

CITY OF GRAHAM  
NORTH CAROLINA

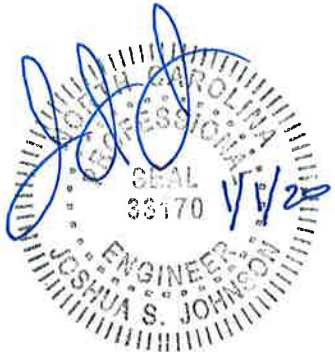
STANDARD  
SPECIFICATIONS

AND

DETAILS

FOR

WATER, SEWER AND STREET  
IMPROVEMENTS



Revised: January 1, 2020



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## **INTRODUCTION**

The purpose of these standards is to serve as a guide in the preparation and submittal of plans for roadway, utility, and development projects for the City of Graham. These guidelines meet the current design standards and ensure more uniformity in the design of those projects. Engineers are encouraged to use these standards in their design process. It is not the intent of this manual to provide an explanation for every design problem encountered, nor, as a substitute for experience, sound judgment, and engineering knowledge.

The City of Graham will use these standards and requirements along with sound engineering principles to review the detailed engineering drawings. These standards shall apply to all roadway and utility improvements and developments within the City of Graham. In addition, these standards apply to areas outside the City Limits that are under the jurisdiction of the City.

The City of Graham has the right of final approval over all construction work done under these guidelines and no work will be accepted until approval is made by the City.

This update of the standard specifications and details will apply to all construction projects submitted after 1/1/2020, and to all preliminary plans approved after 1/1/2020.

**CITY OF GRAHAM**

**January 1, 2020**



MATERIAL SPECIFICATIONS

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Note: Shop drawings for water, sewer, & storm drainage related materials are to be submitted to the City for review approval prior to installation. Additional material specifications may be required at times.

1. General Conditions. The following Specifications cover the material under the applicable documents. Unless otherwise specified, all materials used in the work under this contract shall conform to the requirements of the current specifications of the American Society for Testing Materials, and shall be tested in accordance with the current specifications or current methods of testing of ASTM, where specifications and methods of testing have been adopted, revised, or proposed for such materials. No materials shall be used on the work until accepted by the Design Engineer and the City, and all materials rejected by the Engineer or the City as unsuitable, or not in conformity with the Plans or Specifications, or failing to pass the required tests, shall be removed immediately from the work at no expense to the City. Failure to condemn materials on preliminary inspection shall not be grounds for acceptance if future defects are found. All materials and equipment shall be new and free from all flaws or defects.

2. Cement. All cement used in mortar, or concrete shall conform to Specifications for Portland Cement of ASTM C-150. Brand of cement proposed for use by the Contractor will be subject to the approval of the Engineer. Type II shall be used in all work unless approved by the Engineer.

3. Sand. All sand used in mortar or concrete shall be clean, sharp, practically free from loam, clay or organic matter, and so graded as to ensure workability and water tightness when mixed with other ingredients. Sand will conform to ASTM Specifications C-33 and when made into mortar will have a compressive strength at 7 and 28 days of not less than 100% of mortar made with standard sands.

4. Coarse Aggregate. Coarse aggregate will consist of broken stone, sound, hard and tough, and will conform to the specifications of coarse aggregate given in ASTM Specification C-33. Stone will be broken to the sizes hereinafter specified under "Concrete" for the various classes of concrete, and grading will be well within the limits specified.

5. Water. Water used for mixing concrete and mortar will be clean, and free from deleterious amounts of acids, alkalis, and organic materials.

6. Concrete. All concrete shall be made of Portland cement, water and aggregates as hereinbefore specified, and shall further be in accordance with the following definite requirements for the various classes.

A design of the mix made by an independent laboratory, approved by the Engineer, for each class of concrete, shall be submitted for approval before concreting is started.

During progress of the work, standard compressive strength test specimens shall be made and cured by the Contractor in accordance with ASTM Standard Method, Designation C-31, and tested - by an independent testing laboratory in accordance with ASTM Standard Method, Designation C-39. At least 3 cylinders will be made for each test. Tests results shall be submitted for each one hundred (100) cubic yards, or fraction thereof, for each class of concrete used. Should there be any evidence that concrete is not up to standard, a strength test may be required at any time and the cost paid by the contractor.

If 100 LF of sidewalk is poured, at least one (1) test must be performed. Test on less than 100 ft. may be done at Engineer's or Cities request. Concrete tickets are to be provided for all pours.

Class A concrete shall have a 28-day compressive strength of not less than 3,000 lbs. per square inch and a slump of from 3 to 5 inches and a maximum water-cement ratio of 0.48.



Coarse aggregate for all classes of concrete shall be commercial 1-inch stone, all of which shall pass a 1-1/2" screen.

All concrete used shall be "ready-mixed" concrete made in accordance with ASTM Standard Method Designation C-94. Cement, aggregate, water and design of mixes shall be as above specified. Elapsed time for placing concrete, between adding the mixing water to the mix and placing the concrete in the forms, shall not exceed that set forth in Table 1000-2.

<b>TABLE 1000-2 ELAPSED TIME FOR PLACING CONCRETE</b>		
<b>Air or Concrete Temperature Whichever is Higher</b>	<b>Maximum Elapsed Time</b>	
	<b>No Retarding Admixture Used</b>	<b>Retarding Admixture Used</b>
90°F or above	30 minutes	1 hour 15 minutes
80°F through 89°F	45 minutes	1 hour 30 minutes
79°F or below <sup>A</sup>	60 minutes	1 hour 45 minutes
70°F through 79°F <sup>B</sup>	60 minutes	1 hour 45 minutes
69°F or below <sup>B</sup>	1 hour 30 minutes	2 hour 15 minutes

<sup>A</sup> Applicable to Class AA, A, and Drilled Pier Concrete

<sup>B</sup> Applicable to Class B Concrete

The concrete temperature at the time of placing in the forms shall not be less than 50°F nor more than 95°F except where other temperatures are required by N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

Do not place concrete without permission when the air temperature measured at the location of the concrete operation, in the shade away from artificial heat is below 35°F. When such permission is granted, uniformly heat the aggregates and/or water to a temperature not higher than 150°F. Do not place heated concrete in the forms if the temperature is less than 55°F or more than 80°F.

Deliver concrete to any monolithic unit of a structure at a rate that will permit proper handling, placing, and finishing of the concrete. Regulate the delivery so that the maximum interval between the placing of batches at the work site does not exceed 20 minutes.

All concrete materials and installation shall comply with the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

**7. Steel for Reinforcement.** All reinforcement steel will fulfill the Standard Specifications for Billet Steel Concrete Reinforcement Bars, Designation A615 of ASTM. Intermediate Grade 60 will be used.

All steel will be free from rust, scale, or other coatings which would reduce or destroy the bond when placed in forms and the Contractor will provide such protection as is necessary to insure that the steel will not be injured during the construction period.

**8. Joint Materials.** Joint filler, hot applied joint sealer, low modulus silicone sealant, and bond breaker materials shall comply with Section 1028, Joint Materials, of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

All joint filler shall be sealed unless otherwise specified by the City Engineer.

9. Mortar. Unless otherwise provided, cement mortar will be Type M only. Type M mortar will consist of Portland cement and sand mixed in the proportion of one-part cement to two parts sand with not more than 6-1/2 gallons of water per bag of cement. This mixture may be varied to increase workability only by reducing the amount of sand or blending one or more sands. Mortar in which cement has been placed for more than one hour will not be used.

10. Brick. All brick used on the work will be hard, tough, sound clay or shale brick, of first class quality, thoroughly vitrified and especially suitable to the class of work for which it is to be used. Brick used in manholes shall conform to ASTM Specifications C-216, grade SW.

11. Brick Masonry. All brick masonry will be constructed using Type M mortar and brick as specified.

12. Structural Steel.

a. General. The American Institute of Steel Construction's "Specifications for the Design, Fabrication and Erection of Structural Steel for Building", latest edition, and the American Institute of Steel Construction's "Code of Standard Practice for Steel Buildings and Bridges", latest edition, are hereby made a part of these Specifications to the same extent as if they were written herein, except that they may be amended or superseded by these Specifications or the Drawings.

b. Materials.

- (1) Structural steel shall conform to "Specifications for Structural Steel", ASTM A-36, latest edition.
- (2) Bolts, nuts, and circular washers - where required - shall conform to the requirements of the latest edition of "Specifications for High-Strength Carbon Steel Bolts for Structural Steel Joints: ASTM A-325 in exposed areas. For buried conditions or when used for sewer components, use 304 Stainless Steel.
- (3) Bolt and nut dimensions shall conform to the current requirements of the American Standards Association for heavy hex structural bolts and nuts, ASA Standard B18.2.1.

13. Storm Sewers. Reinforced concrete pipe (RCP) shall conform to AASHTO Specifications M-170, Table III, Class III. High Density Polyethylene (HDPE) double wall corrugated smooth interior drainage pipe shall conform with NCDOT's current "Standard Specifications for Roads and Structures" and AASHTO M-294 Type S for sizes 15" through 48".

ADS HP Storm Gray Polypropylene (HP Storm) per ASTM F2881 with watertight joints may be installed with City Engineer's approval and identified on construction drawings. Installation and fill heights per manufacturers guidelines and ASTM D2321 and is to be tested per ASTM F1417 except as noted. Installation method, including installation detail, from manufacturer is to be included on construction drawings and a preconstruction meeting with manufacturer's representative is required. Maximum cover over pipe is to be 8' unless specifically approved by City Engineer. Pipe is to be backfilled to top of pipe with uniform backfill; site specific geotechnical report shall verify soil conditions are adequate for backfill type. Pipe is to be laid on 6" stone per all storm drain requirements. Joints are not required to be wrapped.

14. Catch Basin Frames and Covers. All catch basin frames and covers shall be of cast iron of superior quality, tough and of even grain, and shall possess a tensile strength of not less than 18,000 psi. Dimensions of the ring and cover shall conform to the Construction Details shown on the attached Drawings. All rings and covers shall be thoroughly cleaned and given two coats of an approved bituminous paint.

15. Ductile Iron Pipe and Fittings. Ductile Iron Pipe shall be manufactured in accordance with the latest revision of ANSI/AWWA C151/A21.51, as amended, and shall be designed for type 2 laying condition with the wall thickness determined by the depth of cover and a working pressure of 150 psi. Pipe wall thickness shall be calculated in accordance with ANSI C150/A21.50.

Joints for ductile iron pipe shall be manufactured in accordance with ANSI C111 or AWWA A21.11, push-on joint or mechanical joint. Flanges, where required shall be ANSI C110 or AWWA 21.10.

Ductile iron fittings through 12" shall be manufactured in accordance with ANSI Specification 21.10. Joints for fittings shall be mechanical joint conforming to ANSI Specification 21.11. Flanged fittings, where required, shall conform to ANSI Specification B16.1.

Pipe and fittings shall have a cement lining in accordance with ANSI Specification 21.4. All hardware to be stainless steel.

D.I. Pipe shall be Class 50, unless pressure or depth requires a higher class of pipe.

16. Gate Valves. Gate valves shall be of the resilient wedge type, iron body, bronze mounted, non-rising stem type designed to work equally well with pressure on either side of the gate. All valves shall conform with the requirements of the latest revision of AWWA Standard C-550 for "Gate Valves for Ordinary Water Works Service". The minimum designed working water pressure shall be 175 psi for valves with diameters of 12" or less.

All buried valves shall be supplied with a 2" square operating nut and shall be opened by turning the operating nut in a counterclockwise direction. Ends shall be mechanical joint.

All inside gate valves shall be handwheel operated with flanged ends.

All gate valves 12" and smaller shall be supplied with double "O" ring seals in lieu of the conventional stuffing box.

Gate valves shall be manufactured by Mueller, Clow, Darling, or equal.

17. Swing Check Valves. Swing check valves shall have weight and lever. Check valves shall have an iron body with bronze seat and disc rings, and shall be approved by Underwriters Laboratories, Inc. Valves shall have a pressure rating of 175 psi and be American-Darling, Clow, Mueller, or equal.

18. Tapping Sleeves. Tapping sleeves shall be of ductile iron, of the split sleeve type with mechanical joint ends, and with a Class 125 outlet flange. The end gaskets shall be Duck-Tipped Rubber Gaskets and all end and side gaskets shall be totally confined to eliminate cold flow. The tapping sleeves shall be as manufactured by Mueller Company, Decatur, Illinois; American-Darling Valve Company; Clow, or equal.

19. Tapping Valves. Tapping valves shall be equal in all respects to the gate valves hereinbefore specified except that they shall come equipped with one end having a Class 125 Flange and the other end having a mechanical joint.

20. Valve Boxes. Valve boxes shall be of cast iron conforming to ASTM Specification A048, Class 35. They shall be of the extension type of a pattern approved by the City. Size of valve box shall be suitable for size valve it is to serve and it's bury. Valve boxes shall be as manufactured by James B. Clow Company, or equal, and shall have the word "WATER/SEWER" cast on the top of the lid.

21. Fire Hydrants. Fire hydrants shall be cast iron bodied, fully bronze mounted, suitable for a working pressure of 150 psi and shall conform with the requirements of the latest revision of AWWA Standard C-502 for "Fire Hydrants for Ordinary Water Works Service". Hydrants shall be constructed to permit withdrawal of internal working parts without disturbing the barrel or casing. Main valves, when closed, shall be reasonably tight when upper portion of the barrel is broken off. For water mains less than 12" in size, main valve opening shall be 4-1/2". For water mains 12" and greater in size fire hydrants shall have main valve opening of 5-1/4". The main valve facing shall be made of rubber. There shall be no chattering under any condition of operation. The hydrants shall be of the compression type, with main valve opening against the pressure and closing with the pressure.

Each hydrant shall be equipped with two (2) 2-1/2" hose connection and one (1) pumper connection. Hose nipples shall be bronze or non-corrosive metal. Threads shall be approved by the City prior to placement of order for the hydrants.

Hydrants shall be Mueller or Clow and painted to city standard color scheme.

22. Mechanical Joint Restraint. Mechanical joint restraint shall be manufactured of ductile iron conforming to ASTM A536-80 such that the device can be used with standardized mechanical joint pipe and conform to ANSI/AWWA A 21.531 C153 and shall be EBAA Iron, Inc., Megalug or Uni Flange Corporation. Megalugs will be installed on all fittings, valves, bends, plugs, and on all pipe sections on hydrant legs.

23. Manhole Rings and Covers. Manhole rings and covers shall be made of cast iron of superior quality, tough and of even grain, and will possess a tensile strength of no less than 18,000 psi. Rings and covers shall be manufactured in accordance with ASTM A-48 Class 30. Rings will weigh not less than 190 lbs., and covers will weigh not less than 120 lbs. The rings will be a maximum of 7 1/2" high and have a minimum opening of 1'-10". See Detail SS-4 for the wording that shall be cast in the covers. The finished rings and covers shall have the bearings surfaces machined or ground so that there will be no variation that will permit rocking or rattling and the diameter of the covers shall be such as to fit the rings without wedging. All rings and covers will be thoroughly cleaned and given two coats of an approved bituminous paint. Rings shall have a solid cover on street work and perforated on outfalls.

24. Manhole Steps. Steps shall be constructed of a reinforced molded copolymer polypropylene plastic shell. Reinforcing shall be a single 1/2" steel bar ASTM designation A615 grade 60 and equal in all respects to step PS1-PF as manufactured by M.A. Ind., Inc.

25. Precast Manholes. Precast manholes shall be constructed of reinforced concrete and shall comply with the requirements of ASTM Designation C-478 "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS".

Shop drawings shall be submitted for approval prior to manufacture. Manholes shall be constructed with a monolithic base with the side wall extending at least 48" above the base; appropriate openings left in the side wall to receive the sewer pipe; barrel or riser sections with a 48" maximum length; and a conical top section having a 24" diameter opening offset in such a manner that the edge of the opening is on a vertical line with the edge of the barrel or riser section.

Manhole steps for precast manholes, unless otherwise approved by the City, shall be as hereinbefore specified and shall be set at a spacing of 12" on centers, with one extra step set in the opposite wall of the conical section.

Manhole rings and covers for precast manholes shall be as hereinbefore specified. Precast manholes shall be as constructed by N. C. Products Corporation, Raleigh, North Carolina, or approved equal.

Precast manholes shall be parged with non-shrink grout at every joint. Block manholes shall be parged from top to bottom.

26. Small Size Pipe. Small size of (2" to 4") pipe will be as follows: 3" or 4" pipe shall be D.I.P., Class 50 minimum. 2" pipe shall be Type "K", soft copper.

27. Air Release Valve. Air release valves shall be as manufactured by G.A. Industries, Clow Corporation, or equal, of size, number, and location as shown on the Drawings depending on the type of service.

28. Steel Encasement Pipe. Wherever a line must be encased under a highway or railway, it must be encased in a steel pipe that has been manufactured in conformance with the standards of AWWA C-202. Joints, coatings, and method of installation shall be in conformance with the requirements of the N.C. State Highway Commission. In general, the encasement pipe will be installed by boring with an auger so as not to displace material on the outside of the casing. Encasement pipe shall be at least twice the diameter as the carrier pipe.

29. Carrier Pipe in Encasement. Wherever a water line or sewer line must be encased under a highway, it shall be of ductile iron as hereinbefore specified and all joints shall be restrained. Provide 3 stainless steel spiders per joint of pipe.

30. PVC Gravity Sewer Pipe. PVC (Poly Vinyl Chloride) Gravity Sewer pipe shall be made of PVC plastic conforming to ASTM D-3034 SDR35. Rubber gaskets shall comply in all respects with the physical requirements specified in ASTM D-3212. The bell shall be an integral part of the pipe and the spigot ends shall be supplied from factory with bevels. The Contractor shall furnish the Owner with an affidavit from the manufacturer that the materials furnished comply with these specifications.

31. Sewer Force Mains. Sewer Force Mains 3" or larger in size shall be of Ductile Iron Pipe, Class 50 as hereinbefore specified. For force mains less than 3" in size, the material shall be PVC C-900, minimum pressure Class 150.

32. Aggregate Base Course. The materials used in the construction of the aggregate base course shall comply with Section 520, Aggregate Base Course, of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

33. Asphalt Concrete Binder Course. The materials used in the construction of the bituminous concrete base course shall comply with Section 610, Asphalt Concrete Binder Course - Type I 19.0B, of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

34. Asphalt Concrete Surface Course. The materials used in the construction of the bituminous concrete surface course shall comply with Section 610, Asphalt Concrete Surface Course – Type S 9.5B, of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

35. Prime Coat. The prime coat shall comply with Section 600 of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

36. Tack Coat. The tack coat shall comply with Section 605 of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

37. Pavement Replacement.

a. Wherever asphalt type pavement has been ordered by the Engineer or the Owner to be cut and replaced, it shall be replaced with 6" Type I-190B or B25.0B, and 2" thick asphalt concrete surface course in conformance with N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended. If existing asphalt is thicker than 7" then additional I19.0B or B25.0B shall be installed to match the existing pavement thickness. Any tack coat used shall conform to same standards.

b. Wherever concrete type pavement has been ordered by the Engineer or Owner to be cut and replaced, it shall be replaced with Class A concrete poured 8" thick. All concrete shall be doweled into existing concrete using NCDOT approved epoxy coated dowels. If existing concrete is greater than 8" then match existing depth.

c. The City Engineer or Public Works Director may require pavement cut areas to provide a 25-foot overlay beyond the cut area each direction. The overlay area shall be milled to provide a smooth transition between new and existing asphalt and is in addition to pavement replacement. Existing striping is to be replaced as required. The overlay requirements will be based upon the condition of the existing asphalt.

38. Stabilization Stone for Pavement Cuts. The stone used in stabilizing pavement cuts shall conform to the Aggregate Base Course as described in the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

39. Stabilization Stone for Ditches. The stone used in stabilizing ditch bottoms, prior to the installation of storm sewer pipe in the said ditch, shall conform to the requirements of Size No. 67 Aggregate as described in the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended.

40. Concrete Curb and Gutter. Concrete used in curb and gutter shall be 3,000 psi concrete as hereinbefore specified.

41. Rip Rap. Rip Rap shall be Class 1 quarry stone as described in Section 1042 of the N.C. State Highway Commission's "Standard Specifications for Roads and Structures", January, 2018 as amended. (Class A & B to be used where specified.)

**STREET AND SITE IMPROVEMENTS: DETAILED SPECIFICATIONS FOR INSTALLATION**

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1. General Provisions. The following Specifications cover work which is to be furnished and installed under STREET IMPROVEMENTS and SITE IMPROVEMENTS. Applicable subsections of MATERIAL SPECIFICATIONS apply to all work.

The alignment and grade shall be checked by the City's representative prior to placement of ABC, curb and gutter, pavement and sidewalk.

2. Scope of Work. The work to be performed under this document includes the Street Improvements.

3. Excavation for Storm Sewers. All trenches shall be excavated in open cut from the surface and in close conformity to the lines on approved plans.

In order that there be sufficient room for properly laying and jointing the pipe, trench widths shall be a minimum of 24" plus the outside pipe diameter. In order to safeguard the pipe, however, the maximum trench width shall not exceed 36" plus the outside pipe diameter. Trench widths shall be measured between faces of the cut at the top of the pipe.

All pipe shall be laid on a bedding of at least 6" of No. 67 stone. If HDPE Pipe is installed, provide bedding stone to spring line of pipe. If the design drawings call for additional stone, the design drawings shall govern. Wet trenches shall be stabilized by the use of additional No. 67 stone as directed by City Engineer or his representative.

Length of trench open ahead of pipe laying shall be no more than 300 feet, and no less than 20 feet.

The Contractor shall keep all trenches free from water during excavation for pipelines. The water shall be pumped out of the ditch or dams built to keep it out of the ditch in such a manner as not to cause injury to the public health, private property, or the work in progress.

Portable bridges shall be erected across trenches to permit the passage of vehicular and/or pedestrian traffic.

The local Fire Department and 911 shall be notified at least 24 hours before any street is blocked by the opening of a trench. The Fire Department and 911 shall also be notified when the street is once again open to traffic.

Sheeting or bracing shall be used wherever necessary to prevent caving of the trench banks. The removal of sheeting shall be done in such a manner as to minimize the loss of friction between the trench walls and the backfill. Sheeting shall be cut off and left in place where its removal will adversely affect the pipeline installation.

4. Rock Excavation in Trenches. Should rock be encountered in the trenches, the excavation shall be carried to a depth of 6" below the body of the pipe and the trench shall be brought back to grade with No. 67 Stone properly compacted.

Should rock be encountered in the trenches and blasting is required for its removal, then all blasting operations shall be conducted in strict accordance with existing ordinances and accepted safe practices relative to the storage and use of explosives.

5. Backfilling Trenches. Trenches shall be filled with suitable soils in layers six-inch (6") deep and thoroughly compacted with mechanically driven rammers. Dry material used in refilling shall be sufficiently moistened so that after tamping future settlement will be at a minimum. Flooding will not be permitted and excess water from any cause shall be removed from the ditch. Material left over from the trench shall be hauled away or disposed of as the Contractor may elect. Compaction to be to 95% Standard Proctor, except top 12" to be 100% Standard Proctor.

6. Pipe Laying - General Provisions. The Contractor shall be responsible for all material which may become a part of the finished work until it is finally in place and accepted by the City, and shall remove from the lines any cracked or defective pipe and shall replace them with new pipe without extra compensation there for.

Should any pipe be cracked or defective, the Contractor may cut off the cracked or defective portion and lay the remainder of the pipe if, in the City and the Contractor's opinion, the cutting off of the cracked or defective end will not injure the balance of the pipe. Permitting such cutting off of cracked or defective ends, however, shall not absolve the Contractor from any of his responsibility toward the work. Cutting of pipe will only be allowed at ends or with special permission of City staff.

All pipe will be laid on lines and grades as shown on the approved Drawings. All pipe shall be placed on a firm foundation, and 6" of No. 67 stone so as to prevent subsequent settlement.

Upon completion of the work, all lines shall present a clean and unbroken barrel, true to line and grade, and any defective lines shall be repaired, and any deposits removed by the Contractor. The Contractor shall provide a video inspection of all storm pipes at completion of construction and provide a copy of such to the City in DVD format. Any defects detected by such video inspection shall be repaired by the contractor.

7. Pipe Laying - Storm Sewers. All materials for laying and jointing the pipe in the trench shall conform to the specifications for such materials hereinbefore given and shall be furnished by the Contractor.

Pipe shall have full bearing for its full length. RCP Joints shall be sealed with a flexible joint sealant and wrapped with silt tight fabric. Except as modified herein, the installation of the storm sewers shall comply with the requirements of the Department of Transportation's "Standard



Specifications for Roads and Structures". HPDE joints shall be silt free type and HPDE Pipe shall be installed in accordance with ASTM D 2321.

ADS HP Storm Gray Polypropylene (HP Storm) per ASTM F2881 with watertight joints may be installed with City Engineer's approval and identified on construction drawings. Installation and fill heights per manufacturers guidelines and ASTM D2321 and is to be tested per ASTM F1417 except as noted. Installation method, including installation detail, from manufacturer is to be included on construction drawings and a preconstruction meeting with manufacturer's representative is required. Maximum cover over pipe is to be 8' unless specifically approved by City Engineer. Pipe is to be backfilled to top of pipe with uniform backfill; site specific geotechnical report shall verify soil conditions are adequate for backfill type. Pipe is to be laid on 6" stone per all storm drain requirements. Joints are not required to be wrapped.

**8. Manholes.** Manholes shall be made of precast concrete and shall conform to the Construction Details that are a part of the standard details.

Manholes shall be provided with plastic coated steps set in the walls 12" apart, and all manholes shall be capped with cast iron manhole frames and covers. The frames shall be furnished and set in mortar with even bearing.

Concrete precast manholes, as specified in material specifications, shall meet ASTM Designation C-478. Joints shall be watertight at completion.

**9. Catch Basins.** Catch basins shall be built where shown on the approved Plans or where directed by the Engineer and shall conform to NCDOT specifications and standard drawings 840.01-840.03. Precast reinforced concrete (4000 psi) structures of size equal to the built-in place basins are also acceptable. Waffle boxes will not be accepted.

Catch basin bottoms are to be a minimum 6" thick poured concrete pad, mortar pads are not acceptable. Block shall be installed on concrete pad and inverts shall be built within the box. Catch basins shall be parged with a non-shrink grout. No more than one course of block shall be used to bring precast catch basins to appropriate grade. Catch basin hoods shall be stamped with a note that the basins drain to streams.

**10. Grading and Trenching.** Scope: All areas designated on site to be either excavated or filled shall be included under this section, including all trench lines for all purposes.

**Excavation.** All areas shall be graded to subgrade elevations or finish grade (as appropriate) as shown on plans. All excess material shall be removed from the site unless areas for such disposal are designated on the plans.

**Backfill and Fill Material.** All backfill and fill material shall be suitable to acquire the following density:

- Building Areas: ASTM-D-698 98% Standard Proctor Density - minimum of 3,000 psf. (includes 5' outside building)
- Road and Parking and trenches in roads: ASTM-D-698 95% Standard Proctor Density except top 12" - 100% Standard Proctor.
- ASTM-D-698 100%. Stone base and asphalt compacted to 100% Standard Proctor.
- General Site Areas (non-structural): ASTM-D-698 90% Standard Proctor Density.

The Contractor will be responsible for testing of site during grading. All areas that do not meet the hereinbefore density test shall be removed and recompacted with acceptable materials at

contractors' expense. Copies of compaction test reports shall be provided to the City prior to placement of stone base and prior to pavement placement. See compaction testing requirements under Section 30.

Should any areas require excavation under subgrade as determined by the soil testing firm, the contractor shall undercut such areas to a depth or bearing determined by the soils engineer. Geotechnical engineer is to be an independent NC professional engineer.

Clearing and Grubbing. All areas to be excavated or backfilled shall be completely cleared and grubbed of all shrubs, trees, stumps, etc. before excavating and backfilling begins. All debris shall be removed from site in accordance with local codes.

Topsoil. Topsoil shall be stripped from areas to be excavated or backfilled. Excess topsoil can be placed in the slopes outside the shoulders in non-structural areas.

Boulders and Rock Disposal. Boulders and rock, if encountered, will not be permitted to be buried on site unless locations for such disposal have been designated on the plans by the Design Engineer. All spoil area shall be covered with a minimum of two (2) feet of earth to grades as set by the Design Engineer.

Embankment. Only suitable material approved by the Design Engineer shall be used in the formation of embankments. Prior to construction of embankments, all brush, roots, rubbish, sod, weeds, topsoil and other unsuitable material shall be removed from the natural ground within the limits of the fill. All surfaces upon which an embankment is to be placed shall be thoroughly scarified prior to its placement. Embankment materials shall be deposited and spread in uniform horizontal layers not more than 8" deep. Each layer shall be thoroughly compacted by rolling with approved equipment before starting the next layer. All embankments shall have 95% Standard Proctor compaction to a point five feet beyond edge of pavement or curb and gutter unless shown otherwise on plans. All fill shall be track placed prior to seeding. All embankments shall be protected with temporary slope drains or diversions. Provide guard rails on all roadway embankments higher than 8' in height.

Proofrolling. Upon completion of stripping and removing other soft or unsuitable material, the exposed subgrade in right-of-way, or other publicly maintained areas to receive fill shall be proofrolled prior to fill placement. The contractor shall also proofroll the final soil subgrade and ABC for pavement and curb line. Proofrolls shall be performed in the presence of the testing firm and city representative. The subgrade shall be proofrolled with a dual axle truck loaded to a min. 25-ton gross weight and verified by certified scale measurements. Any soft areas shall be repaired by the contractor.

11. Adjusting Manholes and Valve Boxes to Grade. All manholes and valve boxes within the project limits will be located by the City and shown to the contractor. It shall be the Contractor's responsibility to preserve and protect all manhole tops and boxes. The tops and boxes shall be adjusted to finished grade and held in place by a concrete collar poured around the castings as detailed on plans. (18" from ring and 8" deep) Concrete collars shall be installed at valve boxes that are located outside of road.

12. Concrete Curb and Gutter. All materials required in the construction of the concrete curb and gutter shall conform to the specifications for such materials as hereinbefore given. Class A concrete shall be used and shall be air entrained.

The dimensions and sizes of the concrete curb and gutter shall conform to the details shown in the Construction Details which are a part of the accompanying Plans. The curb and gutter shall

be constructed where shown on the Plans. The contractor shall provide expansion joints, construction joints, and handicap access per City requirements.

Except as herein modified, the methods used in the construction of the concrete curb and gutter shall comply with the N.C. State Highway Commission's "Standard Specifications for Road Structures", dated January, 2018 (as amended).

**13. Shoulder Drains.** All materials required in the construction of the shoulder drains shall conform to the specifications for such materials as given in this section. Shoulder drains shall be installed behind curb and gutter at the low point of each sag curve as shown in profile view. Shoulder drains shall extend a minimum of 25 feet on each side of the catch basins and shall be daylighted into catch basins.

Shoulder drains shall be constructed as a trench installed parallel to the back of curb. The trench shall be 18-inch deep and 12-inches wide, lined with a geotextile filter fabric. A 4-inch perforated pipe shall be installed in the bottom of the trench and backfilled with 12" of No. 67 washed stone with filter fabric wrapped over the stone to prevent soil migration. Soil shall be used above shoulder drain to bring the area to finished grade.

**14. Concrete Driveway Entrances.** All materials required in the construction of the concrete driveway entrances shall be the same as that specified for concrete curb and gutter.

**15. Aggregate Base Course.** All materials and methods of construction shall conform to Section 520 of the N.C. State Highway Commission's Standard Specifications for Road Structures, dated January, 2018 (as amended). The compacted thickness of the base course shall be 8" minimum (for residential streets only) unless shown otherwise or required by actual field conditions considering soil type and pavement design analysis prepared by a professional engineer. Copies of all base course delivery tickets shall be made available to the City and the Contractor shall certify that the material has been used in the construction of this project.

All materials shall be as hereinbefore specified.

**16. Prime Coat.** All materials and methods of construction shall conform to Section 600 of the N.C. State Highway Commission's "Standard Specifications for Road Structures", dated January, 2018 (as amended). The prime coat shall be applied at the rate of 0.20 - 0.50 gallons per square yard.

**17. Tack Coat.** All materials and methods of construction shall conform to Section 605 of the N.C. State Highway Commission's "Standard Specifications for Road Structures", dated January, 2018 (as amended). The tack coat shall be applied at the rate of 0.04 - 0.08 gallons per square yard. Tack shall be applied to existing asphalt or concrete surfaces prior to installation of all asphalt concrete courses.

**18. Asphalt Pavement Design.** The design engineer may provide a pavement design that shall be based on projected traffic volumes and percentage of trucks for commercial and industrial streets.

If the engineer proposes to reduce the commercial or industrial pavement section, a site-specific pavement design will be required. No reduction will be allowed to the minimum residential pavement section. The pavement design shall be in accordance with the following specifications:

- a. The pavement design and traffic analysis shall be signed and sealed by a North Carolina Professional Engineer and shall be submitted for approval prior to placement of curb and gutter or pavement material. In the absence of actual traffic counts approved by the City, truck volumes for the design of new residential streets shall be 4% for single frame trucks and 1% for multiple frame trucks. All streets maintained by the NCDOT must receive approval of the pavement design from the NCDOT prior to the placement of curb and gutter or pavement material.
- b. Approved pavement design methods include those most current as proposed by NCDOT, AASHTO and the Asphalt Institute MS I document. Other design methods will not be accepted.
- c. The AASHTO method will require use of a terminal serviceability index of 2.0 for collectors and 2.5 for thoroughfares,  $S_t = 0.45$  for flexible pavement or  $S_t = 0.30$  for rigid pavements, and a reliability of 95 percent for thoroughfares and 90 percent for collectors.
- d. Rigid pavement design shall follow the most current AASHTO Method or the Portland Cement Association Method.
- e. Pavement design shall be based on subgrade conditions, a 20-year design life and pre-approved projected traffic loading.
- f. Subgrade conditions shall be based upon corrected soaked CBR values at 0.1-inch penetration per ASTM D1883.
- g. Soil samples used for these CBR tests shall be obtained from the site in the actual location of the proposed roadway. If the proposed roadway is located in cut, the soil sample shall be taken at the proposed subgrade level. Samples shall be obtained at intervals not greater than 500 feet typically; a subdivision will require 2 to 3 soil samples as a part of the pavement design. Larger subdivisions, greater than 150 equivalent lots, may require additional soil samples at the discretion of the City Engineer.
- h. Boring logs and scaled drawings designating the site plan and boring locations with CBR tests and other pertinent data shall accompany the pavement design.

**19. Asphalt Concrete Binder Course.** All materials and methods of construction shall conform to Section 610, Type I-190B of the N.C. State Highway Commission's "Standard Specifications for Road Structures", dated January, 2018 (as amended). The compacted thickness shall be as on approved plans.

Copies of all binder course delivery tickets shall be made available to the City and the Contractor shall certify that the material has been used in the construction of this project.

**20. Asphalt Concrete Surface Course.** All materials and methods of construction shall conform to Section 610, Type S 9.5B of the N.C. State Highway Commission's "Standard Specifications for Road Structures", dated January, 2018 (as amended). The compacted thickness of the surface course shall be as shown on approved plans.

Copies of all surface course delivery tickets shall be made available to the City and the Contractor shall certify that the material has been used in the construction of this project.

21. Asphalt Pavement Repair. This standard applies to anyone cutting and excavating City streets, regardless of the reason for the cut and excavation. The asphalt pavement repair shall extend to 12" beyond the limit of the excavation on all sides located within the pavement. The length of the surface repair measured perpendicular to the street will be at a minimum the full width of a travel lane. If the edge of the excavation extends to within 12" of the crown or edge of travel lane, the surface repair must extend to the full width of the street, or the next travel lane. The cost of all repairs shall be borne by the party cutting the street.

22. Stabilization Stone for Ditches. The stone used for the stabilization of ditch bottoms shall be as hereinbefore specified. All storm sewers shall be laid on 6" of No. 67 Stone for the full trench width.

23. Erosion Control.

A. Reference to Other Documents. The General Conditions, Supplementary Conditions, Material Specifications, and Detailed Specifications for Installation contain requirements relevant to the work covered by this Section. Clearing and Grubbing, Site Grading, Clearing of rights of ways, excavating and backfilling, and Spoil Disposal will be subject to the applicable requirements of this Section.

B. General Requirements. Control of erosion and sedimentation resulting from land disturbing activities is subject to the requirements of the North Carolina Sedimentation Control Commission. Any authorized representative or agent of the commission shall be granted entry or access for purposes of inspection; he shall not be obstructed, hampered, or interfered with while he is in the process of carrying out his official duties. The requirements for erosion and sedimentation control apply to areas which are involved in borrow, waste disposal, and topsoil storage activities; and to areas which are directly involved with the construction of buildings, paving, curb, gutter, and to areas where storm drainage, water, and sewer lines and structures are installed. No Construction shall take place until erosion control permit is in hand and erosion control devices are installed.

Land disturbing activities shall be planned and carried out to achieve the following objectives:

- 1) Expose minimum sized areas at any one time
- 2) Limit exposures of areas to the shortest possible time
- 3) Control surface water run-off to reduce erosion and sediment loss
- 4) Hold off-site erosion and sedimentation damage to a minimum

With reference to requirement No. 2, portions of the site on which land disturbing activities have been undertaken, but upon which no further active construction takes place for a period of 15 working days, shall be planted or otherwise provided with a ground cover sufficient to restrain erosion.

The Contractor shall be responsible for maintaining all temporary and permanent erosion and sedimentation measures and facilities until the project is accepted by the City, or until removal of facilities and cessation of control measures is authorized by the Engineer.

C. Work Included. This Section includes the labor, materials, equipment, and related services required for the installation of berms, drainage structures, storm water drains, straw barriers, vegetative covers, and other devices or methods for control of erosion and sedimentation shown on the Drawings or specified herein.

D. Facilities and Measures for Erosion and Sedimentation Control.

1) Phased Construction. The installation of improvements shall be done in phases as specified on the construction drawings.

This phasing of construction will help limit erosion caused during the installation of the improvements and will act as an erosion control measure.

2) Clearing and Grubbing. The Contractor is to clear the entire width of the permanent easement of trees, stumps, shrubs, and brush. The natural vegetative cover is to remain intact until the installation of the line begins, except that which has to be removed during the clearing and grubbing operation. Stumps, brush, and rubbish resulting from the clearing operation shall not be disposed of by placing on adjoining privately owned property unless the Contractor has a written instrument from the property owner. All other spoil is expected to be trucked off to the sanitary landfill for disposal.

3) Rip Rap. Rip Rap shall be installed at locations as shown on plans or as directed by the Engineer, per the NCDENR erosion control manual.

4) Berms. Drainage berms and ditches shall be installed as shown on the Drawings per the NCDENR erosion control manual.

5) Silt Fence. Silt fences shall be installed as shown on the Drawings or when directed by the Engineer, per the NCDENR erosion control manual.

6) Excelsior Matting. Matting shall be installed at location shown on the Drawings and shall be in compliance with "Standards and Specifications for Soil Erosion and Sediment Control" by the Land Quality Section of NCDENR, per the NCDENR erosion control manual.

7) Permanent Vegetative Cover. Prepare seedbed by ripping, chiseling, harrowing or plowing to depth of six inches so as to produce a loose, friable surface. Remove all stones, boulders, stumps or debris from the surface which would prohibit germination or plant growth, per the NCDENR erosion control manual.

Incorporated into the soil 800 to 1,000 pounds of 10-10-10 fertilizer plus 500 pounds of twenty percent (20%) Superphosphate per acre and two tons of dolomitic lime per acre unless soil tests indicate that a lower rate can be used.

Mulch after seeding with 2.0 tons of grain straw per acre and either crimp straw into soil or tack with liquid asphalt at 400 gallons per acre or emulsified asphalt at 300 gallons per acre.

#### PERMANENT SEEDINGS

<u>PLANTS &amp; MIXTURE</u>	<u>PLANTING RATE/ACRE</u>	<u>PLANTING DATES</u>
TALL FESCUE (LOW MAINTENANCE)	100-150 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE WATERWAYS AND LAWNS (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1

BLEND OF TWO TURF-TYPE TALL FESCUES (90%) AND TWO OR MORE IMPROVED KENTUCKY BLUEGRASS VARIETIES (10%) (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE AND KOBE OR KOREAN LESPEDEZA	100 LBS. & 20-25 LBS.	FEB. 15 - MAY 1 AUG. 15 - OCT. 15
TALL FESCUE AND SERICEA LESPEDEZA	50 LBS. 60 LBS./ACRE	NOV. 1 - FEB. 1 (UNSCARIFIED)
TALL FESCUE AND GERMAN MILLET OR SUNDANGRASS	70 LBS. AND 40 LBS.	JULY AND AUGUST
TALL FESCUE AND RYEGRAIN	70 LBS. AND 25 LBS.	NOV. 1 - JAN. 30
COMMON BERMUDAGRASS	8 LBS. (HULLED) 15-20 LBS. (UNHULLED)	APRIL 15 - JUNE 30 FEB. 1 - MARCH 30

Permanent Seeding Notes:

1. For spring seedlings, use scarified lespedeza seed. For late fall and winter seedings, use unscarified seed.
2. Annuals such as millet, sundangrass and ryegrain must be kept at 10-12" maximum height. The use of annual rye grass is not permitted.

The preceding permanent cover requirements pertain to all areas disturbed during the project construction including road shoulders, temporary access roads, spoil areas, building sites, rights-of-way, easements and line work.

24. Relocation of Hydrants, Water & Sewer Services. The Contractor shall be responsible for and shall move all hydrants, water services and sewer services that require relocation. All relocated utilities shall be inspected by the Engineer and City unless specified otherwise on plans.

25. Existing Pipes, Conduits, and Cables - Care of. Special care must be exercised by the Contractor, in the installation of all improvements and in passing under or over existing storm sewers, sanitary sewers, water lines, gas lines, and telephone or power conduits or cables. All aforementioned pipes, cables, lines, or structures broken or ruptured by the Contractor must be immediately repaired or replaced by him. Contractor shall contact the appropriate utility locating service or personnel prior to initiating construction.

26. Responsibility for Damages. The Contractor shall be held responsible for all damages claimed, as a result of the installation of this project, to all utility poles, driveways, yards, shrubbery and plantings, drain ditches, and pipes, pavement, sidewalks, water lines, gas lines, telephone or power conduits or cables, buildings, fences, etc.

27. Signs and Barricades. The Contractor shall at his cost provide, erect, maintain, and illuminate, where necessary, all barricades, warning signs and local detour signs required.

28. Cleanup. Upon completion of the work the Contractor shall remove all excess materials, earth, debris, etc., along the line of his work and shall cleanup and leave, in its original condition, all affected private property.

29. Guarantee. The Contractor shall guarantee that if any materials, equipment or workmanship covered by these Specifications and the accompanying Drawings proves defective within one year after final acceptance, such defects shall be made good by him. The Engineer shall provide a letter to the City indicating the start of the 12-month guarantee period. If the Contractor chooses to pave the full asphalt cross section of the roadway initially, rather than delay the top course of asphalt, the warranty period for any infrastructure impacted by asphalt pavement failure or replacement shall be extended to a 24-month guarantee period. Provide State required certifications and "As Builts" with guarantee letter.

30. Compaction Testing Requirements. Section 10 provides the standards for compaction in all streets and trenches. Testing reports shall be submitted to the engineer prior to proceeding to the next phase of construction (i.e. Subgrade tests shall be submitted prior to stone placement). The following is the minimum testing schedule for compaction tests and each test shall be independent of other tests and no single test can count for multiple locations. Additional testing may be required by City Engineer or Public Works Director's request:

A. Sanitary and Storm Sewer Line trenches

- i. If trench 0-8 ft. deep, provide one (1) test at half depth and at subgrade between each manhole/structure.
- ii. If trench over 8 ft. deep, provide one (1) test for each 4 ft. and at subgrade excluding bottom of trench between each manhole. Tests shall be taken at the depths based on the trench depth divided by 4. As an example, for a 12 ft. trench, tests are required at the 4 ft. and 8 ft. depths plus at subgrade ( $12/4 = 3$ ).
- iii. Services- provide one (1) compaction test for every 5 services.
- iv. Manholes or curb inlets-provide compaction tests for every 5th MH(CI) within 2 ft. of the manhole based on the trench depth as described above.

B. Water Line trenches

- i. One (1) compaction test for every 500 ft. of line at subgrade if water line is less than 4 ft. of cover and at all street crossings.
- ii. Services- provide one (1) compaction test for every 5 services.

C. Street Compaction tests

- i. One per 500 ft. of street outside of trench lines. This includes the subgrade, stone testing, and asphalt testing.



**WATER MAINS: DETAILED SPECIFICATIONS FOR INSTALLATION**

1. General Provisions
2. Scope of Work
3. Clearing of Rights-of-Way
4. Excavation for Pipelines
5. Rock Excavation in Trenches
6. Pavement Cutting and Removal
7. Backfilling Trenches
8. Pipelines Crossing Gravel Drives
9. Pipe Laying - General Provisions
10. Pipe Laying - Ductile Iron Water Main
11. Setting Valves and Valve Boxes
12. Setting Fire Hydrants
13. Setting Ductile Iron Fittings
14. Joint Restraint
15. Blowoffs
16. Dead End Waterlines
17. Water Services
18. Testing of Water Mains
19. Chlorination of Water Mains
20. Connections to Existing Water Mains
21. Pipelines Under State Highway Pavement
22. Pavement Replacement
23. Existing Pipes, Conduits, and Cables - Care of
24. Responsibility for Damages
25. Signs and Barricades
26. Cleanup
27. Erosion Control
28. Bonds and Permits Required by N.C. State Highway Commission
29. Guarantee
30. Testing Notice
31. Damaged Piping

1. General Provisions. The following Specifications cover work which is to be furnished and installed under the document containing water mains.

2. Scope of Work. The work to be performed under this Contract includes the Water Mains shown on the Drawings complete with all appurtenant items, as shown on the accompanying Plans and as Described in these Specifications.

3. Clearing of Rights-of-Way. Where clearing and grubbing is required, the area to be cleared shall be grubbed of all stumps and shall be left free of all stumps, brush and rubbish resulting from the clearing operation.

4. Excavation for Pipelines. All excavation shall be of one classification regardless of the material encountered, unless a rock clause is included in the supplemental conditions. All trenches shall be excavated in open cut from the surface, except as otherwise provided for herein, and in close conformity to the lines given by the engineer. The contractor shall be responsible for staking water line alignment in streets where curb and gutter will be installed to insure proper alignment and depth.

In order that there be sufficient room for properly laying and jointing the pipe, trench widths shall be a minimum of 24" plus the outside pipe diameter. In order to safeguard the pipe, however, the maximum trench width shall not exceed 36" plus the outside pipe diameter unless approval to the contrary is given by the Engineer. Trench widths will be measured between faces of the cut at the top of the pipe.

Where no special bedding is required, trench bottoms may be machine excavated to slightly above grade and cut down to pipe grade by hand in the fine-grading operation. Should the trench bottom be inadvertently cut below grade, it shall be filled to grade with #67 stone tamped.

Length of trench open ahead of pipe laying shall be no more than 300 feet, and no less than 20 feet unless approval is obtained from the Engineer. Contractor shall open no more trench than can be covered by end of working day.

Wet trenches or those of unstable subgrade shall be stabilized by the use of No. 67 stone.

The Contractor shall keep all trenches free from water during excavation for pipelines. The water shall be pumped out of the ditch or dams built to keep it out of the ditch in such a manner as not to cause injury to the public health, private property, or the work in progress.

Portable bridges shall be erected across trenches, wherever the Engineer deems them necessary to permit the passage of vehicular and/or pedestrian traffic.

The Local Fire Department and 911 shall be notified at least 24 hours before any street is blocked by the opening of a trench. The fire department and 911 shall also be notified when the street is once again open to traffic.

Sheeting or bracing shall be used wherever necessary to prevent caving of the trench banks. The removal of sheeting shall be done in such a manner as to minimize the loss of friction between the trench walls and the backfill. Sheeting shall be cut off and left in place where its removal will adversely affect the pipeline installation.

5. Rock Excavation in Trenches. Should rock be encountered in the trenches, the excavation shall be carried to a depth of 6" below the body of the pipe and the trench shall be brought back to grade with No. 67 stone properly compacted.

Should rock be encountered in the trenches and blasting is required for its removal, then all blasting operations shall be conducted in strict accordance with existing ordinances and accepted safe practices relative to the storage and use of explosives.

No rock excavated from trenches larger than 3" in diameter shall be used to backfill such trenches and no rock is allowed in the first 24" above the top of pipe. The Items named for the various sizes and classification of pipe to be installed shall include the removal and disposal of such excavated rock material. The Contractor shall secure, haul, and place in the trench sufficient suitable backfill material. Suitable backfill material is defined as stabilization stone, sand, or native material free from rocks and of optimum moisture content in order to compact to 95% of standard proctor. The use of native material shall be subject to the sole approval by the Engineer or his representative.

6. Pavement Cutting and Removal. Wherever it becomes necessary to cut pavement, the cuts shall be confined to a maximum width of the nominal pipe diameter plus 24". No pavement shall be cut wider than these Specifications without authorization from the Engineer. All pavement to be removed shall be marked for cutting by chalk line or other acceptable method. After marking, bituminous pavement shall be sawed to its full depth to a neat and true line along the mark. Concrete pavement shall be sawed to a minimum depth necessary for a smooth cut when broken out. All pavement cut shall be removed from the site of the work and shall not be used to backfill trenches.

7. Backfilling Trenches. Trenches shall be filled in layers six inches (6") deep and thoroughly compacted with mechanical compactors to attain 95% of standard proctor, except the top 12" to be 100% of standard proctor. Dry material used in refilling will be sufficiently moistened so that after compacting, future settlement will be at a minimum. Flooding will not be permitted and excess water from any cause will be removed from the ditch. Material left over from the trench shall be hauled away or disposed of as the Engineer may direct and no extra compensation will be allowed for such disposal. If native soil from the trench is unsuitable to attain a stable, unyielding trench; the contractor shall provide suitable backfill at his own expense as defined in paragraph 6. Compaction tests in the trenches shall be provided by a certified testing firm as further provided under Section 10 and 28 in the Street and Site Improvements specifications.

The top twelve inches (12") of all trenches where pavement has been cut, and where directed by the Engineer, shall be backfilled with crushed stone placed in layers six inches (6") deep and thoroughly compacted. This stone shall be Aggregate Base Course meeting the requirements of the N.C. State Highway Commission's "Standard Specifications for Road Structures", dated January, 2018 (as amended). It shall be the Contractor's responsibility to maintain all pavement cuts until paved or accepted by the City.

Wherever pipelines are laid in or across unpaved roads or streets, or along the shoulders of paved roads, backfilling shall be accomplished in the same manner as hereinbefore described for trenches in paved roads or streets except that the trench shall be filled its full depth with earth.

8. Pipelines Crossing Gravel Drives. Wherever a water line crosses a gravel drive, it shall be backfilled as hereinbefore described in backfilling trenches for crossing paved roads, except the top six inches (6") shall be filled with thoroughly compacted aggregate base course (ABC).

9. Pipe Laying - General Provisions. The Contractor shall be responsible for all material which may become a part of the finished work until it is finally in place, tested and accepted by the City, except as otherwise provided for herein, and shall remove from the lines any cracked or defective pipe or fittings and shall replace them with new pipe or fittings without extra compensation. Great care must be exercised by the Contractor in handling lined pipe so as not

to injure the linings. A damaged lining in a piece of pipe or a fitting will be deemed sufficient reason for its rejection by the City.

Should any pipe be cracked or defective, the City may allow the Contractor to cut off the cracked or defective portion and lay the remainder of the pipe if, in the City and the Contractor's opinion, the cutting off of the cracked or defective end will not injure the balance of the pipe. Permitting such cutting off of cracked or defective ends, however, will not absolve the Contractor from any of his responsibility toward the work. Cutting pipe will only be allowed at ends or with special permission of City staff.

All pipe shall be thoroughly cleaned of earth and rubbish before being placed in the trench, and so kept until final completion and acceptance of the work. Every open end of the pipe shall be securely plugged when pipe laying is not in progress.

All pipe shall be laid on lines and grades as directed by the Engineer and as shown on the Drawings. All pipe shall be placed on a firm foundation so as to prevent subsequent settlement, and the trenches shall be carefully excavated to the proper grade, except where rock excavation is encountered, so that it will be unnecessary to fill in under the pipe. Bell holes shall be provided for all pipe laying modes and special care shall be exercised in obtaining full barrel support.

Blue trace wire shall be installed on all water lines. Trace wire shall be 12-gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Trace wire must have an insulating thickness of 30 mil and rated for 30v and should terminate inside the meter box/valve box for access.

10. Pipe Laying - Ductile Iron Water Main. The installation of ductile iron pipe for water main shall be performed in accordance with the appropriate sections and subsections of AWWA C600. Minimum cover for water mains 8" diameter and smaller shall be 3 feet. Minimum cover for water mains 10" and larger shall be 4 feet. Pipe shall be installed as shown on the Plans and as directed by the Engineer.

Handling of pipe and accessories shall at all times be done in such a manner as to prevent damage to lining of body. All pipe, fittings, valves and hydrants shall be lowered into the trench by approved methods. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Pipe shall be swabbed clean before it is laid and any pipe which cannot be cleaned with a swab shall be removed and cleaned with suitable apparatus. Any pipe showing evidence of oil, tar or grease shall be permanently marked and removed from the job and shall not be returned until it has been cleaned to the satisfaction of the Engineer.

Laying of pipe shall be done in accordance with section 7 of AWWA C600, with care being taken to provide uniform bearing for the pipe. The laying of pipe on wood or other blocking will not be permitted. Bell ends shall face direction of laying unless otherwise directed by the Engineer. For lines on an appreciable slope, the Engineer may require that bell ends face upgrade. Bell and spigot of pipe shall be thoroughly cleaned and properly lubricated where a mechanical joint or a "push on" type of joint is employed.

Open ends of pipe shall be plugged with a standard plug or cap at all times when pipe laying is not in progress. Trench water shall not be permitted to enter the pipe.

Pipe cutting, where required, shall be done in a neat and workmanlike manner without damage to the pipe. Pipe cutting shall be done only with equipment especially designed and fabricated for that purpose. The use of chisels and cleavers will not be permitted.

Water mains shall be installed at the locations shown on the Plans or as directed by the Engineer.

**11. Setting Valves and Valve Boxes.** Gate valves shall be set at locations shown on the Plans or as directed by the Engineer. The installation shall be made in accordance with Section 10 of AWWA C600. Each valve shall be equipped with a valve box accurately positioned over the wrench nut. Each valve box shall have a 6" thick x 24" diameter - Class A Concrete collar. Each valve box in pavement shall have a concrete collar poured around casting, 18" from ring and 8" deep. Valve boxes outside of pavement shall have a concrete collar (concrete donut).

**12. Setting Fire Hydrants.** Fire Hydrants shall be set at locations shown on the Plans or as directed by the Engineer. In general, hydrants shall be located in a manner to provide complete accessibility and to minimize possibility of damage from vehicles or injury to pedestrians. The installation shall be made in accordance with Section 11 and 12 of AWWA C600 except as amended herein.

Drainage for hydrants shall be in accordance with subsections 11.4 and 11.5 of AWWA C600.

Each hydrant shall be set plumb and shall be restrained from the hydrant tee through the gate valve to the hydrant using mega-lug mechanical joint restraints. All valves installed on hydrant legs shall be securely anchored to the main line tee with mega-lugs.

Before a hydrant is set, it shall be carefully examined, and all dirt and other foreign matter shall be removed from it.

Fire Hydrants on water mains less than 12" in size shall have a main valve opening of 4-1/2" with 3-6" bury. For water mains 12" and greater in size fire hydrants shall have main valve opening of 5-1/4" with 4'-6" bury.

Fire hydrants shall be repainted after installation - using paint furnished by hydrant supplier, to the City Standard colors.

**13. Setting Ductile Iron Fittings.** Ductile iron fittings shall be set at locations shown in the Plans or as directed by the Engineer. The installation of fittings shall be made in accordance with Section 10 of AWWA C600. Special care shall be taken to properly bell-up the joints and to support the body of the fitting. All fittings shall be restrained using mega-lug mechanical joint restraints.

**14. Joint Restraint.** All ductile iron fittings, hydrants, valves, fittings, and other water main components subject to hydrostatic thrust shall be securely restrained by use of mega-lug mechanical joint restraints.

**15. Blowoffs.** All dead-end water mains, not provided with hydrants reasonably close to such dead ends, shall be equipped with blowoff facilities as provided for in Section 10 of AWWA C-600. Blowoffs shall be installed per details.

**16. Dead End Waterlines:** Dead end waterlines are to be extended beyond pavement and are to be installed to facilitate future extension. Concrete blocking must have #4 rebar mat at twelve inches (12") off center each way. Megalugs are required to be in the middle of the concrete blocking.

**17. Water Services.** Taps shall only be made after the water main is under pressure. No taps on dry mains will be allowed unless specific authorization is obtained from the Engineer. Taps shall be on an angle 45 degrees to a perpendicular through the centerline of the pipe.

The maximum size of direct taps in water mains shall be as follows:

<b>Water Main Size</b>	<b>Tap Size</b>
4"	3/4"
6"	1"
8"	1"
12"	1 1/4"
16" or Larger	2"

The Contractor shall be equipped to make the above size taps on water mains. For taps sizes larger than the maximum size of direct tap allowed will require a double strap bronze design service saddle.

**18. Testing of Water Mains.** All water mains (including *services*), before final acceptance shall be tested by filling the main with water, care being taken to expel all air. As a part of this operation, the main to be tested shall be flushed by opening the terminal valve hydrant or blowoff. A temporary tail ditch shall be provided to carry the flushing water to the nearest drain ditch. A pressure of 150 psi shall be applied to the main at the test pump and shall be maintained at that pressure for a minimum period of 2 consecutive hours. All defective material found shall be replaced by the Contractor.

All leaking joints shall be made tight. The pipe installation will not be accepted unless and until the leakage, evaluated on the pressure test of 150 psi for a minimum of 2 hours, does not exceed 10.0 gallons per day per mile of pipe per inch of nominal diameter. Test pump drawings shall be approved by Engineer.

In general, the pressure test and the leakage test shall be performed in the manner set forth in Section 13 of AWWA Standard C600, except that the Contractor shall furnish his own pressure gauges. The pressure test and the leakage test shall be performed by the Contractor and witnessed by the City Engineer.

**19. Chlorination of Water Mains.** All additions to the water system shall be sterilized by chlorination before being placed in service. Such chlorination must be made under the observation of the Engineer and in accordance with ANSI/AWWA C651. After disinfection the water supply shall not be placed into service until bacteriological test results of representative water samples are found to be satisfactory. Chlorination of water mains and Dechlorination of water mains shall be carried out in the following manner:

**a.** Taps shall be made at the control valve at the upstream end of the line and at all extremities of the line. These taps shall be located in such a manner as to allow HTH solution to be fed into all parts of the main.

**b.** A solution of water containing high test hypochlorite (70% available chlorine) shall be introduced into the main by regulated pumping at the control valve tap. The solution shall be of such concentration that the water in the main will have at least 50 ppm total chlorine residual

immediately after chlorination. The following chart shows the required quantity of 70% HTH compound to be contained in solution in each 1,000-foot section of pipe to produce the desired concentration of 50 ppm:

<u>Pipe Size</u>	<u>Pounds 70% HTH Per 1,000 Ft. of Pipe</u>
6"	0.88
8"	1.56
10"	2.42
12"	3.50

c. The HTH solution shall be circulated in the pipelines by opening the control valve and systematically manipulating hydrants and taps at the main extremities until a uniform concentration has been produced throughout the pipe.

d. The HTH solution shall remain in the main for not less than 24 hours. At the end of this time, the residual chlorine shall be at least 10 ppm. Should the chlorine residual be found to be less than 10 ppm, then the pipelines shall be rechlorinated.

e. Following satisfactory chlorination, the pipelines shall be flushed. Flushing shall continue until only a normal chlorine residual, as determined by the ortho-tolidine test, is present in the water.

f. The Contractor shall be responsible to dechlorinate or dechlorinate any water before it is released to the ground. The Contractor shall use an apparatus that injects or mixes EPA approved chemicals containing one of the following chemicals (ascorbic acid, sodium sulfite or sodium thiosulfate) with the discharged water to neutralize the chloramine or chlorine before it is released to the ground. Approved chemicals for use are: (Vita-D-Chlor Tablets, D-Chlor Tablets, No-Chlor Dechlorination Grade Calcium Thiosulfate Solution, or pre-approved equivalent). Approved dechlorination units are: (Pollard Water LPD250 Diffuser with tablet screen and Dechlorination System, the H2O Neutralizer manufactured by Measurement Technologies, Inc., or pre-approved equivalent), or as directed by the Engineer. Total chlorine residual levels shall be reduced and maintained between a minimum of 1.0 parts per million (1.0mg/l) to a maximum of 4.0 parts per million (4.0mg/l). The Contractor shall test the discharge at 15-minute intervals to ensure that acceptable levels of neutralization are maintained. Discharge shall be stopped if chlorine levels exceed 4.0 parts per million (4.0mg/l). The Contractor under the supervision of the Engineer shall perform the dechloramination and/or dechlorination.

All procedures shall be in accordance with manufacturers recommendations and as approved by the Engineer.

Only in cases where this method is not practical for unique reasons will the City consider allowing the water to be released into the collections system. In those cases, the Contractor will need to make a request at least 48 hours in advance in order for the City to determine the acceptability of the downstream collection facilities.

g. Following the flushing of the pipelines, and after payment has been made for sample fees, samples shall be taken at various points along the line designated by City for bacteriological analyses. City staff will collect samples for bacteriological testing at the State-approved Graham-Mebane Water Treatment Plant. If test results are satisfactory, the pipelines may be placed in service after completion of certifications and as-builts. If test results are not satisfactory, rechlorination shall be undertaken at once.

All chlorination of the water system shall be performed by the Contractor at no cost to the City.

All water samples must be taken prior to 12 PM (noon) on Wednesday.

20. Connections to Existing Water Mains. Connections to existing water mains shall be made as detailed on the plans, using material hereinbefore specified or as shown on the Drawings. No connection to existing water main without approval of the City shall be made.

21. Pipelines Under State Highway Pavement. Where shown on the Plans, or as directed by the Engineer, ductile iron water mains shall be installed under State Highway pavement by encasing in a larger pipe. The carrier pipe shall be of restrained joint ductile iron and the encasement pipe shall be steel.

The encasement pipe shall be installed true to line and grade and in conformance with the requirements of the N.C. State Highway Commission. The size of the encasement and carrier pipes will be as shown on the Drawings.

Following the installation of the carrier pipe, the ends of the encasement pipe shall be suitably protected against the entrance of foreign material but shall not be tightly sealed. In general, this may be accomplished by the use of the same stone specified for trench stabilization. The ductile iron carrier pipe shall extend approximately 5.0 feet beyond each end of the encasement pipe.

Pipelines installed under this section shall not be undertaken without the express approval of the appropriate N.C. State Highway Commission's Division Engineer.

22. Pavement Replacement. All pavement cut and removed from publicly maintained roads, streets, or highways as authorized by the Engineer, shall be replaced by the Contractor. Pavement cuts shall be maintained by the Contractor until such time as the pavement has been replaced, but such replacement shall be done as promptly as weather permits. Pavement shall be replaced within 48 hours of being cut. No pavement cuts are allowed on Friday.

23. Existing Pipes, Conduits, and Cables - Care of. Special care must be exercised by the Contractor, in the installation of the lines and improvements, in passing under or over existing storm sewers, sanitary sewers, water lines, gas lines, and telephone or power conduits or cables. All aforementioned lines, cables, conduits, or structures broken or ruptured by the Contractor must be immediately repaired or replaced by him.

24. Responsibility for Damages. The Contractor shall be held responsible for all damages claimed, as a result of the installation of this project, to all utility poles, driveways, yards, shrubbery and plantings, drain ditches, and pipes, pavement, sidewalks, water lines, gas lines, telephone or power conduits or cables, buildings, fences, etc., and will be required to make satisfactory adjustment of all claims arising from the installation of the work contemplated.

25. Signs and Barricades. The Contractor shall provide, erect, maintain, and illuminate, where necessary, all barricades, warning signs and local detour signs required. The contractor shall be held responsible for all damages to the project due to the failure of the signs and barricades to properly protect the work from traffic, pedestrians, animals, and from all other sources.

26. Cleanup. Upon installation of the specified improvements, the Contractor shall remove all excess materials, earth, debris, etc., along the line of his work and shall cleanup and leave, in its original or better condition, all affected property. The contractor shall clean up all work to the point of construction activity not less than weekly.



## 27. Erosion Control.

A. Reference to Other Documents. The General Conditions, Supplementary Conditions, Material Specifications, and Detailed Specifications for Installation contain requirements relevant to the work covered by this Section. Clearing and Grubbing, Site Grading, clearing of rights of ways, excavating and backfilling, and Spoil Disposal will be subject to the applicable requirements of this Section.

B. General Requirements. Control of erosion and sedimentation resulting from land disturbing activities is subject to the requirements of the North Carolina Sedimentation Control Commission. Any authorized representative or agent of the commission shall be granted entry or access for purposes of inspection; he shall not be obstructed, hampered, or interfered with while he is in the process of carrying out his official duties. The requirements for erosion and sedimentation control apply to areas which are involved in borrow, waste disposal, and topsoil storage activities; and to areas which are directly involved with the construction of buildings, paving, curb, gutter, and to areas where storm drainage, water, and sewer lines and structures are installed. No Construction shall take place until erosion control permit is in hand and erosion control devices are installed.

Land disturbing activities shall be planned and carried out to achieve the following objectives:

- 1) Expose minimum sized areas at any one time
- 2) Limit exposures of areas to the shortest possible time
- 3) Control surface water run-off to reduce erosion and sediment loss
- 4) Hold off-site erosion and sedimentation damage to a minimum

With reference to requirement No. 2, portions of the site on which land disturbing activities have been undertaken, but upon which no further active construction takes place for a period of 15 working days, shall be planted or otherwise provided with a ground cover sufficient to restrain erosion.

The Contractor shall be responsible for maintaining all temporary and permanent erosion and sedimentation measures and facilities until the project is accepted by the City, or until removal of facilities and cessation of control measures is authorized by the Engineer.

C. Work Included. This Section includes the labor, materials, equipment, and related services required for the installation of berms, drainage structures, storm water drains, straw barriers, vegetative covers, and other devices or methods for control of erosion and sedimentation shown on the Drawings or specified herein.

### D. Facilities and Measures for Erosion and Sedimentation Control.

- 1) Phased Construction. The installation of improvements shall be done in phases as specified on the construction drawings.

This phasing of construction will help limit erosion caused during the installation of the improvements and will act as an erosion control measure.

- 2) Clearing and Grubbing. The Contractor is to clear the entire width of the permanent easement of trees, stumps, shrubs, and brush. The natural vegetative cover is to remain intact until the installation of the line begins, except that which has to be removed during the clearing and grubbing operation. Stumps, brush, and rubbish resulting from the clearing operation shall not be disposed of by placing on adjoining privately owned

property unless the Contractor has a written instrument from the property owner. All other spoil is expected to be trucked off to the sanitary landfill for disposal.

3) Rip Rap. Rip Rap shall be installed at locations as shown on plans or as directed by the Engineer per the NC DENR erosion control manual.

4) Berms. Drainage berms and ditches shall be installed as shown on the Drawings per the NC DENR erosion control manual.

5) Silt Fence. Silt fences shall be installed as shown on the Drawings or when directed by the Engineer per the NC DENR erosion control manual.

6) Excelsior Matting. Matting shall be installed at location shown on the Drawings and shall be in compliance with "Standards and Specifications for Soil Erosion and Sediment Control" by the Land Quality Section of NCDENR per the NC DENR erosion control manual.

7) Utility Line Installation. Soil resulting from trench excavation to be used as backfill material shall be placed on the uphill side of the trench. This will prohibit runoff directly into the creek. No excavation shall be placed in the creek or on the bank at any time. Rock encountered during excavation shall be removed from the site and shall not be disposed of by placing on adjoining privately owned property.

8) Permanent Vegetative Cover. Prepare seedbed by ripping, chiseling, harrowing or plowing to depth of six inches so as to produce a loose, friable surface. Remove all stones, boulders, stumps or debris from the surface which would prohibit germination or plant growth per the NC DENR erosion control manual.

Incorporated into the soil 800 to 1,000 pounds of 10-10-10 fertilizer plus 500 pounds of twenty percent (20%) Superphosphate per acre and two tons of dolomitic lime per acre unless soil tests indicate that a lower rate can be used.

Mulch after seeding with 2.0 tons of grain straw per acre and either crimp straw into soil or tack with liquid asphalt at 400 gallons per acre or emulsified asphalt at 300 gallons per acre.

## PERMANENT SEEDINGS

<u>PLANTS &amp; MIXTURE</u>	<u>PLANTING RATE/ACRE</u>	<u>PLANTING DATES</u>
TALL FESCUE (LOW MAINTENANCE)	100-150 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE WATERWAYS AND LAWNS (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
BLEND OF TWO TURF-TYPE TALL FESCUES (90%) AND TWO OR MORE IMPROVED KENTUCKY BLUEGRASS VARIETIES (10%) (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE AND KOBE OR KOREAN LESPEDEZA	100 LBS. & 20-25 LBS.	FEB. 15 - MAY 1 AUG. 15 - OCT. 15
TALL FESCUE AND SERICEA LESPEDEZA	50 LBS. 60 LBS./ACRE	NOV. 1 - FEB. 1 (UNSCARIFIED)
TALL FESCUE AND GERMAN MILLET OR SUNDANGRASS	70 LBS. AND 40 LBS.	JULY AND AUGUST
TALL FESCUE AND RYEGRAIN	70 LBS. AND 25 LBS.	NOV. 1 - JAN. 30
COMMON BERMUDAGRASS	8 LBS. (HULLED) 15-20 LBS. (UNHULLED)	APRIL 15 - JUNE 30 FEB. 1 - MARCH 30

### Permanent Seeding Notes:

1. For spring seedlings, use scarified lespedeza seed. For late fall and winter seedings, use unscarified seed.
2. Annuals such as millet, sundangrass and ryegrain must be kept at 10-12" maximum height. The use of annual rye grass is not permitted.

The preceding permanent cover requirements pertain to all areas disturbed during the project construction including road shoulders, temporary access roads, spoil areas, building sites, rights-of-way, easements and line work.

28. Bonds and Permits Required by N.C. State Highway Commission. The Contractor, at his own expense, will secure from the N.C. State Highway Commission, the "Encroachment Agreement" required prior to the installation of that portion of this project that lies within the right-of way of the said Commission. Any or all other bonds and/or permits required by the said Commission in connection with this project shall be provided by the Contractor. This relates especially to the "Permit to Open Pavement" and the performance bond.

29. Guarantee. The Contractor shall guarantee that if any materials, equipment or workmanship covered by these Specifications and the accompanying Drawings proves defective within one year after final acceptance, such defects shall be made good by him. The Engineer shall provide a letter to the City indicating the start of the 12-month guarantee period. Provide State required certifications and "As Builts" with guarantee letter.

30. Testing Notice. Notice to the City, for any testing related to water line work, will be required of the Contractor 48-hours in advance of testing.

31. Damaged Piping. Should any piping be damaged prior to acceptance by the City, the whole joint will be replaced.

**SANITARY SEWER LINES: DETAILED SPECIFICATIONS FOR INSTALLATION**

1. General Provisions
2. Scope of Work
3. Lines and Grades for Sanitary Sewer Lines
4. Clearing of Rights-of-Way
5. Excavation for Pipelines
6. Rock Excavation in Trenches
7. Pavement Cutting and Removal
8. Backfilling Trenches
9. Pipelines Crossing Gravel Drives
10. Pipe Laying - General Provisions
11. Pipe Laying - PVC Sewer Pipe
12. Pipe Laying - Ductile Iron Pipe Sanitary Sewer Mains
13. Precast Concrete Manholes
14. Drop Manholes
15. Connections to Existing Sewage Collection System
16. Testing Sewer Lines and Force Mains
17. Setting Ductile Iron Fittings
18. Joint Restraint
19. Concrete Encasement
20. Pipelines Under State Highway Pavement
21. Pavement Replacement
22. Existing Pipes, Conduits, and Cables - Care of
23. Responsibility for Damages
24. Signs and Barricades
25. Cleanup
26. Erosion Control
27. Bonds and Permits Required by N. C. State Highway Commission
28. Guarantee
29. Manhole Testing
30. Video Inspection
31. Testing Notice
32. Damaged Pipe

1. General Provisions. The following Specifications cover work which is to be furnished and installed under the document containing Sanitary Sewer Improvements.

2. Scope of Work. The work to be performed under this Contract includes the Sanitary Sewer Improvements shown on the Drawings, complete with all appurtenant items, as shown on the accompanying Plans and as described in these Specifications.

3. Lines and Grades for Sanitary Sewer Lines.

The Contractor shall furnish the following material, equipment, and services:

(a) All intermediate lines, grades, hubs, measurements, etc., required for the actual construction;

(b) Suitable laser equipment for installing the pipe at the indicated grade. Installation by batter boards will not be allowed.

(c) Both a transit and leveling instrument with appurtenances, all meeting the Engineer's approval, shall be kept on the construction site and a person skilled in their operation shall be employed or obtained whenever necessary to give or check elevations, levels, alignment, etc., in the work as the Contractor may need and as the Engineer may request;

(d) Two (2) copies of a daily record of the approximate lineal feet and depth of sewer trench opened per pipe size, the lineal feet of each size of pipe installed at the various incremental pay depths, the number and depth of manholes completed, and the completion of all other pay items. This daily record shall also record the time and location of any blasting. Locations of all work and blasting shown on the daily record shall be identified by station numbers.

4. Clearing of Rights-of-Way. The necessary rights-of-way for all lines crossing privately owned property will be secured by the owner. The permanent and temporary construction easements are of size and location as shown on the drawings. The entire width of the permanent right-of-way shall be cleared by the Contractor to its full width and will be left free of all stumps, brush, and rubbish. The temporary construction easement may be cleared in part to aid in the installation of the line.

All clearing operations conducted by the Contractor on the temporary construction easement shall be performed in exactly the same manner as that performed on the permanent easement.

Stumps, brush, and rubbish resulting from the clearing operation shall not be disposed of by placing on adjoining privately owned property unless the owner of the property in question approves of such disposal, and the Contractor furnishes the Engineer two (2) copies of a written instrument attesting to the said approval signed by the owner of the property.

5. Excavation for Pipelines. All trenches will be excavated in open cut from the surface, except as otherwise provided for herein, and in close conformity to the lines given by the Engineer.

In order that there be sufficient room for properly laying and jointing the pipe, trench widths shall be a minimum of 24" plus the outside pipe diameter. In order to safeguard the pipe, however, the maximum trench width shall not exceed 36" plus the outside pipe diameter unless approval to the contrary is given by the Engineer. Trench widths will be measured between faces of the cut at the top of the pipe.

Where no special bedding is required, trench bottoms may be machine excavated to slightly above grade and cut down to pipe grade by hand in the fine-grading operation. Should the trench bottom be inadvertently cut below grade, it shall be filled to grade with #67 washed stone tamped.

Length of trench open ahead of pipe laying shall be not more than 300 feet, and no less than 20 feet unless approval is obtained from the City and Engineer. Contractor shall open no more trench than can be covered by end of working day.

Wet trenches or those with unstable subgrade shall be stabilized by the use of No. 67 stone.

The Contractor shall keep all trenches free from water during excavation for pipelines. The water shall be pumped out of the ditch or dams built to keep it out of the ditch in such a manner as not to cause injury to the public health, private property, or the work in progress.

Portable bridges shall be erected across trenches, wherever the City deems them necessary to permit the passage of vehicular and/or pedestrian traffic.

The local Fire Department and 911 shall be notified at least 24 hours before any street is blocked by the opening of a trench. The Fire Department shall also be notified when the street is once again open to traffic. The contractor shall provide all temporary signage and barricades which may be required by the Fire Department or the Department of Transportation.

Sheeting or bracing shall be used wherever necessary to prevent caving of the trench banks. The removal of sheeting shall be done in such a manner as to minimize the loss of friction between the trench walls and the backfill. Sheeting shall be cut off and left in place where its removal will adversely affect the pipeline installation.

6. Rock Excavation in Trenches. Should rock be encountered in the trenches, the excavation shall be carried to a depth of 6" below the body of the pipe and the trench shall be brought back to grade with No. 67 Stone properly compacted. Suitable backfill material shall be defined as stabilization stone, sand, or native material free from rocks of optimum moisture content in order to obtain a compaction of 95% standard proctor. The use of native material shall be subject to the approval of the Engineer, his representative, and the City.

Should rock be encountered in the trenches and blasting is required for its removal, then all blasting operations shall be conducted in strict accordance with existing ordinances and accepted safe practices relative to the storage and use of explosives.

No rock excavated from trenches larger than 3" diameter shall be used to backfill such trenches and no rock is allowed in the first 24" above the top of the pipe. The items named for the various sizes and classifications of pipe to be installed shall include the removal and disposal off site of such excavated rock material. The contractor shall secure, haul, and place in the trench sufficient suitable backfill material. Suitable backfill material is defined as stabilization stone, sand or native material free from rocks of optimum moisture content in order to compact to 95% of standard proctor.

7. Pavement Cutting and Removal. Wherever it becomes necessary to cut pavement, the cuts shall be confined to a maximum width of the nominal pipe diameter plus 24". No pavement shall be cut wider than the Specifications without authorization from the City. All pavement to be removed shall be marked for cutting by chalk line or other acceptable method. After marking,

bituminous pavement shall be sawed to its full depth to a neat and true line along the mark. Concrete pavement shall be sawed to a minimum depth necessary for the smooth cut when broken out. All pavement cut shall be removed from the site of the work and shall not be used to backfill trenches.

**8. Backfilling Trenches.** Trenches shall be filled in layers six inches (6") deep and thoroughly compacted with mechanical compactors to attain 95% standard proctor. Dry material used in refilling shall be sufficiently moistened so that after compacting future settlement will be at a minimum. Flooring will not be permitted and excess water from any cause shall be removed from the ditch. Material left over from the trench shall be hauled away and no extra compensation will be allowed for such disposal. If native soils from the trench are unsuitable to attain a stable, unyielding trench; the contractor shall provide suitable backfill material as defined in paragraph 6.

The top twelve inches (12") of all trenches where pavement has been cut, and where directed by the City, shall be backfilled with crushed stone placed in layers six inches (6") deep and thoroughly compacted. This stone shall be Aggregate Base Course stone meeting the requirements of the N. C. State Highway Commission's "Standard Specifications for Roads and Structures", January 1, 2018 (as amended). It shall be the Contractor's responsibility to maintain all pavement cuts until paved or accepted by the Owner.

Wherever pipelines are laid in the shoulders of paved roads, backfilling shall be accomplished in the same manner as hereinbefore described for trenches in paved roads or streets except that the trench shall be filled to its full depth with earth.

**9. Pipelines Crossing Gravel Drives.** Wherever a sewer line crosses a gravel drive, it shall be backfilled as hereinbefore described in backfilling trenches for crossing paved roads, except the top six inches (6") shall be filled with thoroughly compacted ABC Aggregate. It shall be the Contractor's responsibility to maintain all drives until accepted by the City.

**10. Pipe Laying - General Provisions.** The Contractor shall be responsible for all material which may become a part of the finished work until it is finally in place, tested and accepted by the City, except as otherwise provided for herein, and shall remove from the lines any cracked or defective pipe or fittings.

Great care must be exercised by the Contractor in handling lined pipe so as not to injure the linings. A damaged lining in a piece of pipe or a fitting will be deemed sufficient reason for its rejection by the Engineer.

Should any pipe be cracked or defective, the City may allow the Contractor to cut off the cracked or defective portion and lay the remainder of the pipe if, in the City and Contractor's opinion, the cutting of the cracked or defective end will not injure the balance of the pipe. Permitting such cutting off of cracked or defective ends, however, will not absolve the Contractor from any of his responsibility toward the work. Cutting of pipe shall only be done at the end of the pipe unless special permission is given by the City.

All pipe shall be thoroughly cleaned of earth and rubbish before being placed in the trench and so kept until final completion and acceptance of the work. Every open end of the pipe shall be securely plugged when pipe laying is not in progress.



All pipe shall be thoroughly flushed and cleaned after installation but prior to acceptance. All connections to existing lines or manholes shall be plugged to prevent mud and water from entering the existing system during construction.

All pipe shall be laid on lines and grades as directed by the Engineer and as shown on the Drawings. All pipe shall be placed on a firm foundation so as to prevent subsequent settlement, and the trenches will be carefully excavated to the proper grade, except where rock excavation is encountered, so that it will be unnecessary to fill in under the pipe. Bell holes shall be provided for all pipe laying modes and special care shall be exercised in obtaining full barrel support.

Green trace wire shall be installed on all sewer lines and services. Trace wire shall be 12-gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Trace wire must have an insulating thickness of 30 mil and rated for 30v and should be accessible at termination.

11. Pipe Laying - PVC Sewer Pipe. PVC gravity sewer pipe shall be installed using a Class "B" bedding as shown on the plans with a select backfill material to the spring line of the pipe. Minimum cover over PVC sewer pipe shall be 3-feet to any subgrade elevation.

Select backfill material is defined as stabilization stone (Size No. 67)

PVC Sewer Pipe shall be installed in accordance with ASTM D221 - Standard Recommended Practice for Underground Installation for Flexible Thermoplastic Sewer Pipe. PVC Sewer Pipe shall be tested by the contractor for deflection. The pipe shall be mandrelled with a rigid device sized to be cylindrical in shape and constructed with 9 to 10 evenly spaced arms. The mandrel shall be hand pulled by the contractor through all sewer lines. Any sections of sewer not passing the mandrel shall be uncovered and the contractor shall reround or replace the sewer and retest that section of line. The contractor shall submit mandrel drawings and testing schedule to the engineer for approval. The mandrel shall be sized for a 5% deflection allowance.

Haunching must be done up to the spring line on the pipe to provide side support of the PVC pipe as well as to protect against any impact damage. Place initial backfill over the haunching to the top of the pipe and provide a minimum of 6" initial backfill above the pipe to absorb rest of the backfilling material. This should allow for compaction as well as support so that the pipe does not deflect past the 5% tolerance. Compact the remaining backfill depth in lifts of 6" so that compaction requirements can be met. No large stones or rocks over 1.5" in diameter will be allowed in the backfill material.

Previous to being lowered into the trench, each pipe shall be inspected by the pipe foreman, and faulty pipe rejected and removed from the work. No pipe shall be laid in the trench until the Engineer has been notified of the intention of the Contractor to lay pipe, giving the Engineer sufficient time to check the lines and grades before pipe laying is begun. The Contractor shall notify the Engineer at least three days before work is to begin.

12. Pipe Laying - Ductile Iron Pipe Sanitary Sewer Mains. Wherever, in the laying of sanitary sewer lines, the pipe must be supported on piers, where the pipe crosses surface waters, under a highway that cannot be open cut, or in shallow trenches where insufficient cover conditions exist, the Sanitary sewer lines shall be of ductile iron pipe. The material for laying and jointing the pipe shall conform to the specifications hereinbefore given for Ductile Iron Pipe. The ductile iron will be paid for at the unit price bid for the different sizes of pipe installed in the various pipe laying conditions. Force mains shall be of size and type as shown on the drawings and shall be installed in conformance to "Pipe Laying - General Provisions".

Laying conditions will be dependent upon the type of soil and surrounding trench conditions. The detail drawing section for sewer will provide one with the types of laying conditions as well as the minimum requirements for bedding and cover above the pipe. Additional cover or bedding may be necessary and depending on the severity potential damage of the surrounding material. It will be at the engineer's discretion to require a higher level of laying condition for certain sections of pipe.

Previous to being lowered into the trench, each pipe shall be inspected by the pipe foreman, and faulty pipe rejected and removed from the work. No pipe shall be laid in the trench until the Engineer has been notified of the intention of the Contractor to lay pipe, giving the Engineer sufficient time to check the lines and grades before pipe laying is begun. The Contractor shall notify the Engineer at least three days before work is to begin.

13. Precast Concrete Manholes. Precast concrete manholes shall be built where shown on the plans or as directed by the Engineer. The inside diameter of the manholes shall be at least four feet (4'). Inverts will be built up to a depth of three-quarters (3/4) of the diameter of the pipeline as directed to properly take care of the flow through the manholes and to ease the drop from one pipe to the other. Benches shall be sloped for drainage, as shown of the Plans. Manholes shall be provided with flexible sleeves sealed with stainless steel bands at each pipe entering or exiting a manhole.

Joints between sections of the precast manhole shall be sealed with a Neophrene "O" Ring Gasket and bitumastic rope. Manholes shall be bedded on layer of crushed stone. The stone shall be the same as that specified for stabilizing ditches (Size No. 67), and shall be spread in a layer at least six inches (6") thick.

The manholes shall be capped with cast iron manhole frames and covers with the frames set in mortar with even bearing. The C.I. Frame shall be anchored to the manhole wall as shown on the plans. After completion, all manholes will be cleaned out and left in a neat condition with all jointing material protruding from joints shall be removed. All riser joints shall be parged with non-shrink grout. Any infiltration into the manhole will not be allowed.

14. Drop Manholes. Drops in manholes greater than 6" but less than or equal to 30", indicate a concrete slide. If the drop exceeds 30" provide an outside drop manhole. The outside drop manhole shall have a special drop pipe built into the manhole. This drop shall consist of a T-branch in the main sewer where it enters the manhole and a vertical drop pipe down the side of the manhole and supported therefrom and terminating at the bottom by a quarter bend into the manhole. All piping and fittings shall be of ductile iron pipe.

Drop pipe shall be Ductile Iron Pipe and fittings strapped to manhole wall with 1" stainless steel straps and masonry anchor bolts.

15. Connections to Existing Sewage Collection System. Connections to existing sewage collection systems shall be made where shown on the Plans or as directed by the Engineer. Where the connection is made at an existing manhole, it will be necessary to reconstruct the existing invert(s) to accommodate the new line.

No connection to existing manholes or sewer lines shall be made until remaining project construction has been completed and tested.

16. Testing Sewer Lines and Force Mains. After the sewer lines are completed, but prior to their acceptance and before any sewage is permitted to enter, the following test shall be made by the Contractor to determine the water tightness of the lines, including the manholes. The Engineer will determine whether the test to be made shall be for infiltration or exfiltration. If ground conditions are such that an infiltration test would give no significant results, then an exfiltration test shall be made in the manner hereinafter described. The sewer line shall be filled with water to a level equal to the top of the lowest manhole in the section to be tested. At no point in the sewer line shall the head of the pipe reach more than 10 feet of water. The test will not be deemed conclusive, however, unless the head on the pipe reaches at least 3 feet of water at the upper end of the section being tested. Tests shall be run on the lines in separate sections so that the head on the pipe is at least 3 feet of water but does not exceed 10 feet.

Under the exfiltration method the line shall be tested for six hours (6) after filling and the leakage will be carefully measured. Allowable leakage shall be 100 gallons per inch of internal diameter per mile of pipe per 24 hours. If the leakage exceeds this limit the line shall be drained, repaired, and retested. The manholes shall be included in the test.

In the event the Engineer elects to test the sewer line by the infiltration method, the allowable infiltration shall be 10 gallons per inch of internal diameter per mile of pipe per 24 hours. If the infiltration exceeds this limit, the line shall be repaired and retested.

All sewer lines must pass the test requirements prior to their acceptance by the City. Excessive leakage or infiltration in any one section shall be corrected even though the total may come within the allowable limits.

Force mains shall be tested in the manner set forth in Section 13 of AWWA Standard C600, except the Contractor shall furnish his own gauges and perform the test at no cost to the Owner. Before final acceptance, the force main shall be filled with water, care being taken to expel all air.

A pressure test of 150 psi shall be applied to the line at the test pump and shall be maintained at that pressure for a minimum period of two consecutive hours.

All defective material found shall be replaced by the Contractor. All leaking joints shall be made tight. The pipe installation will not be accepted unless and until leakage, evaluated on the pressure test of 150 psi for 2 hours, does not exceed 10.0 gallons per day per mile of pipe per inch of nominal diameter. The contractor has the option of using an air test method in lieu of the exfiltration method in testing the sewer line. The following requirements apply.

## Air Test:

### Low-Pressure Air Test for Sanitary Sewers:

\*Introduction - Numerous laboratory and field air tests have been devised over the years since the early 1960's. Much of the information contained in these tests was utilized by the American Society for Testing and Materials (ASTM) when preparing ASTM C828, a low-pressure air test for sanitary sewers.

Described below is the procedure for air testing sewer lines to demonstrate the integrity of the installed material and the construction methods.

\*Summary of Method - The section of the sewer line to be tested is plugged. Low-pressure air is introduced into the plugged line. The amount and rate of air loss is used to determine the acceptability of the section being tested.

\*Preparation of the Sewer Line - Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets to resist the test pressure. Give special attention to stoppers and laterals. Testing to include all completed sewers including sewer services if included as a part of the work.

\*Procedures - Determine the test duration for the section under test by computation from the applicable equations shown in ASTM C828, or from prepared air test tables. The pressure-holding time is based on an average holding pressure of 3 psi (21 kPa) gage or a drop from 3.5 psi (24 kPa) to 2.5 psi (17 kPa) gage.

Add air until the internal air pressure of the sewer line is raised to approximately 4.0 psi (28 kPa) gage. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi (24 kPa) gage, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psig. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi (7 kPa) gage during the test period, the line is presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.

\*Safety - The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 lb. (1112N) is exerted on an 8-in. (203-mm) plug by an internal pipe pressure of 5 psi (34 kPa), it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

As a safety precaution, pressurizing equipment may include a regulator or relief valve set at perhaps 10 psi (69 kPa) to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

\*Table - The air test table below has been prepared utilizing applicable equations from ASTM C828. It is based on an allowable air loss of 0.003 ft<sup>3</sup>/min·ft<sup>2</sup> of internal pipe surface, a maximum air loss per test section of 3.5 ft<sup>3</sup>/min and a minimum significant air loss per test section of 2.0 ft<sup>3</sup>/min. (Test sections of such length that an air loss of 3.5 ft<sup>3</sup>/min would be exceeded using the allowable loss of air per square foot of internal pipe surface may be tested in segments where total air loss would be between 2.0 and 3.5 ft<sup>3</sup>/min.). It applies when testing one pipe diameter only and for convenience ignores 4" and 6" lateral sewers, which in most instances create only insignificant differences in test time.

AIR TEST TABLE

Based on Equations from ASTM C828

SPECIFICATION TIME (min:sec) REQUIRED FOR PRESSURE DROP FROM 3-1/2 TO 2-1/2 PSIG

WHEN TESTING ONE PIPE DIAMETER ONLY

PIPE DIAMETER, INCHES

LENGTH OF LINE, FEET	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:20	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	-	-
175	0:31	1:09	2:03	3:13	4:37	7:05	-	-	-
200	0:35	1:19	2:21	3:40	5:17	-	-	-	12:06
225	0:40	1:29	2:38	4:08	5:40	-	-	10:25	13:36
250	0:44	1:39	2:56	4:35	-	-	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	-	-	9:21	12:44	16:38
300	0:53	1:59	3:31	-	-	-	10:12	13:53	18:09
350	1:02	2:19	3:47	-	-	8:16	11:54	6:12	21:10
400	1:10	2:38	-	-	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	-	-	6:48	10:38	15:19	20:50	27:13
500	1:28	-	-	5:14	7:34	11:49	17:01	23:09	30:14

17. Setting Ductile Iron Fittings. Ductile iron fittings shall be set at locations shown in the Plans or as directed by the Engineer. The installation of fittings shall be made in accordance with Section 10 of AWWA C600. Special care shall be taken to properly bell-up the joints and to support the body of the fitting. All fittings shall be restrained using mega-lug mechanical joint restraints.

18. Joint Restraint. All ductile iron fittings, hydrants, valves, fittings, and other water line components subject to hydrostatic thrust shall be surely restrained by use of mega-lug mechanical joint restraints.

19. Concrete Encasement. Wherever in the laying of the sanitary sewer line the pipe is in a shallow trench where insufficient cover conditions exist, or where shown on the Drawings, or as directed by the Engineer, the pipe shall be completely encased in Class "C" concrete. This encasement shall conform to the typical section shown on the drawings. Delivery tickets on the concrete thus shall be turned in to the Engineer no later than the following working day after delivery was made.

20. Pipelines Under State Highway Pavement. Where shown on the Plans, or as directed by the Engineer, ductile iron sewer mains shall be installed under State Highway pavement by encasing in a larger pipe. The carrier pipe shall be of restrained joint ductile iron and the encasement pipe shall be of steel.

The encasement pipe shall be installed true to line and grade and in conformance with the requirements of the N. C. State Highway Commission. The size of the encasement and carrier pipes shall be as shown on the Drawings.

Following the installation of the carrier pipe, the ends of the encasement pipe shall be suitably protected against the entrance of foreign material, but shall not be tightly sealed. In general, this may be accomplished by the use of the same stone specified for trench stabilization. The ductile iron carrier pipe shall extend approximately 5.0 feet beyond each end of the encasement pipe.

Pipelines installed under this Section shall not be undertaken without the express approval of the appropriate N. C. State Highway Commission's Division Engineer.

21. Pavement Replacement. All pavement cut and removed from publicly maintained roads, streets or highways as authorized by the Engineer, shall be replaced by the Contractor. Pavement cuts shall be maintained by the Contractor until such time as the pavement has been replaced, but such replacement shall be done as promptly as weather permits. Pavement shall be replaced within 48 hours after being cut. No pavement cuts are allowed on Friday.

22. Existing Pipes, Conduits and Cables - Care of. Special care must be exercised by the Contractor, in the installation of the storm sewers, in passing under or over existing storm sewers, sanitary sewers, water lines, gas lines and telephone or power conduits or cables. All aforementioned structures broken or ruptured by the Contractor must be immediately repaired or replaced by him. It shall be the contractor's responsibility to verify the location of all underground lines before construction.

23. Responsibility for Damages. The Contractor shall be held responsible for all damages claimed, as a result of the installation of this project, to all utility poles, driveways, yards, shrubbery and planting, drain ditches and pipes, pavement, sidewalks, water lines, gas lines, telephone or power conduits or cables, buildings, fences, etc., and will be required to make satisfactory adjustment of all claims arising from the installation of the work contemplated in this contract prior to final settlement.

24. Signs and Barricades. The Contractor shall provide, erect, maintain and illuminate, where necessary, all barricades, warning signs and local detour signs required. The Contractor shall be held responsible for all damages to the project due to the failure of the signs and barricades to properly protect the work from traffic, pedestrians, animals, and from all other sources. Signs and barricades shall comply with Manual on Uniform Traffic Control Devices for Streets and Highways as amended by the N. C. Department of Transportation.

25. Cleanup. Upon installation of the specified improvements, the Contractor shall remove all excess materials, earth, debris, etc., along the line of his work and shall cleanup and leave, in its original or better condition, all affected property. The contractor shall clean up all work to the point of construction activity not less than weekly.

26. Erosion Control.

A. Reference to Other Documents. The General Conditions, Supplementary Conditions, Material Specifications, and Detailed Specifications for Installation contain requirements relevant to the work covered by this Section. Clearing and Grubbing, Site Grading, Clearing of rights of ways, excavating and backfilling, and Spoil Disposal will be subject to the applicable requirements of this Section.

B. General Requirements. Control of erosion and sedimentation resulting from land disturbing activities is subject to the requirements of the North Carolina Sedimentation Control Commission. Any authorized representative or agent of the commission shall be granted entry or access for purposes of inspection; he shall not be obstructed, hampered, or interfered with while he is in the process of carrying out his official duties. The requirements for erosion and sedimentation control apply to areas which are involved in borrow, waste disposal, and topsoil storage activities; and to areas which are directly involved with the construction of buildings, paving, curb, gutter, and to areas where storm drainage, water, and sewer lines and structures are installed. No Construction shall take place until erosion control permit is in hand and erosion control devices are installed.

Land disturbing activities shall be planned and carried out to achieve the following objectives:

- 1) Expose minimum sized areas at any one time
- 2) Limit exposures of areas to the shortest possible time
- 3) Control surface water run-off to reduce erosion and sediment loss
- 4) Hold off-site erosion and sedimentation damage to a minimum

With reference to requirement No. 2, portions of the site on which land disturbing activities have been undertaken, but upon which no further active construction takes place for a period of 15 working days, shall be planted or otherwise provided with a ground cover sufficient to restrain erosion.

The Contractor shall be responsible for maintaining all temporary and permanent erosion and sedimentation measures and facilities until the project is accepted by the City, or until removal of facilities and cessation of control measures is authorized by the Engineer.

C. Work Included. This Section includes the labor, materials, equipment, and related services required for the installation of berms, drainage structures, storm water drains, straw barriers, vegetative covers, and other devices or methods for control of erosion and sedimentation shown on the Drawings or specified herein.

D. Facilities and Measures for Erosion and Sedimentation Control.

- 1) Phased Construction. The installation of improvements shall be done in phases as specified on the construction drawings.

This phasing of construction will help limit erosion caused during the installation of the improvements, and will act as an erosion control measure.

2) Clearing and Grubbing. The Contractor is to clear the entire width of the permanent easement of trees, stumps, shrubs, and brush. The natural vegetative cover is to remain intact until the installation of the line begins, except that which has to be removed during the clearing and grubbing operation. Stumps, brush, and rubbish resulting from the clearing operation shall not be disposed of by placing on adjoining privately owned property unless the Contractor has a written instrument from the property owner. All other spoil is expected to be trucked off to the sanitary landfill for disposal.

3) Rip Rap. Rip Rap shall be installed at locations as shown on plans or as directed by the Engineer per the NC DENR erosion control manual.

4) Berms. Drainage berms and ditches shall be installed as shown on the Drawings per the NC DENR erosion control manual.

5) Silt Fence. Silt fences shall be installed as shown on the Drawings or when directed by the Engineer per the NC DENR erosion control manual.

6) Excelsior Matting. Matting shall be installed at location shown on the Drawings and shall be in compliance with "Standards and Specifications for Soil Erosion and Sediment Control" by the Land Quality Section of NCDENR per the NC DENR erosion control manual.

7) Utility Line Installation. Soil resulting from trench excavation to be used as backfill material shall be placed on the uphill side of the trench. This will prohibit runoff directly into the creek. No excavation shall be placed in the creek or on the bank at any time. Rock encountered during excavation shall be removed from the site, and shall not be disposed of by placing on adjoining privately owned property.

8) Permanent Vegetative Cover. Prepare seedbed by ripping, chiseling, harrowing or plowing to depth of six inches so as to produce a loose, friable surface. Remove all stones, boulders, stumps or debris from the surface which would prohibit germination or plant growth per the NC DENR erosion control manual.

Incorporated into the soil 800 to 1,000 pounds of 10-10-10 fertilizer plus 500 pounds of twenty percent (20%) Superphosphate per acre and two tons of dolomitic lime per acre unless soil tests indicate that a lower rate can be used.

Mulch after seeding with 2.0 tons of grain straw per acre and either crimp straw into soil or tack with liquid asphalt at 400 gallons per acre or emulsified asphalt at 300 gallons per acre.



## PERMANENT SEEDINGS

<u>PLANTS &amp; MIXTURE</u>	<u>PLANTING RATE/ACRE</u>	<u>PLANTING DATES</u>
TALL FESCUE (LOW MAINTENANCE)	100-150 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE WATERWAYS AND LAWNS (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
BLEND OF TWO TURF-TYPE TALL FESCUES (90%) AND TWO OR MORE IMPROVED KENTUCKY BLUEGRASS VARIETIES (10%) (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE AND KOBE OR KOREAN LESPEDEZA	100 LBS. & 20-25 LBS.	FEB. 15 - MAY 1 AUG. 15 - OCT. 15
TALL FESCUE AND SERICEA LESPEDEZA	50 LBS. 60 LBS./ACRE	NOV. 1 - FEB. 1 (UNSCARIFIED)
TALL FESCUE AND GERMAN MILLET OR SUNDANGRASS	70 LBS. AND 40 LBS.	JULY AND AUGUST
TALL FESCUE AND RYEGRAIN	70 LBS. AND 25 LBS.	NOV. 1 - JAN. 30
COMMON BERMUDAGRASS	8 LBS. (HULLED) 15-20 LBS. (UNHULLED)	APRIL 15 - JUNE 30 FEB. 1 - MARCH 30

### Permanent Seeding Notes:

1. For spring seedlings, use scarified lespedeza seed. For late fall and winter seedings, use unscarified seed.
2. Annuals such as millet, sundangrass and ryegrain must be kept at 10-12" maximum height. The use of annual rye grass is not permitted.

The preceding permanent cover requirements pertain to all areas disturbed during the project construction including road shoulders, temporary access roads, spoil areas, building sites, rights-of-way, easements and line work.

**27. Bonds and Permits Required by N. C. State Highway Commission.** The Contractor, at his own expense, will secure from the N. C. State Highway Commission, the "Encroachment Agreement" required prior to the installation of that portion of this project that lies within the right of way of the said Commission. Any or all other bonds and/or permits required by the said Commission in connection with this project shall be provided and paid for by the Contractor. This relates especially to the "Permit to Open Pavement" and the performance bond.

**28. Guarantee.** The Contractor shall guarantee that if any materials, equipment or workmanship covered by these Specifications and the accompanying Drawings proves defective within one year after final acceptance, such defects shall be made good by him. The Engineer shall provide a letter to the City indicating the start of the 12-month guarantee period. Provide State required certifications and "As Builts" with guarantee letter.

**29. Manhole Testing.** This section is to supplement the manhole specifications. All manholes shall be tested using either the exfiltration test or vacuum test as specified below. Manholes shall be tested by plugging the inlet and outlet lines with airtight plugs prior to performing the manhole test. All manholes must be backfilled before vacuum test.

- a. **Exfiltration:** Fill the manhole to the rim with water and allow the level to equalize due to saturation.

Refill the manhole and mark the level to begin the test. The test shall last at least 2 hours and allowable leakage shall be 3 gallons per hour. Manholes that fail the test shall be repaired as necessary and retested until they pass.

- b. **Vacuum Air:** The manhole shall be sealed at the top of the rim with the test rig and shall have 10-inches of mercury applied through the rig. The time for the mercury to drop from 10-inches to 9-inches shall be measured. The minimum test time for the specified drop shall not be less than that shown in the following table. All manholes on the project shall be tested. If any manhole fails, it shall be repaired as necessary and retested until it passes.

<u>Manhole Depth</u>	<u>Diameter of Manhole</u>		
	48" Ø	60" Ø	72" Ø
≤ 10 ft.	60 sec.	75 sec.	90 sec.
> 10 ft. but < 15 ft.	75 sec.	90 sec.	105 sec.
> 15 ft.	90 sec.	105 sec.	120 sec.

**30. Video Inspection.** All sewers shall be video inspected by the Contractor and a copy of such tape delivered to the City. Prior to the video of the sewers, all lines shall be pressure cleaned and flushed. Contractor shall pour 5 gallons of water down each service before videoing services. All defects noted during the video inspection shall be corrected by the Contractor. The Contractor shall provide 48 hours' notice to the City prior to the video inspection in the event the City desires to witness the inspection.

**31. Testing Notice.** Notice to the City, for any testing related to sewer line work, will be required of the Contractor 48-hours in advance of testing.

**32. Damaged Piping.** Should any piping be damaged prior to acceptance by the City, the whole joint will be replaced.

RELATION OF WATER MAINS TO SEWERS

(a) *Lateral Separation of Sewer and Water Mains. Water Mains shall be laid at least 10 feet laterally from outside of pipe to outside of pipe, from existing or proposed sewer, unless local conditions or barriers prevent a 10' foot lateral separation in which case:*

1. *The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or*
2. *The water main is laid in the same trench as the sewer with the water main located at one side of a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.*

(b) *Crossing a Water Main over a Sewer. Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation – – in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.*

(c) *Crossing a Water Main Under a Sewer. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.*

**CITY OF GRAHAM**

**W-1**

RELATION OF WATER MAINS TO SEWERS

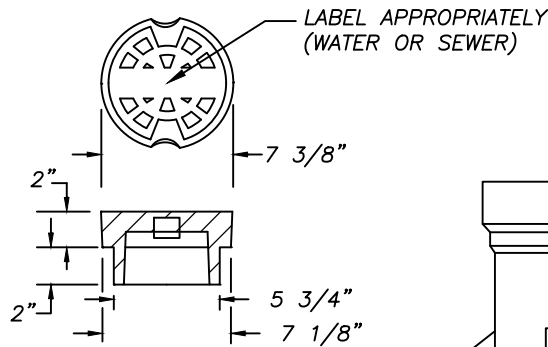
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REV.

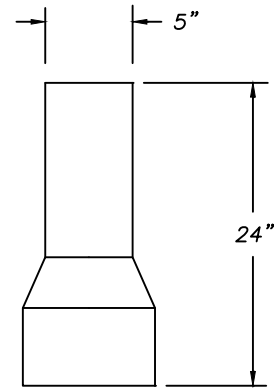
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DETAILS/2018  
DETAILS/WATER

2/1/15

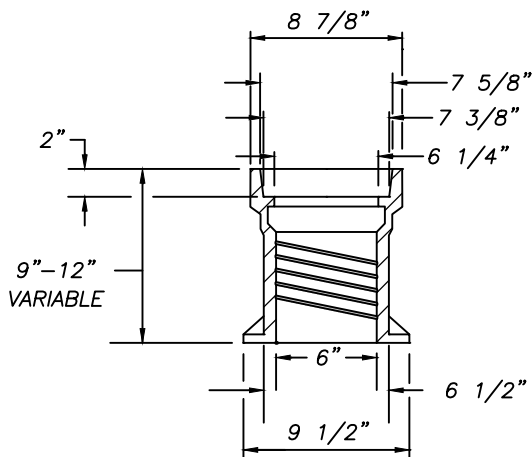




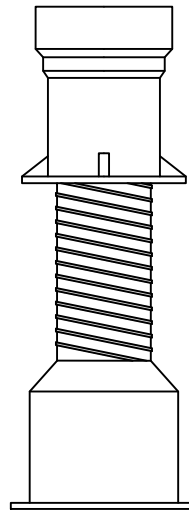
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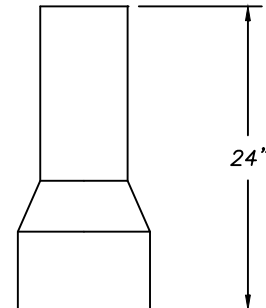
EXTENSION  
FIELD CUT IF  
REQUIRED



**TOP SECTION**



**TWO-PIECE  
VALVE BOX,  
ASSEMBLED**



**BASE**

CAST IRON VALVE BOX – SCREW TYPE  
ACCOMMODATES 4" THROUGH 12" VALVES  
5 1/4-INCH SHAFTS

**NOTES:**

VALVE BOX AND COVER WILL CONFORM  
TO ASTM A 48 CLASS 35

**CITY OF GRAHAM**

**W-3**

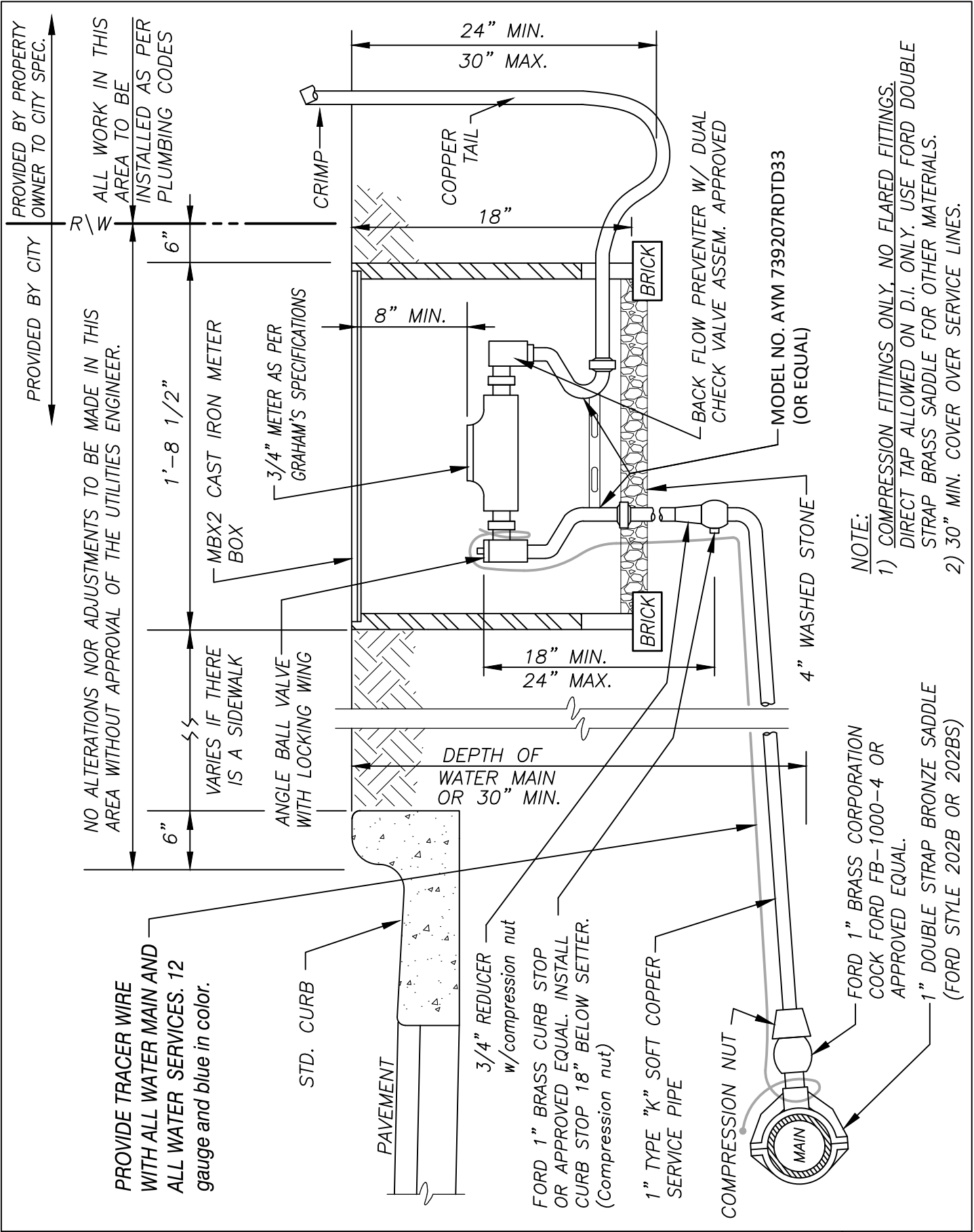
CAST IRON VALVE BOX

DWG NO.

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T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

6/25/18



# CITY OF GRAHAM

**W-4**

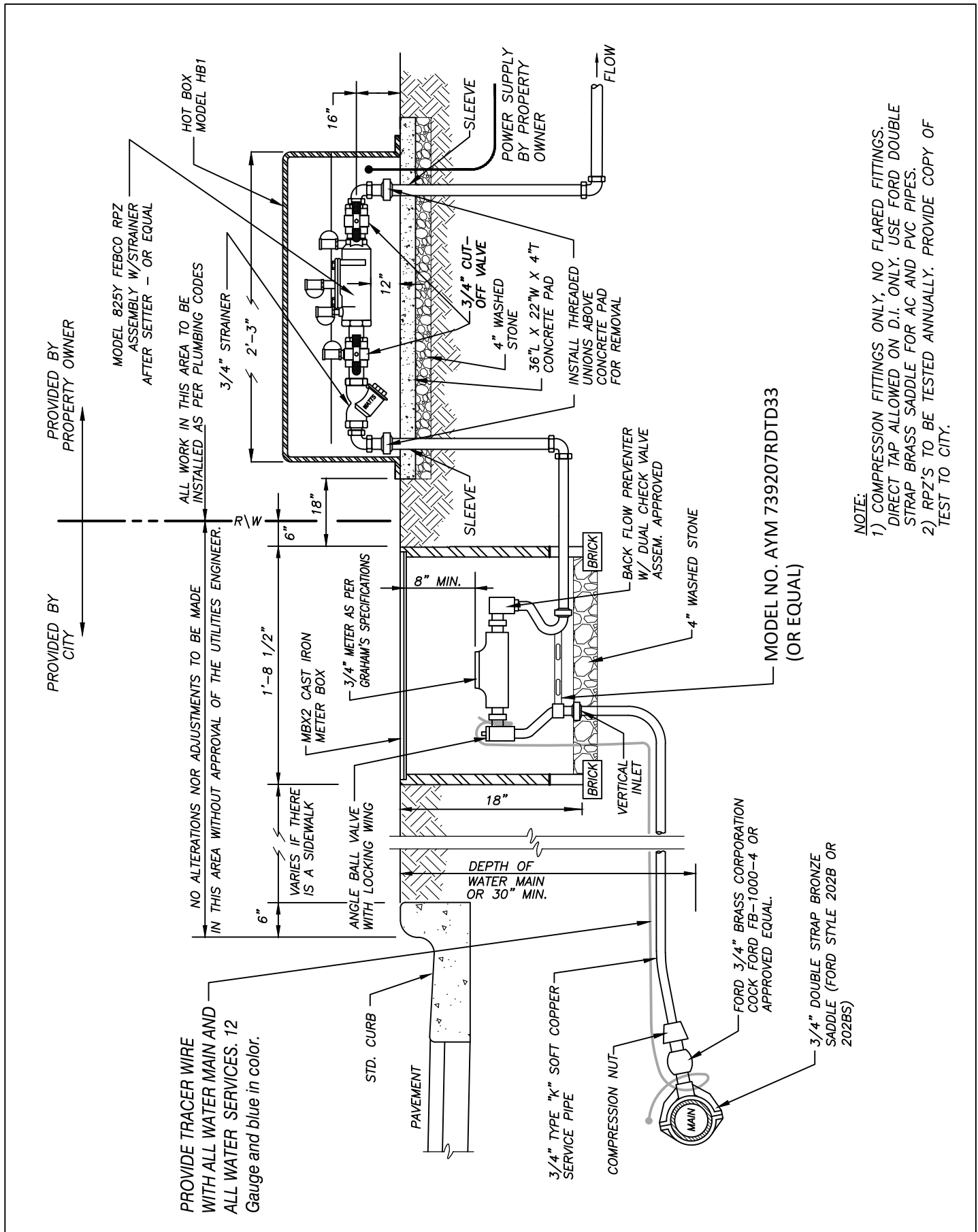
**3/4" WATER SERVICE CONNECTION  
WITH 1" SERVICE LINE**

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/12/19



NOTE:  
 1) COMPRESSION FITTINGS ONLY, NO FLARED FITTINGS. DIRECT TAP ALLOWED ON D.I. ONLY. USE FORD DOUBLE STRAP BRASS SADDLE FOR AC AND PVC PIPES.  
 2) RPZ'S TO BE TESTED ANNUALLY. PROVIDE COPY OF TEST TO CITY.

# CITY OF GRAHAM

W-5

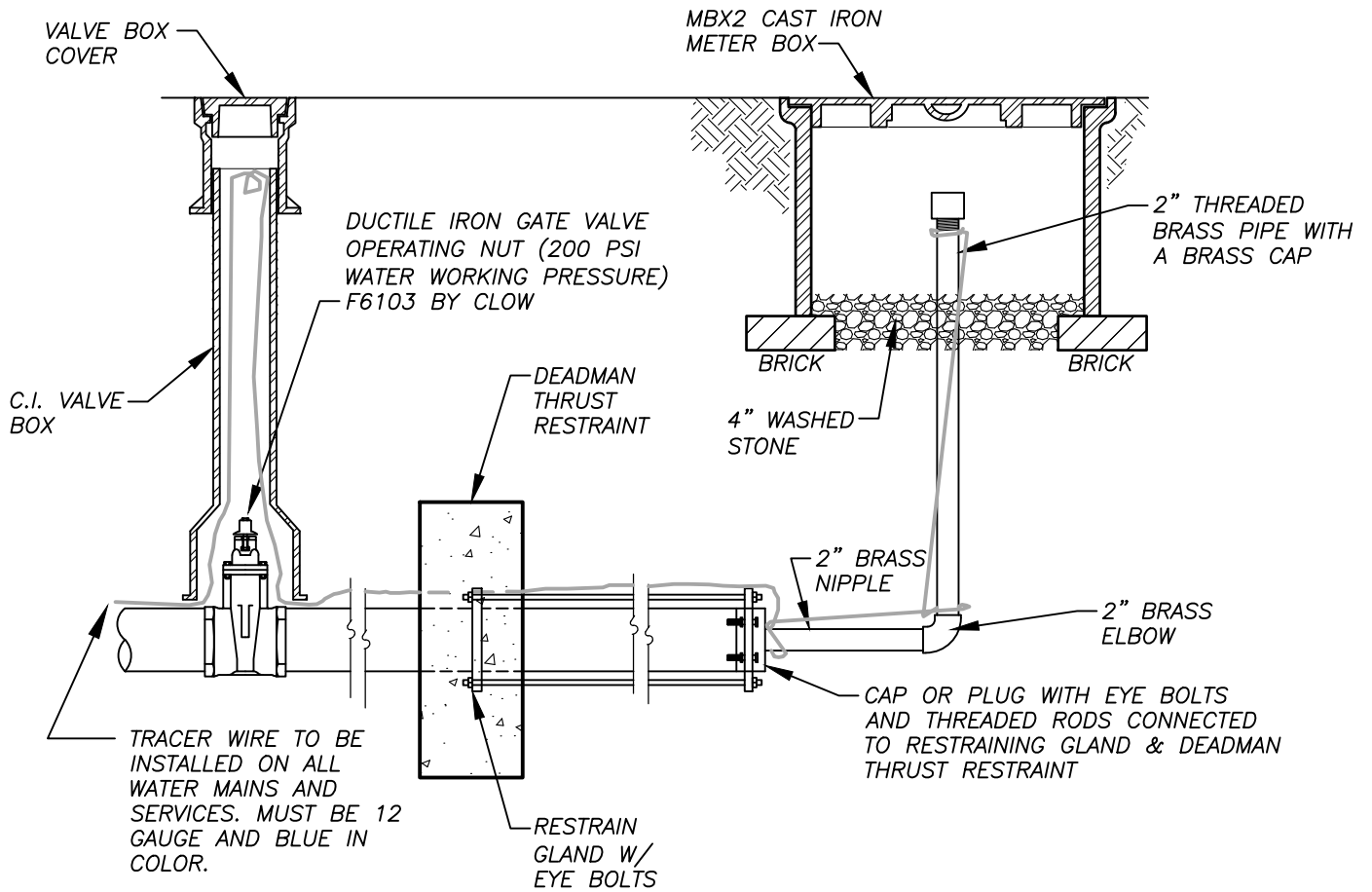
3/4" IRRIGATION CONNECTION WITH RPZ BACKFLOW ASSEMBLY

DWG NO.

REV.

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/WATER

6/25/18



- NOTES: 1. 1" BLOW-OFF REQUIRED ON 2", 3" & 4" MAINS  
 2. 2" BLOW-OFF REQUIRED ON 6" & 8" MAINS  
 3. 4" BLOW-OFF REQUIRED ON 10" & GREATER MAINS  
 4. ALL BLOW-OFF'S SHALL BE BEHIND CURB & SIDEWALK

FOR DEAD END LINES PROVIDE A 2" THREADED TAP IN THE PLUG AND A 2" GATE VALVE WITH A 2" OPERATING NUT.

# CITY OF GRAHAM

W-6

## STANDARD 2" IN-LINE BLOW-OFF ASSEMBLY

DWG NO.

REV.

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/WATER

10/30/18



APPROVED DEVICES

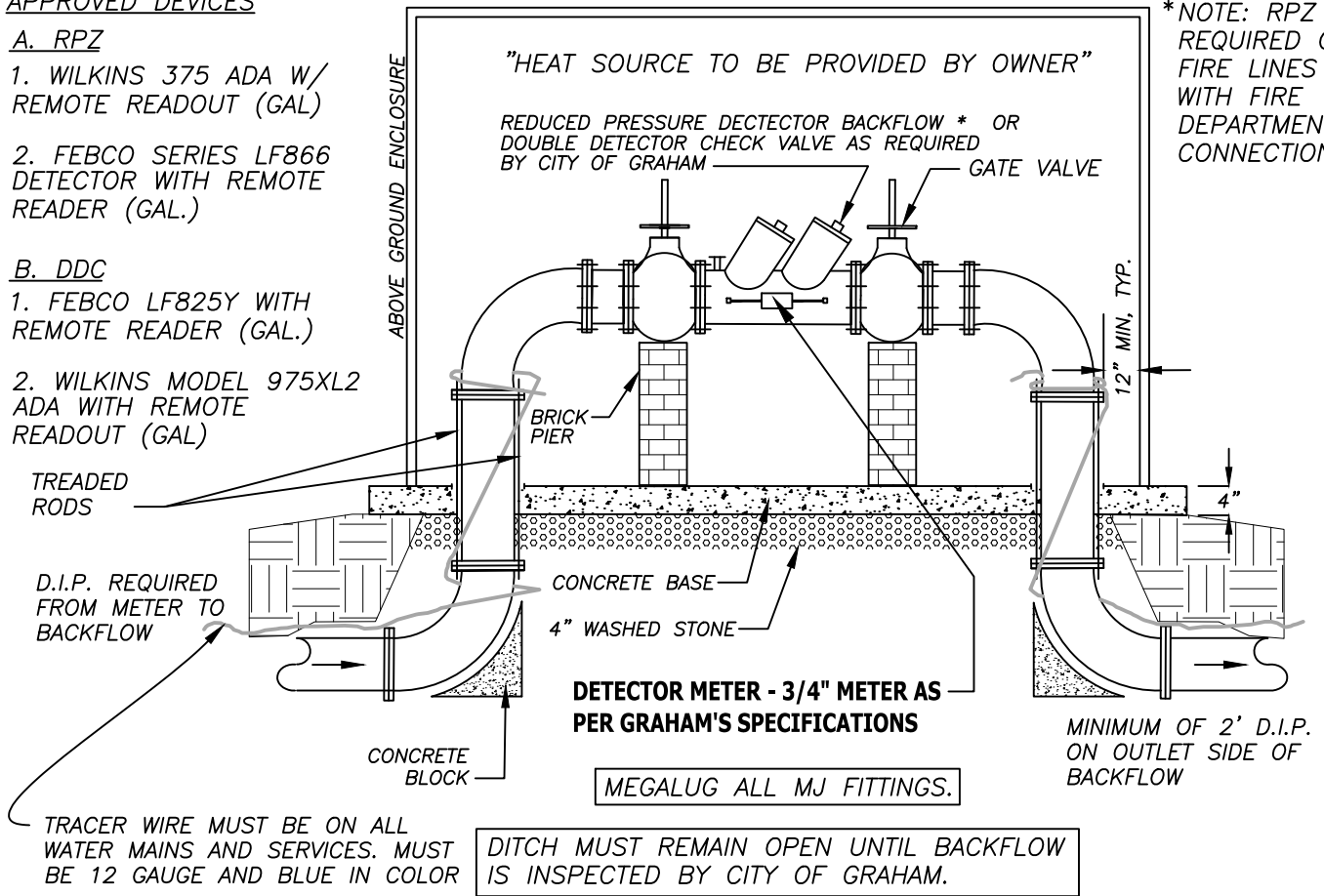
A. RPZ

1. WILKINS 375 ADA W/ REMOTE READOUT (GAL)
2. FEBCO SERIES LF866 DETECTOR WITH REMOTE READER (GAL.)

B. DDC

1. FEBCO LF825Y WITH REMOTE READER (GAL.)
2. WILKINS MODEL 975XL2 ADA WITH REMOTE READOUT (GAL)

\*NOTE: RPZ REQUIRED ON FIRE LINES WITH FIRE DEPARTMENT CONNECTIONS.



NOTES

1. THE BACKFLOW DEVICE SHALL BE WITHIN 10' OF AND ON THE PROPERTY SIDE OF THE METER. ENCLOSURE SHALL NOT OBSTRUCT SITE DISTANCE AT ROAD CROSSINGS.
2. ALL BACKFLOW DEVICES SHALL BE INSTALLED ABOVE GROUND IN A HORIZONTAL POSITION UNLESS OTHERWISE PREAPPROVED BY THE CITY OF GRAHAM.
3. SHUT OFF VALVES SHALL BE RESILIENT SEAT WITH FLANGED END AND O.S.&Y HAND WHEELS.
4. ALL INTERIOR AND EXTERIOR IRON SURFACES SHALL HAVE EXPOXY COATINGS TO CONFORM TO ANSI/AWWA C550 OR MANUFACTURED OF STAINLESS STEEL.
5. APPROVED ABOVE GROUND ENCLOSURES: "HOT BOX", HYDROCOWL, SMI MODEL #b68-EHPZD, B80-EHPZD, B110-EHPZD) OR BFP (#640-1PD, 800-1PD, 950-APD OR 1150-APD). ENCLOSURE MUST HAVE A DRAIN.
6. TANDEM BACKFLOWS REQUIRED IF SERVING MULTIPLE USERS OR SERVICE CANNOT BE INTERRUPTED.
7. DETECTOR METER AND BACKFLOW ASSEMBLY SHALL BE INSTALLED IN ENCLOSURE.
8. PIPE & FITTINGS BELOW GRADE TO BE M.J. WITH RETAINER GLANDS, 150 PSI MIN. WORKING PRESSURE.
9. INSTALL BACKFLOW DEVICE NEAR MAIN WATERLINE CONNECTION AT STREET RIGHT OF WAY.
10. ALL BACKFLOW DEVICES SHALL BE TESTED, INSPECTED, AND MAINTAINED BY THE OWNER. PROVIDE ANNUAL REPORTS TO CITY.

**CITY OF GRAHAM**

**W-7**

ABOVE GRADE BACKFLOW PREVENTER,  
3" AND GREATER

DWG NO.

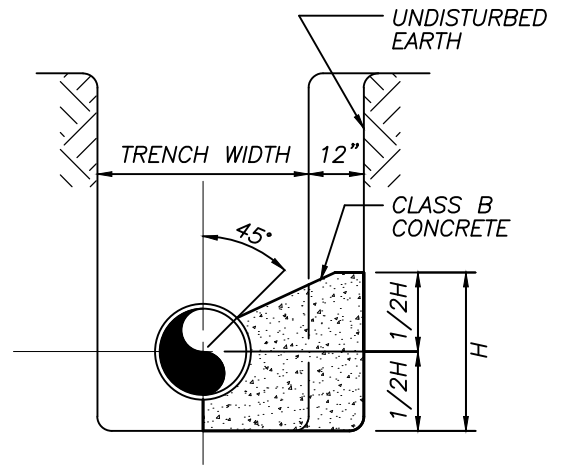
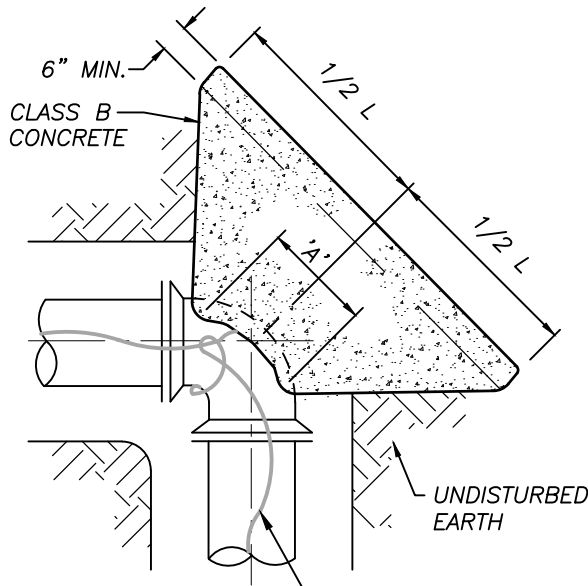
REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/19

PLAN - BENDS

SECTION



TRACER WIRE SHALL BE INSTALLED ON ALL WATER MAINS AND SERVICES. 12 GAUGE WIRE AND BLUE IN COLOR.

BUTTRESS DIMENSIONS						
PIPE SIZE	22 1/2° BENDS		45° BENDS		90° BENDS	
	L	H	L	H	L	H
6"	1'-0"	1'-0"	1'-0"	1'-0"	1'-4"	1'-2"
8"	1'-0"	1'-0"	1'-4"	1'-2"	1'-10"	1'-6"
12"	1'-4"	1'-4"	1'-10"	1'-10"	2'-8"	2'-3"

NOTES:

1. DIMENSION 'A' SHOULD BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH THE MECHANICAL JOINT BOLTS.
2. THE SHAPE OF THE BACK OF THE BUTTRESS MAY VARY PROVIDED THE CONCRETE IS AGAINST FIRM, UNDISTURBED EARTH.
3. BUTTRESS DIMENSIONS ARE BASED UPON A SOIL RESISTANCE OF TWO TONS PER SQ. FT. AND A WATER PRESSURE OF 150 P.S.I.

**CITY OF GRAHAM**

**W-8**

THRUST BLOCK - BENDS

DWG NO.

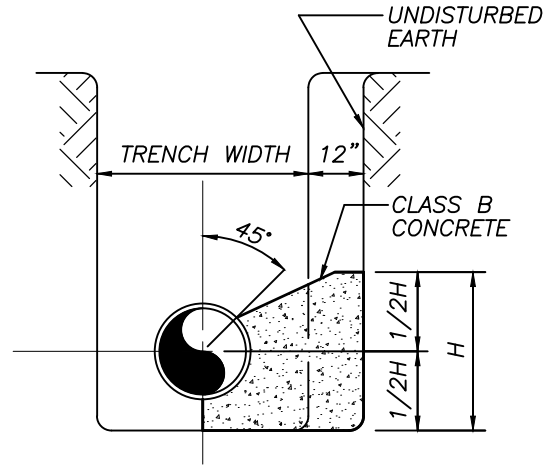
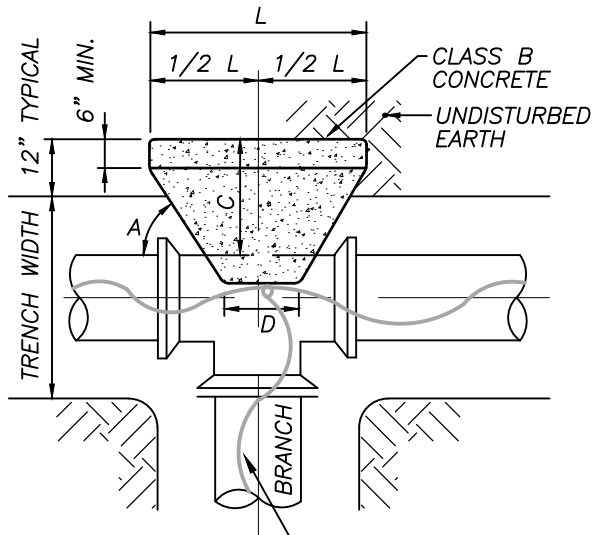
REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/19

PLAN - TEE

SECTION



TRACER WIRE SHALL BE INSTALLED ON ALL WATER MAINS AND SERVICES. 12 GAUGE WIRE AND BLUE IN COLOR.

BUTTRESS DIMENSIONS				
B. D.	L	H	C	D
6"	1'-3"	1'-0"	SEE NOTE NO. 1	SEE NOTE NO. 2
8"	1'-6"	1'-4"	SEE NOTE NO. 1	SEE NOTE NO. 2
12"	2'-3"	2'-0"	SEE NOTE NO. 1	SEE NOTE NO. 2

B. D. = BRANCH DIAMETER

NOTES:

1. DIMENSION 'C' SHOULD BE LARGE ENOUGH TO MAKE ANGLE 'A' EQUAL TO OR GREATER THAN 45°.
2. DIMENSION 'D' SHOULD BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH EHT MECHANICAL JOINTS.
3. BUTTRESS DIMENSIONS ARE BASED UPON A SOIL RESISTANCE OF TWO TONS PER SQ. FT. AND A WATER PRESSURE OF 150 P.S.I.

**CITY OF GRAHAM**

**W-9**

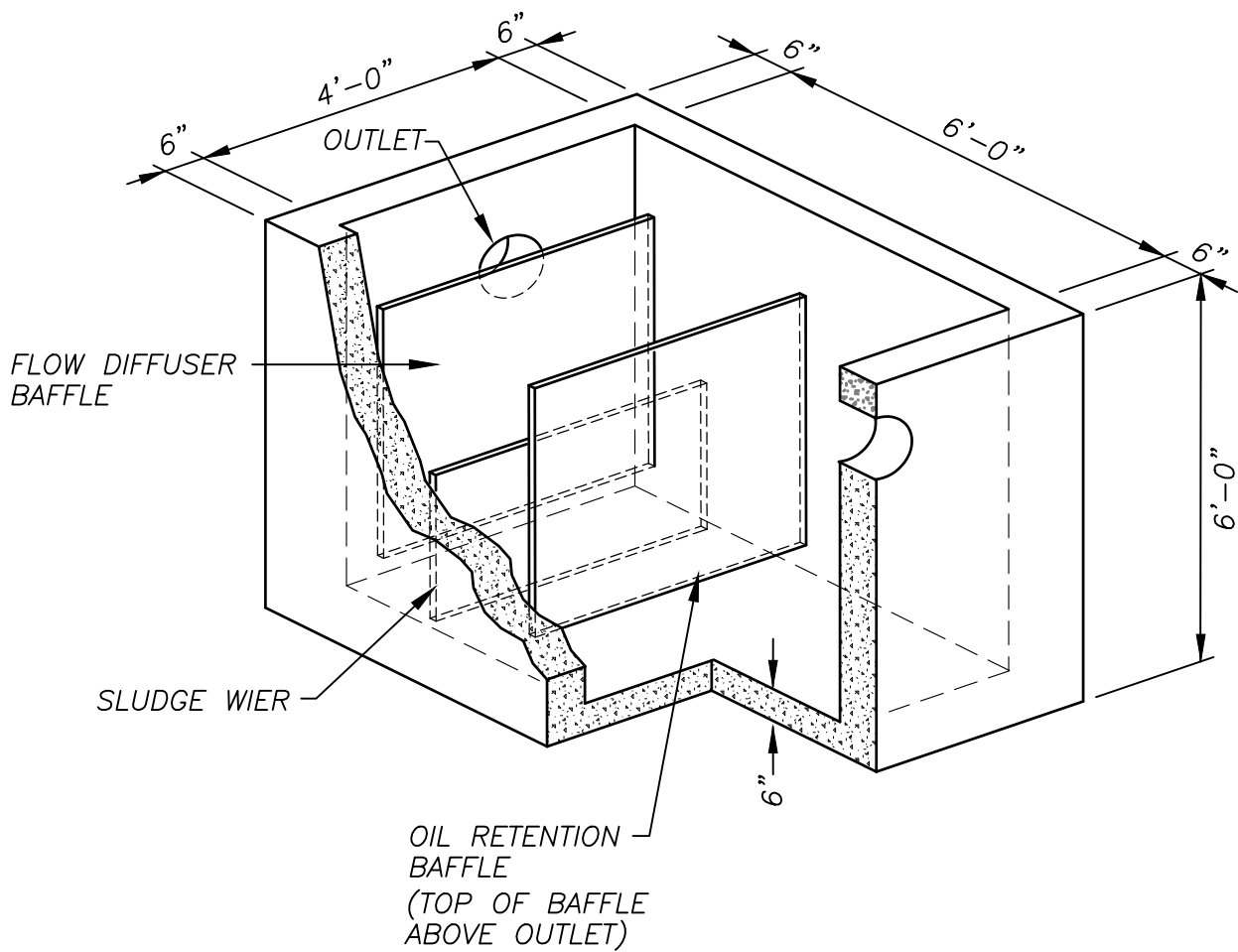
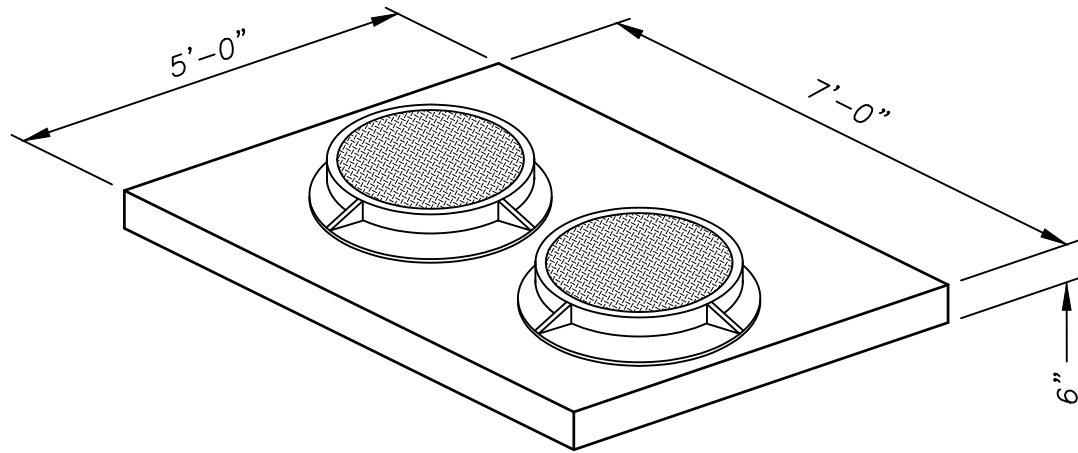
THRUST BLOCK - TEES

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/19



NOTE : ALL BAFFLE AND WIER PLATES ARE TO BE CONCRETE OR APPROVED EQUAL.

**CITY OF GRAHAM**

**W-10**

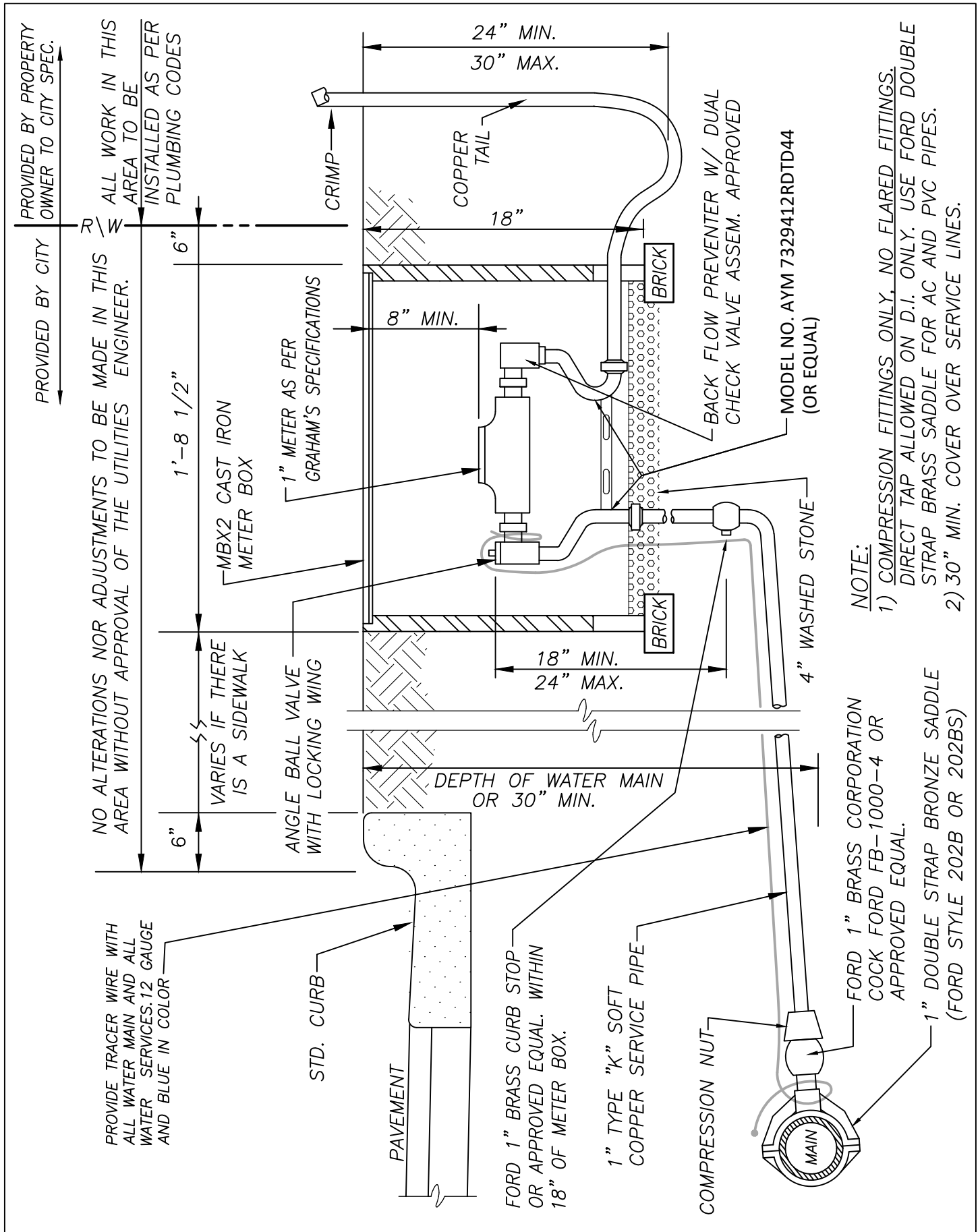
OIL WATER SEPARATOR  
4' X 6' I.D.

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

2/1/15



**NOTE:**  
 1) COMPRESSION FITTINGS ONLY, NO FLARED FITTINGS.  
 DIRECT TAP ALLOWED ON D.I. ONLY. USE FORD DOUBLE STRAP BRASS SADDLE FOR AC AND PVC PIPES.  
 2) 30" MIN. COVER OVER SERVICE LINES.

**CITY OF GRAHAM**

**W-11**

**1" DOMESTIC WATER SERVICE CONNECTION**

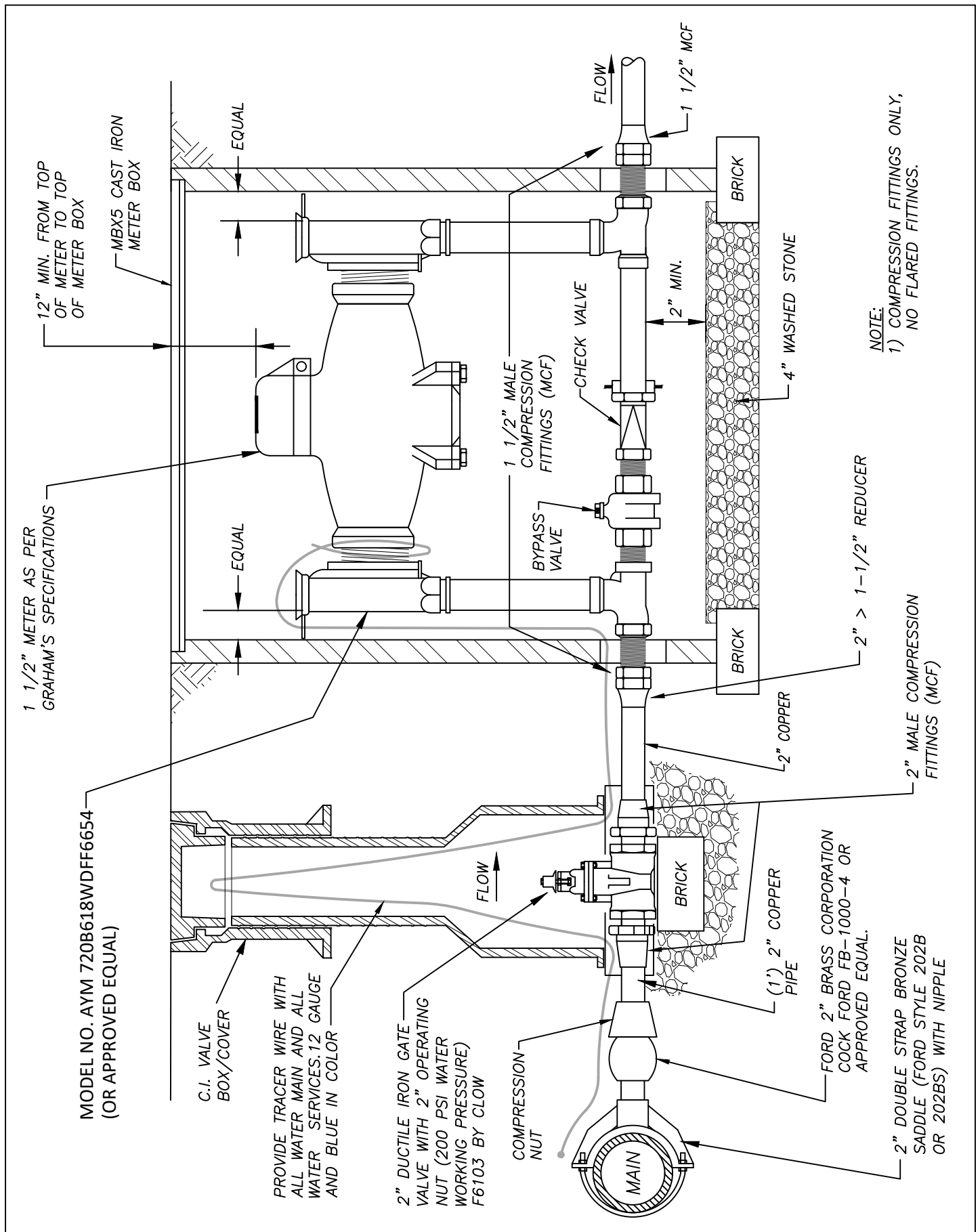
**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/WATER

7/31/19





NOTE:  
 1) COMPRESSION FITTINGS ONLY,  
 NO FLARED FITTINGS.

# CITY OF GRAHAM

W-13

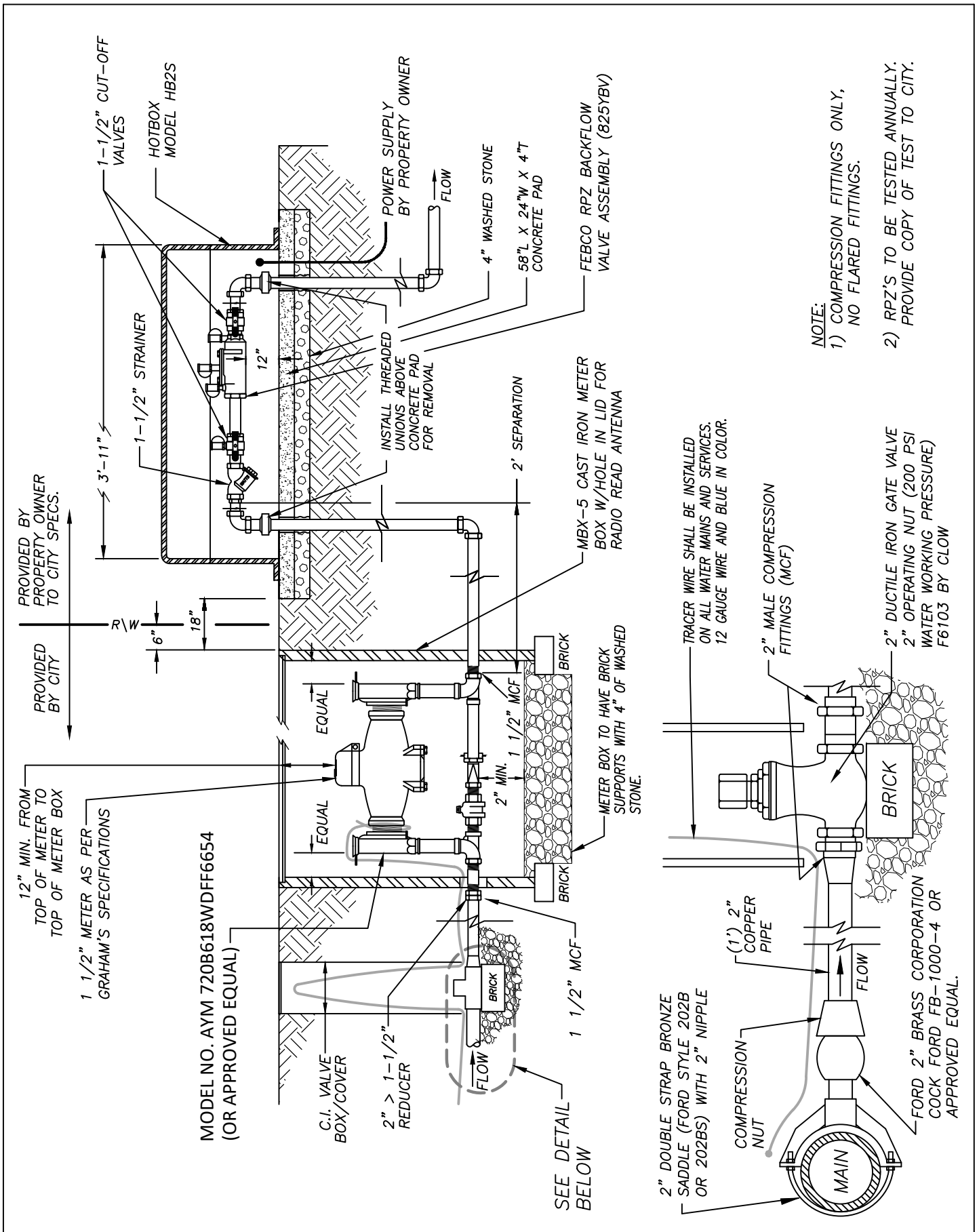
1 1/2" DOMESTIC WATER CONNECTION

DWG NO.

REV.

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/WATER

7/31/19



# CITY OF GRAHAM

W-14

1 1/2" IRRIGATION / FIRE SPRINKLER CONNECTION  
WITH RPZ BACKFLOW ASSEMBLY

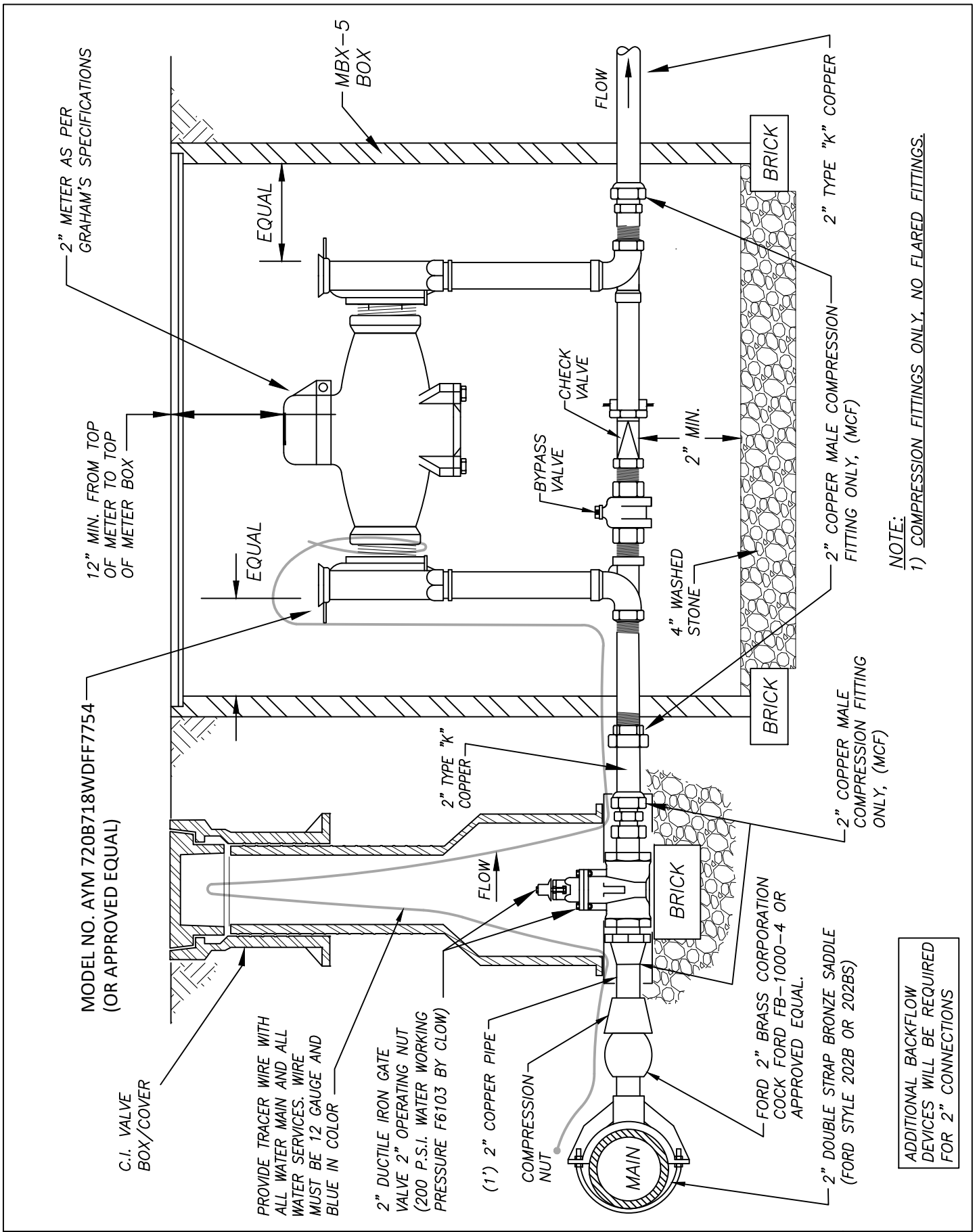
DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/19





**NOTE:**  
 1) COMPRESSION FITTINGS ONLY, NO FLARED FITTINGS.

**ADDITIONAL BACKFLOW DEVICES WILL BE REQUIRED FOR 2" CONNECTIONS**

# CITY OF GRAHAM

**W-15**

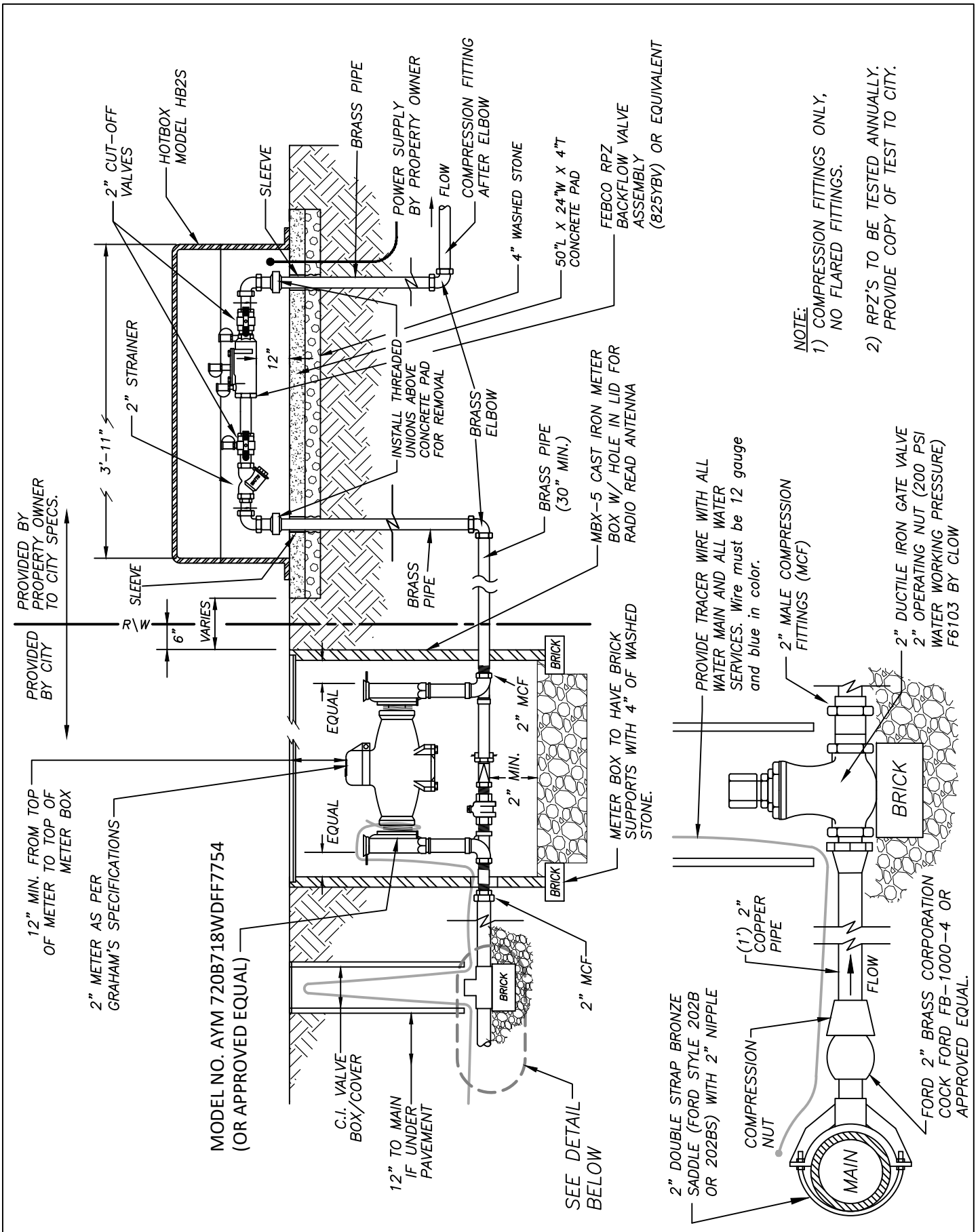
## 2" DOMESTIC WATER CONNECTION

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/WATER

7/31/19



NOTE:  
 1) COMPRESSION FITTINGS ONLY, NO FLARED FITTINGS.  
 2) RPZ'S TO BE TESTED ANNUALLY. PROVIDE COPY OF TEST TO CITY.

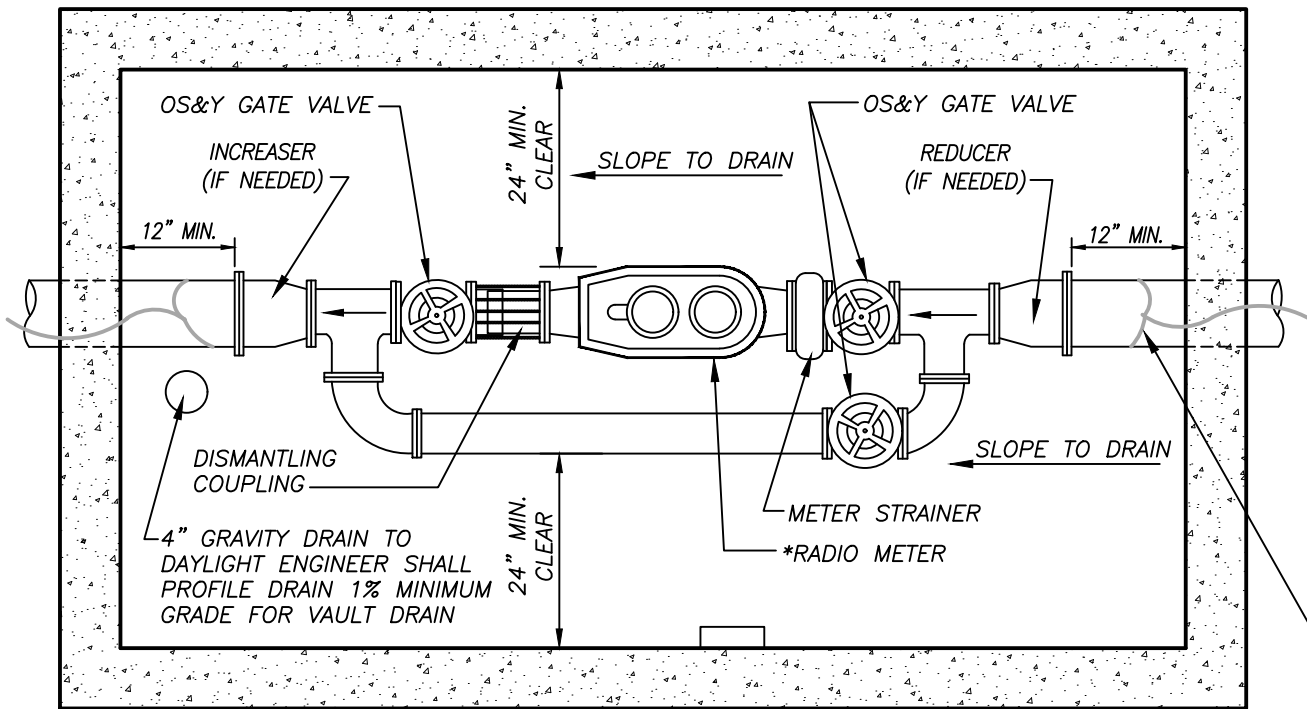
**CITY OF GRAHAM**

**W-16**

**2" IRRIGATION / FIRE SPRINKLER CONNECTION WITH 2" METER AND RPZ BACKFLOW ASSEMBLY**

DWG NO.  
 T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/WATER

REV.  
 10/15/18

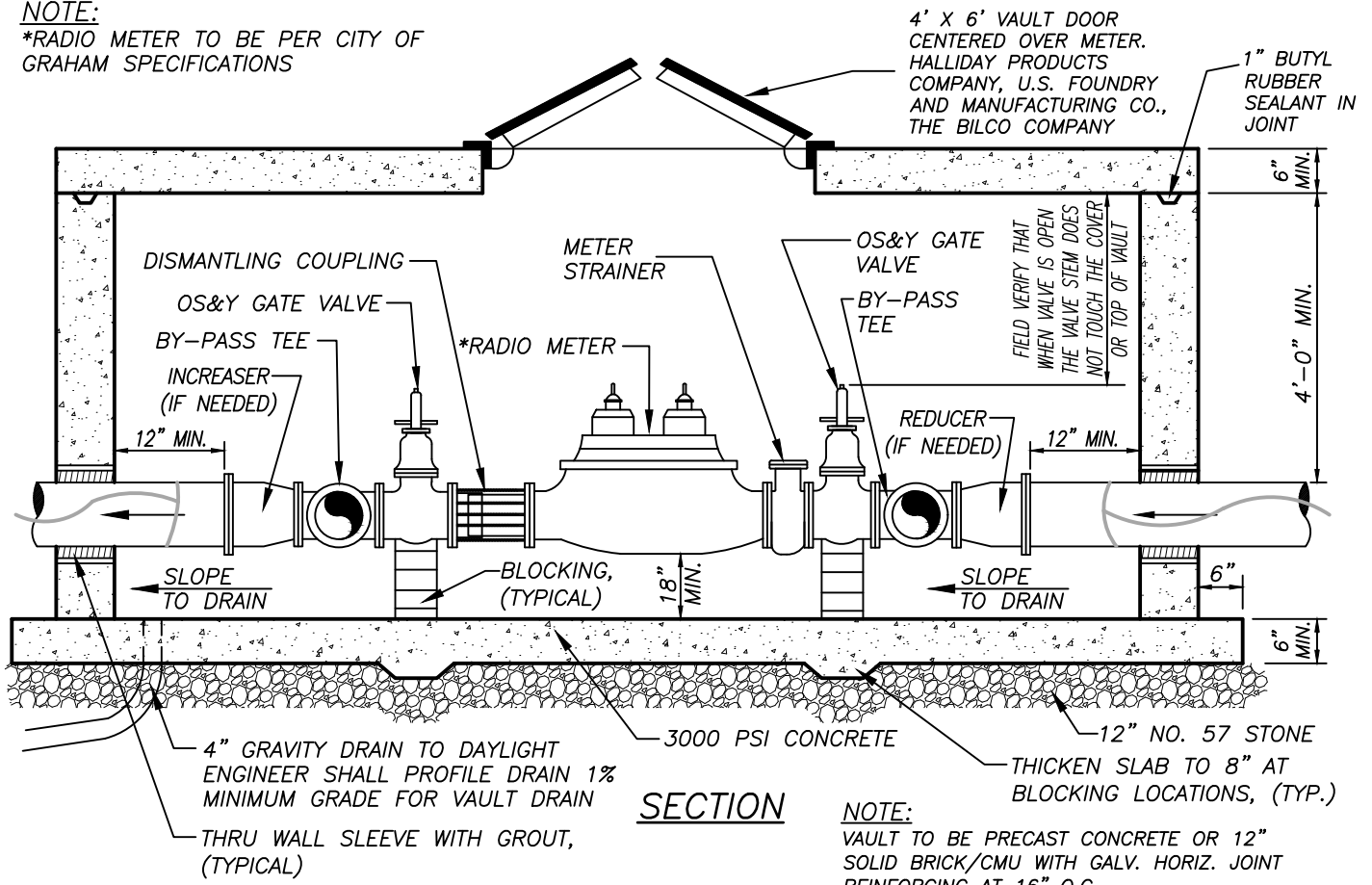


**TOP VIEW**

TRACER WIRE IS TO BE INSTALLED ON ALL WATER MAINS AND SERVICES. WIRE MUST BE 12 GAUGE AND BLUE IN COLOR.

**NOTE:**

\*RADIO METER TO BE PER CITY OF GRAHAM SPECIFICATIONS



**SECTION**

**NOTE:**

VAULT TO BE PRECAST CONCRETE OR 12" SOLID BRICK/CMU WITH GALV. HORIZ. JOINT REINFORCING AT 16" O.C.

**CITY OF GRAHAM**

**W-17**

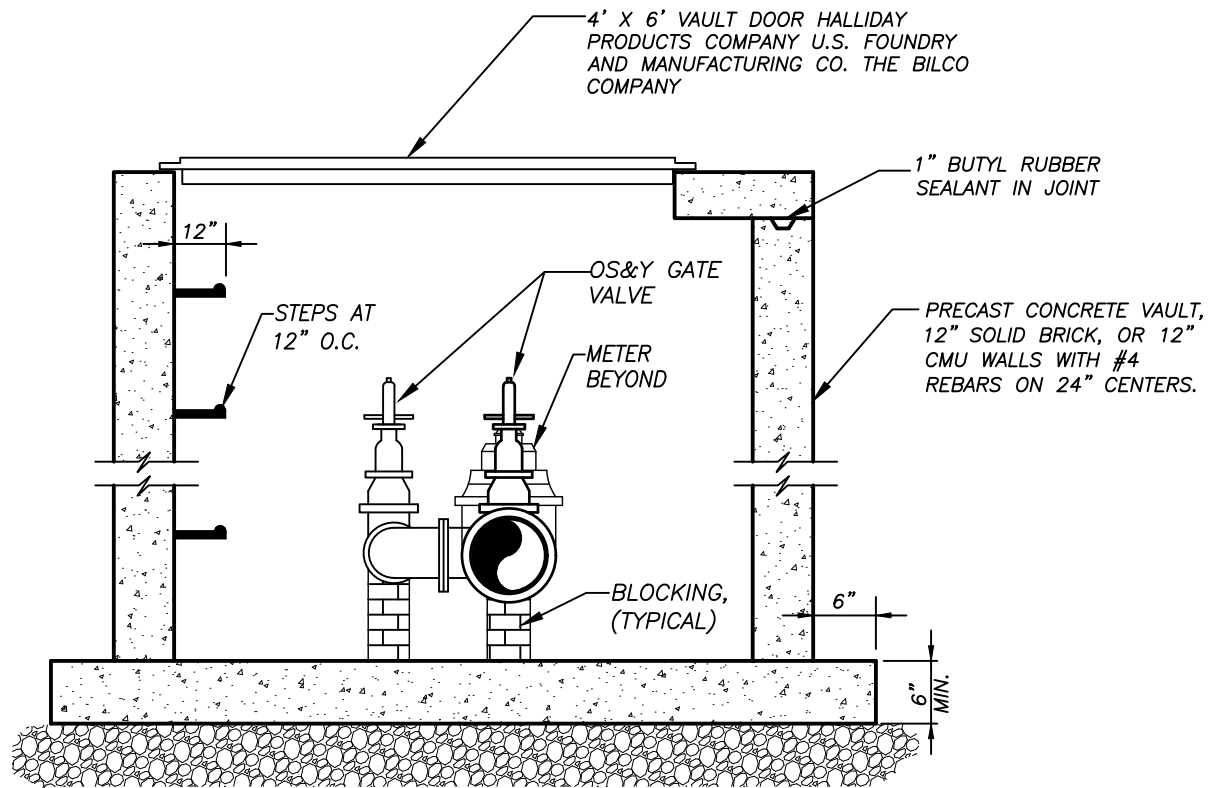
3 AND 4 INCH METER ASSEMBLY  
(SHEET 1 OF 2)

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/2019



## SECTION

### NOTES:

- 1 - VAULT WALLS TO BE THE MIN CONCRETE THICKNESS INDICATED, REINFORCED WITH NO. 4 REBAR ON 12" CENTERS EACH WAY, PLACED 2" FROM THE INSIDE WALL THE AMOUNT OF REINFORCING AND WALL THICKNESS MAY BE INCREASED FOR EXTRA DEPTH WALLS OR IN HEAVY TRAFFIC SITUATIONS AS REQUIRED BY THE ENGINEER.
- 2 - SUBSTITUTE MATERIALS MAY BE USED AS APPROVED BY THE ENGINEER.
- 3 - REINFORCED CONCRETE LID WITH TRAFFIC BEARING DOORS H-20 LOADING TO BE USED IN TRAFFIC SITUATIONS.
- 4 - PROVIDE A THRU WALL SLEEVE AT OPENING IN CONCRETE OR CMU WALL LARGE ENOUGH FOR FLANGE OF PIPE TO PASS THRU. FILL VOID BETWEEN PIPE AND SLEEVE WITH NON SHRINK GROUT.
- 5 - PIPE OUTSIDE VAULT TO BE M.J. WITH RETAINER GLANDS.
- 6 - ALL CLEARANCE DIMENSIONS ARE MINIMUMS.
- 7 - ALL JOINTS TO BE FLANGED THROUGH OUT VAULT.
- 8 - STEPS ARE TO BE INSTALLED IN ALL VAULTS EXCEEDING 4 FEET DEEP AT A LOCATION FOR EASE OF ACCESS. LOCATE DOOR OVER STEPS. CONTRACTOR TO COORDINATE SIZE OF VAULT TO THE SIZE OF VAULT DOOR TO WORK PROPERLY.
- 9 - CONCRETE TO BE A MINIMUM OF 3000 PSI.
- 10 - ALL METERS MUST BE INSTALLED LEVEL.
- 11 - MFM-MCT METERS MUST BE INSTALLED WITH AT LEAST 8 DIAMETERS OF STRAIGHT PIPE SAME SIZE AS METER ON INLET SIDE.
- 12 - ALL VALVES GREATER THAN 2" SHALL BE OS&Y VALVES.
- 13 - ADDITIONAL BACKFLOW PREVENTION WILL BE REQUIRED ON ALL 3 & 4 INCH METERS.

**CITY OF GRAHAM**

**W-18**

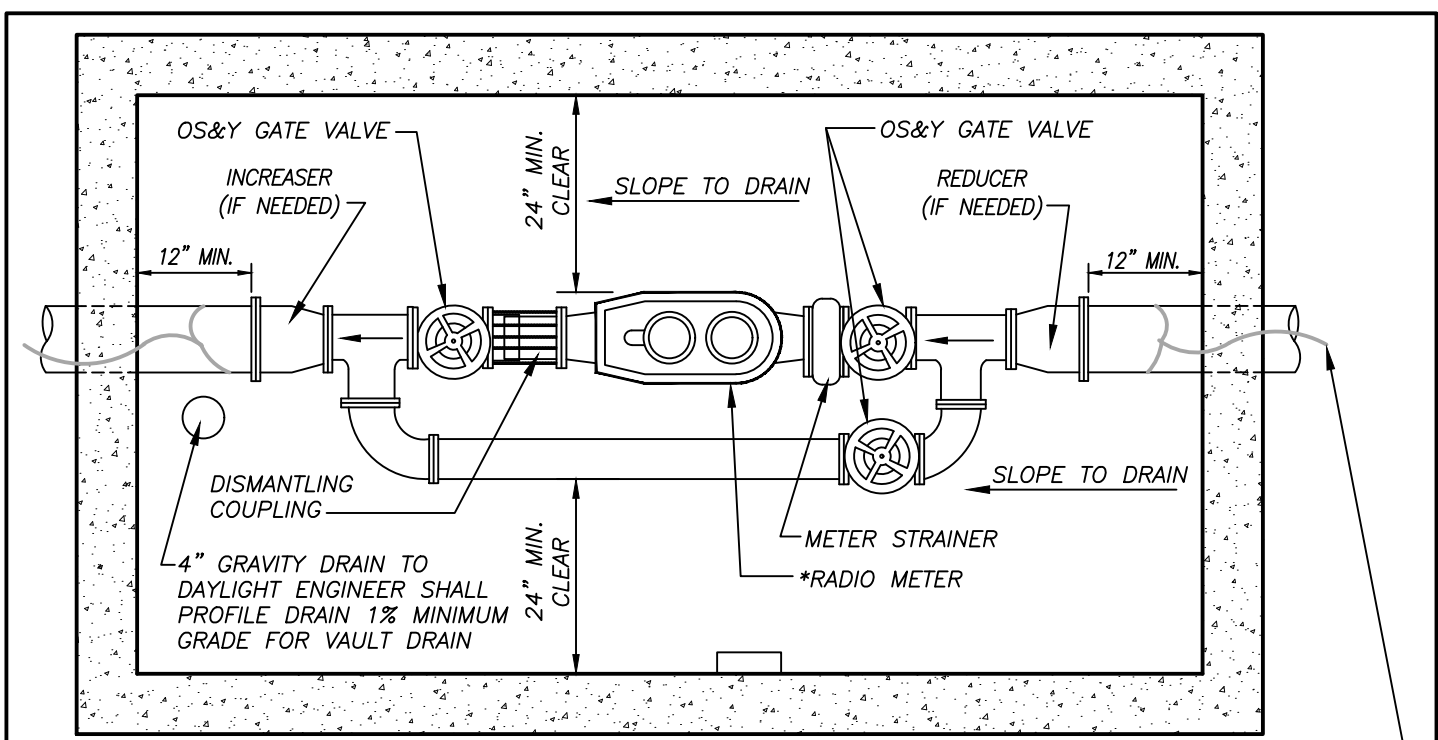
3 AND 4 INCH METER ASSEMBLY  
(SHEET 2 OF 2)

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

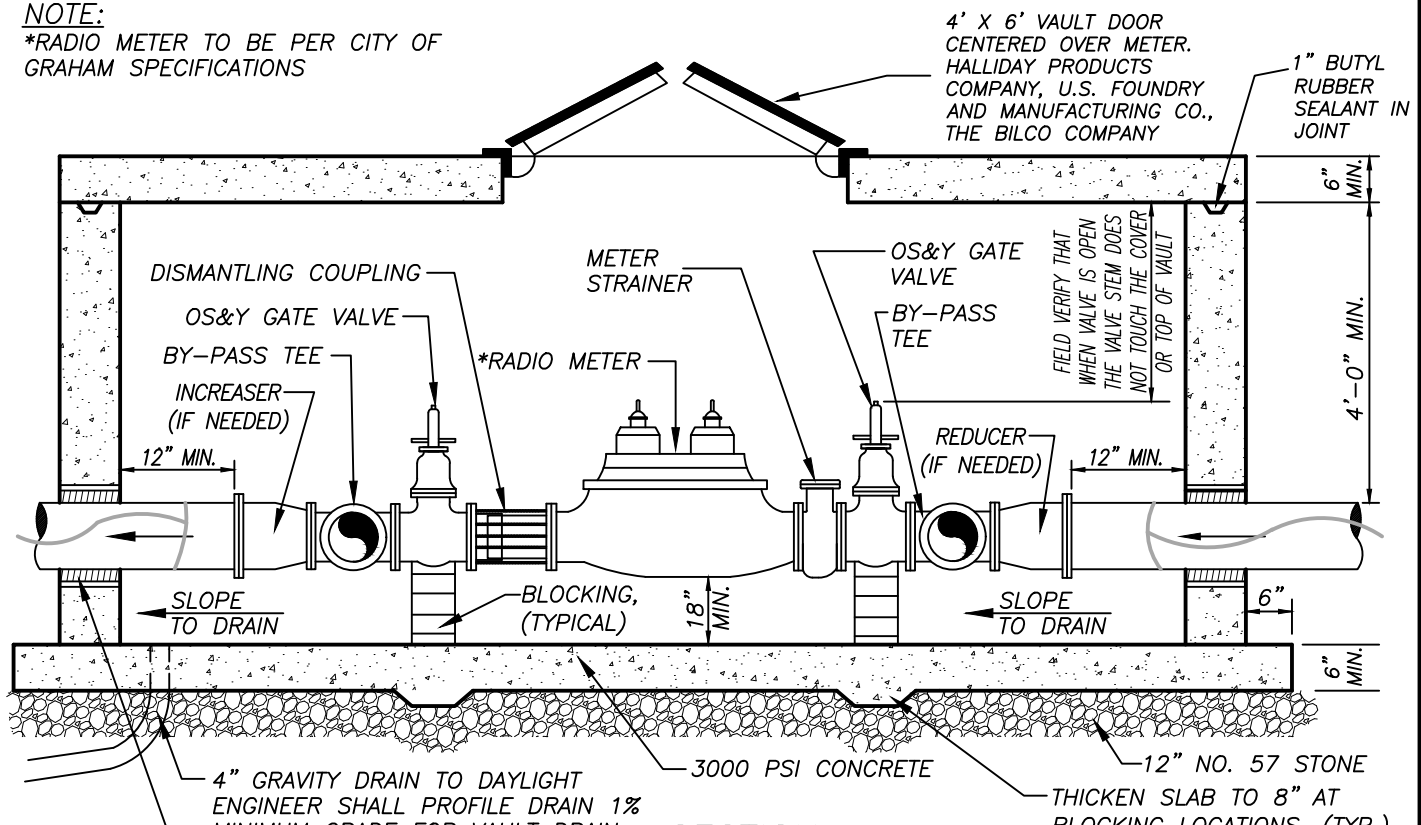
7/31/19



**TOP VIEW**

TRACER WIRE IS TO BE INSTALLED ON ALL WATER MAINS AND SERVICES. WIRE MUST BE 12 GAUGE AND BLUE IN COLOR.

**NOTE:**  
\*RADIO METER TO BE PER CITY OF GRAHAM SPECIFICATIONS



**SECTION**

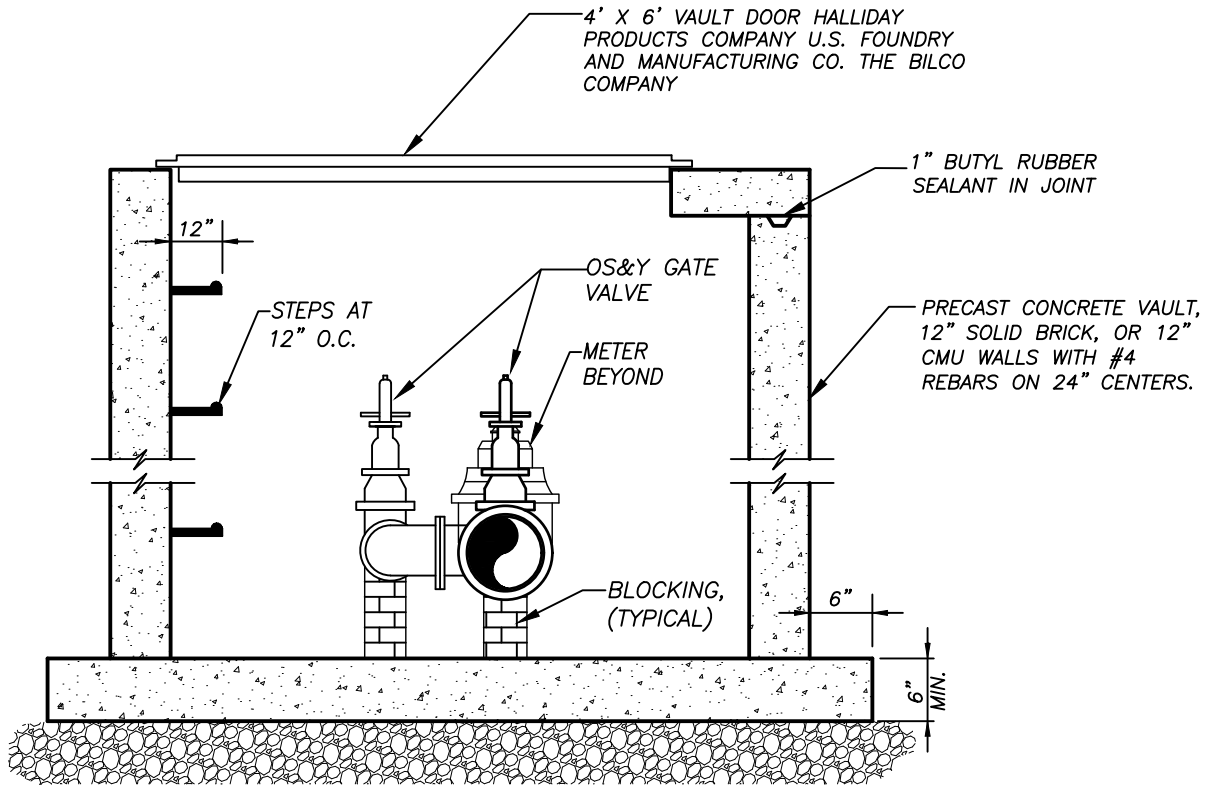
**NOTE:**  
VAULT TO BE PRECAST CONCRETE OR 12\"/>

**CITY OF GRAHAM**

**W-19**

**6 AND 8 INCH METER ASSEMBLY**  
(SHEET 1 OF 2)

<b>DWG NO.</b>	<b>REV.</b>
T:DETAILS/GRAHAM DETAILS/2018 DETAILS/WATER	7/31/19



### SECTION

NOTES:

- 1 – VAULT WALLS TO BE THE MIN CONCRETE THICKNESS INDICATED, REINFORCED WITH NO. 4 REBAR ON 12" CENTERS EACH WAY, PLACED 2" FROM THE INSIDE WALL THE AMOUNT OF REINFORCING AND WALL THICKNESS MAY BE INCREASED FOR EXTRA DEPTH WALLS OR IN HEAVY TRAFFIC SITUATIONS AS REQUIRED BY THE ENGINEER.
- 2 – SUBSTITUTE MATERIALS MAY BE USED AS APPROVED BY THE ENGINEER.
- 3 – REINFORCED CONCRETE LID WITH TRAFFIC BEARING DOORS H-20 LOADING TO BE USED IN TRAFFIC SITUATIONS.
- 4 – PROVIDE A THRU WALL SLEEVE AT OPENING IN CONCRETE OR CMU WALL LARGE ENOUGH FOR FLANGE OF PIPE TO PASS THRU. FILL VOID BETWEEN PIPE AND SLEEVE WITH NON SHRINK GROUT.
- 5 – PIPE OUTSIDE VAULT TO BE M.J. WITH RETAINER GLANDS.
- 6 – ALL CLEARANCE DIMENSIONS ARE MINIMUMS.
- 7 – ALL JOINTS TO BE FLANGED THROUGH OUT VAULT.
- 8 – STEPS ARE TO BE INSTALLED IN ALL VAULTS EXCEEDING 4 FEET DEEP AT A LOCATION FOR EASE OF ACCESS. LOCATE DOOR OVER STEPS. CONTRACTOR TO COORDINATE SIZE OF VAULT TO THE SIZE OF VAULT DOOR TO WORK PROPERLY.
- 9 – CONCRETE TO BE A MINIMUM OF 3000 PSI.
- 10 – ALL METERS MUST BE INSTALLED LEVEL.
- 11 – MFM-MCT METERS MUST BE INSTALLED WITH AT LEAST 8 DIAMETERS OF STRAIGHT PIPE SAME SIZE AS METER ON INLET SIDE.
- 12 – ALL VALVES GREATER THAN 2" SHALL BE OS&Y VALVES.
- 13 – ADDITIONAL BACKFLOW PREVENTION WILL BE REQUIRED ON ALL 6 & 8 INCH METERS.

**CITY OF GRAHAM**

**W-20**

6 AND 8 INCH METER ASSEMBLY

DWG NO.

REV.

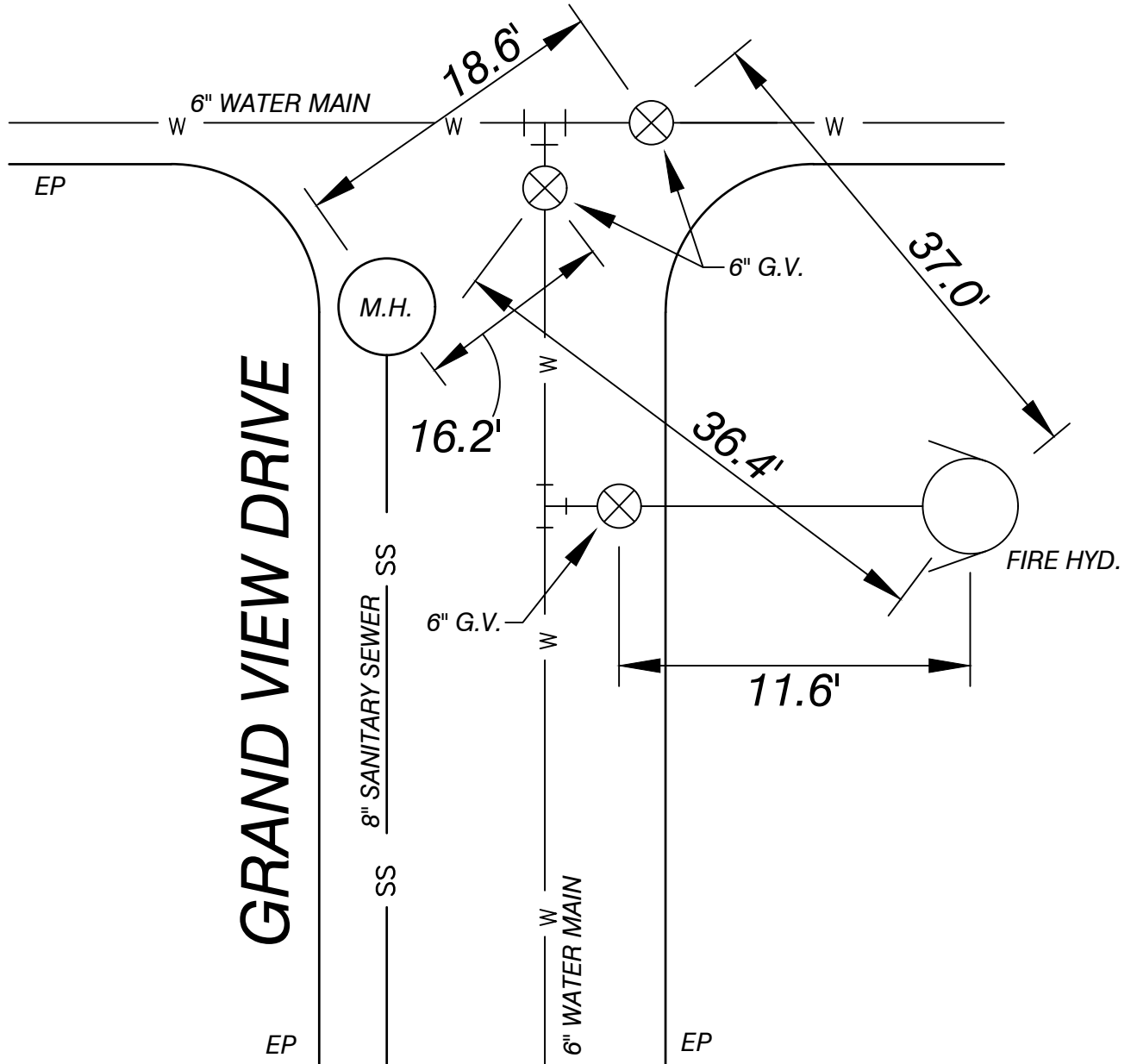
(SHEET 2 OF 2)

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

10/15/18

# PALMER DRIVE

EP



**CITY OF GRAHAM**

**W-21**

*As Built Valve/Manhole Location Requirement*

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/19

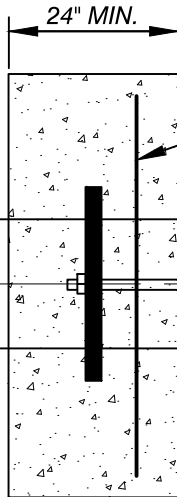
THRUST BLOCK - MINIMUM  
3000 PSI CONCRETE, CLASS A,  
NON-AIR ENTRAINED

CAP OR PLUG WITH EYE  
BOLTS AND THREADED  
RODS CONNECTED TO  
RESTRAINING GLAND

RESTRAINING GLANDS  
SHALL BE WRAPPED  
WITH POLYETHYLENE  
AND SECURED PRIOR TO  
POURING CONCRETE.

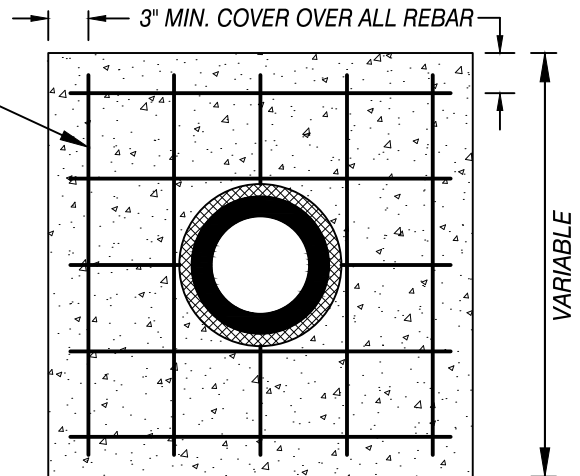
RESTRAINING GLAND WITH EYE BOLTS AND  
TREAD RODS. GRIPPING WEDGES SHALL BE  
TORQUED TO MANUFACTURER'S  
SPECIFICATIONS.

24" MIN.  
PLAN VIEW



PROFILE VIEW

#4 REBAR MAT @  
12" O.C. EACH WAY



FRONT VIEW

**NOTES:**

1. THRUST BLOCK SHALL BE ORIENTED APPROXIMATELY CENTER OF PIPE JOINT.
2. \*OPTIONAL\* A WELDED COLLAR (INSTALLED BY PIPE MANUFACTURER) MAY BE USED IN LIEU OF RESTRAINING GLANDS. ALL OTHER DESIGN REQUIREMENTS SHALL APPLY AS SHOWN.
3. FOR PIPES LARGER THAN 16" DIAMETER, THE DEADMAN THRUST RESTRAINT WITH BLOCKING MUST BE DESIGNED AND SEALED BY A N.C. PROFESSIONAL ENGINEER.
4. ANY PROPOSED MODIFICATIONS TO THIS STANDARD BASED ON THE FIELD CONDITIONS MUST BE PRE-APPROVED BY THE CITY AND/OR THE ENGINEER OF RECORD.
5. QUANTITIES SHOWN BELOW ARE TO THE NEAREST QUARTER YARD AND ARE BASED ON MINIMUM MASS WEIGHT REQUIREMENTS OF THE TEST PRESSURES SHOWN.

<b>MINIMUM CUBIC YARDS OF CONCRETE REQUIRED</b>			
PIPE DIAMETER	150 PSI TEST PRES.	200 PSI TEST PRES.	250 PSI TEST PRES.
6"	0.75	1.0	1.25
8"	1.5	2.0	2.25
10"	2.0	3.0	3.5
12"	3.0	5.0	5.0
16"	5.5	7.25	9.0

**CITY OF GRAHAM**

**W-22**

**DEADMAN THRUST RESTRAINT WITH MASS WEIGHT  
BLOCKING FOR DUCTILE IRON PIPE**

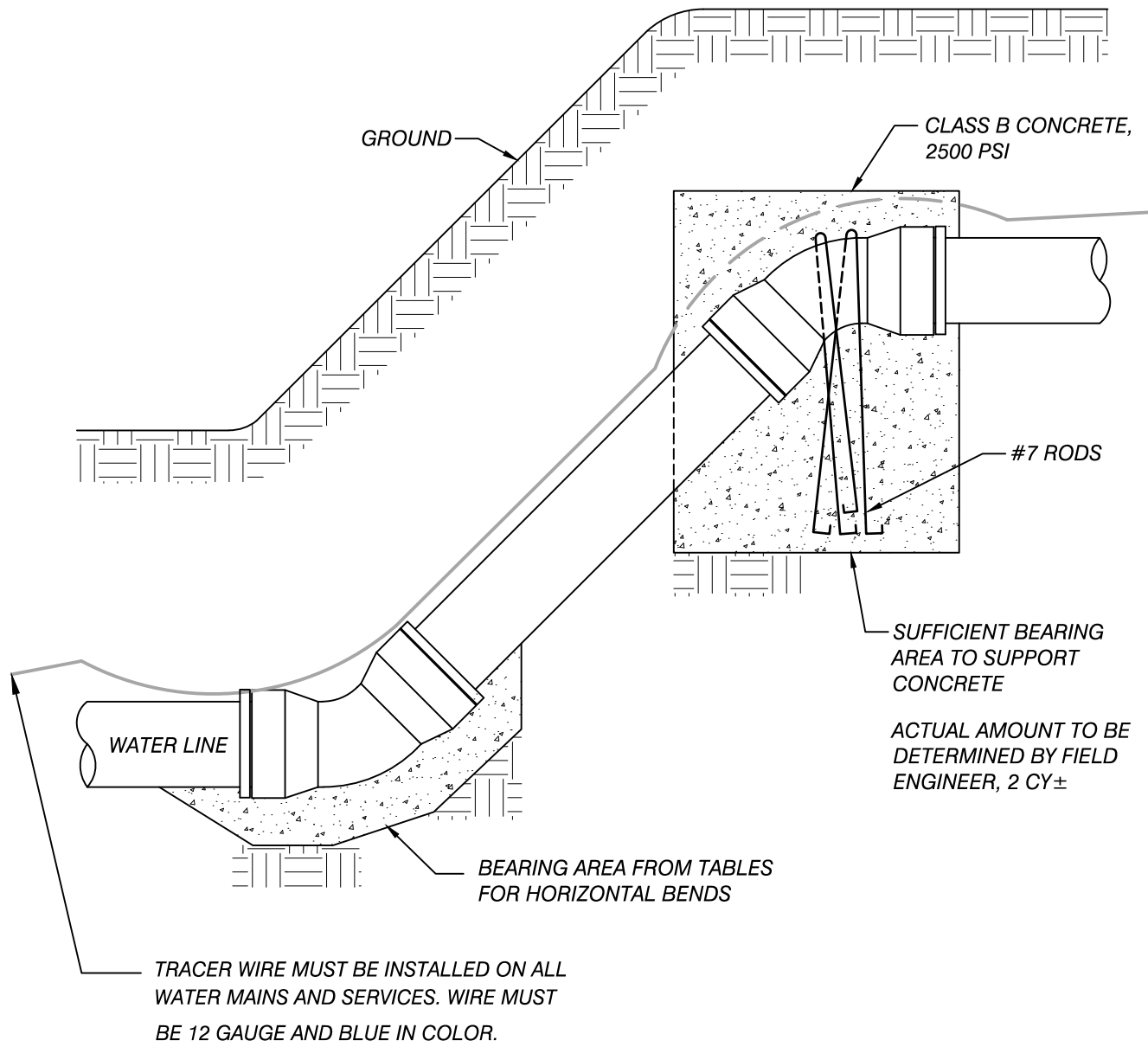
**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

6/22/18





CUBIC YARDS OF CONCRETE TO ANCHOR VERTICAL BEND			
PIPE DIA.	11 1/4 ° BEND	22 1/2 ° BEND	45 ° BEND
6"	1/2 CY	1/2 CY	1.0 CY
8"	1/2 CY	3/4 CY	1.5 CY
12"	1.0 CY	1-3/4 CY	3.5 CY
16"	1-1/2 CY	3.0 CY	6.0 CY

**CITY OF GRAHAM**

**W-23**

STANDARD VERTICAL BEND ANCHORS

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

7/31/19

	<b>SIZE OF BEND</b>	<b>THRUST</b>	<b>REQUIRED RODS</b>	<b>MAXIMUM SIZE EACH STRAP</b>
6"	11-1/4 °	831 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	22-1/2 °	1,655 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	45 °	3,246 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	90 °	5,998 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	PLUG	4,241 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
8"	11-1/4 °	1,478 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	22-1/2 °	2,942 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	45 °	5,771 LBS.	2 EACH @ 5/8" DIA.	2" X 1/2" THICK
	90 °	10,663 LBS.	2 EACH @ 3/4" DIA.	2" X 1/2" THICK
	PLUG	7,540 LBS.	2 EACH @ 3/4" DIA.	2" X 1/2" THICK
10"	11-1/4 °	2,310 LBS.	2 EACH @ 1/2" DIA.	2" X 1/2" THICK
	22-1/2 °	4,597 LBS.	2 EACH @ 5/8" DIA.	2" X 1/2" THICK
	45 °	9,017 LBS.	2 EACH @ 3/4" DIA.	2" X 1/2" THICK
	90 °	16,661 LBS.	2 EACH @ 1" DIA.	2" X 1/2" THICK
	PLUG	11,781 LBS.	2 EACH @ 7/8" DIA.	2" X 1/2" THICK
12"	11-1/4 °	3,326 LBS.	2 EACH @ 3/4" DIA.	2" X 1/2" THICK
	22-1/2 °	6,619 LBS.	2 EACH @ 3/4" DIA.	2" X 1/2" THICK
	45 °	12,984 LBS.	2 EACH @ 7/8" DIA.	2" X 1/2" THICK
	90 °	23,992 LBS.	2 EACH @ 1" DIA.	2" X 1/2" THICK
	PLUG	16,965 LBS.	2 EACH @ 1" DIA.	2" X 1/2" THICK
16"	11-1/4 °	5,912 LBS.	2 EACH @ 7/8" DIA.	2" X 1/2" THICK
	22-1/2 °	11,768 LBS.	2 EACH @ 7/8" DIA.	2" X 1/2" THICK
	45 °	23,083 LBS.	2 EACH @ 1-1/8" DIA.	2" X 5/8" THICK
	90 °	42,652 LBS.	2 EACH @ 1-1/4" DIA.	2" X 5/8" THICK
	PLUG	30,159 LBS.	2 EACH @ 1-1/4" DIA.	2" X 5/8" THICK

**NOTES:**

STEEL RODS ARE CALCULATED ON THE BASIS OF NET THREADED SECTION USING MAXIMUM TENSILE STRESS OF 20,000 PSI.

STRAPS ARE CALCULATED ON BASIS OF MAXIMUM SHEAR STRESS OF 13,000 PSI.

ALL RODS AND STRAPS ARE TO BE HEAVILY COATED WITH AN APPROVED BITUMASTIC COMPOUND.

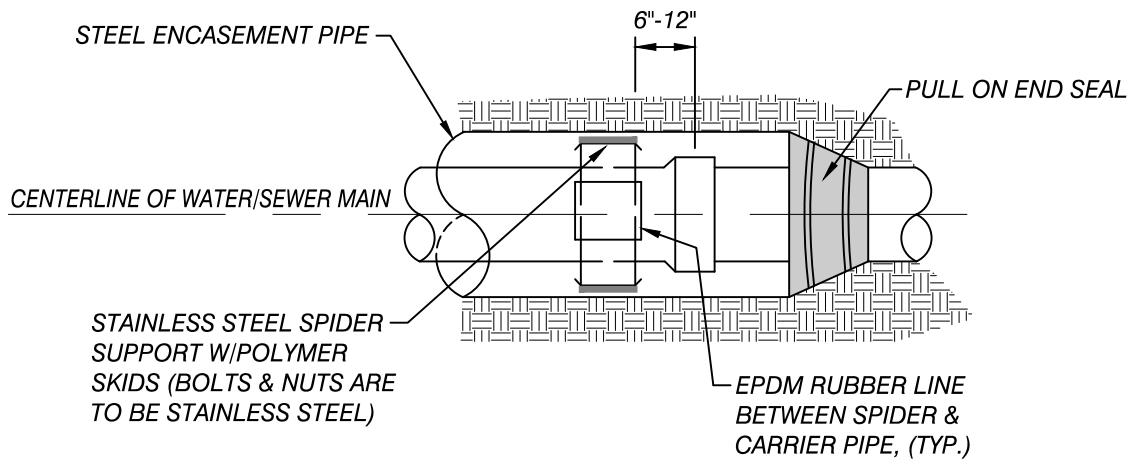
**CITY OF GRAHAM**

**W-24**

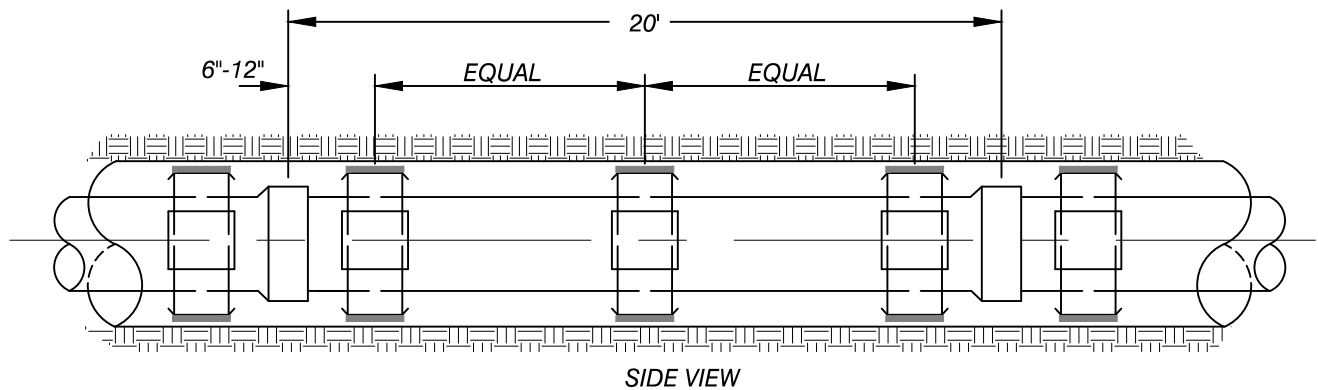
STANDARD FOR RODS AND STRAPS  
TO HOLD FITTINGS WHERE CONCRETE  
REACTION BLOCKING CANNOT BE USED

DWG NO.  
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/WATER

REV.  
6/22/18



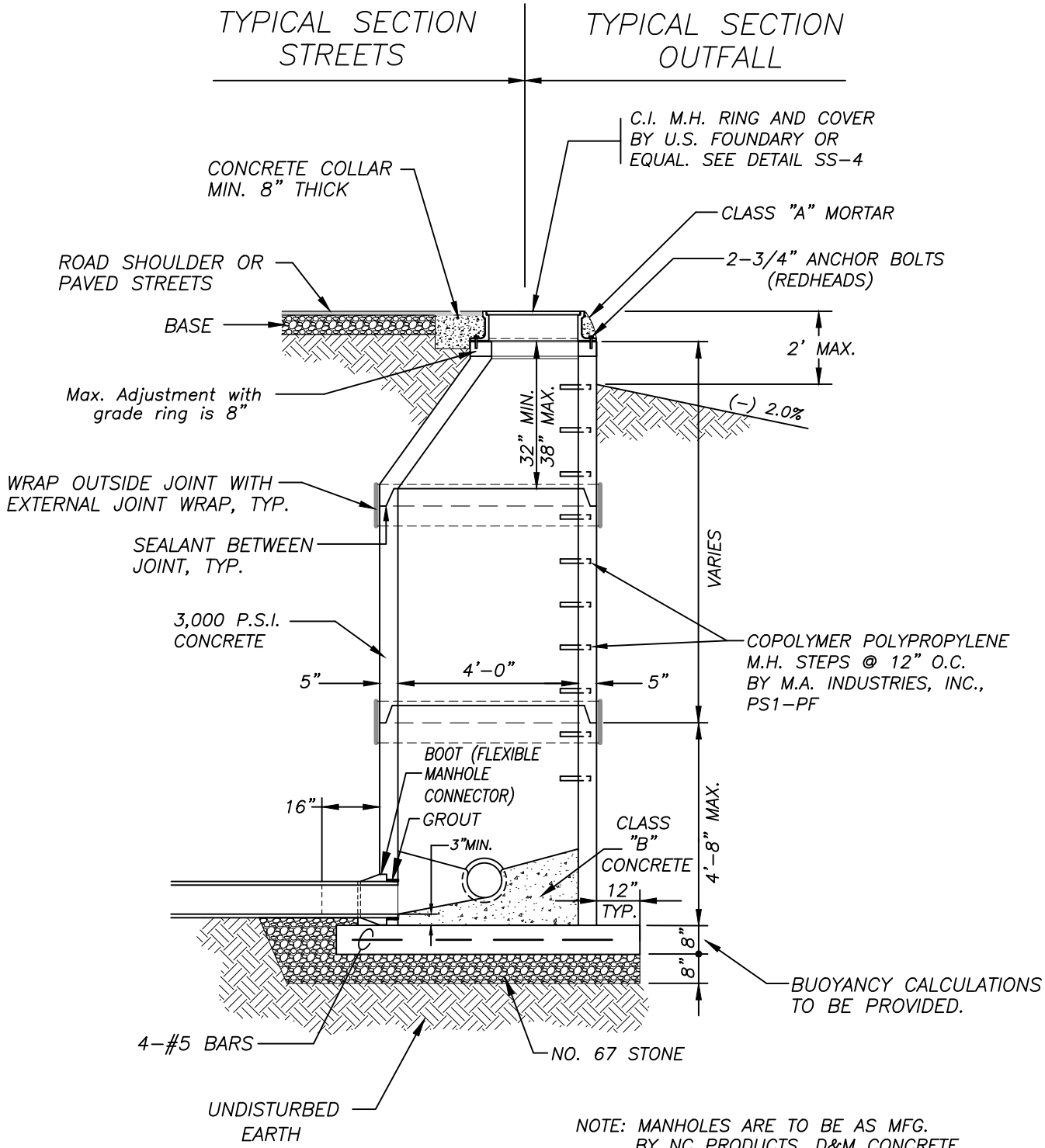
ENCASEMENT END SECTION



TYPICAL SPACING FOR SPIDERS

<b>CITY OF GRAHAM</b>		<b>W-25</b>
<b>STEEL ENCASEMENT PIPE WITH CARRIER PIPE DETAIL</b>	<b>DWG NO.</b>	<b>REV.</b>
	T:DETAILS/GRAHAM DETAILS/2018 DETAILS/WATER	6/22/18



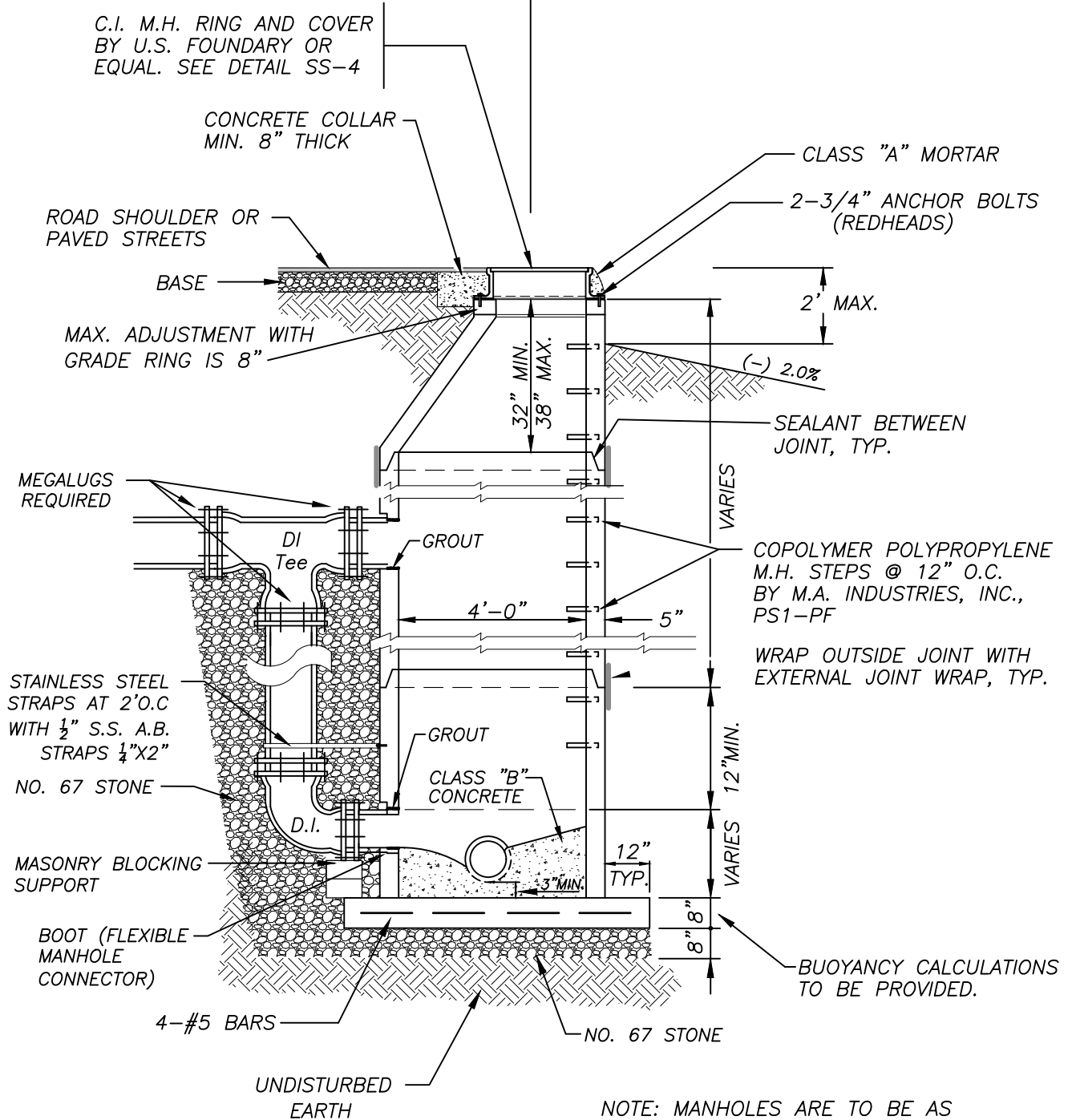


**PARGE ALL INSIDE JOINTS WITH NON-SHRINK GROUT**

<b>CITY OF GRAHAM</b>		<b>SS-1</b>
STANDARD PRECAST MANHOLE		REV.
		7/31/19
		DWG NO.
		T:DETAILS/GRAHAM DETAILS/2018 DETAILS/SEWER

TYPICAL SECTION  
STREETS

TYPICAL SECTION  
OUTFALL



NOTE: MANHOLES ARE TO BE AS  
MFG. BY NC PRODUCTS, D&M  
CONCRETE COMPANY INC. OR  
APPROVED EQUAL.

PARGE ALL INSIDE JOINTS WITH NON-SHRINK GROUT

**CITY OF GRAHAM**

**SS-2**

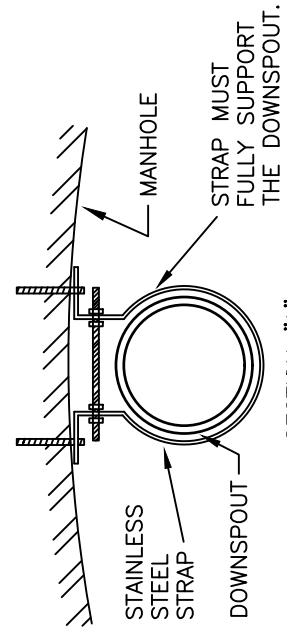
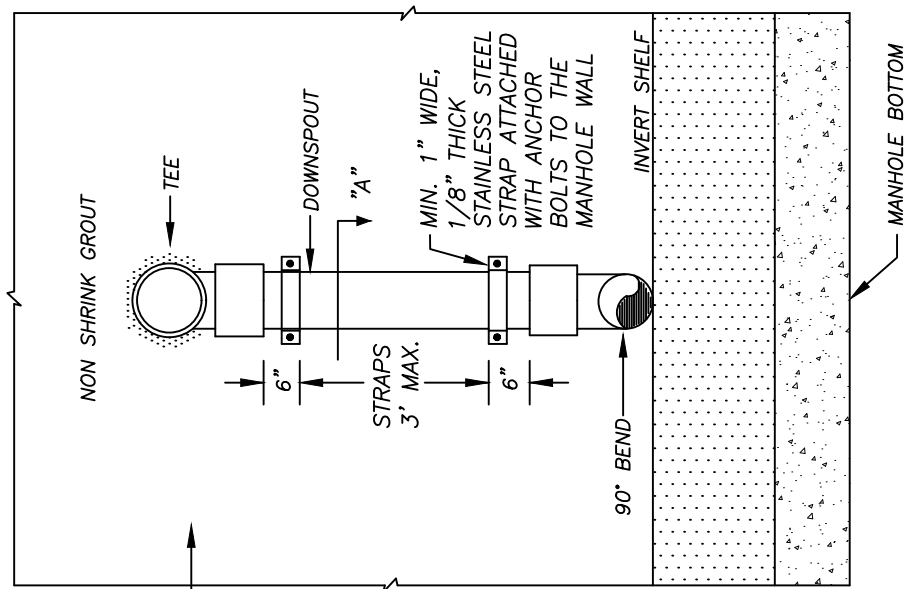
STANDARD PRECAST OUTSIDE DROP MANHOLE

DWG NO.

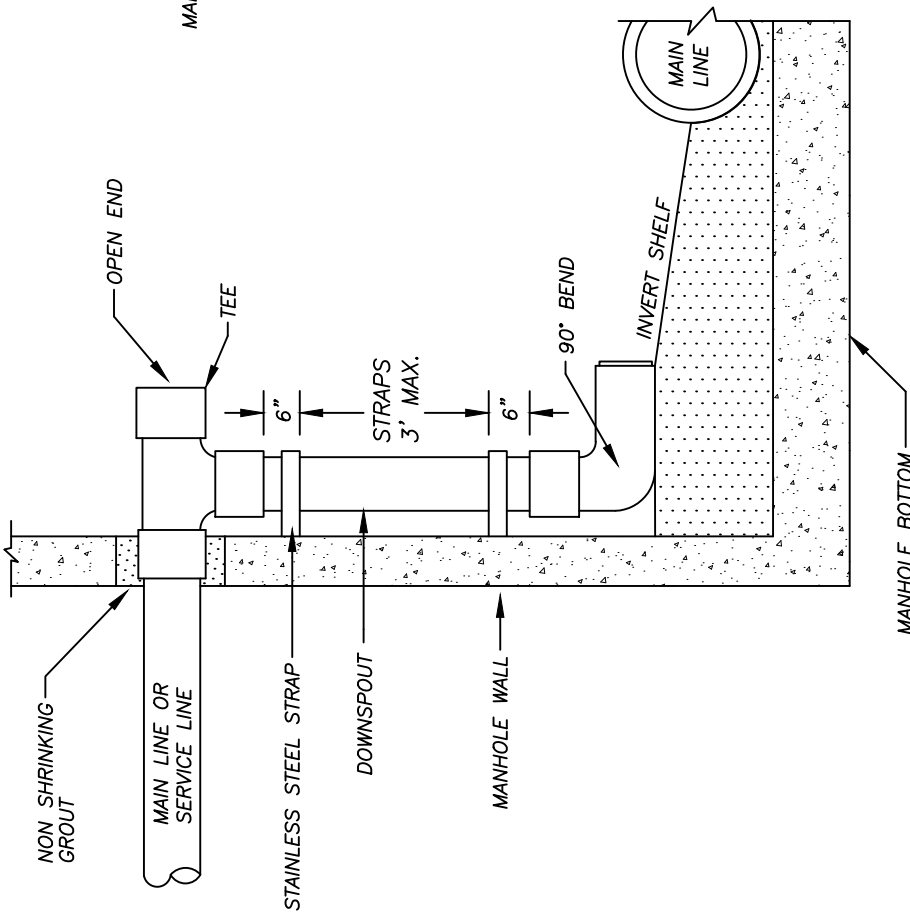
REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

9/20/18



SECTION "A"  
N.T.S.



**NOTES:**

1. PIPING CONFIGURATION TO BE USED ON ALL DROPS OVER 30".
2. DROPS TO BE CONSTRUCTED OF PVC SCH. 80 PIPE.
3. SERVICE LINE MAY NOT ENTER MANHOLE THROUGH CONE SECTION OR ITS JOINT.
4. THIS DETAIL MAY NOT BE USED FOR FORCE MAINS.
5. 5' (MIN.) DIAMETER MANHOLE SHALL BE USE FOR NEW INSIDE DROPS.

# CITY OF GRAHAM

**SS-3**

STANDARD INSIDE DROP FOR SANITARY SEWER SERVICE

DWG NO.  
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

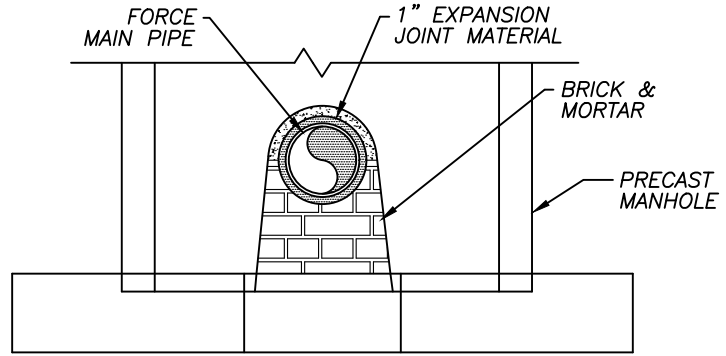
REV.  
9/20/18

**NOTES**

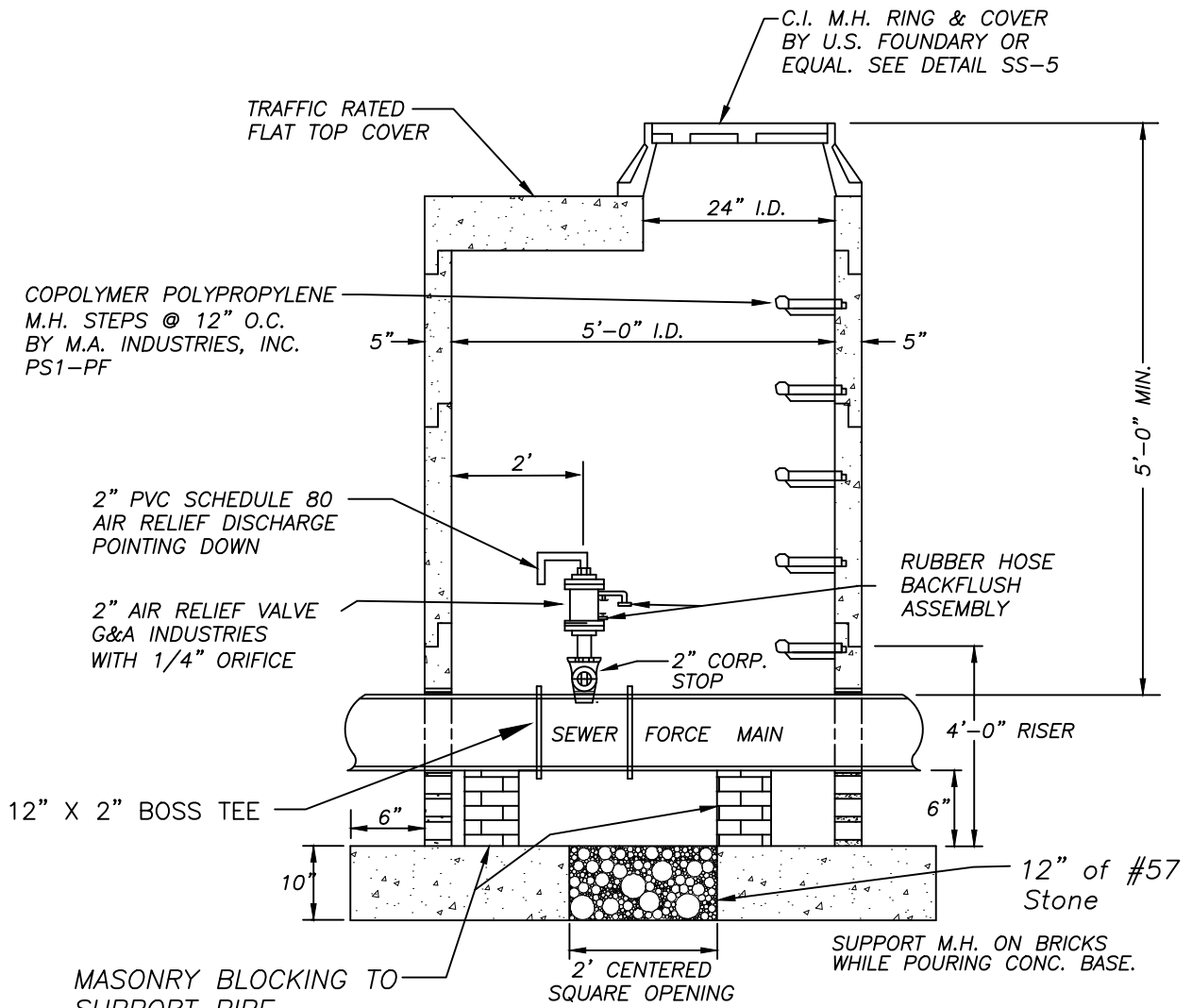
MANHOLES OVER 3'-6" IN DEPTH SHALL BE PROVIDED WITH STEPS 1'-0" ON CENTERS.

ON NEW INSTALLATION A MAXIMUM OF (2) GRADE RINGS SHALL BE USED.

PROVIDE CHECK VALVE IN AIR RELIEF VALVE ASSEMBLY IF AIR RELIEF VALVE IS HIGHER THAN DISCHARGE ELEVATION



ELEVATION



SECTION THRU MANHOLE

**CITY OF GRAHAM**

**SS-4**

**AIR RELIEF VALVE WITH ASSEMBLY & MANHOLE**

**DWG NO.**

**REV.**

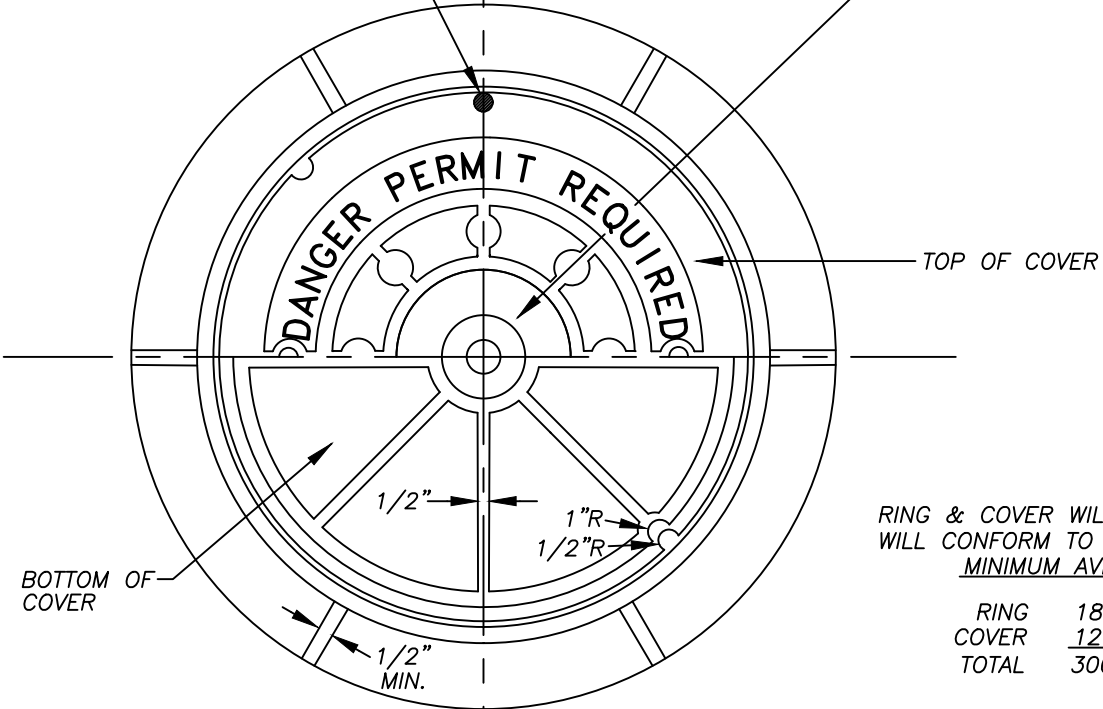
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

7/12/19



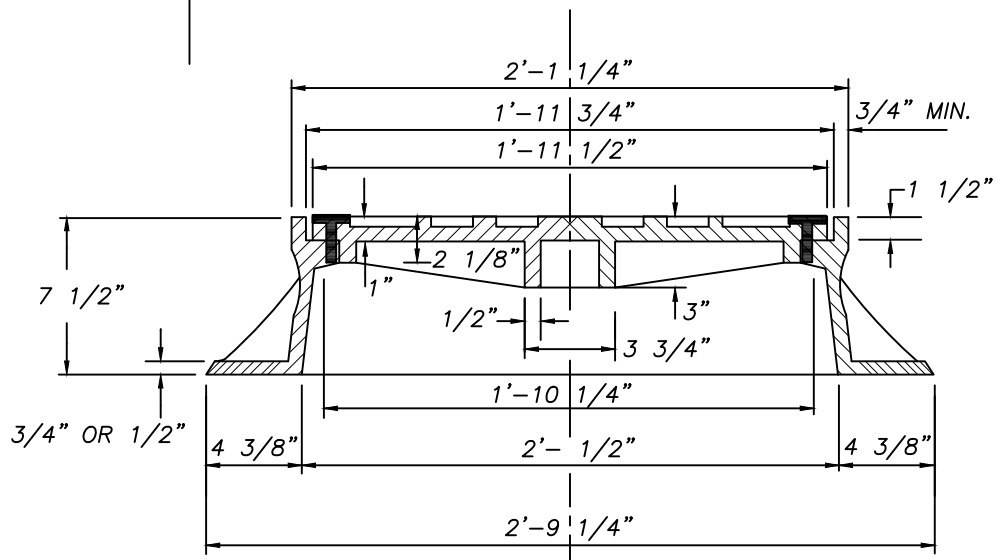


4- 1/2" X 13/4" HEXHEAD,  
STAINLESS STEEL BOLTS  
AT 90° COUNTERSUNK.  
BOLTS TO BE TYPE 316  
STAINLESS STEEL.  
(FOR WATERTIGHT MANHOLES)



RING & COVER WILL BE MACHINED AND  
WILL CONFORM TO ASTM A48, CLASS 30B  
MINIMUM AVERAGE WEIGHTS

RING	180 LBS.
COVER	120 LBS.
TOTAL	300 LBS.



# CITY OF GRAHAM

SS-5

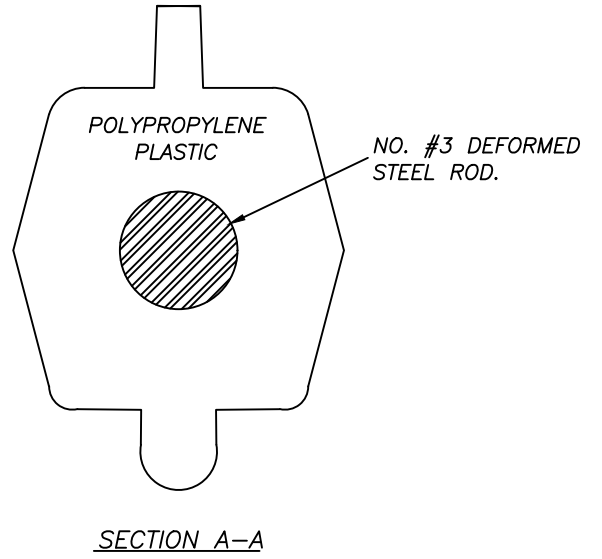
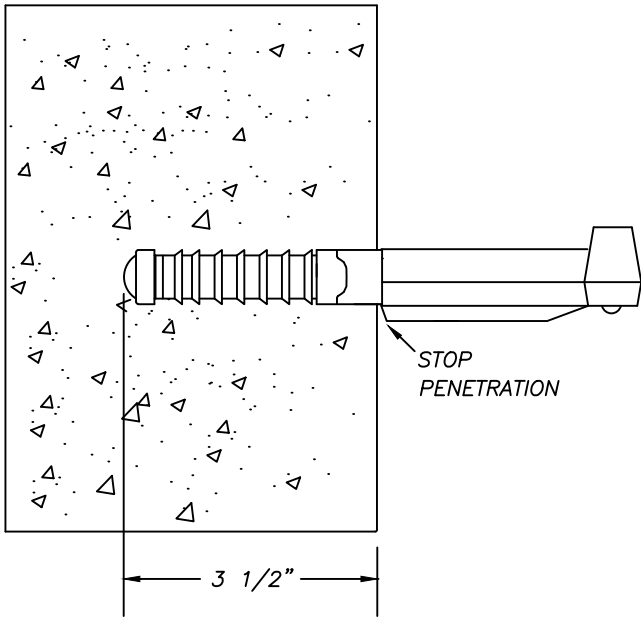
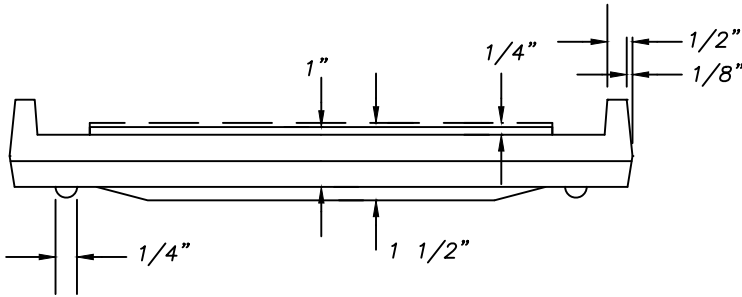
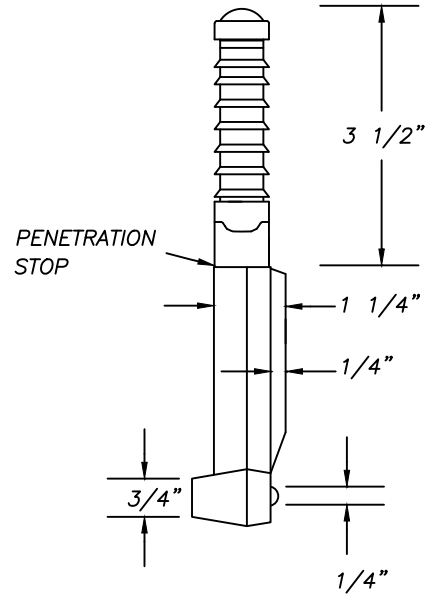
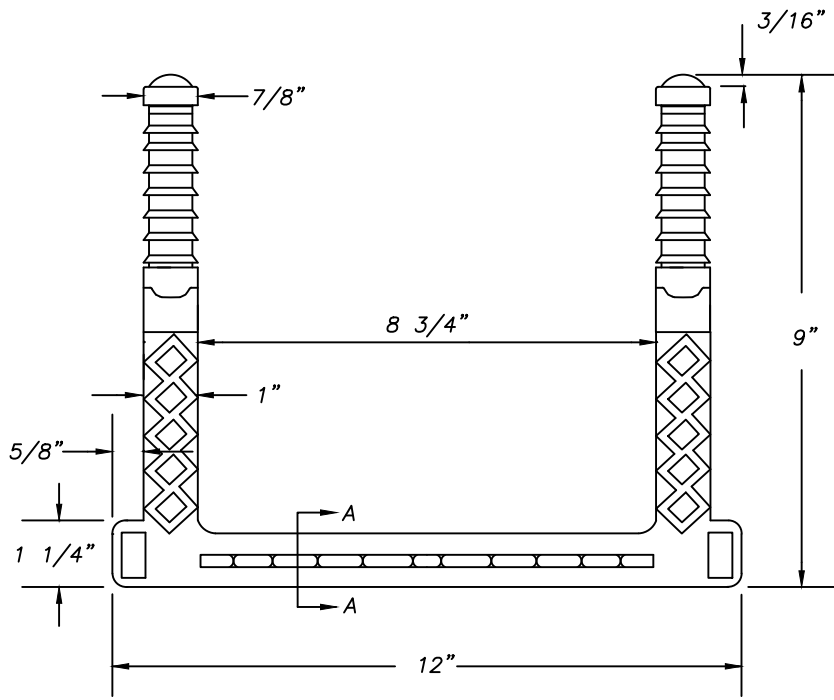
MANHOLE RING AND COVER

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

9/20/18



**CITY OF GRAHAM**

**SS-6**

POLYPROPYLENE MANHOLE STEP

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2015  
DETAILS/SEWER

10/30/19

INFLUENTS MAY BE LOCATED AT ANY ANGLE PAST 35° EITHER SIDE OF EFFLUENT

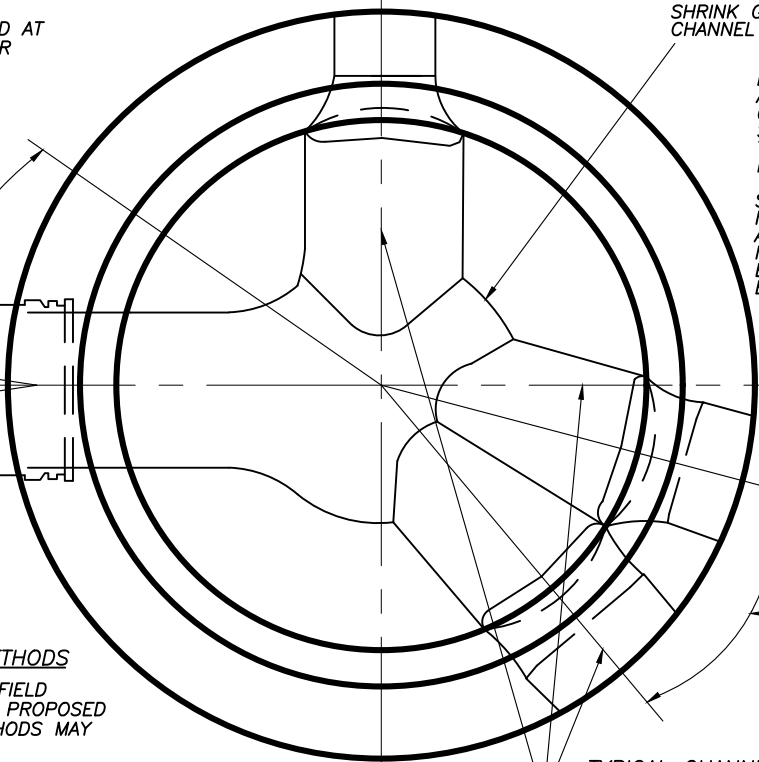
JOINT PERMITS 6 1/2" LINE ADJUSTMENT IN ANY DIRECTION

6 1/2"  
6 1/2"

BUBBLE TO BE GROUTED WITH NON-SHRINK GROUT TO FORM A SMOOTH CHANNEL THROUGH MANHOLE.

EFFLUENT & INFLUENTS MAY BE ANY COMBINATION OF 12, 10, 8 OR 6 IN. PIPES. UNEQUAL PIPE SIZE MAY BE ALIGNED AT THE TOP OR CENTER TO PREVENT REVERSE FLOW

STANDARD DROP THROUGH MANHOLE IS 1". OTHER SLOPES ARE AVAILABLE FROM MANUFACTURER. DROPS WILL BE AS SHOWN ON THE ENGINEERS DRAWINGS.



35° MIN. ANGLE

**EFFLUENT CONNECTION METHODS**

WHEN LINE PIPE CANNOT BE FIELD CUT TO LOCATE MANHOLE ON PROPOSED CENTER, THE FOLLOWING METHODS MAY BE USED:

- 1) USE SHORTER STANDARD LENGTHS OF PIPE TO MAKE ADJUSTMENTS AS LINE APPROACHES MANHOLES.
- 2) STOCK SEVERAL DIFFERENT LENGTHS OF DOUBLE SPIGOTS AND SELECT APPROPRIATE LENGTH.
- 3) USE A COMBINATION OF 1 & 2.

**TYPICAL CHANNEL ARRANGEMENTS.**

WHEN REQUIRED FILLETS MAY BE ADDED IN THE FIELD TO DIRECT THE FLOW TO ACCOMMODATE A PARTICULAR NEED.

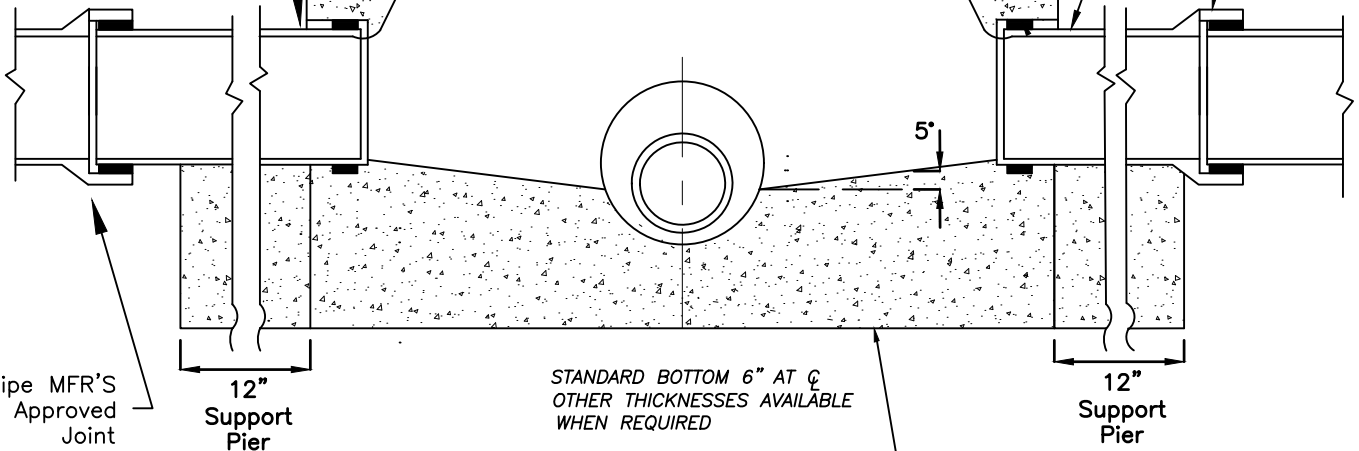
RISER SECTION AND CONE TO BE ADDED AS PER DETAIL DRAWING FOR PRECAST REINFORCED CONCRETE MANHOLE.

Double Spigot Effluent Adaptor

MFR'S JOINT

STARTER INFLUENT ADAPTER

PIPE MFR'S APPROVED JOINT



Pipe MFR'S Approved Joint

12" Support Pier

STANDARD BOTTOM 6" AT C OTHER THICKNESSES AVAILABLE WHEN REQUIRED

12" Support Pier

MANHOLE SHALL BE MANUFACTURED AS PER THE REQUIREMENTS OF ASTM C-478

**CITY OF GRAHAM**

**SS-7**

PRECAST REINFORCED CONCRETE MANHOLE WITH PRECAST INVERT

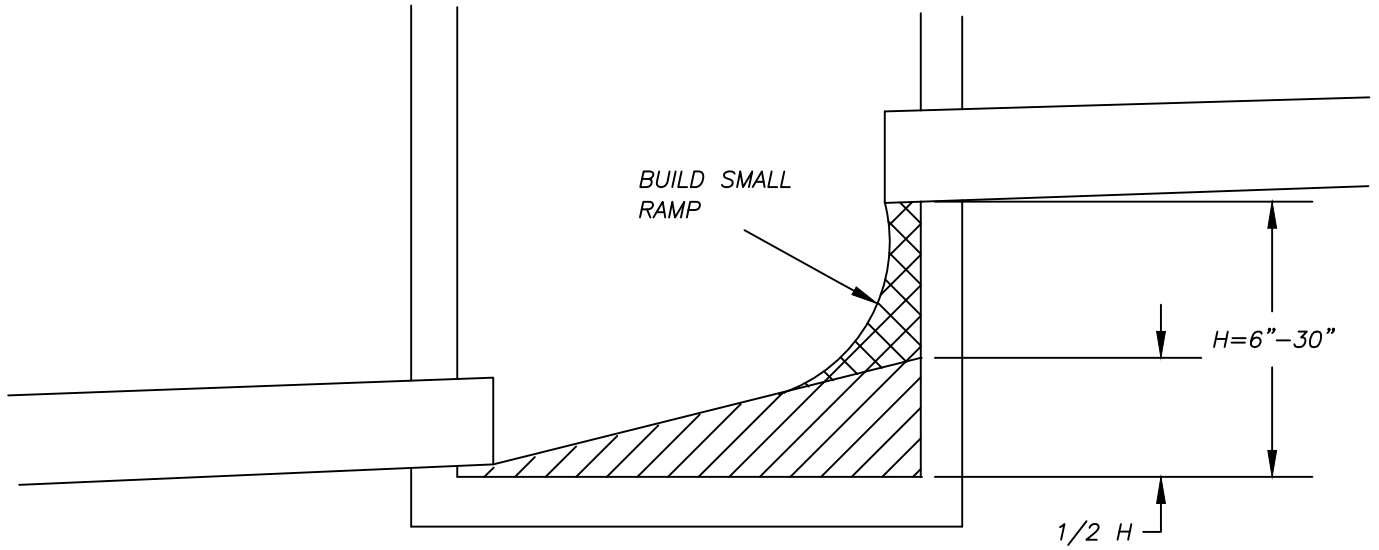
DWG NO.

REV.

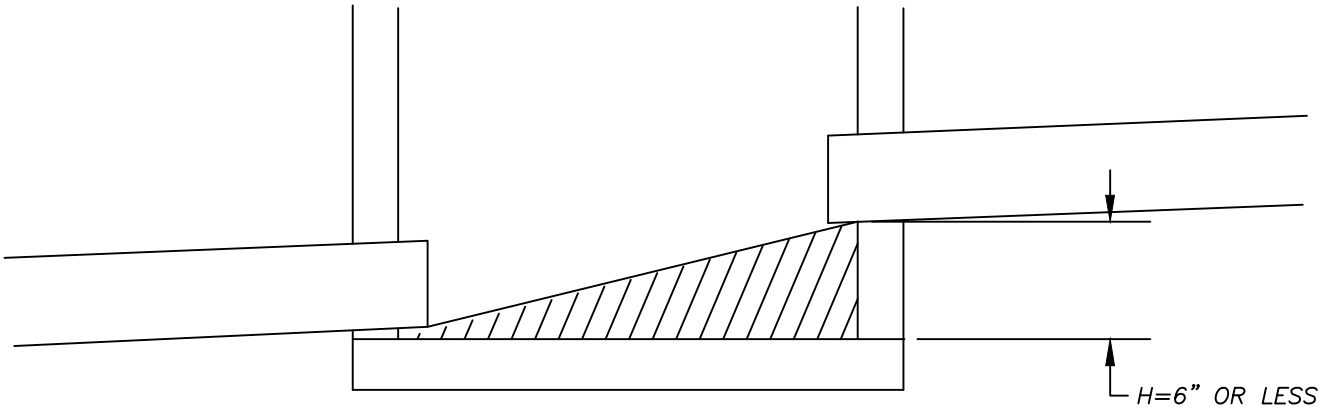
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

7/31/19

1- IF "H" IS BETWEEN 6"-30"



2- IF "H" IS 6" OR LESS



H= ELEVATION DIFFERENCE BETWEEN INVERT OF EFFLUENT PIPE AND INVERT OF INFLUENT PIPE.

**CITY OF GRAHAM**

**SS-8**

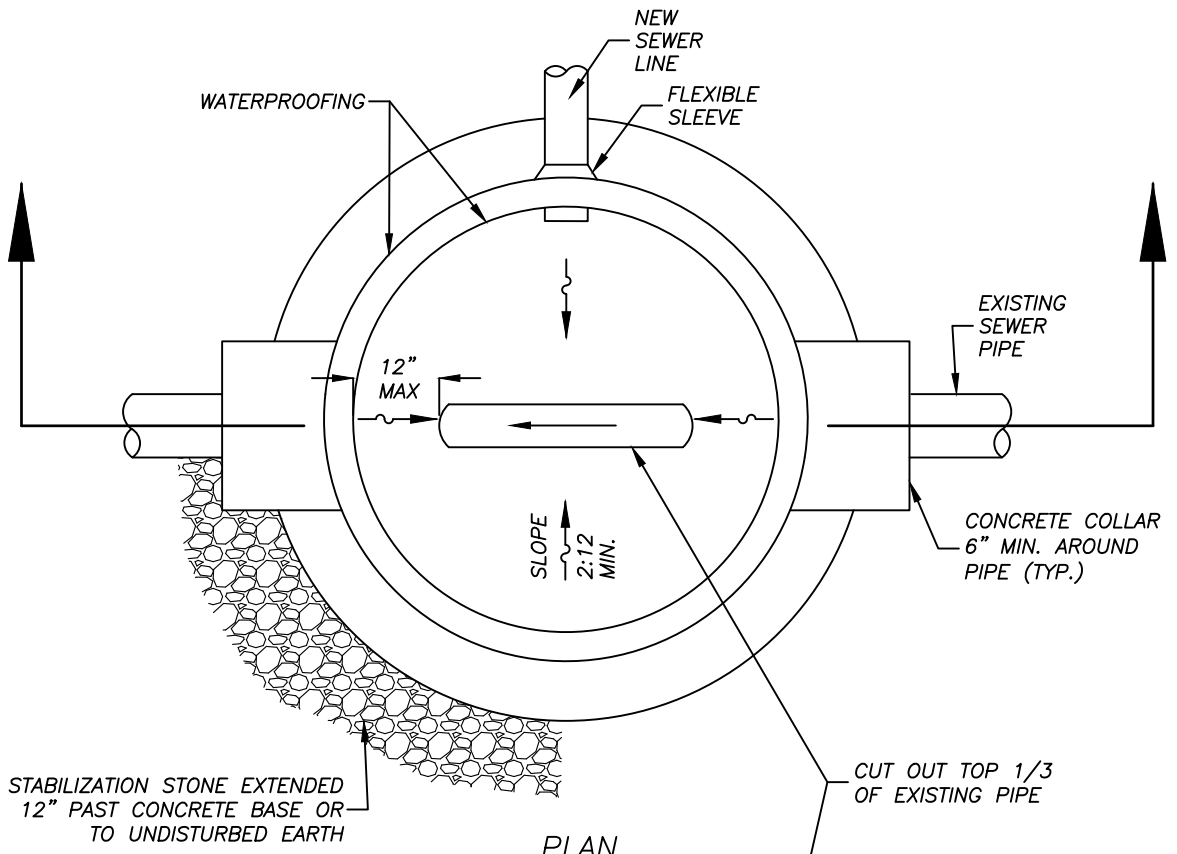
MANHOLE CHANNEL

DWG NO.

REV.

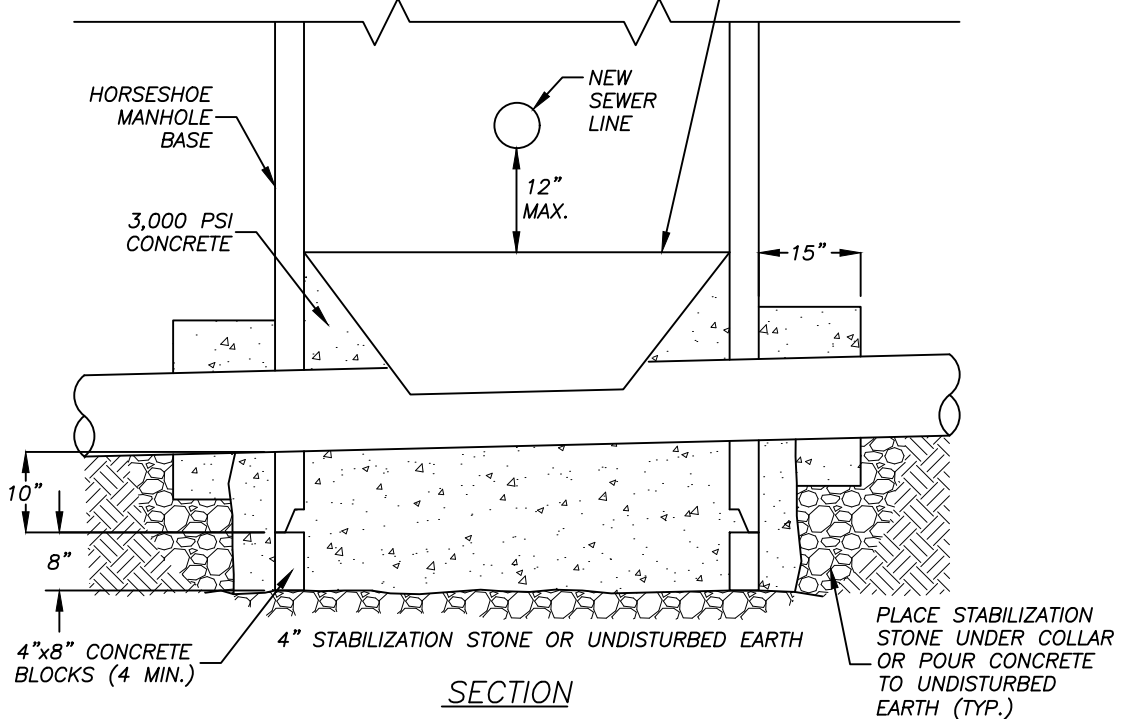
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

2/1/15



PLAN

- NOTES:
1. PLACE HORSESHOE MANHOLE BASE IN WET CONCRETE (3,000 PSI).
  2. CUT OUT TOP THIRD OF EXISTING PIPE. FINISH INVERTS AND WATERPROOF ALL COLD JOINTS AND AROUND ALL PIPES.
  3. POUR CONCRETE COLLARS.



SECTION

**CITY OF GRAHAM**

**SS-9**

**DOGHOUSE MANHOLE**

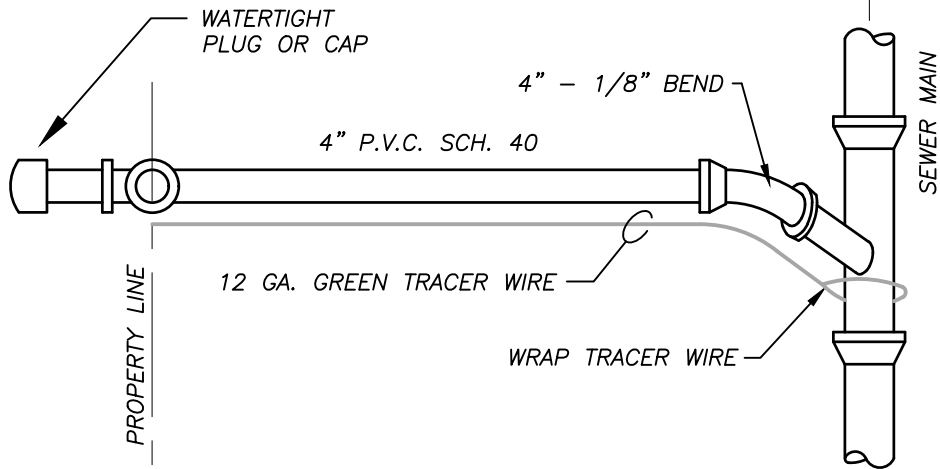
**DWG NO.**

**REV.**

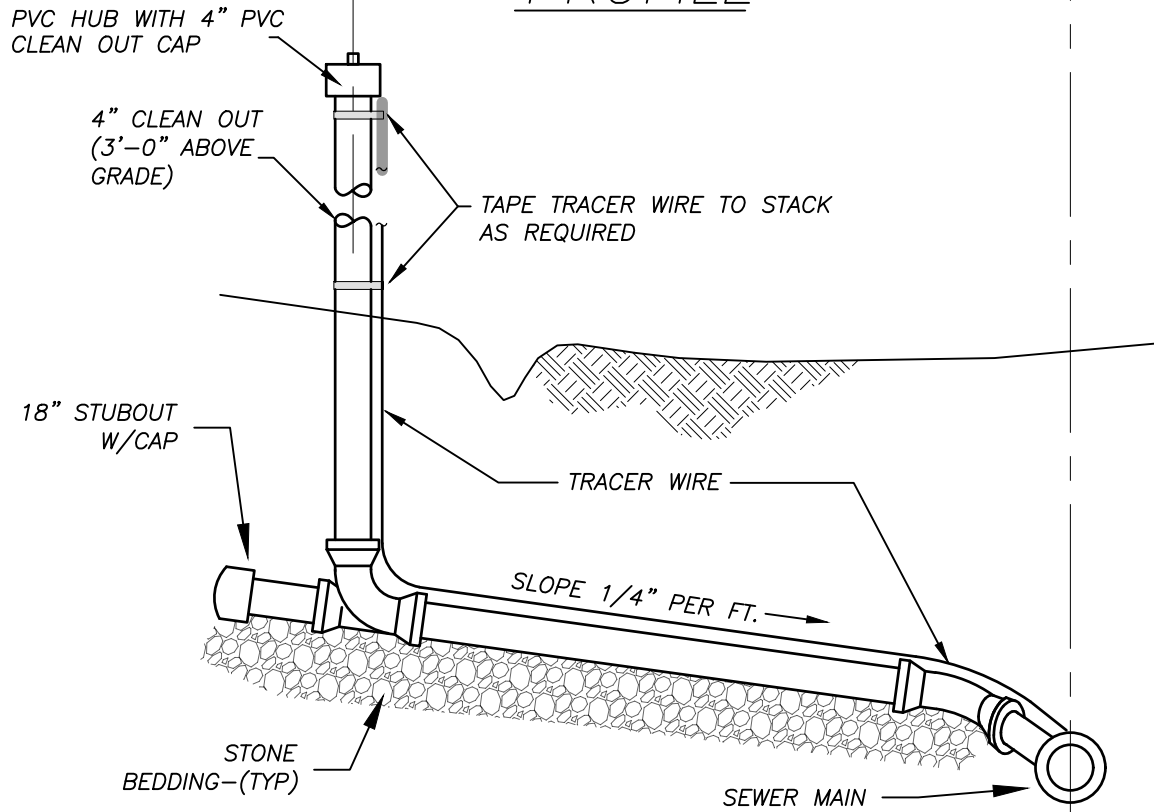
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

2-6-18

# PLAN



# PROFILE



NOTE: PLUMBER TO CONNECT TO STUB-OUT/STACK AND LOWER CLEAN-OUT CAP TO GROUND LEVEL  
 All services must have tracer wire.  
 Tracer wire must be 12 gauge and green in color.

**CITY OF GRAHAM**

**SS-10**

STANDARD SEWER SERVICE CONNECTION

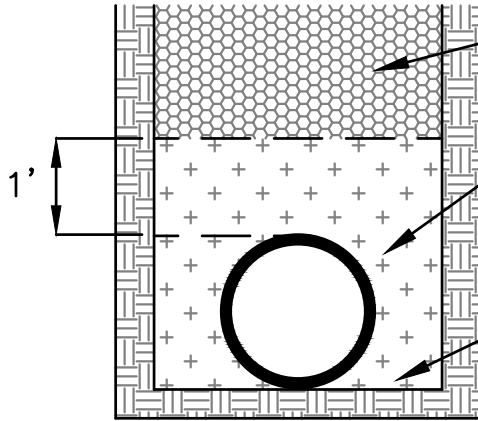
DWG NO.

REV.

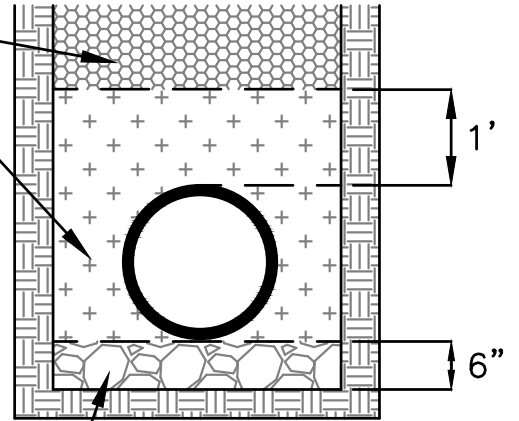
T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/SEWER

1/1/2020

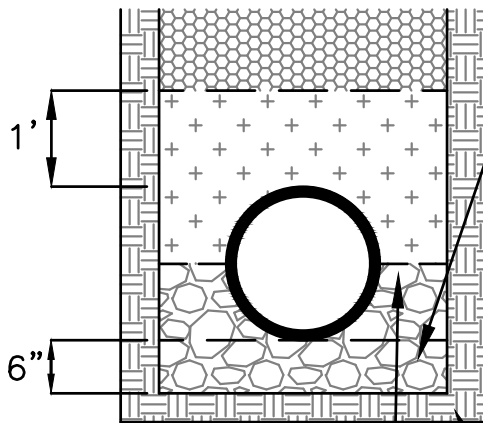
TYPE 1



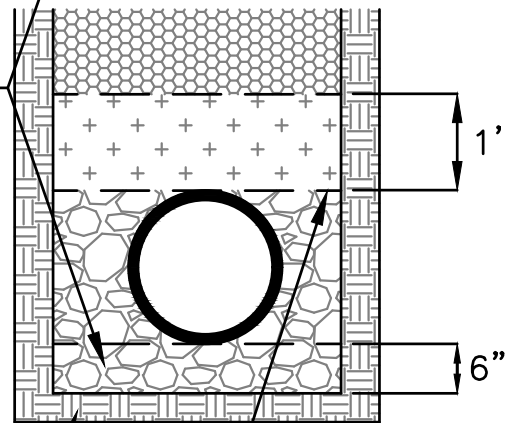
TYPE 2



TYPE 3



TYPE 4



FILL TO  
SPRING LINE

UNDISTURBED  
EARTH

FILL TO TOP  
OF PIPE

**NOTE:**  
 THE INSPECTOR OR ENGINEER RESERVES THE RIGHT TO  
 REQUIRE DIP TO BE BEDDED ON STONE DEPENDING UPON  
 TRENCH CONDITIONS.

**CITY OF GRAHAM**

**SS-11**

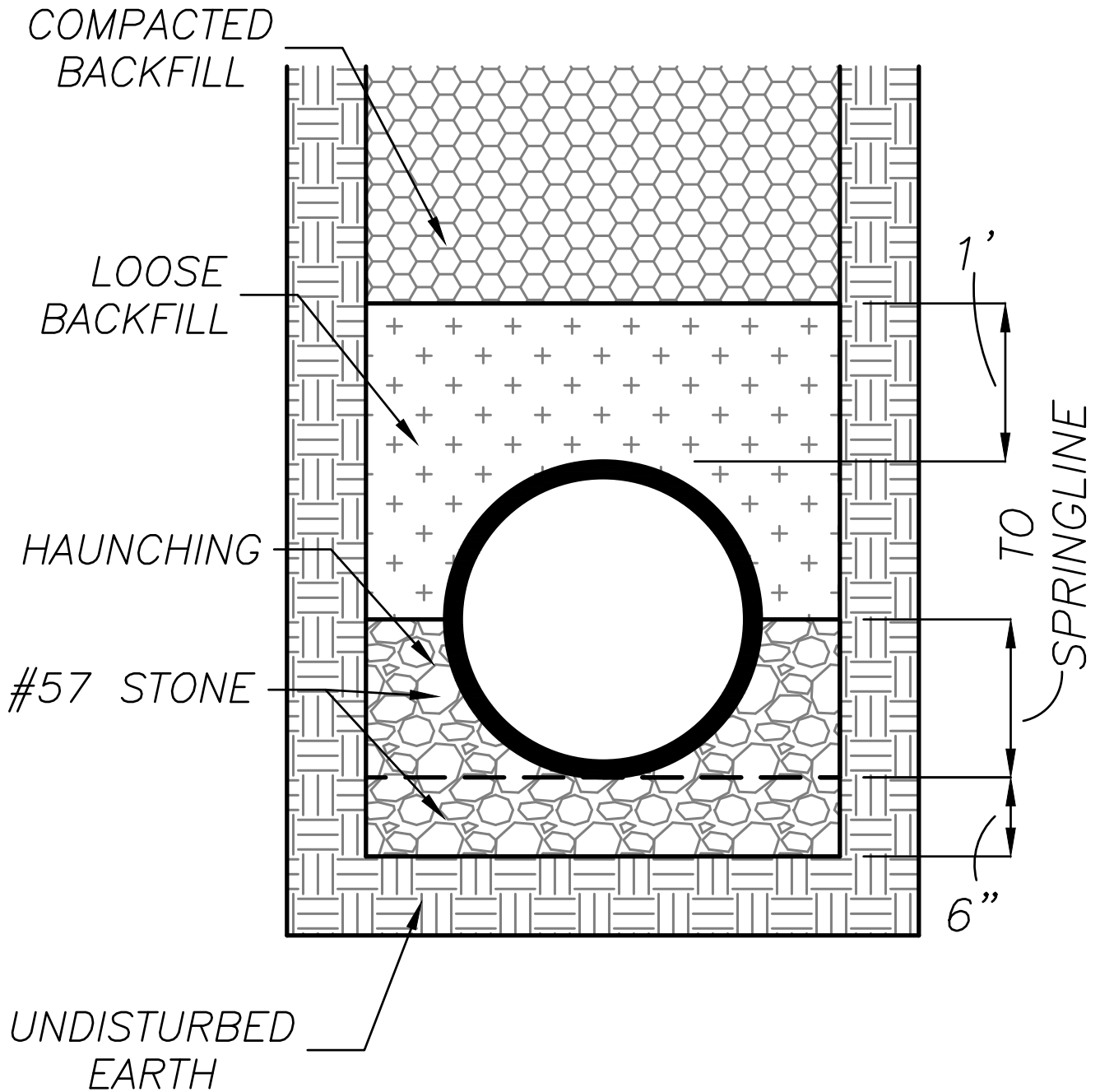
DIP SANITARY SEWER BEDDING

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

8/8/19



**CITY OF GRAHAM**

**SS-12**

*Pipe Embedment for PVC Sewer Lines*

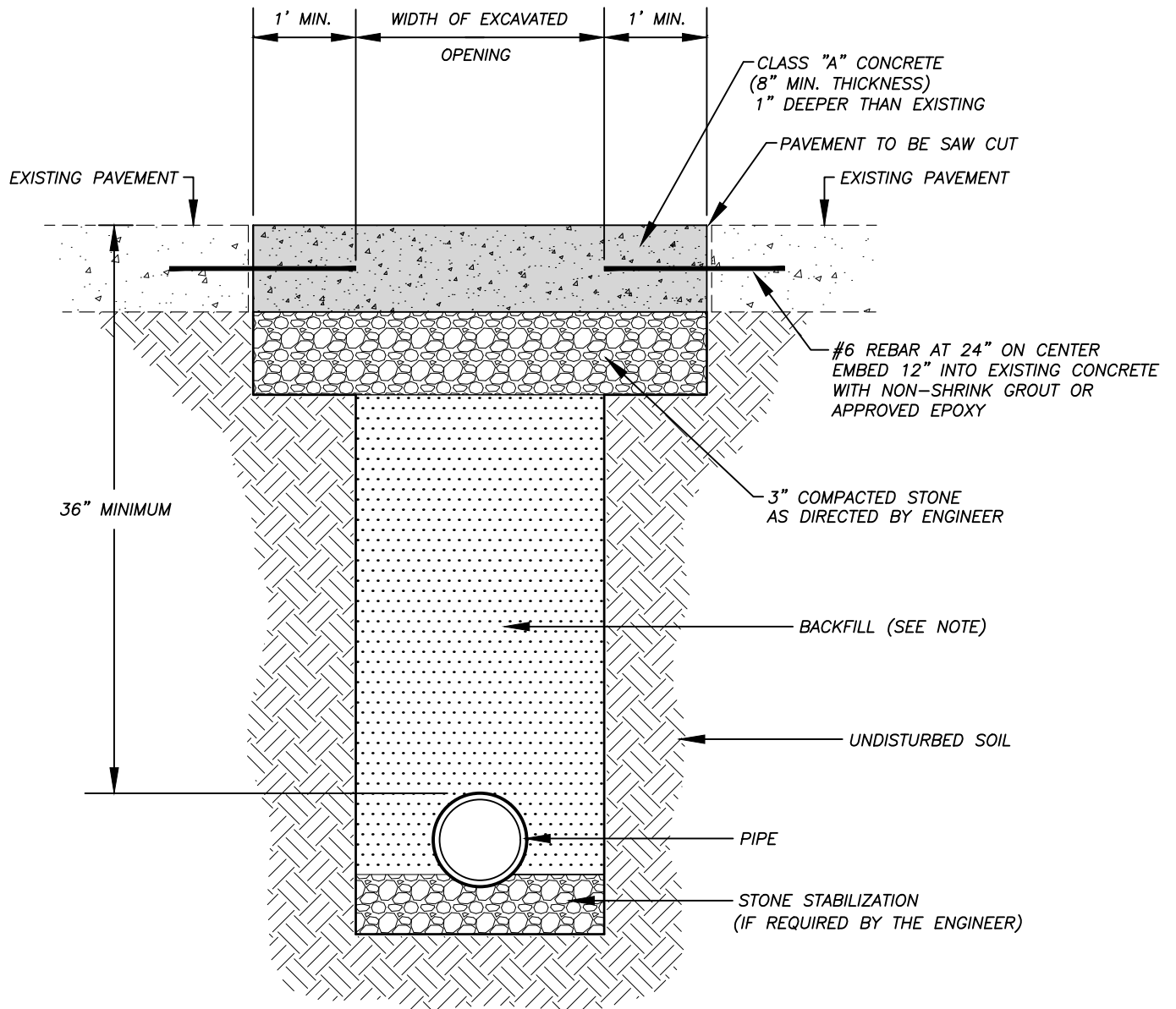
**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/SEWER

2/1/15





NOTE:  
 WHERE THE EDGE OF THE PATCH OR SECTION OF REMOVED PAVEMENT IS LESS THAN 10' FROM A TRANSVERSE EXPANSION OR CONTRACTION JOINT OR CRACK, THE ENTIRE SECTION OF PAVEMENT SHALL BE REMOVED UP TO THE JOINT OR CRACK AND REPLACED WITH NEW CONCRETE AND ABC STONE IN ACCORDANCE WITH THE MOST CURRENT N.C.D.O.T. STANDARD SPECIFICATIONS.

THE BACKFILL SHALL BE MADE IN 6" LAYERS AND SHALL BE COMPACTED TO AT LEAST 95% OF STANDARD DENSITY (AASHTO METHOD T-99). EACH LAYER MUST BE THOROUGHLY TAMPED BY A MECHANICAL TAMP BEFORE THE NEXT LAYER IS PLACED.

# CITY OF GRAHAM

SS-13

CONCRETE DRIVEWAY REPAIR DETAIL

DWG NO.

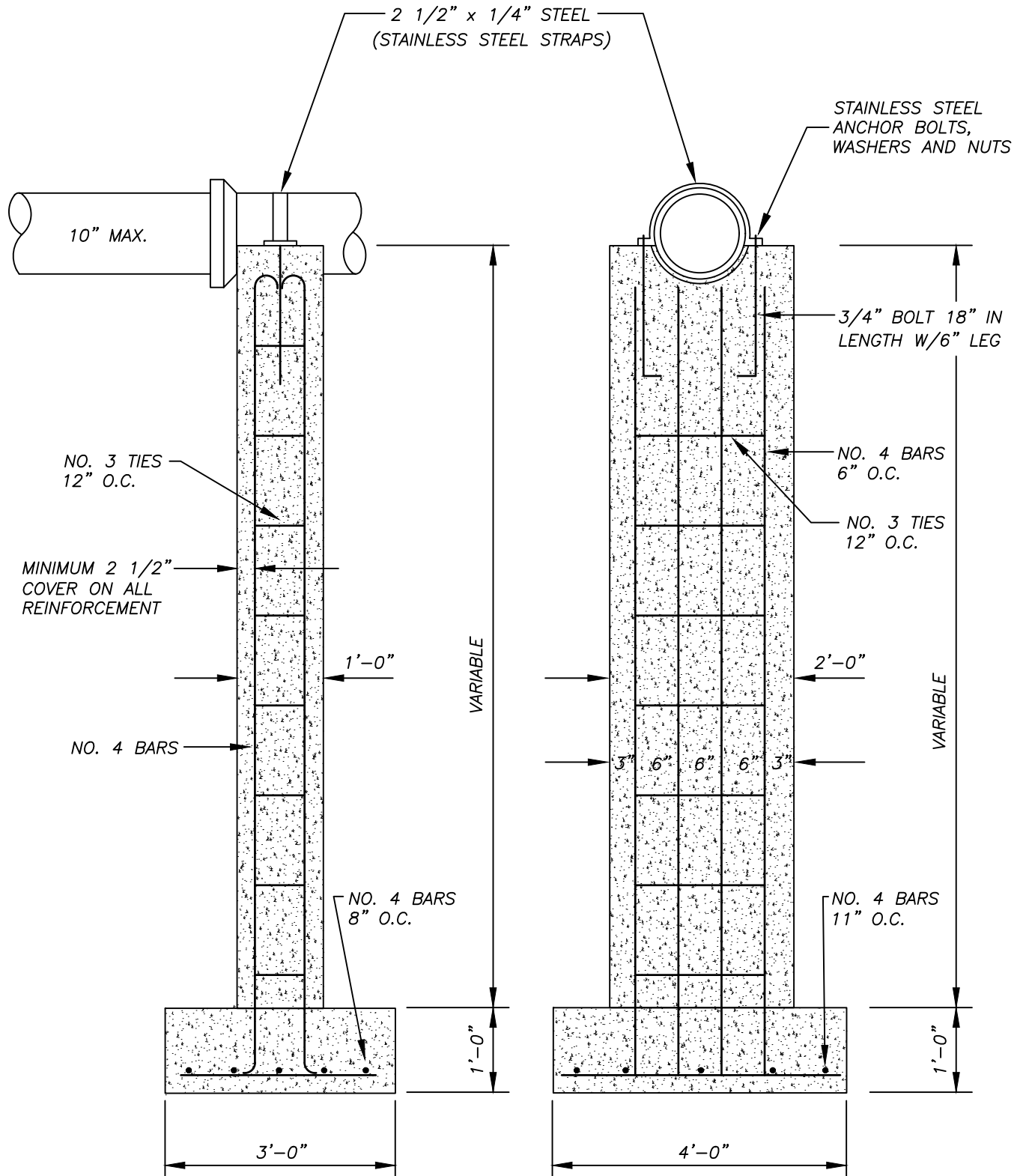
REV.

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/SEWER

9/20/18







# CITY OF GRAHAM

SS-16

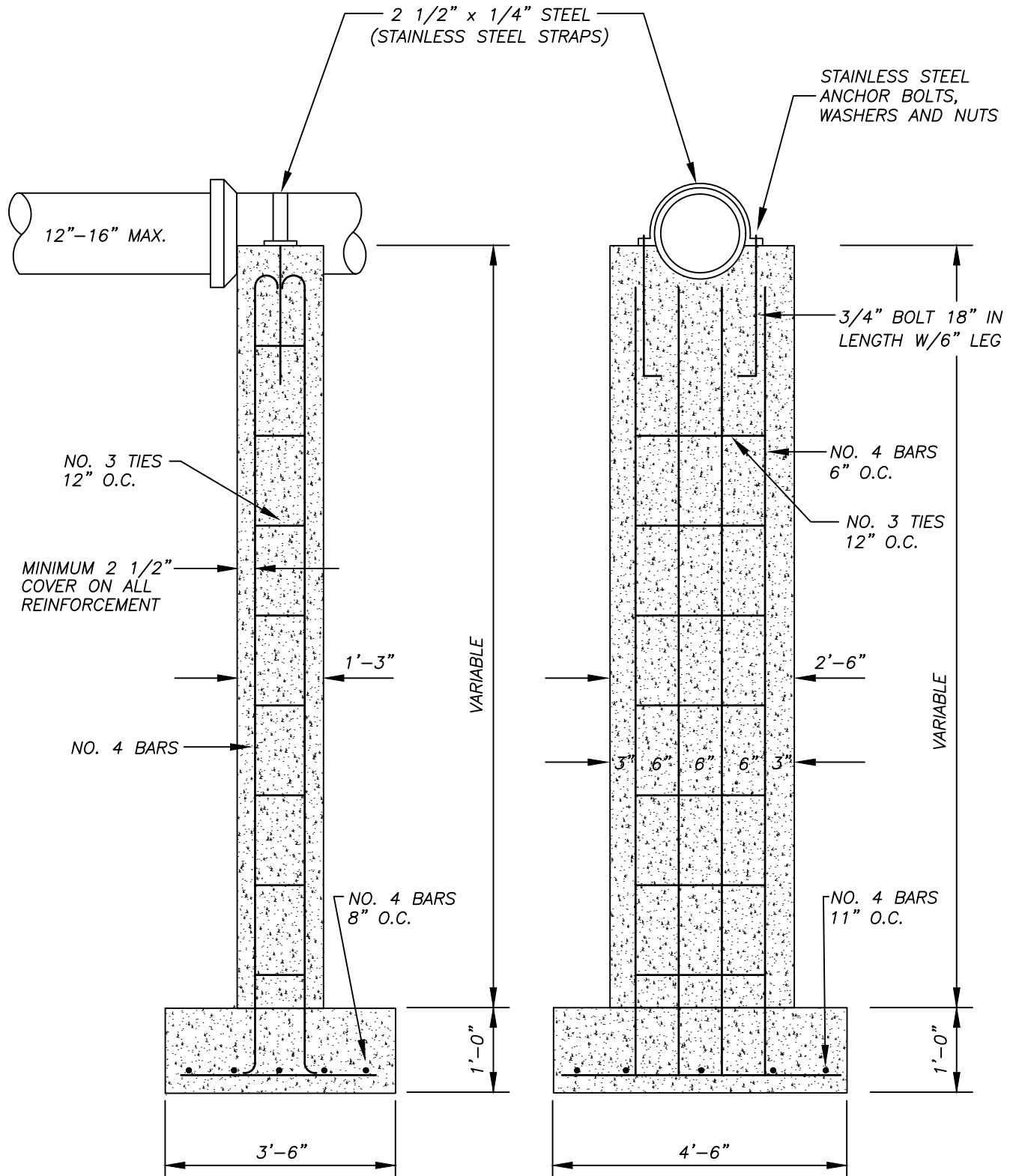
CONCRETE PIER  
10" MAXIMUM SANITARY SEWER

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

2/1/15



# CITY OF GRAHAM

SS-17

CONCRETE PIER  
12"-16" MAXIMUM SANITARY SEWER

DWG NO.

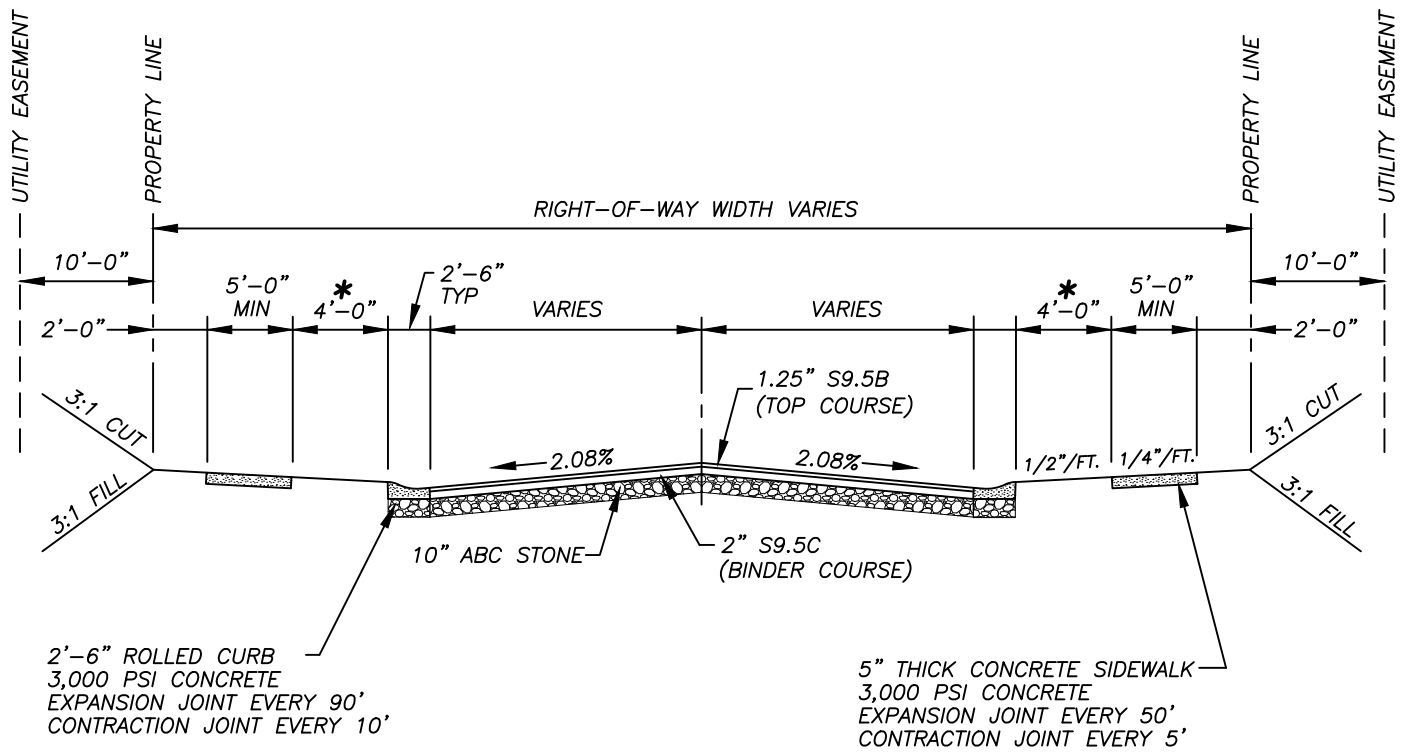
REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/SEWER

2/1/15



\* GRASS STRIP BETWEEN BACK OF CURB AND EDGE OF SIDEWALK TO BE A 4' WIDE STRIP UNLESS OTHERWISE NOTED AND/OR AS SHOWN ON DRAWINGS.

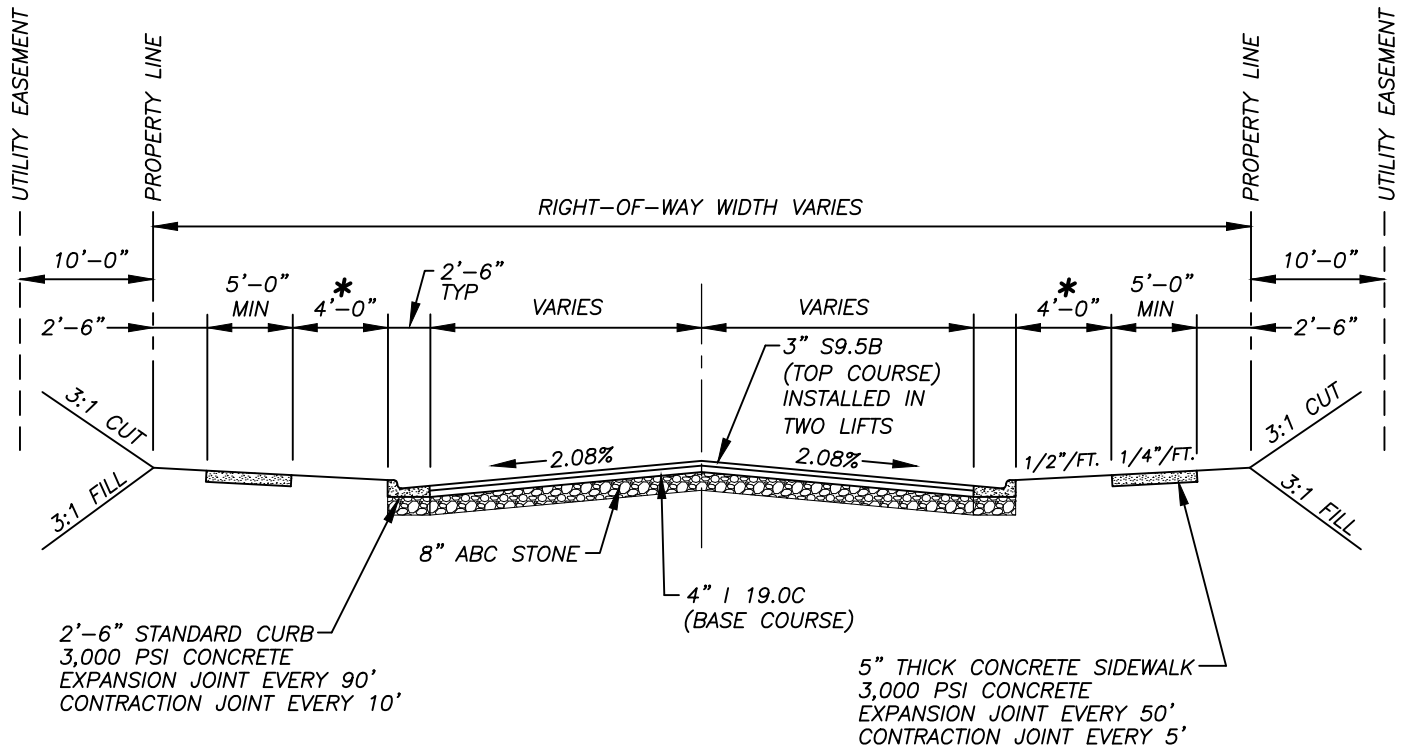


**NOTES:**

1. CONTRACTOR MUST PRESENT INSPECTOR WITH ASPHALT TICKETS.
2. REFER TO THE CITY OF GRAHAM DEVELOPMENT ORDINANCE FOR APPROPRIATE DIMENSIONS. ALTERNATIVE STREET WIDTHS AND PAVEMENT SECTIONS MAY BE APPROVED PER THE UDO AND CITY OF GRAHAM TRC.
3. ALL ASPHALT CEMENT PLANT MIX AND METHOD OF PLACEMENT SHALL COMPLY WITH N.C. DOT STANDARD SPECIFICATIONS.
4. ALL WORK SHALL COMPLY WITH N.C. DOT STANDARD SPECIFICATIONS.
5. TOP COURSE TO BE PLACED WITHIN 12 MONTHS OF ASPHALT BINDER COURSE.
6. ALL ROADWAYS SHALL BE PROOFROLLED PRIOR TO PLACEMENT OF ABC STONE, BINDER COURSE AND TOP COURSE. ALL DEFECTS IN SUBGRADE AND/OR PAVEMENT SHALL BE REPAIRED.

<b>CITY OF GRAHAM</b>		<b>ST-1</b>
<b>RESIDENTIAL STREET SECTION</b>		<b>DWG NO.</b>
		<b>REV.</b>
		T:DETAILS/GRAHAM DETAILS/2018 DETAILS/STREET
		1/1/2020

\* GRASS STRIP BETWEEN BACK OF CURB AND EDGE OF SIDEWALK TO BE A 4' WIDE STRIP UNLESS OTHERWISE NOTED AND/OR AS SHOWN ON DRAWINGS.



**NOTES:**

1. REFER TO THE CITY OF GRAHAM DEVELOPMENT ORDINANCE FOR APPROPRIATE DIMENSIONS.
2. ALL ASPHALT CEMENT PLANT MIX AND METHOD OF PLACEMENT SHALL COMPLY WITH N.C. DOT STANDARD SPECIFICATIONS.
3. ALL WORK SHALL COMPLY WITH N.C. DOT STANDARD SPECIFICATIONS.
4. SITE CONDITIONS MUST BE MET TO USE THE COMMERCIAL MEDIUM STREET SECTION. REFER TO UDO TO DETERMINE APPROPRIATE STREET SECTION.
5. PAVEMENT CROSS SECTION SHOWN IS THE STANDARD PAVEMENT SECTION. IF A SITE SPECIFIC STUDY IS PROVIDED BY A GEOTECHNICAL ENGINEER SHOWING THAT AN ALTERNATIVE PAVEMENT CROSS SECTION WILL BE SUFFICIENT FOR THE PROPOSED TRAFFIC LOADING, ALTERNATIVE PAVEMENT SECTIONS WILL BE CONSIDERED ON A CASE BY CASE BASIS.

**CITY OF GRAHAM**

**ST-2**

**COMMERCIAL STREET SECTION**

**DWG NO.**

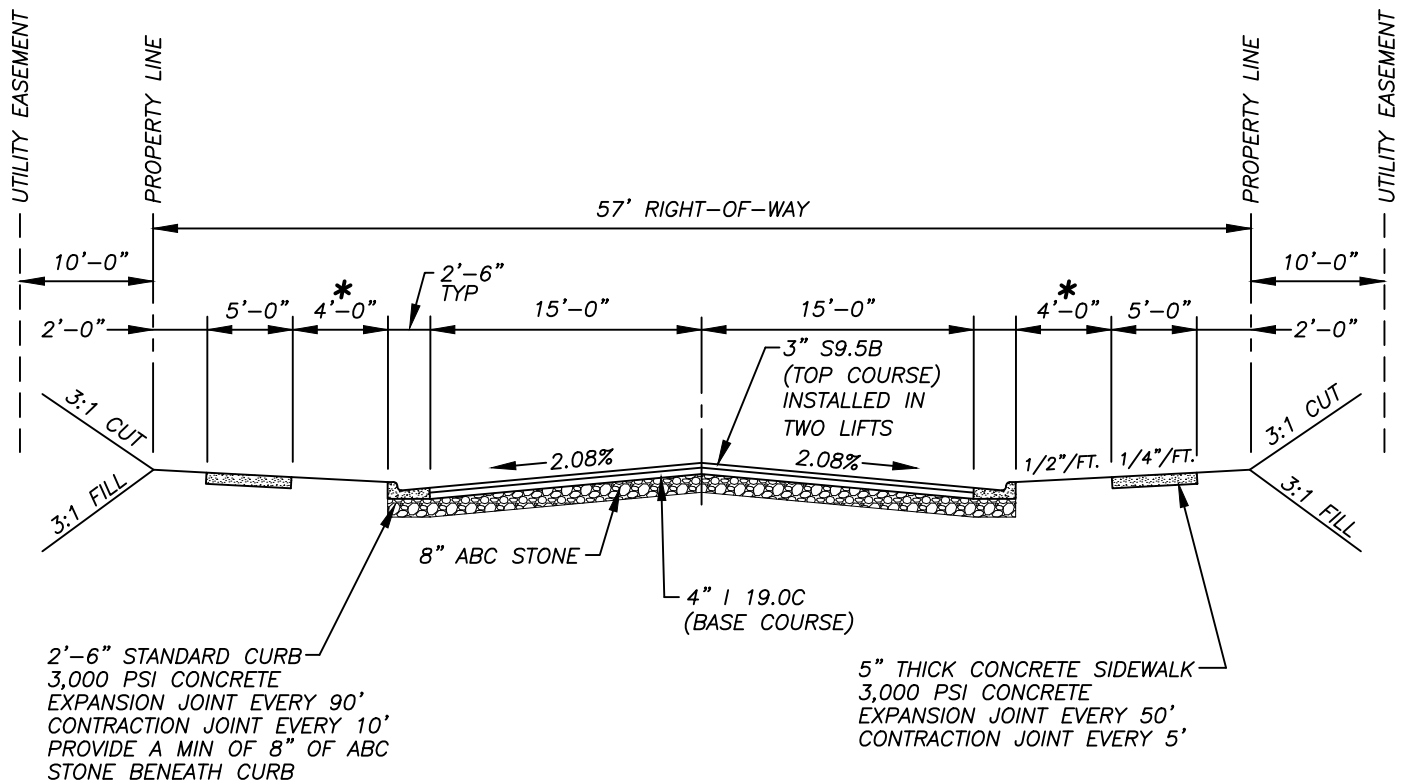
**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

1/1/2020



\* GRASS STRIP BETWEEN BACK OF CURB AND EDGE OF SIDEWALK TO BE A 4' WIDE STRIP UNLESS OTHERWISE NOTED AND/OR AS SHOWN ON DRAWINGS.



**NOTES:**

1. ALL ASPHALT CEMENT PLANT MIX AND METHOD OF PLACEMENT SHALL COMPLY WITH N.C. DOT STANDARD SPECIFICATIONS.
2. ALL WORK SHALL COMPLY WITH N.C. DOT STANDARD SPECIFICATIONS.
3. SITE CONDITIONS MUST BE MET TO USE THE INDUSTRIAL STREET SECTION. REFER TO UDO TO DETERMINE APPROPRIATE STREET SECTION.
4. PAVEMENT CROSS SECTION SHOWN IS THE STANDARD PAVEMENT SECTION. IF A SITE SPECIFIC STUDY IS PROVIDED BY A GEOTECHNICAL ENGINEER SHOWING THAT AN ALTERNATIVE PAVEMENT CROSS SECTION WILL BE SUFFICIENT FOR THE PROPOSED TRAFFIC LOADING, ALTERNATIVE PAVEMENT SECTIONS WILL BE CONSIDERED ON A CASE BY CASE BASIS.

**CITY OF GRAHAM**

**ST-3**

**INDUSTRIAL STREET SECTION**

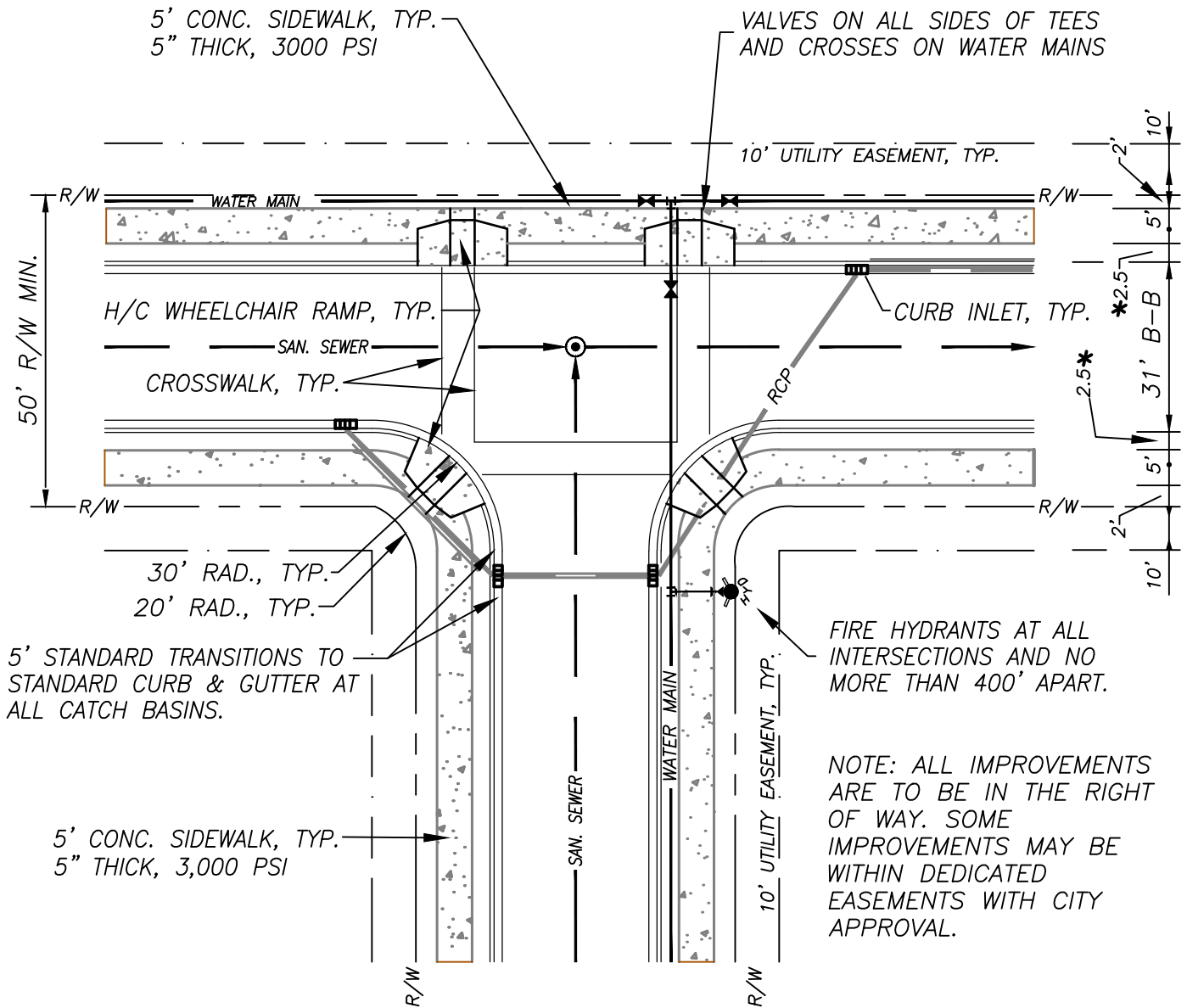
**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

1/1/2020

\* GRASS STRIP BETWEEN BACK OF CURB AND EDGE OF SIDEWALK TO BE A 2.5' WIDE STRIP UNLESS OTHERWISE NOTED AND/OR AS SHOWN ON DRAWINGS.



# CITY OF GRAHAM

ST-4

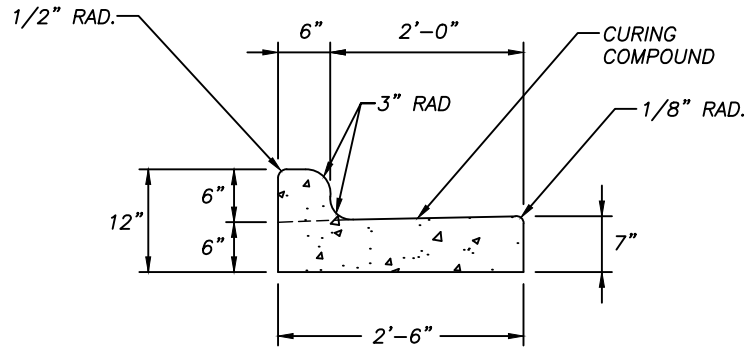
GENERAL SUBDIVISION REQUIREMENTS  
FOR ROADWAYS AND UTILITIES

DWG NO.

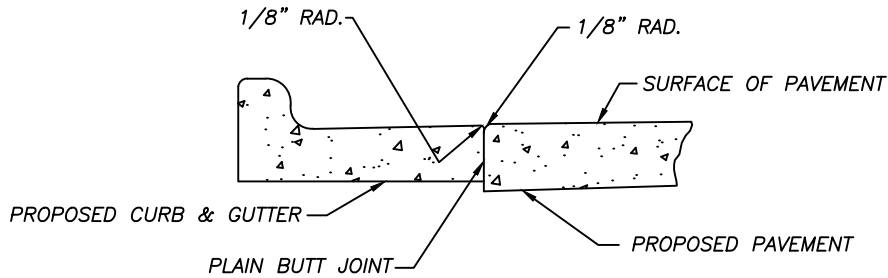
REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

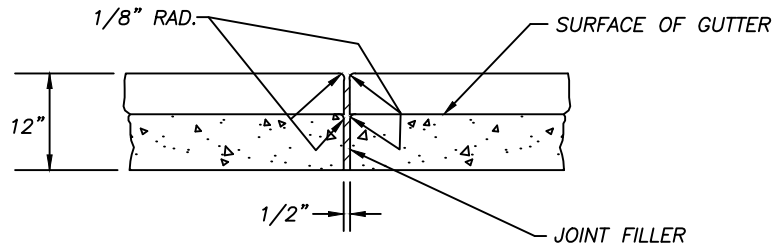
12/31/2019



2'-6" CURB AND GUTTER



LONGITUDINAL PLAIN BUTT JOINT



TRANSVERSE EXPANSION JOINT  
IN CURB AND GUTTER

GENERAL NOTES:

CONTRACTION JOINTS SHALL BE SPACED AT 10 FOOT INTERVALS, EXCEPT THAT A 15 FOOT SPACING MAY BE USED WHEN A MACHINE IS USED OR WHEN SATISFACTORY SUPPORT FOR THE FACE FORM CAN BE OBTAINED WITHOUT THE USE OF TEMPLATES AT 10 FOOT INTERVALS.

JOINT SPACING MAY BE ALTERED BY THE ENGINEER TO PREVENT UNCONTROLLED CRACKING.

CONTRACTION JOINTS MAY BE INSTALLED BY THE USE OF TEMPLATES OR FORMED BY OTHER APPROVED METHODS. WHERE SUCH JOINTS ARE NOT FORMED BY TEMPLATES, A MINIMUM DEPTH OF 1-1/2" OBTAINED.

EXPANSION JOINTS SHALL BE SPACED AT 90 FOOT INTERVALS AND ADJACENT TO ALL RIGID OBJECTS.

CONCRETE (3000 PSI @ 28 DAYS)

**CITY OF GRAHAM**

**ST-5**

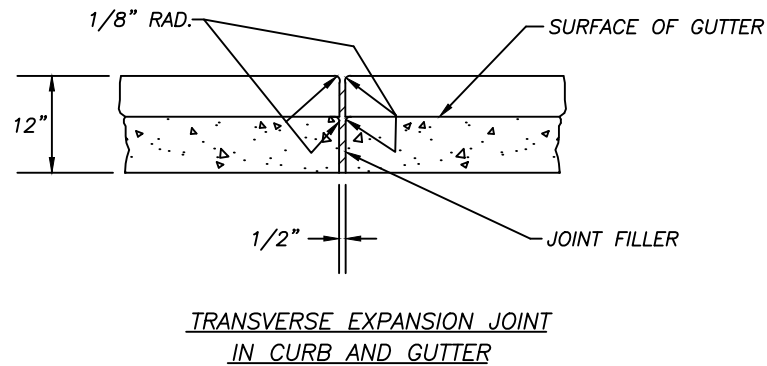
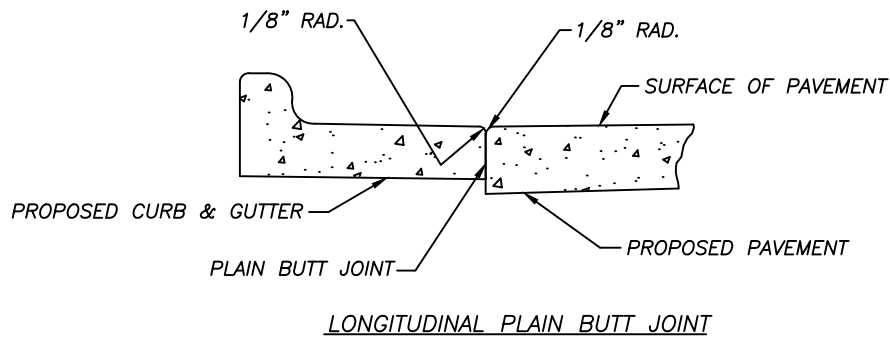
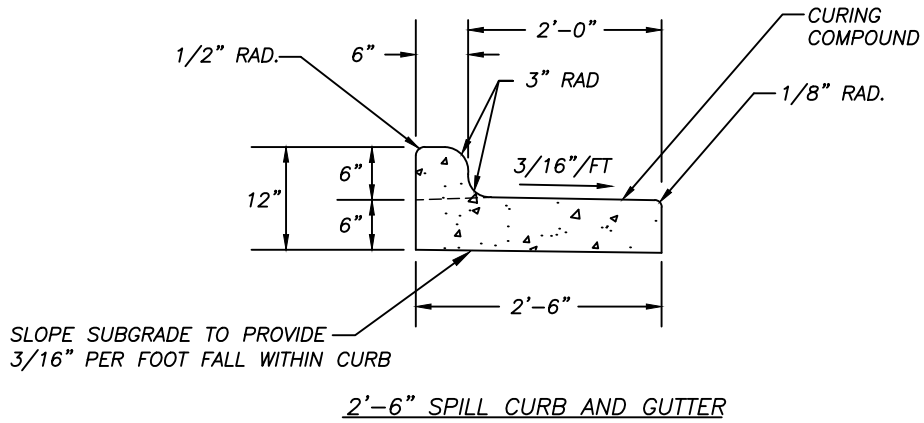
STANDARD CONCRETE CURB AND CURB & GUTTER

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

6/11/18



**GENERAL NOTES:**

CONTRACTION JOINTS SHALL BE SPACED AT 10 FOOT INTERVALS, EXCEPT THAT A 15 FOOT SPACING MAY BE USED WHEN A MACHINE IS USED OR WHEN SATISFACTORY SUPPORT FOR THE FACE FORM CAN BE OBTAINED WITHOUT THE USE OF TEMPLATES AT 10 FOOT INTERVALS.

JOINT SPACING MAY BE ALTERED BY THE ENGINEER TO PREVENT UNCONTROLLED CRACKING.

CONTRACTION JOINTS MAY BE INSTALLED BY THE USE OF TEMPLATES OR FORMED BY OTHER APPROVED METHODS. WHERE SUCH JOINTS ARE NOT FORMED BY TEMPLATES, A MINIMUM DEPTH OF 1-1/2" OBTAINED.

EXPANSION JOINTS SHALL BE SPACED AT 90 FOOT INTERVALS AND ADJACENT TO ALL RIGID OBJECTS.

CONCRETE (3000 PSI @ 28 DAYS)

**CITY OF GRAHAM**

**ST-6**

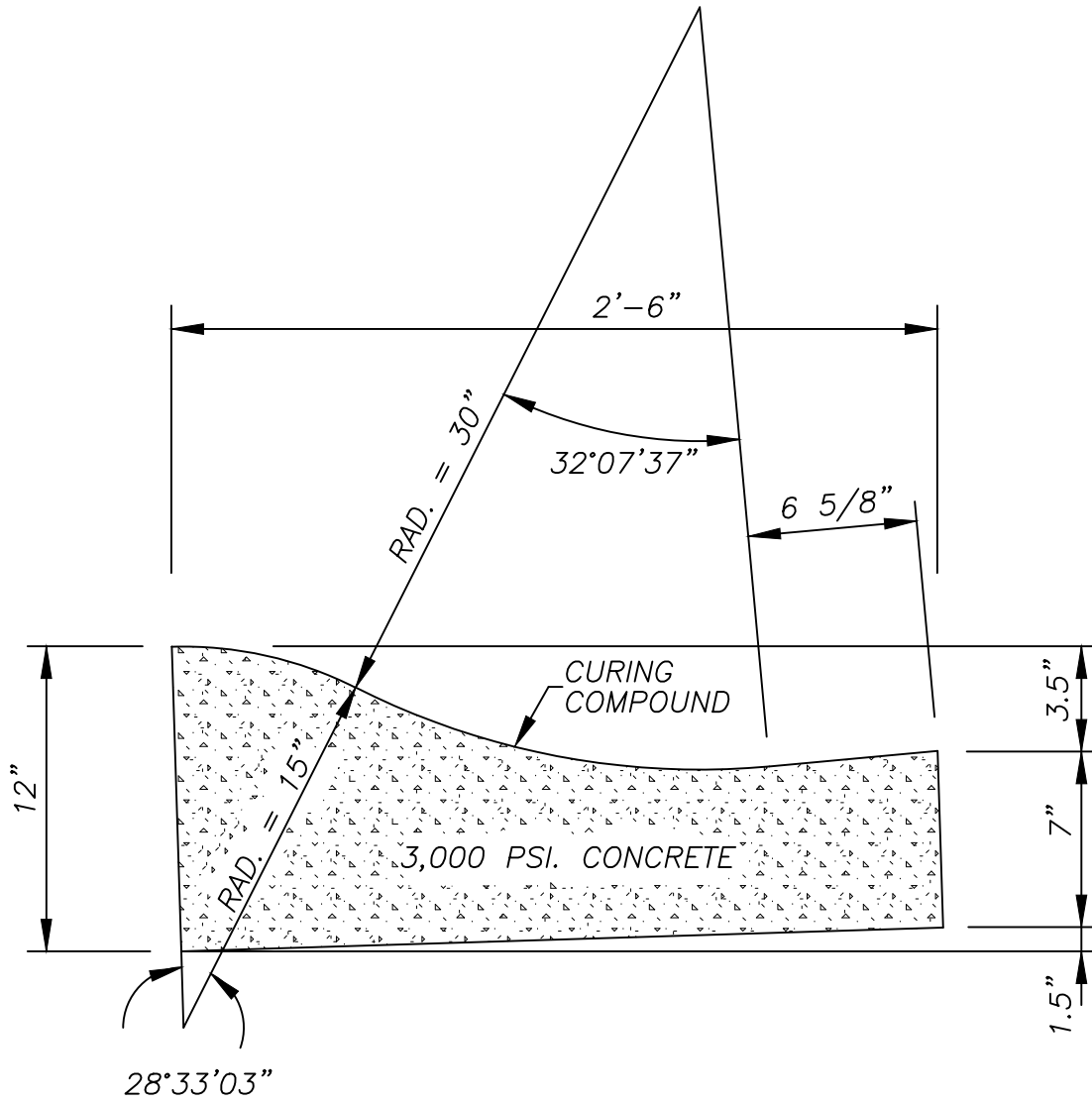
STANDARD CONCRETE SPILL CURB & GUTTER

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

6/11/18



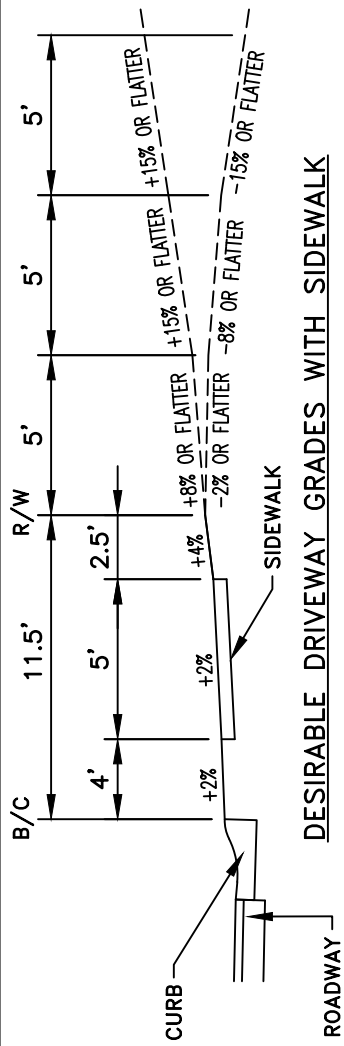
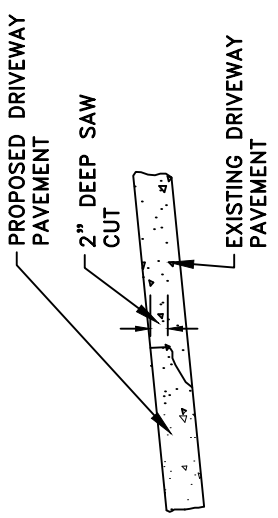
NOTE : EXPANSION JOINT EVERY 90 FT.  
 CONTRACTION JOINT EVERY 10 FT.  
 Apply Curing Compound after  
 curb/gutter is poured.

BRUSH FROM BACK TO FRONT

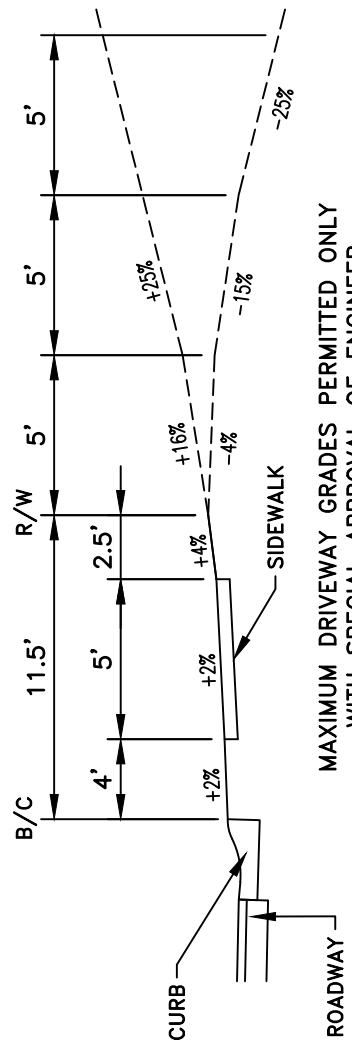
NCDOT APPROVED SEALANT IN EXPANSION JOINTS

<b>CITY OF GRAHAM</b>		<b>ST-7</b>
30" ROLLED CURB	<b>DWG NO.</b>	<b>REV.</b>
	T:DETAILS/GRAHAM DETAILS/2018 DETAILS/STREET	7/11/19

**METHOD OF TIE IN**  
 WHEN EXISTING DRIVEWAY PAVEMENT IS CONCRETE, A SAW CUT 2" DEEP SHALL BE REQUIRED AT THE POINT OF TIE IN WITH EXISTING DRIVEWAY GRADE. SAW JOINT TO BE PERPENDICULAR TO EDGE OF EXISTING DRIVEWAY PAVEMENT.

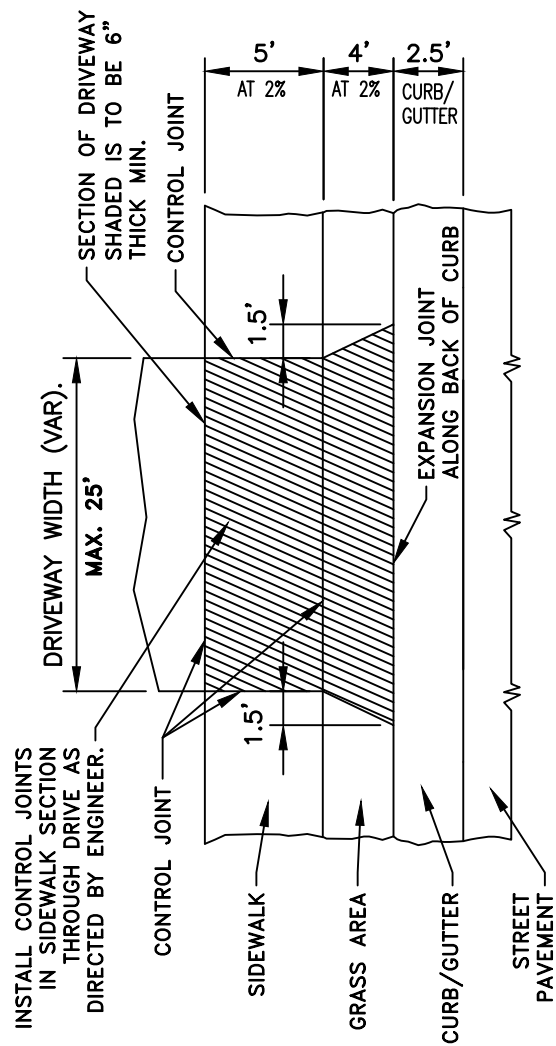


**DESIRABLE DRIVEWAY GRADES WITH SIDEWALK**



**MAXIMUM DRIVEWAY GRADES PERMITTED ONLY WITH SPECIAL APPROVAL OF ENGINEER**

**MAXIMUM DRIVEWAY GRADES WITH SIDEWALK**



**DETAIL OF PROPOSED DRIVEWAY W/ ROLLED CURB**

**GENERAL NOTES:**

1. INSTALL CAST IRON CLEAN-OUT FRAME & COVER OVER CLEAN OUT IF CLEAN-OUT IS IN DRIVEWAY. SEE GRAHAM'S SPECIFICATIONS DETAIL SS-14 FOR DETAILS.
2. WATER METER BOX IS TO LOCATED A MINIMUM OF 2'-0" FROM EDGE OF DRIVEWAY.
3. DRIVEWAY APRON IS TO BE 3,000 PSI CONCRETE AND AIR ENTRAINED.

**CITY OF GRAHAM**

**ST-8**

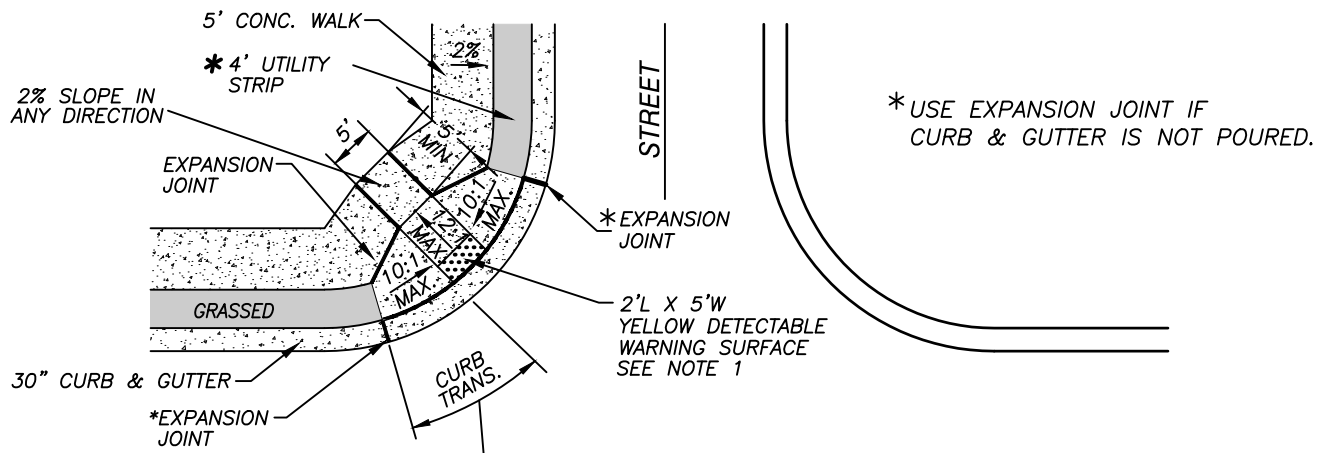
**STANDARD DRIVEWAY TURNOUT DROP CURB TYPE**

**DWG NO.**

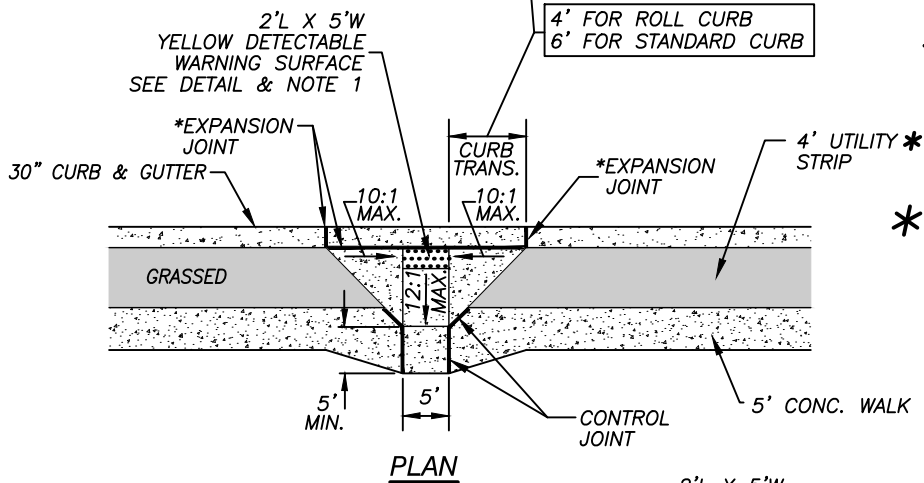
**REV.**

T:DETAILS/GRAHAM  
 DETAILS/2018  
 DETAILS/STREET

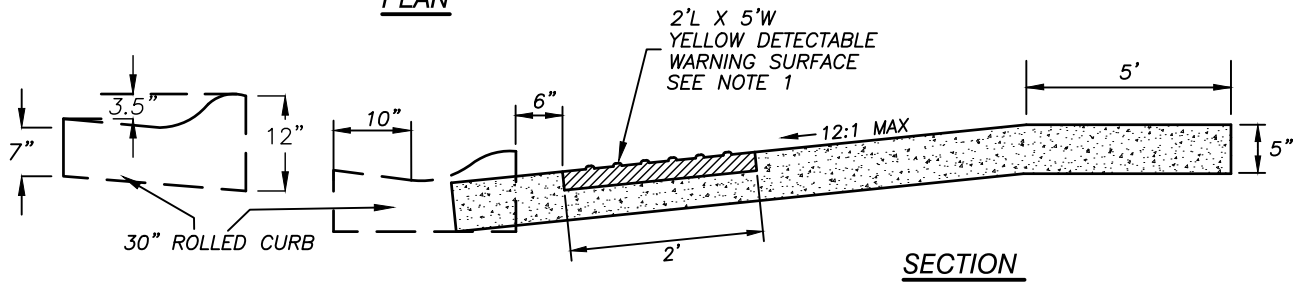
6/11/18



\*USE EXPANSION JOINT IF CURB & GUTTER IS NOT POURED.

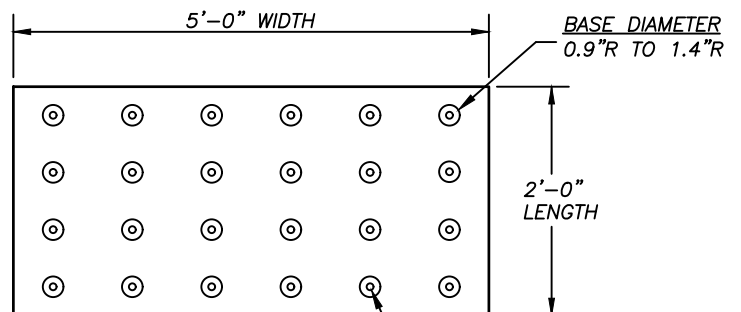
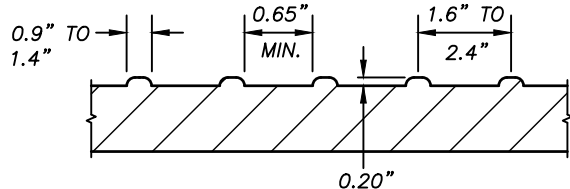


\* GRASS STRIP BETWEEN BACK OF CURB AND EDGE OF SIDEWALK TO BE A 2.5' WIDE STRIP UNLESS OTHERWISE NOTED AND/OR AS SHOWN ON DRAWINGS.



**NOTES:**

1. DETECTABLE WARNING DOMES SHALL COVER 2'-0" LENGTH AND FULL WIDTH OF THE RAMP FLOOR AS SHOWN ON THE DETAILS.
2. CAST IN PLACE DOMES ARE REQUIRED. SURFACE MOUNTED DOMES ARE NOT ACCEPTABLE



TOP DIAMETER OF NO LESS THAN 50% TO NO MORE THAN 65% OF THE BASE DIAMETER

**DETECTABLE WARNING DOMES DETAIL**

**CITY OF GRAHAM**

**ST-9**

**CURB RAMP**

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

12/30/19

NOTES:

1. CONSTRUCT THE RAMP SURFACE TO BE STABLE, FIRM, AND SLIP RESISTANT. CONSTRUCT THE CURB RAMP TYPE AS SHOWN IN THE PAVEMENT MARKING PLANS OR AS DIRECTED BY THE ENGINEER.
2. LOCATE CURB RAMPS AND PLACE PEDESTRIAN CROSSWALK MARKINGS AS SHOWN IN THE PAVEMENT MARKING PLANS. WHEN FIELD ADJUSTMENTS REQUIRE MOVING CURB RAMPS OR MARKINGS AS SHOWN, CONTACT THE CITY OF GRAHAM OR LOCATE AS DIRECTED BY ENGINEER.
3. COORDINATE THE CURB RAMP AND THE PEDESTRIAN CROSSWALK MARKINGS SO A 4'X4' CLEAR SPACE AT THE BASE OF THE CURB RAMP WILL FALL WITHIN THE PEDESTRIAN CROSSWALK LINES.
4. SET BACK DISTANCE FROM INSIDE CROSSWALK MARKING TO NEAREST EDGE OF OF TRAVEL LANE IS 4' MINIMUM.
5. REFER TO THE PAVEMENT MARKING PLANS FOR STOP BAR LOCATIONS AT SIGNALIZED INTERSECTIONS. IF A PAVEMENT MARKING PLAN IS NOT PROVIDED, CONTACT THE CITY OF GRAHAM FOR THE STOP BAR LOCATIONS OR LOCATE AS DIRECTED BY ENGINEER.
6. TERMINATE PARKING A MINIMUM OF 20' BACK OF A PEDESTRIAN CROSSWALK.
7. CONSTRUCT CURB RAMPS A MINIMUM OF 5' WIDE.
8. CONSTRUCT THE RUNNING SLOPE OF THE RAMP 8.33% MAXIMUM.
9. ALLOWABLE CROSS SLOPE ON SIDEWALKS AND CURB RAMPS WILL BE 2% MAXIMUM.
10. CONSTRUCT THE SIDE FLARE SLOPE A MAXIMUM OF 10% MEASURED ALONG THE CURB LINE.
11. CONSTRUCT THE COUNTER SLOPE OF THE GUTTER OR STREET AT THE BASE OF THE CURB RAMP A MAXIMUM OF 5% AND MAINTAIN A SMOOTH TRANSITION.
12. CONSTRUCT LANDINGS FOR SIDEWALK A MINIMUM OF 5'X5' WITH A MAXIMUM SLOPE OF 2% IN ANY DIRECTION. CONSTRUCT LANDINGS FOR MEDIAN ISLANDS A MINIMUM OF 5'X5' WITH A MAXIMUM SLOPE OF 2% IN ANY DIRECTION.
13. TO USE A MEDIAN ISLAND AS A PEDESTRIAN REFUGE AREA, MEDIAN ISLANDS WILL BE A MINIMUM OF 6' WIDE. CONSTRUCT MEDIAN ISLANDS TO PROVIDE PASSAGE OVER OR THROUGH THE ISLAND.
14. SMALL CHANNELIZATION ISLANDS THAT CANNOT PROVIDE A 5'X5' LANDING AT THE TOP OF A RAMP WILL BE CUT THROUGH LEVEL WITH THE SURFACE STREET.
15. CURB RAMPS WITH RETURNED CURBS MAY BE USED ONLY WHERE PEDESTRIANS WOULD NOT NORMALLY WALK ACROSS THE RAMP. THE ADJACENT SURFACE IS PLANTING OR OTHER NON-WALKING SURFACE OR THE SIDE APPROACH IS SUBSTANTIALLY OBSTRUCTED.
16. PLACE A 1/2" EXPANSION JOINT WHERE THE CONCRETE CURB RAMP JOINS THE CURB.
17. PLACE ALL PEDESTRIAN PUSH BUTTON ACTUATORS AND CROSSING SIGNALS AS SHOWN IN THE PLANS OR AS SHOWN IN THE MUTCD.
18. CURB RAMPS THROUGH MEDIAN ISLANDS, SINGLE RAMPS AT DUAL CROSSWALKS OR LIMITED R/W SITUATIONS, WILL BE HANDLED BY SPECIAL DETAILS. CONTACT THE CITY OF GRAHAM OR AS DIRECTED BY ENGINEER FOR A SPECIAL DESIGN.

**CITY OF GRAHAM**

**ST-10**

**CURB RAMP NOTES**

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

6/11/18



## PERMANENT SEEDING SPECIFICATIONS

### PREPARATION

PREPARE SEEDBED BY RIPPING, CHISELING, HARROWING OR PLOWING TO DEPTH OF SIX INCHES SO AS TO PRODUCE A LOOSE, FRIABLE SURFACE. REMOVE ALL STONES, BOULDERS, STUMPS OR DEBRIS FROM THE SURFACE WHICH WOULD PROHIBIT GERMINATION OR PLANT GROWTH.

INCORPORATED INTO THE SOIL 800 TO 1,000 POUNDS OF 10-10-10 FERTILIZER PLUS 500 POUNDS OF TWENTY PERCENT (20%) SUPERPHOSPHATE PER ACRE AND TWO TONS OF DOLOMITIC LIME PER ACRE UNLESS SOIL TESTS INDICATE THAT A LOWER RATE OF LIME CAN BE USED.

MULCH AFTER SEEDING WITH 2.0 TONS OF GRAIN STRAW PER ACRE AND EITHER CRIMP STRAW INTO SOIL OR TACK WITH LIQUID ASPHALT AT 400 GALLONS PER ACRE OR EMULSIFIED ASPHALT AT 300 GALLONS PER ACRE.

### PERMANENT SEEDINGS

PLANTS & MIXTURE	PLANTING RATE/ACRE	PLANTING DATES
TALL FESCUE (LOW MAINTENANCE)	100-150 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE WATERWAYS AND LAWNS (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
BLEND OF TWO TURF-TYPE TALL FESCUES (90%) AND TWO OR MORE IMPROVED KENTUCKY BLUEGRASS VARIETIES (10%) (HIGH MAINTENANCE)	200-250 LBS.	AUG. 15 - OCT. 15 FEB. 15 - MAY 1
TALL FESCUE AND KOBE OR KOREAN LESPEDEZA	100 LBS. AND 20-25 LBS.	FEB. 15 - MAY 1 AUG. 15 - OCT. 15
TALL FESCUE AND SERICEA LESPEDEZA	50 LBS. 60 LBS./ACRE	NOV. 1 - FEB. 1 (UNSCARIFIED)
TALL FESCUE AND GERMAN MILLET OR SUNDANGRASS	70 LBS. AND 40 LBS.	JULY AND AUGUST
TALL FESCUE AND RYEGRASS	70 LBS. AND 25 LBS.	NOV. 1 - JAN. 30
COMMON BERMUDAGRASS	8 LBS. (HULLED) 15-20 LBS. (UNHULLED)	APRIL 15 - JUNE 30 FEB. 1 - MARCH 30

### PERMANENT SEEDING NOTES:

- FOR SPRING SEEDINGS, USE SCARIFIED LESPEDEZA SEED. FOR LATE FALL AND WINTER SEEDINGS, USE UNSCARIFIED SEED.
- ANNUALS SUCH AS MILLET, SUNDANGRASS AND RYEGRASS MUST BE KEPT AT 10-12" MAXIMUM HEIGHT.  
THE USE OF ANNUAL RYE GRASS IS NOT PERMITTED.

## TEMPORARY SEEDING SPECIFICATIONS

### CONDITIONS WHERE PRACTICE APPLIES

WHERE BARE SOIL HAS BEEN EXPOSED BY GRADING, AND VEGETATIVE COVER IS NEEDED FOR ONE YEAR OR LESS. MAY INCLUDE SUCH AREAS AS TEMPORARY SEDIMENT POND, DIVERSIONS, SOIL STOCKPILES, BUILDING PADS, ROUGH-GRADED ROAD BANKS, ETC. IT IS ALSO USED TO PROVIDE A TEMPORARY PERIMETER BUFFER.

### PREPARATION

PREPARE SEEDBED BY RIPPING, CHISELING, HARROWING, OR PLOWING TO DEPTH OF AT LEAST SIX INCHES SO AS TO PRODUCE A LOOSE, FRIABLE SURFACE. INCORPORATE 750 - 1,000 POUNDS 10-10-10 FERTILIZER AND UP TO TWO TONS OF DOLOMITIC LIME PER ACRE (NOTE: LIME MAY NOT BE NEEDED IF A SOIL TEST INDICATES A PH OF 6.5 OR HIGHER). MULCHING IS REQUIRED ACCORDING TO THE SAME SPECIFICATIONS AS FOR PERMANENT SEEDING UNLESS WAIVED BY SOIL SCIENTIST.

### TEMPORARY SEEDINGS

SEEDING MIXTURE	SEEDING RATE/ACRE	PLANTING DATES
RYE GRAIN AND KOBE LESPEDEZA	120 LBS. 50 LBS.	JAN. 1 - MAY 1 MAY 1 - AUG. 15
GERMAN MILLET OR SUDAN GRASS	40 - 50 LBS.	
RYE (GRAIN)	120 LBS.	AUG. 15 - DEC. 30
(MAY SUBSTITUTE OATS BEFORE OCT. 1 OR WHEAT FROM OCT. 1 - NOV. 15)		

### NOTE:

THE USE OF ANNUAL RYE GRASS AND WEEPING LOVE GRASS IS NOT PERMITTED.

# CITY OF GRAHAM

# ST-11

**PERMANENT AND TEMPORARY  
SEEDING SPECIFICATIONS**

**DWG NO.**

**REV.**

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STREET

2/1/15



METAL FRAME & GRATE CURB INLET.  
SEE NCDOT DETAILS 840.01, 840.02 &  
840.03 FOR ADDITIONAL NOTES &  
DETAILS

30" ROLLED CURB  
SEE ST-7

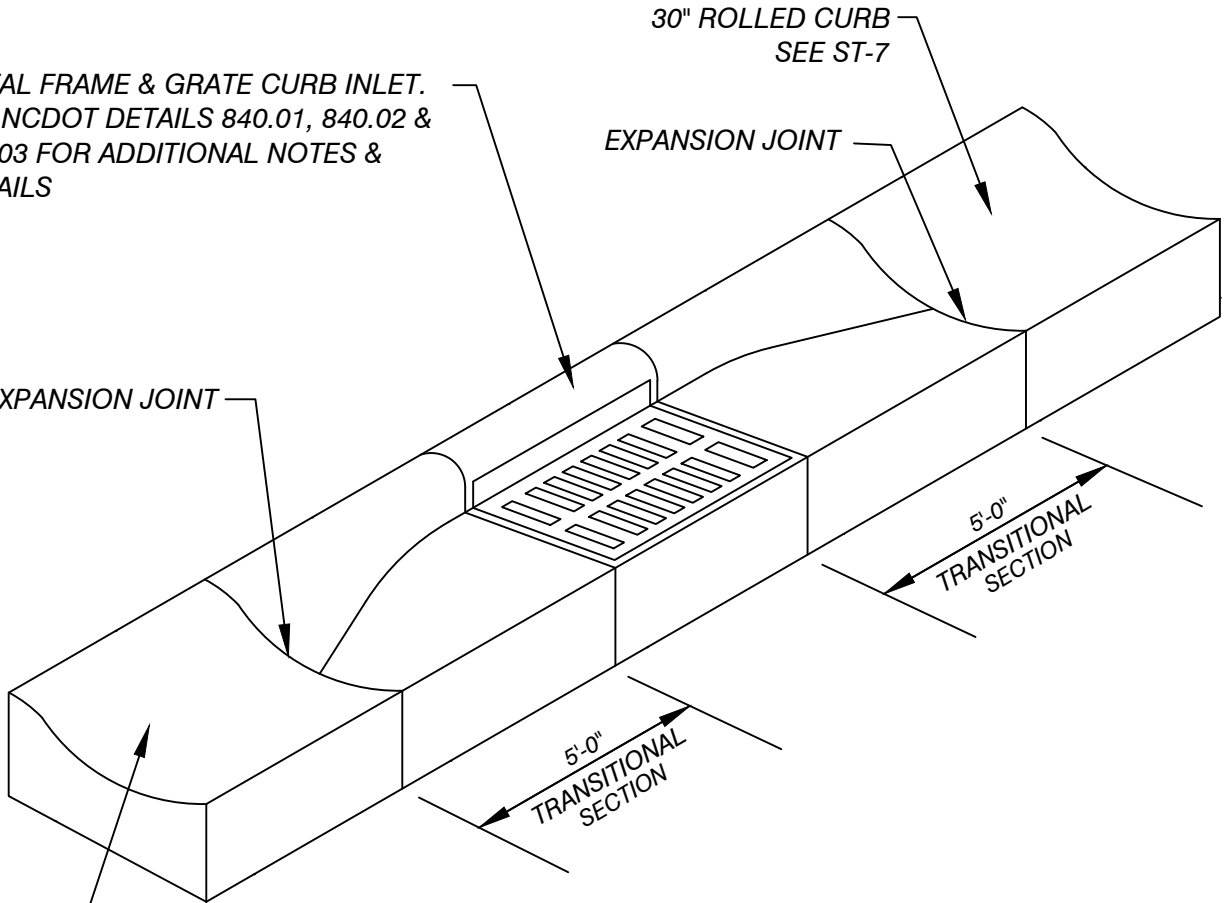
EXPANSION JOINT

EXPANSION JOINT

5'-0"  
TRANSITIONAL  
SECTION

5'-0"  
TRANSITIONAL  
SECTION

BROOM MARKS ALONG  
CURB AND GUTTER  
ARE TO BE BACK TO FRONT



**CITY OF GRAHAM**

**SD-1**

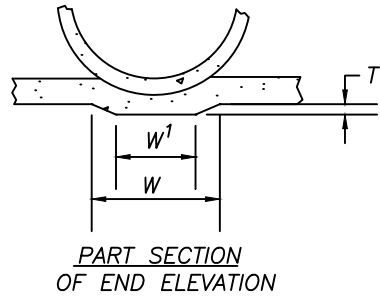
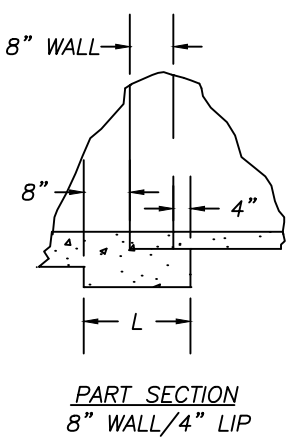
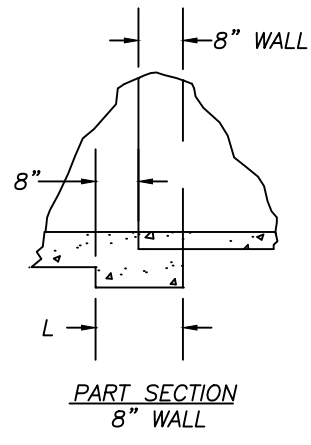
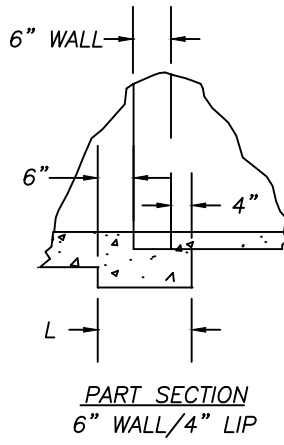
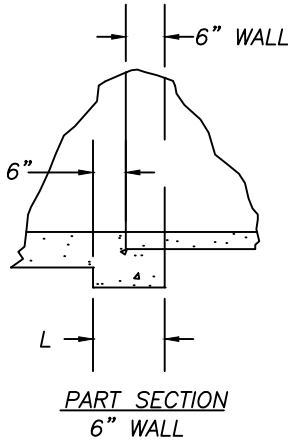
STANDARD CATCH BASIN  
W/TRANSITION TO ROLLED CURB

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

7/12/19



**GENERAL NOTES:**

THIS STANDARD SHALL BE USED WITH ALL DRAINAGE STRUCTURES USING REINFORCED CONCRETE PIPE SET IN BASE SLAB.

TABLES OF QUANTITIES FOR PIPE SET IN PAD						
PIPE D	"W" DIM	"W1" DIM	"T" DIM	C.Y. QUANTITIES WHEN L IS		
				12"	16"	20"
12"	1'-1 7/8"	0'-7 7/8"	0'-1 3/4"	0.005	0.007	0.008
15"	1'-3 5/8"	0'-9 1/8"	0'-9 7/8"	0.006	0.008	0.010
18"	1'-5 1/4"	0'-10 3/8"	0'-2"	0.007	0.010	0.012
24"	1'-8 3/4"	1'-0 1/8"	0'-2 1/2"	0.011	0.014	0.018
30"	2'-0 1/4"	1'-2 3/4"	0'-2 3/4"	0.014	0.018	0.023
36"	2'-3 3/4"	1'-5 3/8"	0'-3"	0.017	0.023	0.025
42"	2'-7 1/8"	1'-7"	0'-3 1/2"	0.075	0.030	0.036
48"	2'-10 5/8"	1'-8 3/4"	0'-4"	0.028	0.038	0.047
54"	3'-2 1/8"	1'-10 1/2"	0'-4 1/2"	0.035	0.047	0.058
60"	3'-5 5/8"	2'-0 1/4"	0'-5"	0.042	0.056	0.071
66"	3'- 9"	2'-2 1/4"	0'-5 1/2"	0.050	0.067	0.084
72"	4'-0 1/2"	2'-3 3/4"	0'-6"	0.058	0.078	0.098

**CITY OF GRAHAM**

**SD-2**

STD. CONCRETE BASE PAD FOR DRAINAGE STRUCTURES

DWG NO.  
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

REV.

9/20/18

**FOR PRECAST BOXES, BRICK AND MORTAR MUST BE USED INSIDE AND OUTSIDE OF BOX AT PIPE OPENINGS**

NOTES:

ALL DROP INLETS OVER 3'-6" IN DEPTH TO BE PROVIDED WITH STEPS 1'-0" ON CENTER.

CLASS 'A' CONCRETE TO BE USED (3,000 PSI)

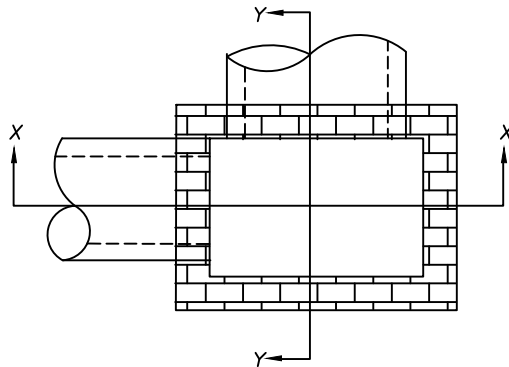
BRICK MASONRY DROP INLET TO BE USED IN LOCATIONS SUBJECT TO TRAFFIC, ONLY UPON APPROVAL BY ENGINEER.

PRECAST CONCRETE DROP INLET WILL BE PERMITTED.

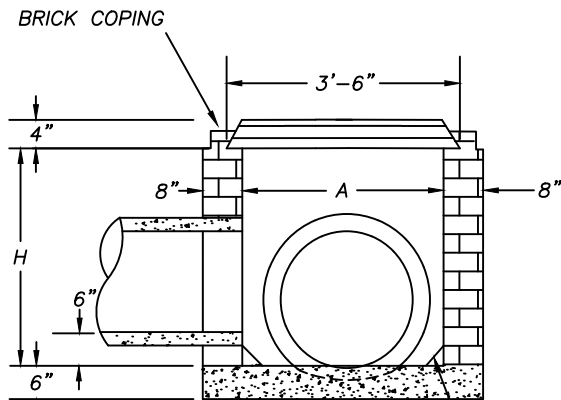
JUMBO BRICK WILL BE PERMITTED. CONCRETE BRICK OR PRECAST CONCRETE BLOCKS MAY BE USED IN LIEU OF CLAY BRICK.

FOR 8'-0" IN HEIGHT OR LESS, USE 8" WALL. OVER 8'-0" IN HEIGHT, USE 12" WALL TO 6'-0" FROM TOP OF WALL, AND 8" WALL FOR THE REMAINING 6'-0".

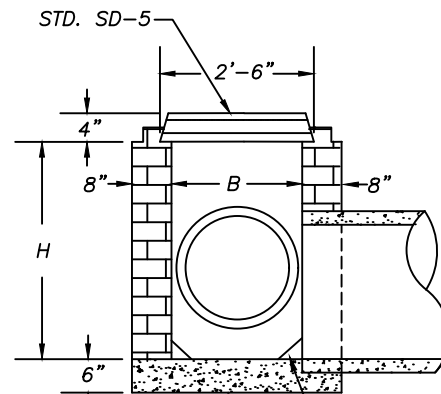
IF REINFORCED CONCRETE PIPE IS SET IN BASE OF SLAB BOX, IT SHALL BE IN ACCORDANCE WITH STD. SD-2.



PLAN  
WITH COPING REMOVED



SECTION-XX



SECTION -YY

PIPE	DIMENSIONS OF BOX & PIPE			COVER DIMENSION	
	SPAN	WIDTH	HEIGHT	F	E
D	A	B	H(MIN)		
12"	3'-0"	2'-0"	2'-8"	3'-6"	2'-6"
15"	3'-0"	2'-0"	3'-0"	3'-6"	2'-6"
18"	3'-0"	2'-0"	3'-5"	3'-6"	2'-6"
24"	3'-0"	2'-0"	4'-0"	3'-6"	2'-6"
30"	3'-0"	2'-0"	4'-5"	3'-6"	2'-6"

**CITY OF GRAHAM**

**SD-3**

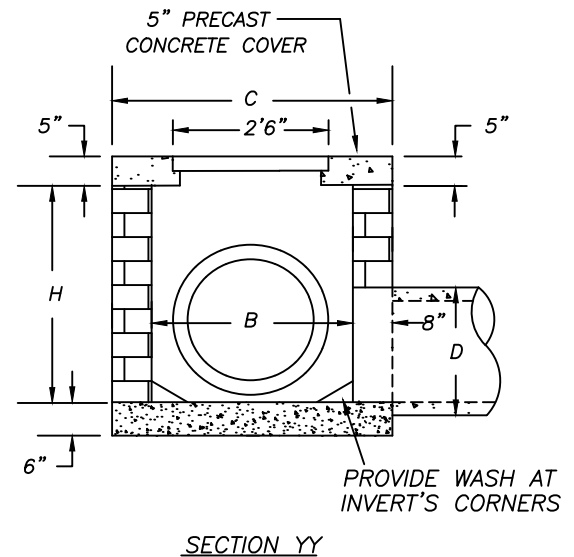
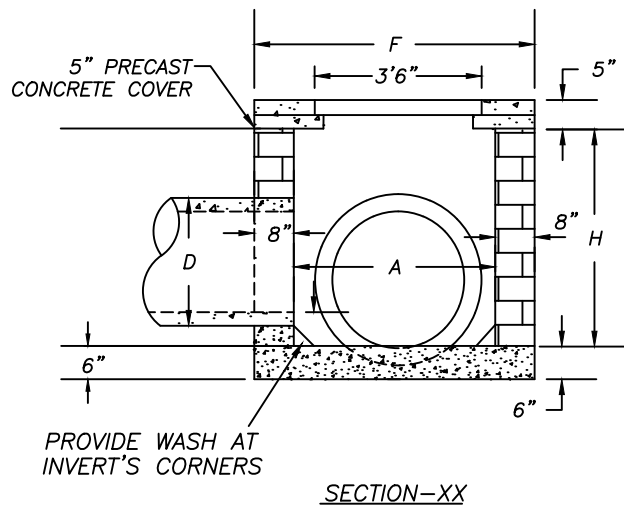
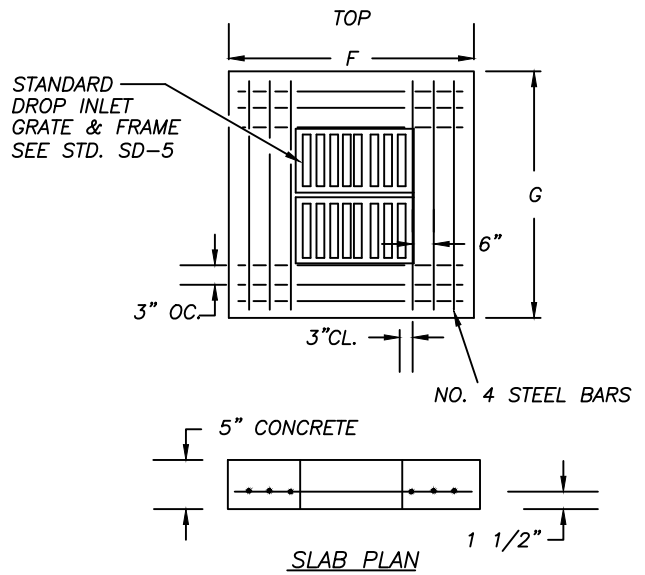
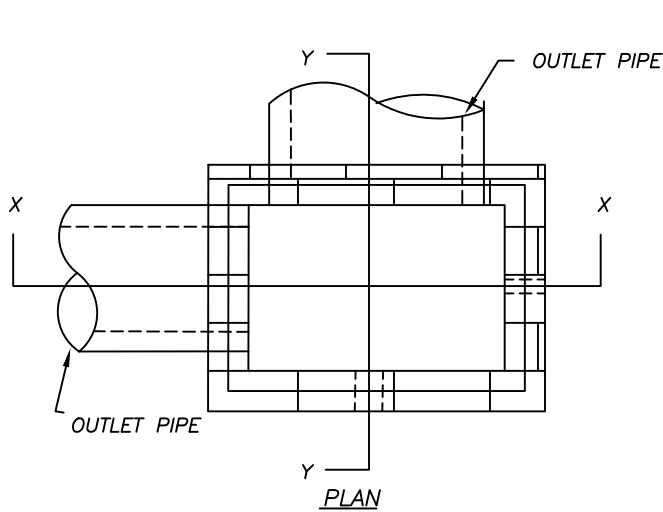
STANDARD BRICK DROP INLET  
12" THRU 30" PIPE

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

6/11/18



**NOTES:**

ALL DROP INLETS OVER 3'-6" IN DEPTH TO BE PROVIDED WITH STEPS 1'-0" ON CENTER.

CLASS 'A' CONCRETE TO BE USED (3,000 PSI)

PRECAST CONCRETE DROP INLET WILL BE PERMITTED.

JUMBO BRICK WILL BE PERMITTED. CONCRETE BRICK OR PRECAST CONCRETE BLOCKS MAY BE USED IN LIEU OF CLAY BRICK.

FOR 8'-0" IN HEIGHT OR LESS, USE 8" WALL. OVER 8'-0" IN HEIGHT, USE 12" WALL TO 6'-0" FROM TOP OF WALL, AND 8" WALL FOR THE REMAINING 6'-0".

IF REINFORCED CONCRETE PIPE IS SET IN BASE OF SLAB BOX, IT SHALL BE IN ACCORDANCE WITH STD. SD-2.

REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60.

**SECTION YY**

DIM'S OF BOX & PIPE				COVER DIMENSION	
PIPE	SPAN	WIDTH	HEIGHT	F	G
D	A	B	H(MIN)		
30"	4'-0"	3'-6"	3'-11"	5'-4"	4'-10"
36"	4'-0"	3'-6"	4'-6"	5'-4"	4'-10"
42"	4'-0"	3'-6"	4'-11"	5'-4"	4'-10"
48"	4'-6"	4'-0"	5'-5"	5'-10"	5'-4"

**FOR PRECAST BOXES, BRICK AND MORTAR MUST BE USED INSIDE AND OUTSIDE OF BOX AT PIPE OPENINGS**

**CITY OF GRAHAM**

**SD-4**

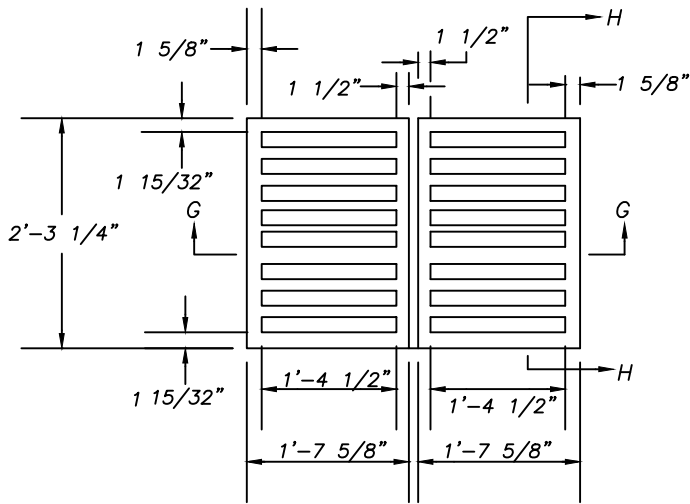
STANDARD BRICK DROP INLET  
WITH SINGLE & MULTIPLE PIPES 30" THRU 48"

DWG NO.

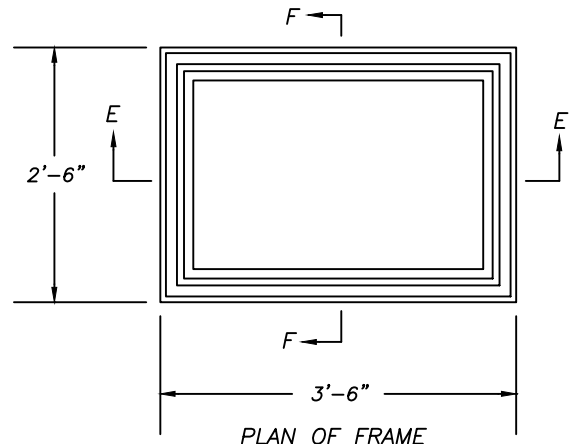
REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

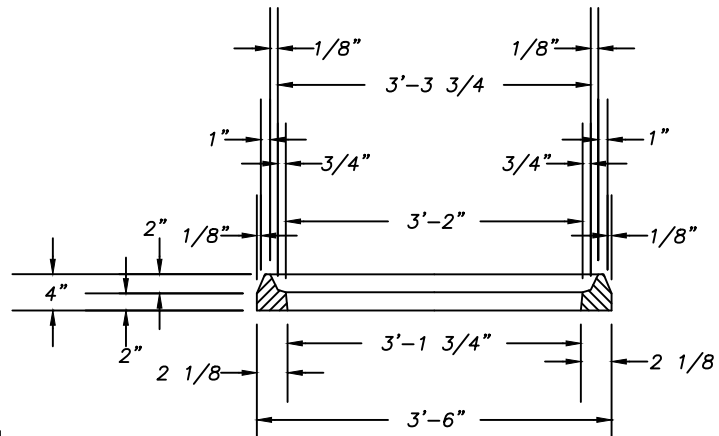
6/11/18



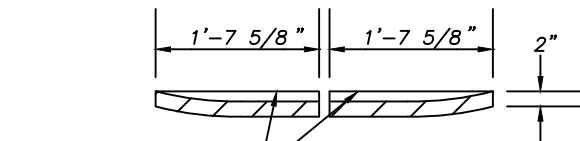
PLAN OF GRATING  
CAST IRON



PLAN OF FRAME  
CAST IRON

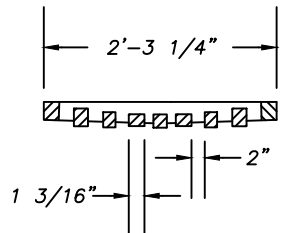


SECTION-EE

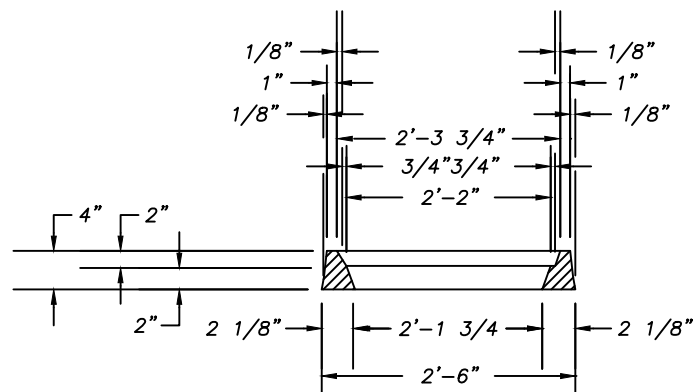


1" DEPRESSION

SECTION-GG



SECTION-HH



SECTION-FF

**NOTES:**

USE ON STANDARD DROP INLET SEE DRAWING SD-3 & SD-4.

**CITY OF GRAHAM**

**SD-5**

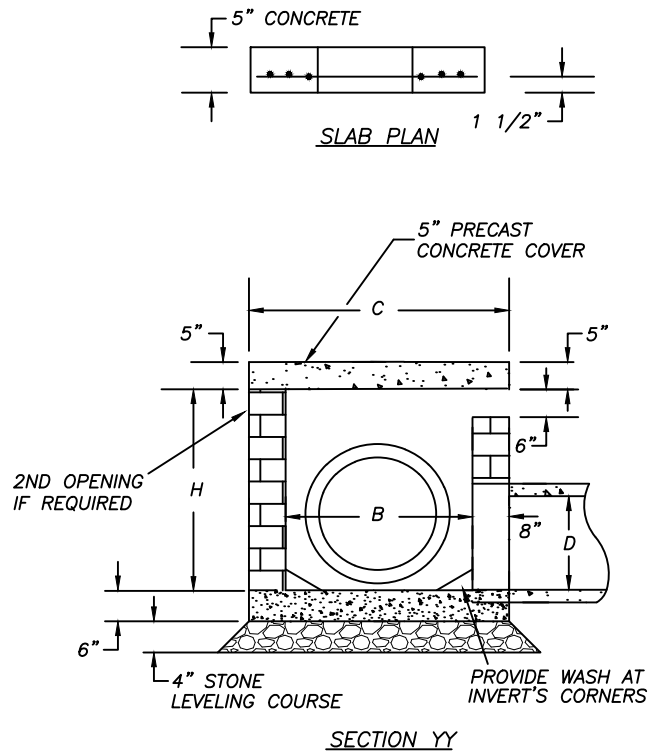
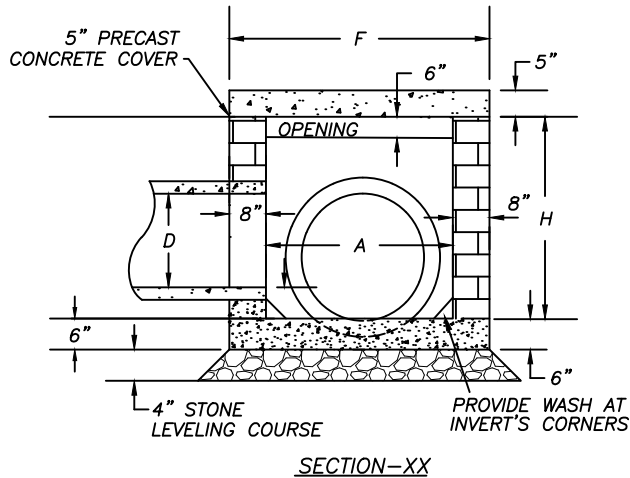
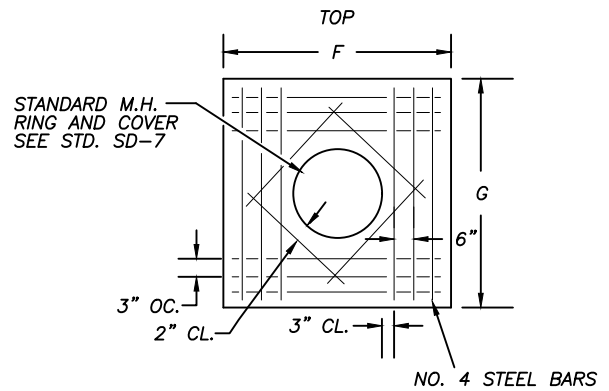
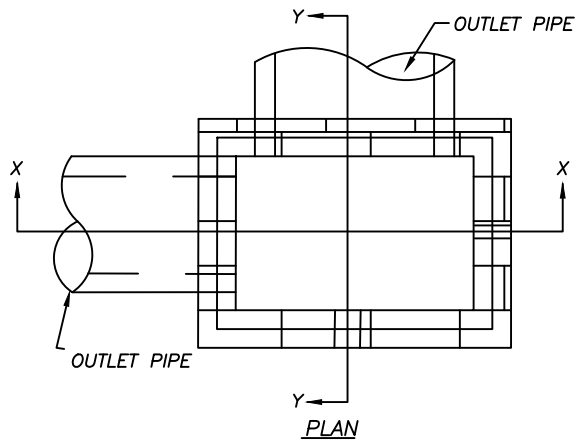
STANDARD DROP INLET  
GRATES AND FRAME

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

6/11/18



**NOTES:**

ALL CATCH BASINS OVER 3'-6" IN DEPTH TO BE PROVIDED WITH STEPS 1'-0" ON CENTER.

CLASS 'A' CONCRETE TO BE USED (3,000 PSI)

PRECAST CONCRETE DROP INLET WILL BE PERMITTED.

JUMBO BRICK WILL BE PERMITTED. CONCRETE BRICK OR PRECAST CONCRETE BLOCKS MAY BE USED IN LIEU OF CLAY BRICK.

FOR 8'-0" IN HEIGHT OR LESS, USE 8" WALL. OVER 8'-0" IN HEIGHT, USE 12" WALL TO 6'-0" FROM TOP OF WALL, AND 8" WALL FOR THE REMAINING 6'-0".

IF REINFORCED CONCRETE PIPE IS SET IN BASE OF SLAB BOX, IT SHALL BE IN ACCORDANCE WITH STD. SD-2.

REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60.

**FOR PRECAST BOXES, BRICK AND MORTAR MUST BE USED INSIDE AND OUTSIDE OF BOX AT PIPE OPENINGS**

DIMENSIONS OF BOX & PIPE				COVER DIMENSION	
PIPE	SPAN	WIDTH	HEIGHT	F	G
D	A	B	H(MIN)	F	G
12"	3'-6"	2'-3"	2'-4"	4'-10"	3'-7"
15"	3'-6"	2'-3"	2'-7"	4'-10"	3'-7"
18"	4'-0"	2'-8"	2'-11"	5'-4"	4'-0"
24"	4'-0"	2'-8"	3'-5"	5'-4"	4'-0"
30"	4'-0"	3'-6"	3'-11"	5'-4"	4'-10"
36"	4'-0"	3'-6"	4'-6"	5'-4"	4'-10"
42"	4'-0"	3'-6"	4'-11"	5'-4"	4'-10"
48"	4'-6"	4'-0"	5'-5"	5'-10"	5'-4"

# CITY OF GRAHAM

**SD-6**

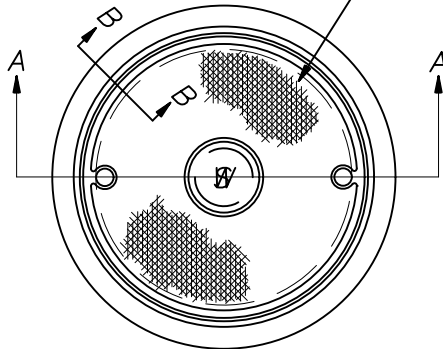
STANDARD BRICK YARD INLET WITH  
SINGLE & MULTIPLE PIPES 12" THRU 48"

DWG NO.  
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

REV.  
7/12/19

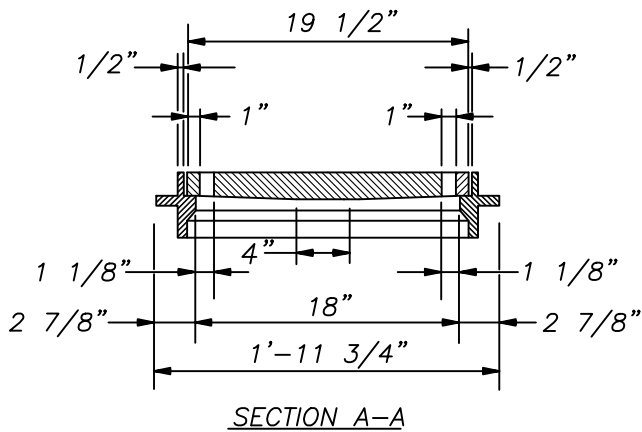


NOTE: ACCESS COVERS SHALL BE CAST WITH THE FOLLOWING STATEMENT: "STORM SEWER, CONFINED SPACE, ENTRY PERMIT REQUIRED". WATER AND SEWER MANHOLE ACCESS COVERS SHALL ALSO BE CAST WITH THE SAME STATEMENT WITH THE APPROPRIATE UTILITY NAME SUBSTITUTED ACCORDINGLY.

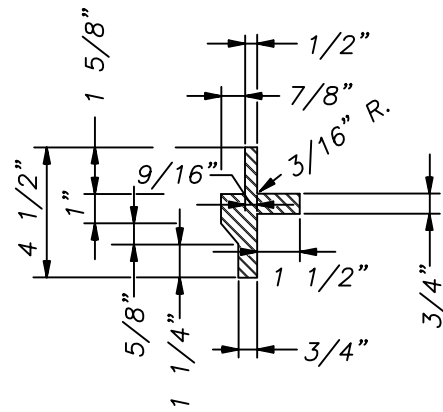


PLAN

RING - 70 LBS.  
COVER - 118 LBS.



SECTION A-A



SECTION B-B

**CITY OF GRAHAM**

**SD-7**

STANDARD INLET RING & COVER

DWG NO.

REV.

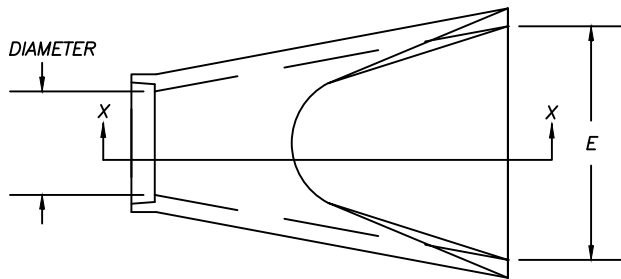
T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

6/11/18

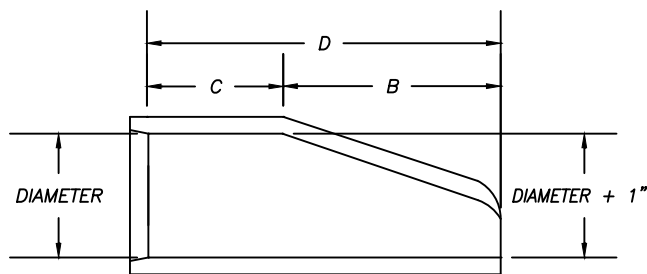
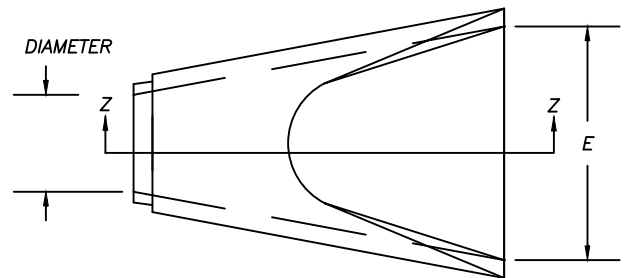
PIPE DIAMETER	WALL THICKNESS	SLOPE	B	C	D	E	WEIGHT
12	2 1/4	3:1	24	49	73	24	730
15	2 1/4	3:1	27	46	73	30	910
18	2 1/2	3:1	27	46	73	36	1190
21	2 3/4	3:1	36	37	73	42	1370
24	3	3:1	42	31 1/2	73 1/2	48	1770
27	3 1/4	3:1	48	25 1/2	73 1/2	54	2130
30	3 1/2	3:1	54	19 3/4	73 3/4	60	2380
36	4	3:1	63	34 3/4	97 3/4	72	5320
42	4 1/2	3:1	63	35	98	78	5920
48	5	3:1	72	26	98	84	7470
54	5 1/2	2.4:1	66	34	100	90	8810
60	6	2:1	60	39	99	96	11180
72	7	2:1	78	21	99	108	13980

DIMENSIONS IN INCHES WEIGHT IN POUNDS

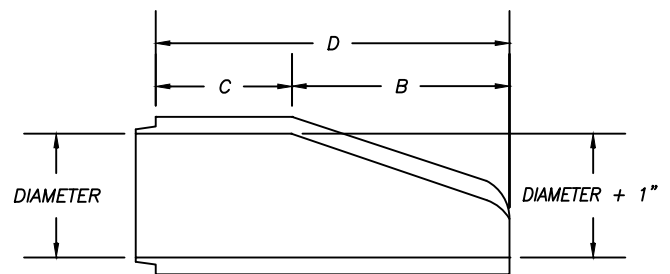
FLARED END SECTION—OUTLET



FLARED END SECTION—INLET



SECTION X-X



SECTION Z-Z

**CITY OF GRAHAM**

**SD-8**

INLET & OUTLET FLARED END SECTIONS

DWG NO.

REV.

T:DETAILS/GRAHAM  
DETAILS/2018  
DETAILS/STORM

6/11/18

**WATER TAPS OVER 1" IN SIZE**

1. WATER TAPS OVER 1" SHALL BE MADE BY OTHERS TO CITY SPECS. ALL COMMERCIAL TAPS ARE TO BE MADE BY CONTRACTOR/OTHERS.
2. A PRE-CAST VAULT SHALL BE USED WITH PRIOR CITY APPROVAL.
3. A BY-PASS SHALL BE USED ON ALL TAPS 1 ½" AND GREATER.
4. ALL METERS AND METER VAULTS SHALL BE PLACED ON THE PROPERTY LINE OR RIGHT OF WAY.
5. ALL BACKFLOW ASSEMBLIES SHALL BE TESTED PRIOR TO CITY ACCEPTANCE.
6. BACKFLOW PREVENTION DEVICES SHALL BE ABOVE GROUND IN HOT BOX ENCLOSURE OR EQUAL BEHIND THE METER FOR ALL METERS LARGER THAN 2 INCHES, UNLESS OTHERWISE APPROVED BY THE CITY OF GRAHAM. TYPE OF BACKFLOW PREVENTION DEVICE WILL BE DICTATED BY USE.

**SEWER TAPS**

1. ALL SEWER TAPS SHALL BE MADE BY THE CITY UNLESS OTHERWISE SPECIFIED.
2. 4" SEWER TAPS SHALL BE THE MINIMUM SIZE PERMITTED BY THE CITY.
3. ALL SEWER SERVICES SHALL BE WITH THE WATER SERVICE.
4. ALL SEWER SERVICES SHALL HAVE A CLEANOUT AT THE PROPERTY LINE AND AS REQUIRED BY BUILDING CODE.
5. ALL SERVICE PIPE SHALL BE PVC, SCHEDULE 40 OR BETTER.
6. NO SEWER TAPS SHALL BE DIRECTLY INTO MANHOLES.

## FIRE LINES AND SPRINKLER SYSTEMS

1. ALL VAULTS AND DETECTOR CHECKS SHALL BE SET ON THE PROPERTY LINE OR RIGHT OF WAY.
2. VAULTS SHALL HAVE A PROVISION FOR DRAINAGE.
3. ALL BACKFLOW ASSEMBLIES LARGER THAN 2 INCHES SHALL BE ABOVE GROUND IN "HOT BOX" OR EQUAL ENCLOSURE AND TESTED PRIOR TO CITY ACCEPTANCE. BACKFLOW ASSEMBLIES ARE ONLY ALLOWED IN VERTICAL RISERS IN BUILDINGS, WHEN APPROVED BY THE CITY OF GRAHAM (WHERE ACCESS CAN BE READILY GAINED BY THE CITY).
4. ALL FIRE DEPARTMENT CONNECTIONS SHALL BE LABELED (FDC) WITH 6 INCH LETTERS IN FRONT OF BUILDING WITH DIRECTIONAL ARROWS POINTING TOWARD LOCATION.

## GENERAL UTILITY REQUIREMENTS

### **1. UTILITY LOCATIONS**

- Water line shall be located in the roadway shoulder 5-feet off edge of pavement or back of curb.
- Sewer line - middle of street or 5-feet off edge of pavement.
- Natural gas between sidewalk and curb and gutter or in roadway shoulder.
- Electric underground in 10' utility easement. Utility poles shall be located (or relocated) to avoid sidewalk or other infrastructure impacts. Costs associated with relocation shall be borne by the developer and shall be shown on design plans.
- Telephone in 10' utility easement.
- Cable in right of way behind sidewalk or in utility easement.

### **2. WATER AND SEWER IMPROVEMENTS**

- All water lines are to be a minimum of 8" in size except for cul-de-sacs where 6" is allowed when less than 600 ft. and 4" is allowed when less than 400 ft.
- Water main is to be ductile iron pipe class 50 only.
- Sewer mains are to be a minimum of 8" in size.
- Sewer mains are to be D.I.P., Class 50, PVC SDR-35 may be used in residential areas. VCP may be used with special permission.
- All sewer mains and services shall be pressure cleaned and flushed, and videoed prior to acceptance by the City.

### **3. STORM DRAINAGE**

- All storm drains are to be a minimum of 15" in size.
- Materials are to be reinforced concrete pipe. Alternative pipe material may be used as approved by the Public Works Director.
- Catch basins to be located where no more than 1.0 acre of drainage contributes to any inlet.
- All storm drains shall be pressure cleaned and flushed, and videoed prior to acceptance by the City.
- All storm drains shall be pressure cleaned and flushed and videoed after roads receive final layer of asphalt.

### **4. CONCRETE SIDEWALKS**

- 3,000 P.S.I.
- 5' wide and 5" thick.

### **5. OTHER**

- Any changes to the general requirements shall be preapproved by the Public Works Director.
- City of Graham Standard Specifications and Details are to be used.
- No burning allowed inside the City of Graham.

## BROKEN OR DAMAGED CURB AND GUTTER & SIDEWALK POLICY

The following methods will be permitted for replacement of broken or damaged curb and gutter:

1. REPLACE THE COMPLETE SECTION OF CURB AND GUTTER.
2. DRIVEWAY CUTS SHALL NOT LEAVE LESS THAN AN 8' JOINT ON EITHER SIDE OF DRIVEWAY UNLESS OTHERWISE APPROVED BY THE CITY OF GRAHAM PUBLIC WORKS DEPARTMENT.

The following methods will be permitted for replacement of broken or damaged sidewalk:

1. The sidewalk shall be cut at the nearest joint beyond the section(s) requiring repair or replacement. The damaged sections of sidewalk shall be removed and disposed of properly. New sidewalk shall be formed up and poured to match the existing sidewalk. Expansion joints shall be installed at each end where new sidewalk meets existing sidewalk.

## CONSTRUCTION OBSERVATION

Construction observation shall be provided on a daily basis by the Engineer or his designated representative. The construction observer shall be duly qualified to inspect the work in progress. The City shall be advised of any construction problems during the project and shall witness all tests prior to acceptance by the City. All cost associated with inspections, tests, etc., shall be borne by the developer. The City shall be notified in advance of the observer's name and qualifications and has the right to reject such name.

In the event that inadequate inspection services are being offered by the developer, the City has the right to employ separate construction inspection services to complete the project and the cost of same shall be paid by the developer before final plat approval.

### CONSTRUCTION AS-BUILTS

The City shall be furnished a complete set of "As Built" plans at the completion of all water, sewer, storm drain and street projects.

"As Built" shall include actual rim, top of grate, top of curb, invert elevations of all sewer and storm sewer manholes, catch basins, and junction boxes. The "As-Builts" shall also include all valve and blow off "tie downs" to at least two (2) permanent markers. Provide one (1) reproducible copy, one (1) copy of the "As-Builts", one (1) copy of PDF, and one (1) copy of Autocad.dwg file are required.

### SEWER LINE TIE-INS

All sewer tie-ins to existing manholes shall be cored with a boot.

### Parking Lots

1. All parking lots shall be paved.
2. All parking lots to have curb and gutter.
3. Curb and gutter to meet the same specification as in street specifications. In private parking lots, 24" curb and gutter is allowable.

### Driveways

1. The first 10' or to the right of way line (whichever is longest) shall be an improved surface. An improved surface is to be 6" thick concrete or the City of Graham's standard paving section.
2. Driveways are to be inspected by a City of Graham representative prior to curb cut AND prior to installation.
3. Driveways shall be located at least 30' from an intersection and parking areas shall be outside of the sight triangle
4. If needed the minimum driveway pipe diameter is to be 15" with the bell end facing upstream.



# CITY OF GRAHAM, N.C.

201 S. Main St.  
Graham, N.C. 27253  
Phone (336) 570-6700  
Fax (336) 570-6703

## CONSTRUCTION DOCUMENTS CHECKLIST FOR PLAN REVIEW

**Date-January 1, 2020**

### Section 1: General Plan Preparation Guidelines

- Sheets shall be no larger than 36" x 24" plan and profile paper.
- Minimum text size shall be 1/8"
- Scale on plan view shall be no smaller than 1" = 50'; scale on profile view shall be no smaller than 1" = 50' horizontally and 1" = 5' vertically using a grid showing 1' intervals.
- Cover sheet shall have a vicinity map at a scale no smaller than 1" = 200'.
- Provide a legend indicating existing and proposed lines, features and symbols.
- Cover sheet shall include all general notes, owner's name, telephone number, and mailing address.
- All elevations shall be given in relation to mean sea level; elevations in profile view shall be labeled in 10' intervals on the heavy lines (Ex. 350, 360).
- Benchmark elevations and locations shall be shown on plan view.
- Plan views shall have a north arrow on each drawing.
- Each drawing shall have the following information in the title block: Street or project title, limits, horizontal and vertical scales, original date, revisions date, drawing number, checked by and drawn by. Recommended placement is lower right-hand corner.
- All drawings sealed, signed and dated by a NC Professional Engineer.
- Plan view shall show all actual street names. State road numbers shall be shown if applicable. Plan view should also indicate whether street is asphalt, concrete, gravel or dirt. Proposed street & Right-of-way widths will be dimensioned back-to-back and labeled in plan view.
- Plan view shall show proposed and existing curb and gutter, storm sewers, drainage structures, driveway pipes, water mains, sanitary sewer mains, etc. All available elevations shall be shown on the profile view. Direction of flow shall be shown on plan view for all sanitary sewers and storm drains. Materials and pipe sizes shall be labeled.
- Existing utility lines shall be shown and labeled on plan view and indicated in the legend.
- Plans shall show final proposed locations and dimensions of all water, storm drain, and sanitary sewer lines, including services to each property line for water and sanitary sewer, devices to be installed on the system, catch basins, culverts, ditches, including grades, pipes sizes, elevations, assumptions, calculations, invert elevations for all inlets and manholes and profiles of sanitary sewer lines.
- Plan shall bear the note: "All construction to be in accordance with all City of Graham, Specifications and Standard Details, latest edition."
- All existing and proposed water, storm drainage and sanitary sewer easements shall be shown on all applicable sheets.

## Section 2: Water Distribution Design

Applicant Validation		COG Staff Check	
N/A	Included	Check	
_____	_____	_____	<p>All water distribution system extensions shall be designed to provide fire flow plus peak daily water demand. The peak daily water demand is based on 2.5 times the average daily water demand for the type of user. The distribution system shall be designed to maintain a minimum of 20 PSI at all points in the distribution system under all conditions of usage, including fire flow.</p> <p>Fire flow demand varies with the type and size of user; however, the following shall be used as the minimum fire flow demand to design the distribution system extensions:</p> <p>A. Residential Buildings</p> <ol style="list-style-type: none"> <li>1. One and two family dwellings if more than 11 ft. of separation between buildings-----1000 GPM</li> <li>2. One and two family dwellings if less than 11 ft. of separation between buildings-----1500 GPM</li> <li>3. Multifamily units-----1500 GPM minimum but refer to Table B105.1 in the NC Fire Prevention Code if more applies.</li> </ol> <p>B. Commercial/Business Users-----2000 GPM minimum but refer to Table B105.1 in the NC Fire Prevention Code if more applies.</p> <p>C. Industrial Users-----2500 GPM minimum but refer to Table B105.1 in the NC Fire Prevention Code if more applies.</p> <p>At the time of preliminary development plans, a preliminary design shall be submitted which indicates that the proposed distribution system extensions comply with the above requirements. Upon submittal of the construction plans, detailed modeling documentation shall be submitted showing compliance with the above requirements. Acceptable modeling programs include Watercad, HydrauliCad, WatSys by CivilSystems, or other modeling programs approved in advance using a C factor of 130. The minimum size water line extension shall be 8", except that in cul-de-sacs, 6" is allowed if less than 500 ft. in length and 4" is allowed if less than 250 ft. in length.</p>
_____	_____	_____	<p>In all residential districts, the maximum distance between fire hydrants, measured along public street centerlines and/or other private travel ways shall be 500 feet.</p>
_____	_____	_____	<p>Valves should be installed on all branches from feeder mains and between mains and hydrants according to the following schedule:</p> <ol style="list-style-type: none"> <li>a. three (3) valves at X's (crosses),</li> <li>b. two (2) valves at T's (tees) and</li> <li>c. one (1) valve on single hydrant branch</li> </ol> <p>Note: Additional valves may be required for specific design conditions.</p>
_____	_____	_____	<p>All fittings, valves, hydrants, plugs, etc. must be called off in a fitting box with the number of items.</p>
_____	_____	_____	<p>Show water service to each lot and show the water meter box 6" on street side of the right-of-way line. The developer will be responsible for the cost of relocating services and meters that fall within driveways.</p>
_____	_____	_____	<p>Multi-family, Commercial and Industrial Developments - Hydrants shall be located within 250 feet of most remote portion of building(s).</p>

**Section 2: Water Distribution Design – cont.**

<b>Applicant Validation</b>		<b>COG Staff Check</b>	
<b>N/A</b>	<b>Included</b>		
_____	_____	_____	Minimum Radius for ductile iron pipe without fittings: 4" - 125' 6" - 145' 8" - 195' 10" - 195' 12" - 195' 14" - 285' 16" - 285' 18" - 340' 20" - 340' 24" - 450"
_____	_____	_____	On all 12" and larger water main, provide joint restraint calculations. Fittings, valves, and hydrants to be restrained with Megalugs and concrete.
_____	_____	_____	Main line valves on straight runs between street intersections shall be spaced no greater than the distances given below and shall be located within fifty (50) feet of the nearest hydrant to their location. Main Size Maximum Spacing 6" - 600' 8" - 900' 12" - 1000' 16" - 1000' 24" - 1500'
_____	_____	_____	When phasing a project, locate valves in order to not place any existing service out of water. When extending water line to a new phase add additional valves beyond above requirements if necessary.
_____	_____	_____	Indicate in profile vertical separation 24" water to storm drain 18" water to a sanitary sewer.
_____	_____	_____	Provide 3 foot of cover minimum over water main (8" or less), 4 foot of cover (10" or greater) and 5 foot of cover minimum at air release valve installation. Design cover shall be a minimum of 4'.
_____	_____	_____	If water main is outside of street right-of-way indicate 20 feet easement. Show all existing and proposed water line easements
_____	_____	_____	Indicate water main material Ductile Iron Pipe and class (Class 50 is min.)
_____	_____	_____	Indicate how new water will connect to existing water main.
_____	_____	_____	Indicate backflow prevention.
_____	_____	_____	Hydrant leads are off hydrant tees unless at the end of a water main.
_____	_____	_____	If road bore and jack is required show bore size (dia.), length, thickness of steel encasement and length of restrained pipe through encasement.
_____	_____	_____	For water service connections >3/4" show meter size, vault, backflow prevention etc., meter to be per City of Graham Utilities Department and to be radio read.

### Section 3: Sanitary Sewer Collection Design

Applicant Validation		COG Staff Check
N/A	Included	Check
_____	_____	_____ All gravity sewer mains shall be designed and sized to serve the total natural drainage basin. The total off-site drainage area in acres must be shown on the plans and calculations should be submitted to the City upon request to justify pipe sizing. An 8-inch main shall be the minimum size permitted.
_____	_____	_____ When preparing the plans for sewer mains, deflection angles for all horizontal turns shall be shown on the drawings (at least 90°). All elevations shall be tied to mean sea datum and the benchmark shall be shown or described on the plans. Spot elevations on 100-foot stations, 75 feet from the centerline on both sides, shall be shown on the plan, or cross-sections supplied to ensure that the sewer can adequately serve the property. The plans shall show the manhole number (MH #1 etc.), top elevation, station, depth including invert elevations, length of sewer reach between manholes, and slope (in percent). Established creek centerlines and inverts will be platted on the sewer plan and profile sheets, adjacent to proposed sewer alignment, within 75 feet.
_____	_____	_____ Grades for sanitary sewers must be such that a minimum flow velocity of 2 feet per second is maintained. The minimum grade for an 8-inch sewer line is 0.50%. If necessary, for slope to be less then 0.50%, provide reason.
_____	_____	_____ Minimum widths of permanent and construction sanitary sewer easements, for public sewer mains, are: Permanent / Construction 8" & 15" main - 20 feet wide / 30 feet wide 18" & 24" main - 20 feet wide / 40 feet wide Larger size easements may be required based upon the depth of installation or other consideration as determined by the Staff. Sewer mains shall be centered in the easement. Indicate all existing and proposed easements.
_____	_____	_____ If less than 3 feet of cover over proposed sanitary sewer, pipe shall be ductile iron.
_____	_____	_____ Show sewer service terminating at a cleanout on the right-of-way line. Do not tie 4" lateral sanitary service directly into manhole. Cleanouts shall not be placed in drives.
_____	_____	_____ Indicate in profile vertical separation 24" sanitary sewer to storm drain and 18" sanitary sewer to water main.
_____	_____	_____ Sanitary sewer lines shall be located a minimum distance of 100 feet from the center of any well used as a community or private water supply. This buffer may be reduced to 50 feet provided that the sanitary sewer lines are constructed of materials and joints that are equivalent to water main standards.
_____	_____	_____ The maximum length of sewer line, which shall be constructed between manholes, shall be four hundred twenty five (425') feet.

### Section 3: Sanitary Sewer Collection Design – cont.

<b>Applicant Validation</b>		<b>COG Staff Check</b>																										
<b>N/A</b>	<b>Included</b>																											
_____	_____	_____ The elevation of all sewer lines at creek crossings shall be set such that the top of the pipe is at or below the elevation of the stream bed or for crossings above water level, the bottom of the pipe should be located above the 25-year flood elevation.																										
_____	_____	_____ Sewer manholes located within the 100-year flood plain shall be constructed for watertight manholes, or sewer manholes located within the 100-year flood plain shall have a minimum height of two (2') feet above the 100-year flood elevation.																										
_____	_____	_____ Drop in manhole greater than 6" but less than or equal to 30" indicate concrete slide. If drop is greater than 30" provide an outside drop manhole. Inside drops may be allowed with specific approval by the City.																										
_____	_____	_____ Public sanitary sewer pipe material shall be indicated in profile and bedding type. Connections to existing manholes shall be made by coring into the manhole. Provide plugs in all new line connections until the project is accepted to prevent mud and inflow into the existing sewer system.																										
_____	_____	_____ Where it is not possible to provide gravity sanitary sewer service, indicate which lots will have a private pump system.																										
_____	_____	_____ Minimum Slope requirements: <table border="1"> <thead> <tr> <th>Dia of Pipe (inches)</th> <th>Minimum Slope (Feet per 100 feet)</th> </tr> </thead> <tbody> <tr><td>8</td><td>0.50</td></tr> <tr><td>10</td><td>0.28</td></tr> <tr><td>12</td><td>0.22</td></tr> <tr><td>14</td><td>0.17</td></tr> <tr><td>15</td><td>0.15</td></tr> <tr><td>16</td><td>0.14</td></tr> <tr><td>18</td><td>0.12</td></tr> <tr><td>21</td><td>0.10</td></tr> <tr><td>24</td><td>0.08</td></tr> <tr><td>27</td><td>0.07</td></tr> <tr><td>30</td><td>0.06</td></tr> <tr><td>36</td><td>0.05</td></tr> </tbody> </table>	Dia of Pipe (inches)	Minimum Slope (Feet per 100 feet)	8	0.50	10	0.28	12	0.22	14	0.17	15	0.15	16	0.14	18	0.12	21	0.10	24	0.08	27	0.07	30	0.06	36	0.05
Dia of Pipe (inches)	Minimum Slope (Feet per 100 feet)																											
8	0.50																											
10	0.28																											
12	0.22																											
14	0.17																											
15	0.15																											
16	0.14																											
18	0.12																											
21	0.10																											
24	0.08																											
27	0.07																											
30	0.06																											
36	0.05																											
_____	_____	_____ If road bore and jack is required show bore size (dia.), length, thickness of steel encasement and length of restrained pipe through encasement.																										

## Section 4: Roadway and Street Design

	<b>Applicant Validation</b>	<b>COG Staff</b>	
N/A	Included	Check	
_____	_____	_____	Street typical sections shall be on the cover sheet or the first sheet of plan and profiles and will include street and right-of-way width, sidewalk location, cross-slopes, and pavement design. Do not place aggregate under curb for City streets.
_____	_____	_____	Pavement Cross Section to meet or exceed City Standards.
_____	_____	_____	Plan view shall show all property lines and lot frontages. Existing property irons shall be labeled "E.I.P." Right-of-way lines shall be dimensioned and labeled "R/W."
_____	_____	_____	Complete street curve data shall be shown on plans. This information shall include, but is not limited to: intersection radii, length of all arcs, internal angles, sight triangles, intersection centerlines, superelevation rates, if any along with the top of curb or edge of pavement profiles, vertical curve length, rate of vertical curvature (K), PVI, PVC, and PVT station and elevation, horizontal curve length, tangent, centerline radius, and delta. Minimum K factors per City of Graham Development Ordinance and/or NCDOT minimum Construction Standards Manual for Subdivision Roads. Show top of curb elevations around all radii at intersections and every 25 ft. around cul-de-sacs.

**Other: The design engineer shall provide a copy of this checklist with each submittal of construction plans and shall check the appropriate response under the applicant validation column and sign below.**

Name \_\_\_\_\_ Date \_\_\_\_\_  
 Company \_\_\_\_\_

**OTHER**

1. Refer to Graham Storm Sewer Design Manual, Stormwater Ordinance, and Flood Damage Prevention Ordinance.
2. All Storm Sewers to be Designed for Q10 Storm, except that the Q100 flows shall be confined to within the curb inlets.

