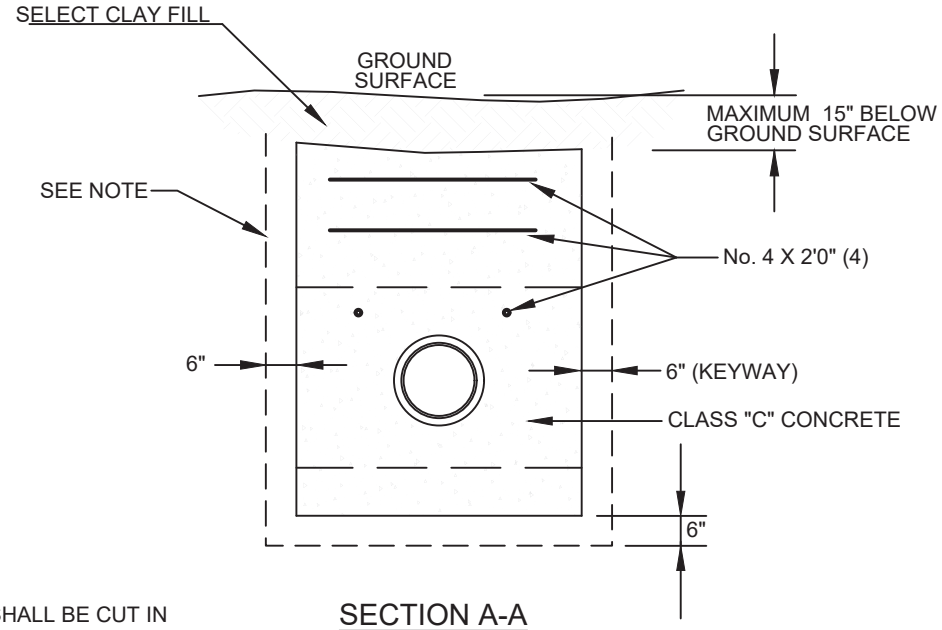
10/18/2023
UTILITIES DIRECTOR DATE

City of Lebanon Tennessee

UTILITIES DEPARTMENT

CONCRETE THRUST BLOCKING

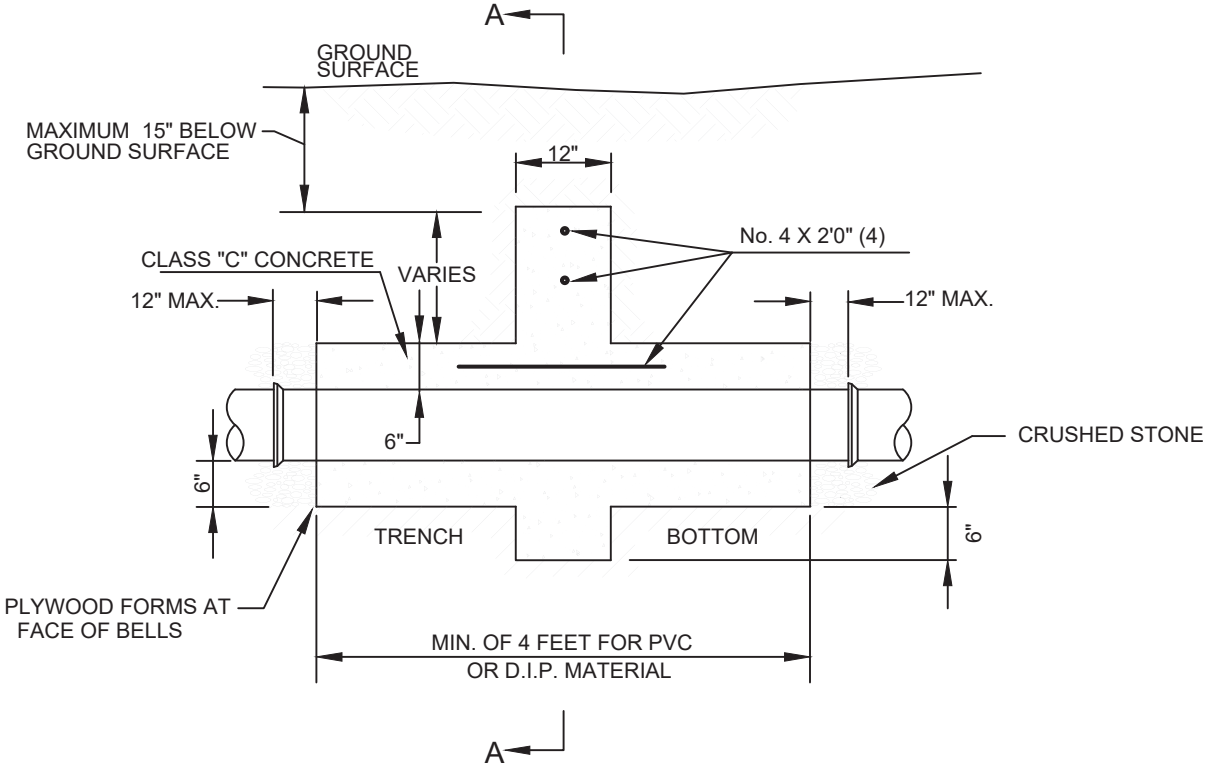
S-45



SECTION A-A

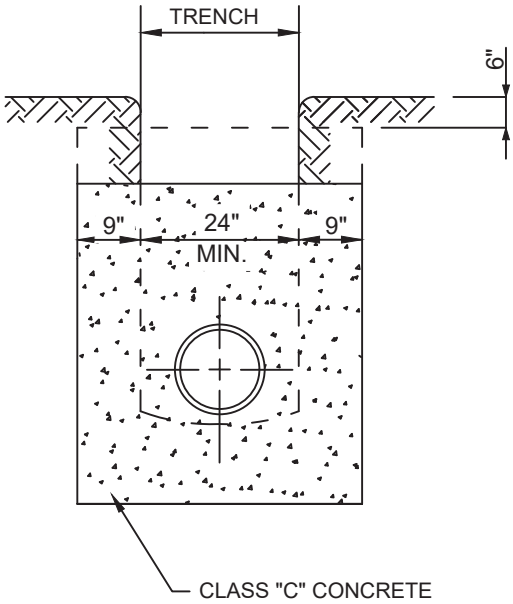
NOTE: A 6-INCH KEYWAY SHALL BE CUT IN DIRT EXCAVATION. FRACTURED AND SHOT ROCK SHALL BE REMOVED TO CLEAN SOLID ROCK IN ROCK TRENCHES. THIS IS REQUIRED ON SIDES IN ADDITION TO BOTTOM. IF BOTTOM IS OVER SHOT IT MUST BE CLEANED TO SOLID UNFRACTURED ROCK.

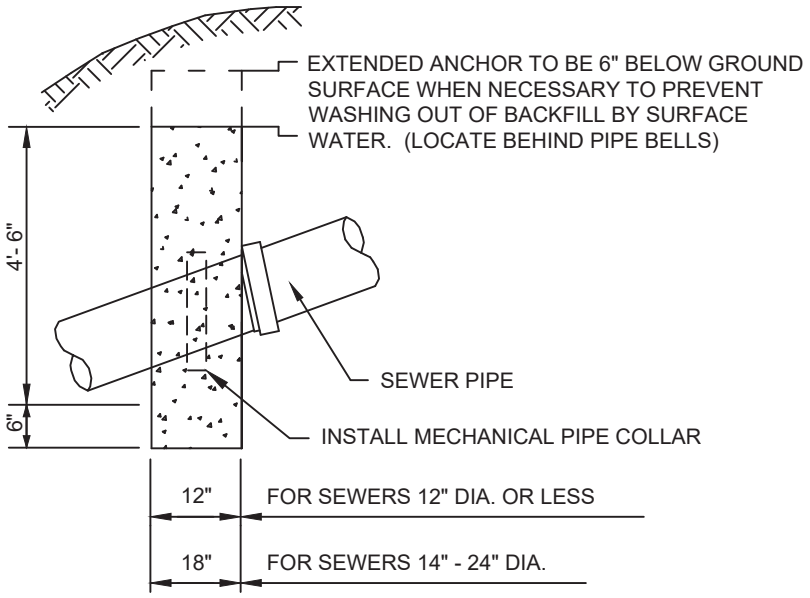
NOTE: ALL CHECK DAMS REQUIRE BOTH INSPECTION AND GPS DATA COLLECTION BEFORE BACKFILLING.



NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	CONCRETE CHECK DAM
Regina Santana 10/18/2023		S-46
UTILITIES DIRECTOR DATE		



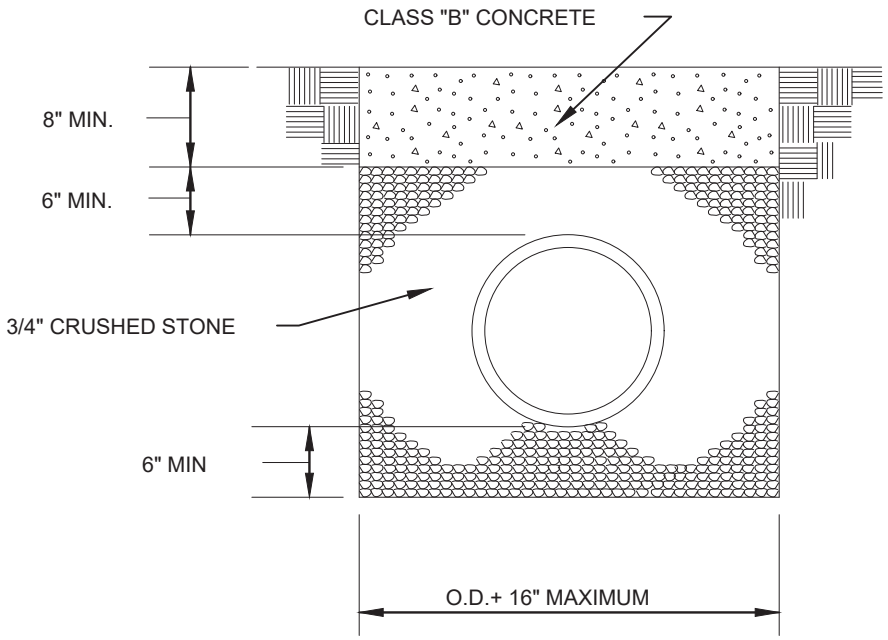


NOTE:
PROVIDE NO ANCHOR ON GRADES LESS THAN 18.86% UNLESS NOTED.
PROVIDE ANCHOR 36' C-C ON GRADES BETWEEN 18.86% AND 34%.
PROVIDE ANCHOR 24' C-C ON GRADES BETWEEN 34% AND 50%.
FOR CONDITIONS OTHER THAN SHOWN HEREON PROVIDE ANCHORS AS REQUIRED BY THE CONTRACT OR ORDERED BY THE ENGINEER IN THE FIELD.
ANCHORS WILL BE REQUIRED TO BE INSPECTED AND GPS LOCATED BEFORE BACKFILLING.

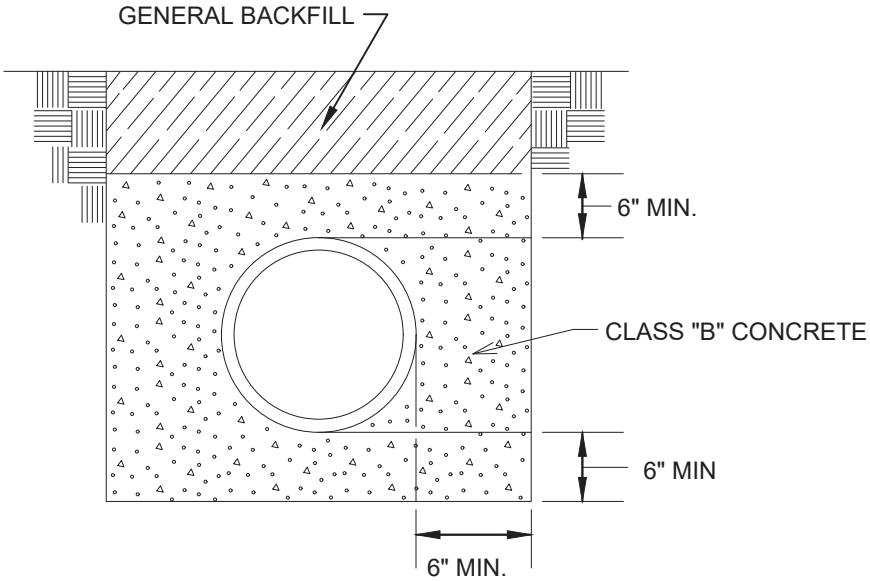
NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		CONCRETE ANCHOR
Regina Santana 10/18/2023		S-47
UTILITIES DIRECTOR DATE		

NOTES:
1. THICKNESS OF CAP MAY BE ADJUSTED TO MEET FIELD CONDITIONS.
2. CONCRETE CAP TO BE FLUSH WITH SURROUNDING GRADE.



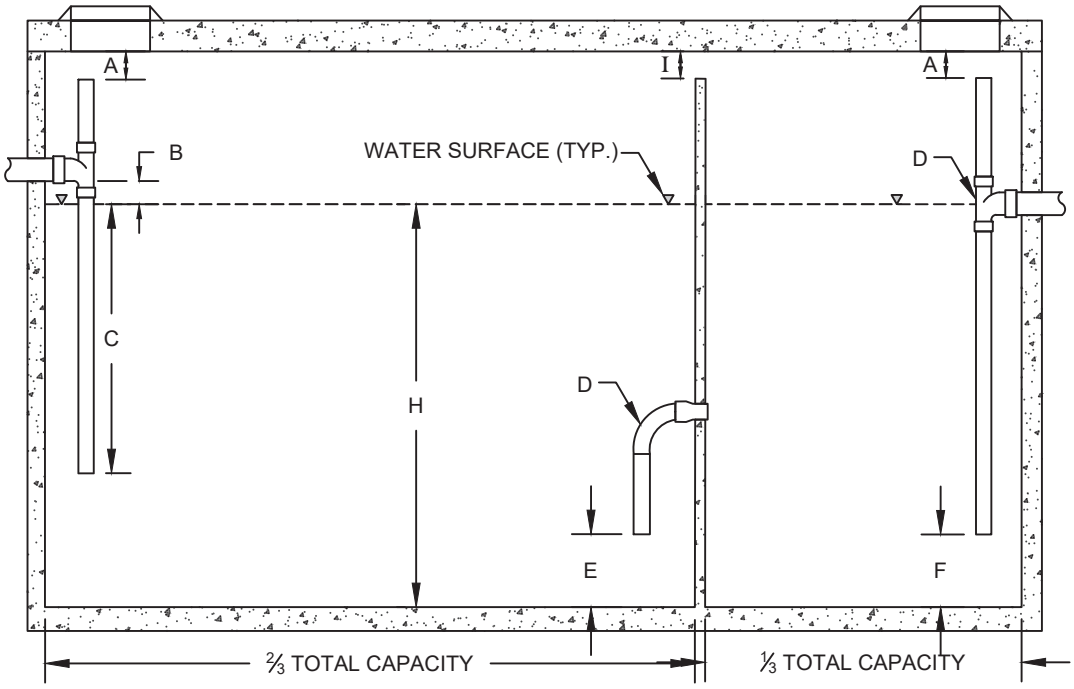
CONCRETE CAP



CONCRETE ENCASEMENT

NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		CONCRETE ENCASEMENT & CONCRETE CAP
Regina Santana 10/18/2023		S-48
UTILITIES DIRECTOR DATE		



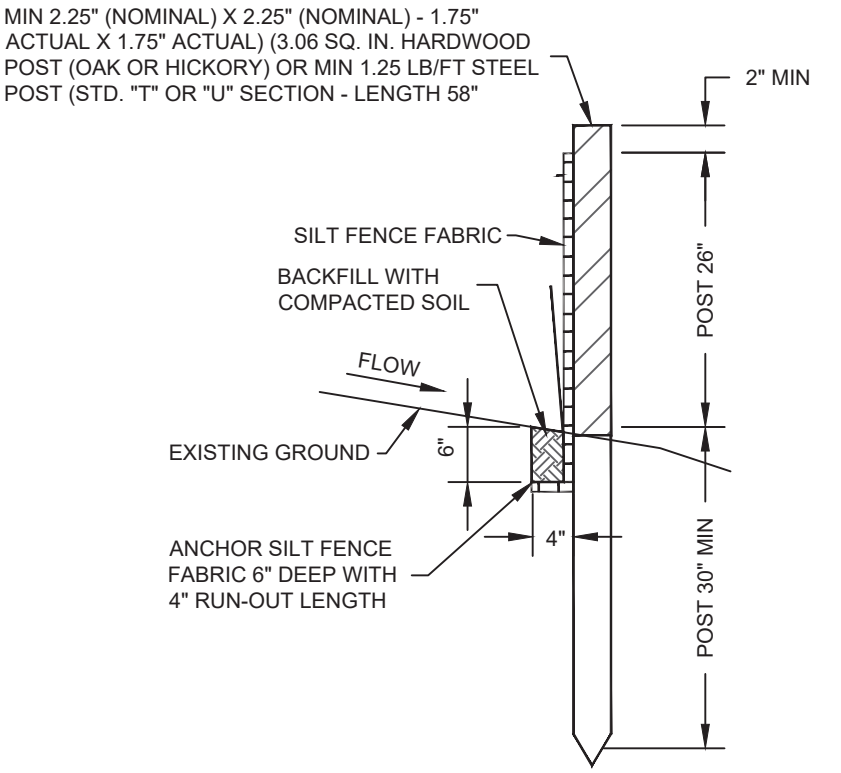
A) MINIMUM 6", BUT NOT LESS THAN PIPE DIAMETER
B) INLET PIPE INVERT TO BE 2 ½" ABOVE LIQUID SURFACE
C) INLET PIPE TO TERMINATE ⅔ DEPTH OF WATER LEVEL
D) 90° SWEEP, MINIMUM SIZE - 6"
E) 12" FROM FLOOR TO END OF SWEEP
F) 12" FROM FLOOR TO END OF OUTLET PIPE
G) OUTLET PIPE NO SMALL THAN INLET PIPE, MINIMUM 4"
H) MINIMUM DEPTH OF LIQUID CAPACITY - 42"
I) MAXIMUM DISTANCE FROM CEILING - 6"

NOTES:

1. THE GREASE INTERCEPTOR SHALL BE CONSTRUCTED OF SOUND, DURABLE MATERIALS NOT SUBJECT TO EXCESSIVE CORROSION OR DECAY AND SHALL BE WATER AND GAS TIGHT.
2. EACH INTERCEPTOR SHALL BE STRUCTURALLY DESIGNED TO WITHSTAND ANY ANTICIPATED LOAD TO BE APPLIED ON THE INTERCEPTORS SUCH AS VEHICULAR TRAFFIC IN PARKING OR DRIVING AREAS.

NOT TO SCALE

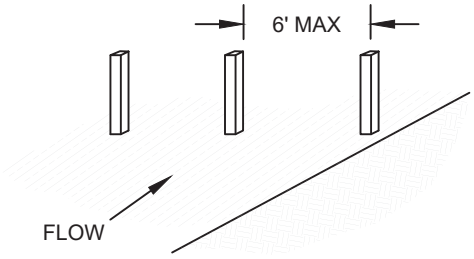
10/18/2023 UTILITIES ENGR. DATE	City of Lebanon Tennessee	UTILITIES DEPARTMENT
		TYPICAL GREASE TRAP
Regina Santana 10/18/2023 UTILITIES DIRECTOR DATE		S-49



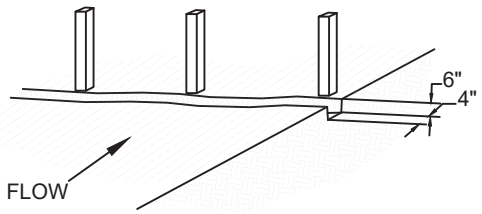
NOTE:
1. SILT FENCE SHALL BE INSTALLED ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS.
2. SILT FENCE J-HOOKS SHALL BE INSTALLED PER TDEC "EROSION & SEDIMENT CONTROL HANDBOOK" (LATEST REVISIONS) AS REQUIRED

SILT FENCE SECTIONAL VIEW

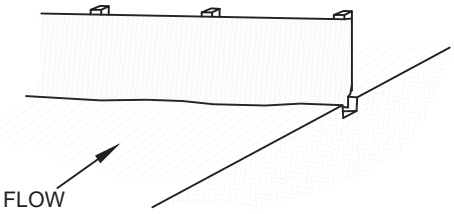
1. SET THE STAKES.



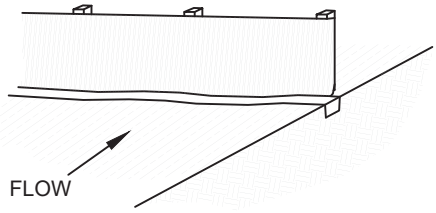
2. EXCAVATE A 4"x4" TRENCH UPSLOPE ALONG THE LINE OF STAKES.



3. STAPLE FILTER MATERIAL TO STAKES AND EXTEND IT INTO THE TRENCH.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.

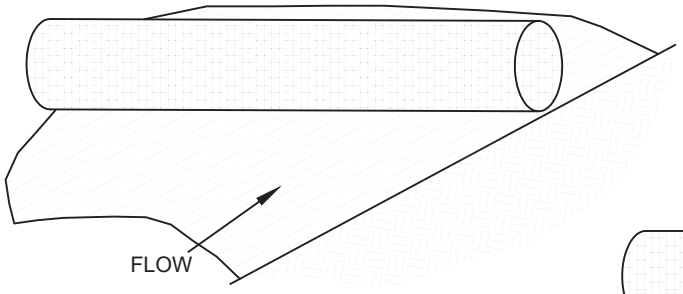


CONSTRUCTION OF A FILTER BARRIER

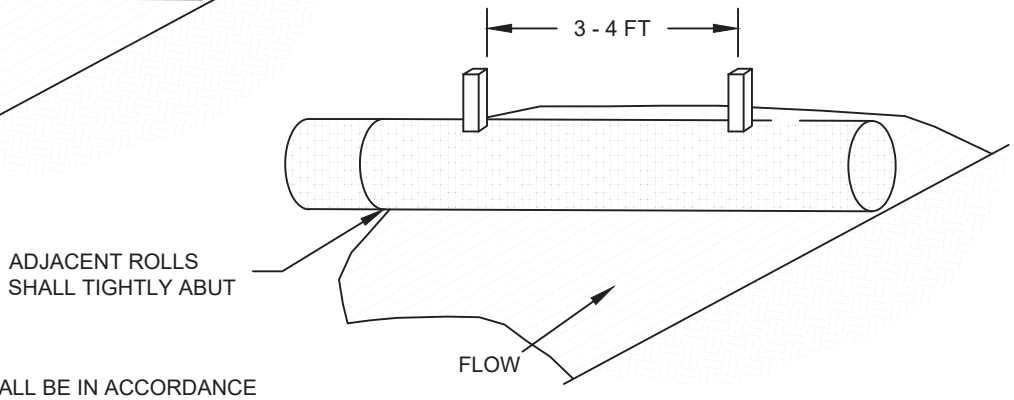
NOT TO SCALE

10/18/2023	City of Lebanon Tennessee	UTILITIES DEPARTMENT
UTILITIES ENGR. DATE		EROSION CONTROL TYPICAL SILT FENCE INSTALLATION
Regina Santana 10/18/2023		S-50
UTILITIES DIRECTOR DATE		

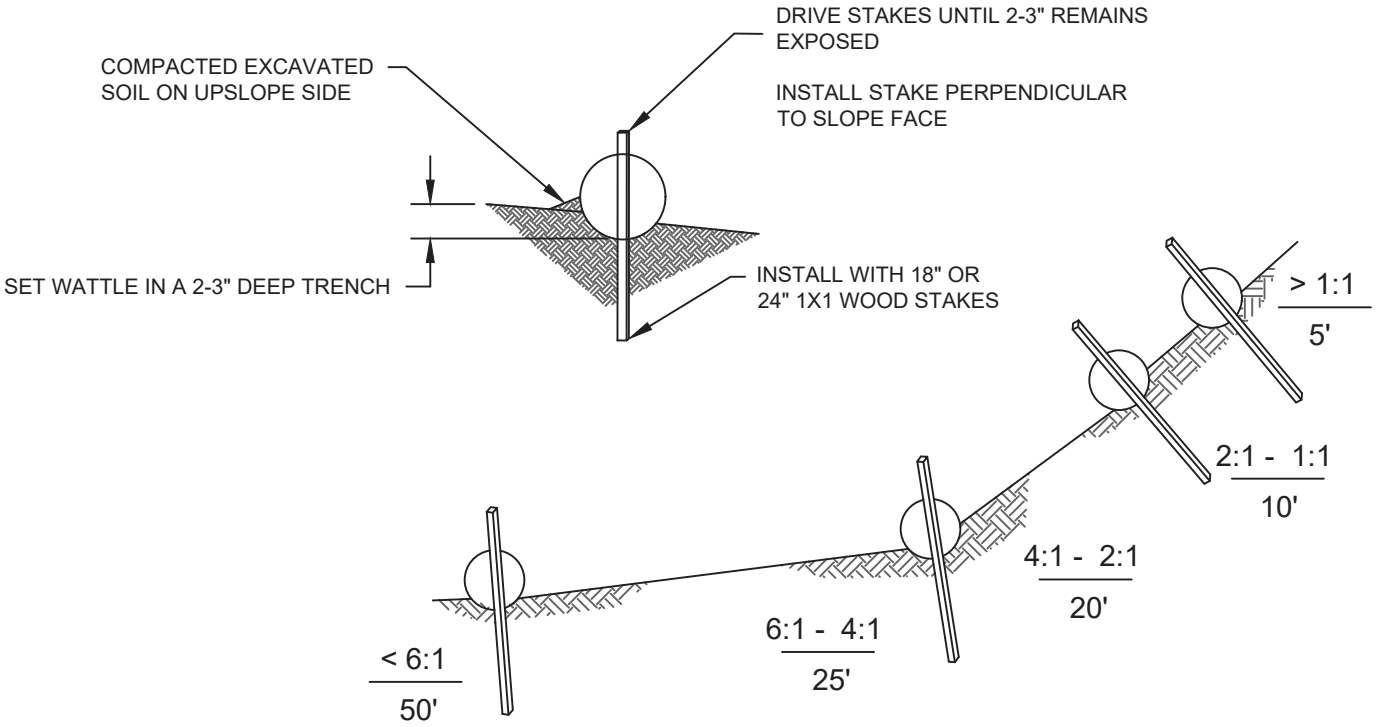
1. LAYOUT TO INTERCEPT RUNOFF



2. STAKE IN CROSS PATTERN ON DOWN SLOPE SIDE OF WADDLE/TUBE.



NOTE:
1. FILL MATERIAL OF TUBES SHALL BE IN ACCORDANCE TO TDEC/KDEP REGULATIONS.
2. SEDIMENT TUBES SHALL BE INSTALLED ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS.



NOT TO SCALE

10/18/2023		UTILITIES DEPARTMENT
UTILITIES ENGR. DATE	City of Lebanon Tennessee	EROSION CONTROL SEDIMENT TUBE TYPICAL INSTALLATION
10/18/2023		S-51
UTILITIES DIRECTOR DATE		