# City of Union City


# Development Regulations

# CITY OF UNION CITY, GEORGIA

# DEVELOPMENT REGULATIONS

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# THE DEVELOPMENT REGULATIONS
# OF THE
# CITY OF UNION CITY, GEORGIA

## ARTICLE I – AUTHORITY, PURPOSE AND TITLE

AN ORDINANCE ESTABLISHING RULES AND REGULATIONS GOVERNING THE DEVELOPMENT OF LAND WITHIN THE INCORPORATED CITY OF UNION CITY, GEORGIA; DEFINING STANDARDS FOR STREET, UTILITIES AND DRAINAGE IMPROVEMENTS; PROVIDING FOR THE METHOD OF ADMINISTRATION AND AMENDMENT; PRESCRIBING PENALTIES FOR THE VIOLATION OF ITS PROVISIONS; AND FOR OTHER PURPOSES.

### Section 1.1 Authority

This Ordinance is adopted under the authority of the Constitution of the State of Georgia and laws enacted pursuant thereto.

### Section 1.2 Short Title

This Ordinance shall be known and may be cited as "The Development Regulations of the City of Union City, Georgia."

### Section 1.3 Purpose

These regulations are intended to serve the following purposes.

(A) To protect and promote the health, safety and general welfare.

(B) To provide a system for the subdividing of lands and the accurate recording of land titles.

(C) To encourage economically sound and orderly land development in accordance with the Comprehensive Plan and other policies and objectives of the City.

(D) To assure the provision of needed open spaces and public facility sites in new land subdivisions through the dedication or reservation of land for public purposes.

(E) To assure equitable review and approval of all land subdivisions by providing uniform procedures and standards for the subdivider.

(F) To assure the provision of required streets, utilities, and other facilities and services to new developments and to redevelopments in conformance with public improvement policies of the City.

(G) To assure adequate provision of safe and convenient traffic access and circulation, both vehicular and pedestrian, in new land developments and in redevelopments.

Section 1.4 Intent and Application

It is the intent of this Ordinance that it will apply to and provide guidance for the development of lands within the incorporated limits of the City of Union City, Georgia, whether the developments involve the subdivision of land or the construction of buildings and/or other improvements on a single parcel. Any land development activity must first comply with this Ordinance.

## ARTICLE II - DEFINITIONS

Section 2.1 Use of Words and Interpretation

(a) For the purposes of this Ordinance, the following shall apply to the use of all words:

(1) Words used in the present tense shall include the future tense,

(2) Words used in the singular number include the plural and words in the plural number include the singular,

(3) Words in masculine gender shall include the feminine and words in feminine gender shall include the masculine,

(4) The term "shall" is mandatory and not discretionary,

(5) The word "may" is permissive,

(6) Use of the word "and" is inclusive and requires that all of the component phrases so connected must be present or fulfilled for sufficiency,

(7) Use of the word "or" is not exclusive and requires that at least one of the component phrases so connected must be present or fulfilled for sufficiency. The word "or" may allow more than one component phrase to be present or fulfilled, as in the term, "and/or".

(b) In this Ordinance the following shall control the interpretation of words and phrases:

(1) Words and phrases defined in this Article shall be interpreted as defined herein without regard to other meanings in common or ordinary use, unless the context of the word indicates otherwise.

(2) Words or phrases not defined herein shall be interpreted as defined in the Zoning Ordinance of Union City, Georgia, as defined in the Land Subdivision Regulations of the City of Union City, Georgia, as defined in the Soil Erosion and Sediment Control Ordinance of Union City, Georgia, as defined in the Sewer Use Ordinance of the City of Union City, Georgia, or the Flood Plain Ordinance of Union City, Georgia, as applicable to the use of the word or phrase within the context of this Ordinance.

(3) Words or phrases not defined herein or in any other applicable code, Regulations or ordinance of the City of Union City, Georgia shall be construed to have the meaning customarily assigned to them.

Section 2.2 Definitions of Words and Phrases

City - The City of Union City, Georgia, a municipal corporation.

City Council - The legally constituted and elected governing body of the City of Union City, Georgia.

Clearing - The removal of trees, other vegetation and/or above ground improvements including, but not limited to, buildings and structures, walls, fences, steps, walks, curbs, gutters, concrete slabs, pavements (including bases for pavements) and surfacing.

Developer - Any person, individual, firm, partnership, association, corporation, estate, trust, or any other group or combination acting as a unit who directs the undertaking or proposes to undertake development activities as herein defined, whether the development involves the subdivision of the land for sale to individual users, the construction of buildings or other improvements on a single land ownership or both.

Development - 1. (noun) A specific subdivision or project which is a single entity or intended to be constructed as an interrelated whole, whether simultaneously or in phases. 2. (verb) All activities associated with the conversion of land or the expansion or replacement of an existing use to any new use intended for human operation, occupancy or habitation other than for agricultural purposes. Such activities include land disturbance and the construction of improvements such as, but not limited to, streets, driveways, parking areas, sidewalks, buildings, structures, utilities, or storm drainage facilities.

Development Plans - The detailed and professional plans showing the layout and design, site work and construction activities proposed for a project (other than architectural/engineering buildings plans); including, but not limited to, Site Plans, Grading Plans, Erosion and Sediment Control Plans, Tree Protection Plans, Landscape Plans, Street Plans and Profiles, Water Supply Plans, Sanitary and Storm Sewer Plans and Profiles, Other Site Improvement Plans and Other Appropriate Sections, Details, Notes, Schedules, Legends and Diagrams.

Drainage Improvements - Those facilities and structures intended to control and direct the passage of storm waters and other surface water flows from and across property; including but

not limited to, modified natural drainageways, modified creeks, modified streams, channels, swales, ditches, flumes, culverts, cross drains and other piping, catch basins, area drains, drop inlets, junction boxes, headwalls, flared end sections, detention ponds and basins, rip rap, drainageway lining systems, and energy dissipation devices.

**Erosion Control Regulations** - The City of Union City, Georgia Soil Erosion and Sediment Control Ordinance.

**Georgia DOT** - The Department of Transportation of the State of Georgia.

**Grading** - The movement, removal, or addition of soil, earth, sand, silt or rock on a site by use of mechanical equipment.

**Grubbing** - The removal of stumps, roots, and abandoned underground facilities including, but not limited to, utilities, structures, walls, footings, foundations, wells, septic tanks, storage tanks, and pipe.

**Health Department** - The Health Department of Fulton County, Georgia.

**Mean Sea Level** - The average height of the sea for all stages of the tide. For purposes of these Regulations, the term is synonymous with National Geodetic Vertical Datum.

**Planning Commission** - The Union City Planning Commission.

**Project** - A principal building or structure, or a group of buildings or structures, planned as an interdependent unit together with all accessory uses of structure, utilities, drainage, access, and circulation facilities, whether built in whole or in phases. Examples include, but are not limited to, a principal building on a lot, a residential subdivision, a multi-family development, an industrial plant, an institutional building, a shopping center or an office complex.

**Public Services Department** - The Department of Public Services of the City of Union City, Georgia.

**Sewer Use Regulations** - The City of Union City, Georgia, Sewer Use Ordinance.

**Street, Substandard** - a street which does not comply to at least the standards for the designated street classifications as contained in these Regulations and the Land Subdivision Regulations.

**Subdivision Regulations** - The City of Union City, Georgia, Land Subdivision Regulations.

**Zoning Regulations** - The City of Union City, Georgia, Zoning Ordinance.

# ARTICLE III - GENERAL PROVISIONS

## Section 3.1 Zoning Ordinance, Subdivision Regulations and other Regulations

Whenever there is a discrepancy between minimum standards or dimensions required under this Ordinance and those contained in zoning regulations, subdivision regulations, building codes or other ordinances or regulations, the most restrictive shall apply.

## Section 3.2 Required Public Improvements

Every developer of lands within the jurisdiction of this Ordinance shall provide the public improvements included in this Ordinance, in accordance with these Development Regulations and other pertinent ordinances, codes, and regulations of the City of Union City, Georgia. These public improvements together with associated rights-of-way, easements, and other lands shall be provided at no cost to the City and shall be dedicated or otherwise transferred, as required, to the public in perpetuity and without covenant or reservation.

## Section 3.3 Plan Review and Approval

Any developer of land within incorporated Union City, Georgia, shall first submit to the City such plans, plats, or construction drawings as may be required by these Regulations and receive approval of those documents by the City prior to the initiation of development activities. Approval of plans, plats, or construction drawings by the City shall not imply nor transfer acceptance of responsibility for the application of the principles of engineering, surveying, architecture, landscape architecture, or any other profession, from the professional corporation or individual under whose hand or supervision the plans, plats, or construction drawings were prepared and sealed.

## Section 3.4 Other Permits

Nothing in these Regulations shall impose any obligation on the City to obtain or assist in obtaining permits, approvals, and/or clearances from other local, state or Federal agencies

having jurisdiction over elements of a project. It is solely the developer's responsibility to obtain all such required permits, approvals, and/or clearances. The developer shall furnish the City with copies of all such permits, approvals and/or clearances before authorization to proceed with development is requested.

## Section 3.5 Standard Specifications

The City will maintain on file for consultation and distribution a series of standard specifications for construction of utilities and drainage facilities for the development of land in accordance with these Development Regulations.

The standard specifications describe minimum acceptable standards for utility and drainage construction of land development activities authorized under this Ordinance, but shall not supersede more restrictive prudent design requirements or good engineering practice as applied to specific situations on a case- by-case basis.

The standard specifications are included in this Ordinance as Appendix B and are subject to the modifications and appeal provisions of Articles VIII and X.

## Section 3.6 Standard Drawings

The City will maintain on file for consultation and distribution a series of standard drawings illustrating details of construction and design of streets, utilities, drainage facilities, site improvements and other elements related to the development of land in accordance with these Development Regulations.

The standard drawings illustrate minimum acceptable standards for land development activities authorized under this Ordinance, but shall not supersede more restrictive prudent design requirements or good engineering practice as applied to specific situations on a case-by-case basis.

The standard drawings are included in this Ordinance as Appendix C and are subject to the modification and appeal provisions of Articles VIII and X.

## ARTICLE IV - STREET IMPROVEMENT STANDARDS

### Section 4.1 Street Improvements

Streets, whether abutting or internal, existing or new, public or private, shall be constructed or improved under those circumstances and to the standards as established in these Regulations. Roadway improvements shall be in accordance with the street classification system defined in the Land Subdivision Regulations. Specific street classification designations shall be as shown in adopted transportation plans of the City or as established by the Planning Commission.

### Section 4.2 Minimum Right-of-Way and Pavement Widths

The minimum widths for public rights-of-way or private street ingress/egress easements and pavements shall be as given in the Land Subdivision Regulations or shown on standard drawings.

On any existing street having a right-of-way less than the minimum which abuts a property being developed, one-half of the required width of right-of-way shall be dedicated at no cost to the City along the entire property boundary abutting the existing street.

Additional street right-of-way width may be required to be dedicated at intersections or other locations fronting the property where turning lanes, storage lanes, medians, islands, or realignments are required for traffic safety and minimum right-of-way standards would be inadequate to accommodate the improvements.

### Section 4.3 Street Widening

When property fronting on an existing City street is to be developed and when the property is to be accessed from the existing City street, roadway improvements (pavement, curb and gutter and drainage) are required along the existing road across the entire property frontage. Required improvements shall not be less than provided in these Regulations for the designated street classification.

Widening, curb and gutter and drainage shall be provided from the centerline of the existing roadway along the side of the road upon which the property abuts. In lieu of installation of curbs and gutters and/or related improvements, the developer must have presented to and received approval by the City for a Street Improvements and Storm Water Drainage Plan for the development and its affected environs. Said plan must provide for adequate storm water drainage, and will further address as a minimum, street grading, paving, and curbs and gutters, and or other innovative provisions for said drainage. This plan must conform to the applicable standards and specification established by the City and be prepared, signed, and sealed by a Georgia registered professional engineer.

The developer shall be responsible for the relocation and/or modifications of public and/or private utilities as necessitated by the required street improvements.

Section 4.4 New Streets

All public streets proposed to be constructed in a subdivision or other development shall be designed and constructed at least to the standards contained in these Regulations in accordance with the appropriate street classification of said streets.

Section 4.5 Substandard Streets

In the event that a development has access to a substandard street and if that substandard street provides the primary means of access to the development, the substandard street, except as indicated below, shall be fully upgraded along the entire property frontage and continuing to the nearest standard paved road along the route of primary access.

In the event that a development has access to a substandard street and if that substandard street is other than the primary means of access to the development, the substandard street, except as indicated below, shall be fully upgraded only along the entire property frontage and shall be paved on the opposite side of the road from the development, 12 feet from the street centerline.

The upgrading of substandard streets used for access will not be required if any of the following conditions are met:

(a) The development consists of a single one or two family residence on an existing recorded lot within the City;

(b) Total traffic on the substandard street is less than 2000 vehicles per day including projected traffic volume from the development; or

(c) The development is a small business with ingress/egress of less than 100 vehicles per day.

Section 4.6 Acceleration/Deceleration Lanes

Except as indicated, acceleration and deceleration lanes shall be provided for new street and driveway connections to existing streets. The lanes will not be required if any of the following conditions are met:

(a) The driveway is for a one or two family residence;

(b) Total traffic on the existing roadway is less than 3000 vehicles per day (count of existing traffic must have been made within one year of the development plan submittal date);

(c) The driveway is for a small business with ingress/egress of less than 150 vehicles per day; or

## Section 4.7 Improvements Along State and Federal Highways

For any development which abuts a State or Federal highway, improvements to the highway and the location and design of any street or driveway providing access from the highway shall comply with the standards and requirements of the Georgia Department of Transportation. A copy of the approved Georgia DOT permit shall be provided to the City prior to issuance of land disturbing or building permits.

## Section 4.8 Specifications

Unless otherwise specifically set forth herein, all of the materials, methods of construction, and workmanship for street construction shall conform to the latest edition of the Georgia Department of Transportation Standard Specifications - Construction of Transporation Systems including all amendments.

## Section 4.9 Subgrade Preparation

(a) Clear and grub entire street right-of-way before commencing street earthwork construction. For specific technical requirements reference is made to Georgia DOT Specifications Section 201-Clearing and Grubbing Right-of-Way. Combustible material generated from clearing and grubbing operations may be burned only when authorized and permitted by the Union City Fire Marshall.

(b) Conduct street earthwork construction in accordance with Georgia DOT Specification Sections 205 - Roadway Excavation and 208 - Embankments. For purposes of these Regulations, the maximum density of soil material shall be determined by ASTM D 698 (Standard Proctor) test procedures.

(c) Complete utility and drainage earthwork before starting street subgrade construction.

(d) Perform subgrade construction in accordance with Georgia DOT Specification section 209 - Subgrade Construction.

(e) The developer shall provide quality control testing during earthwork and subgrade construction as necessary to assure the entire earthwork, including all fill layers and subgrades, meet the minimum requirements of these Regulations. The minimum quality control testing to be provided consists of the following:

(1) Moisture - density relationship curve for each type soil encountered.

(2) One in-place density test (ASTM D 1556 or other recognized method) per 1,200 square yards or fraction thereof of subgrade or base to be paved..

(3) One in-place density test (ASTM D1556 or other recognized method) per 1000 cubic yards or fraction thereof of fill placed.

(f) Earthwork which falls below specified minimum quality control limits shall be removed, reconstructed and retested until compliance with specified requirements is achieved.

(g) After completing street earthwork operations and before beginning street base construction, the developer shall file a copy of the quality control test results demonstrating compliance with these requirements with the City. At any time during the construction process, representatives of the City may request to review and the developer shall provide quality control test results.

## Section 4.10 Minimum Street Sections and Design Speeds

(a) The minimum street sections are defined in the Subdivision Regulations and in Appendix C, Standard Details, of these Regulations. Specific Details and required design speeds for the standard street classifications are as follows:

| Street Classifications | Detail | Design Speed in MPH |
|---|---|---|
| (1) Major Thoroughfares With Medians - | R010 | 50 |
| (2) Major Thoroughfares (Industrial/Commercial) - | R020 | 45 |
| (3) Collector Streets - | R030 | 40 |
| (4) Local Streets - | R040 | 30 |
| (5) Interior Streets - | R050 | 30 |
| (6) Alleys - | R060 | 20 |

(b) Construct street and alley bases in accordance with Georgia DOT Specification Section 300 - Specifications Applying to All Base and Subbase Courses. The following Georgia DOT Specification Sections shall apply to base materials indicated on the Standard Detail Typical Street Sections:

(1) Graded Aggregate Base - Section 310 - Graded Aggregate Construction.

(c) Construct surface and binder asphaltic paving courses, including prime, in accordance with Georgia DOT Specification Section 400 - Hot Mix Asphaltic Concrete Construction.

(d) When street earthwork and paving are complete, the developer shall grass and stabilize all disturbed areas including roadway shoulders which are not covered by paving or other improvements. It shall be the developer's responsibility to maintain grassed areas by watering, fertilizing, weeding, mowing, trimming, regrading and replanting as required to establish a smooth, acceptable stand of grass free of eroded or bare areas. Grassed areas will be considered acceptable when a viable stand of grass covers at least 90 percent of the total area with no bare spots exceeding one square foot and the ground surface is fully stabilized against erosion. Grassing operations shall meet the technical requirements of Georgia DOT Specification Section 700 - Grassing for Planting Zone 1.

(e) The developer shall provide quality control testing during base and pavement construction as necessary to assure the entire pavement structure meets the minimum requirements of these Regulations. The minimum quality control testing to be provided consists of the following:

(1) Moisture-density relationship curve for each base material used on project.

(2) For soil cement base, conduct mix design to determine Portland cement content (percent of dry weight of the soil) to achieve a minimum compressive strength of 300 psi at seven days when testing in accordance with ASTM D 1632 and D 1633.

(3) One in-place density test (ASTM D 1556 or other method acceptable to the City) per 1200 square yards or fraction thereof of base.

(4) One thickness measurement normal to base surface per 1200 square yards or fraction thereof of base.

(5) One surface tolerance measurement using a 15 foot straight edge per 250 square yards or fraction thereof of base.

(6) One asphalt extraction (ASTM D 2172) and aggregate gradation analysis (ASTM C 136) per 2400 square yards or fraction thereof of surface course and per 2400 square yards or fraction thereof of binder course (if any). Obtain samples for extraction and gradation tests in accordance with ASTM D 979.

(7) One density and compacted thickness measurement per 1200 square yards or fraction thereof of each course placed. Density determined to be made in accordance with ASTM D 1188. Remove not less than 3 inch

diameter nor larger than 12 inch square test specimens. Repair test specimen holes with full depth application of fresh hot asphaltic plant mix.

(8) One surface tolerance measurement using 15 foot straight edge per 250 square yards or fraction thereof of surface course.

(f) Base and/or paving construction which falls below specified minimum quality control limits shall be removed, reconstructed and retested until compliance with specified requirements is achieved.

(g) After completing base and paving construction, the developer shall file a copy of the quality control test results demonstrating compliance with these Regulations with the City. At any time during the construction process, representatives of the City may request to review and the developer shall provide quality control test results.

(h) In the event the developer desires to utilize base or paving materials or systems not included in these Regulations, the developer shall provide an engineering study prepared by a Georgia registered professional engineer comparing the proposed material or system to the appropriate system which is included in these Regulations. The engineering study will include a pavement structural design based on the AASHTO "Guide for Design of Pavement Structures" and suggested specifications for the materials and construction of the proposed system. The City will treat the developer's request through the appeals process described elsewhere in these Regulations.

## Section 4.11 Curb and Gutter

(a) All new streets or street widening sections shall be provided with curb and gutter, except as provided herein under. All gutters shall drain smoothly with no areas of ponding. In lieu of installation of curbs and gutters and/or related

improvements, the developer must have presented to and received approval by the City for a Street Improvements and Storm Water Drainage Plan for the development and its affected environs. Said plan must provide for adequate storm water drainage, and will further address as a minimum, street grading, paving, and curbs and gutters, and or other innovative provisions for said drainage This plan must conform to the applicable standards and specification established by the City and be prepared, signed, and sealed by a Georgia registered professional engineer.

(b) Concrete used for curb and gutter construction shall have a minimum 3000 psi compressive strength at 28 days (ASTM C 39); a 2 inch to 4 inch slump (ASTM C 143) and, 3 to 6 percent air content (ASTM C 231 or C 173) and shall comply with ASTM C 94.

(c) The developer shall use a standard curb and gutter section. The section is shown in Appendix C, Standard Details.

(d) Construct curb and gutter true to line, grade and cross section on properly prepared subgrade. Apply Georgia DOT Type 2 membrane curing compound.

(e) Protect completed curb and gutter work from damage until dedication to the City. As soon as the curb and gutter will not be damaged, backfill, compact, stabilize and grass adjacent ground to achieve design line and grade. Acceptably repair or replace broken or defective curbs and gutters.

## Section 4.12 Sidewalks

Sidewalks shall be provided along public streets for all developments and in such other locations as deemed necessary by the City for safe pedestrian movement.

## Section 4.13 Traffic Control Devices

Traffic control devices consisting of street name signs, traffic control signs, traffic markings and traffic signals shall be provided by the developer as appropriate to serve each development. All traffic control devices and installation thereof shall conform to the Federal Highway Administration "Manual on Uniform Traffic Control Devices".

For residential developments, minimum traffic control devices shall consist of street name signs on at each street intersection, stop or yield signs at each intersection, one speed limit sign per block, school or pedestrian crossing signs where appropriate, and limited pavement marking such as crosswalk lines for school or pedestrian crossings.

Minimum traffic control devices for non-residential developments shall include those devices for residential developments and lane and centerline markings, stop lines, and parking space markings. Additionally, appropriate other signs and signals shall be provided by the developer.

## Section 4.14 Street Lighting

The developer shall provide a street lighting standard at each street intersection and at an interval not exceeding 400 feet. The developer shall provide lighting standards at no cost to the City

## Section 4.15 Preparation of Street Improvement Plans

Street improvement plans for all new streets, street widenings and existing street upgrades shall be prepared by a Georgia registered professional engineer. An electronic copy (in pdf or dwa format) and at least three copies of the plans shall be submitted to the City for review and comment. Within thirty days of submittal of the plans, the City will either approve the plans or make comment on items requiring changes and/or additional information. When not approved, the cycle of plan submittal and review will be repeated until the plans can be approved by the City.

Information to be shown on the plans shall consist of not less than the following:

(a) Profiles of existing ground levels along street centerlines and each right-of-way. Field determined elevations shall be indicated at intervals not exceeding 100 feet. Where cross sections are provided at least every 100 feet, only centerline elevations need be shown on the profile.

(b) Existing facilities and features within and adjacent to rights-of-way which affect or could be affected by street improvement construction. Items include, but are not limited to, streets, rights-of-way, buildings, parking lots, driveways, fences, tree lines, and railroads.

(c) All drainageways, lakes, streams, creeks, channels, wetlands, and drainage facilities.

(d) All existing utilities and appurtenances within and adjacent to rights-of-way which affect or could be affected by street improvement construction. The utility type, size, depth, material and location in relation to street improvements should be indicated.

(e) Existing and proposed property and easement lines and land lot and land district lines intersecting street rights-of-way.

(f) Limits of new construction.

(g) New road improvements, including but not limited to, curbs and gutters, sidewalks, pavements, driveways, wheel chair ramps, traffic control devices, and street lights (if any).

(h) Profiles of each pavement edge or line of curb and gutter with new finished grade elevations at intervals not exceeding 100 feet.

(i) Horizontal and vertical street geometry including street centerline angles of deflection, radii, degree of curvature, design speed, tangent lengths, arc lengths,

bearings street grades, and lengths of vertical curves. Stations for all points of curve, points of tangency, points of intersection, both horizontal and vertical, should be shown.

(j) Benchmarks for vertical control.

(k) Name of the development, names, addresses and telephone numbers of developer and developer's engineer, engineer's seal, north arrow, scale, and date.

Plans shall be prepared in conformance with the following:

(a) Where specific design guidance is not given, in these regulations or other regulations, rules, ordinances, of the City, the AASHTO publication "A Policy on Geometric Design of Highways and Streets", latest edition shall be followed.

(b) All elevations shall be based on and tied to U.S. Coast and Geodetic Survey mean sea level datum.

(c) Plan drawings shall be at a scale of at least 1 inch equals 50 feet. In developed or conjested areas, a scale of 1 inch equals 20 feet or less shall be utilized.

(d) For profile drawings, the horizontal scale shall be the same as that used for associated plan drawings. The vertical scale shall be at least 1 inch equals 10 feet. A 1 inch equals 5 feet vertical scale is often necessary to properly depict grade changes in flat areas.

(e) The desired drawing size is 22 inches by 34 inches. In no case shall drawings be larger than 30 inches by 42 inches nor smaller than 11 inches by 17 inches.

# ARTICLE V - UTILITIES

## Section 5.1 Placement of Utilities

All authorized public and private underground or overhead utilities shall be located within the right-of-way of a public street or within an easement designated for such use. Within must public street rights-of-way, placement of the various authorized utilities (water, sanitary sewer, natural gas, power, telephone, and cable TV) shall conform to the specific locations for such use designated by the City, as illustrated in Appendix C, Standard Details. Private underground utilities such as lawn sprinkler systems, septic tanks and drain fields, exterior lighting systems, and heating and cooling piping are not permitted within public street rights-of-way.

## Section 5.2 Easements

Permanent easements for public water, drainage and sanitary sewer facilities shall be dedicated to the City. The minimum width permanent easements for a single utility shall be 20 feet. Where more than one utility has a common easement, the minimum easement width shall be increased by 10 feet for each additional utility. Before dedication, the developer shall grass and stabilize all disturbed areas within and adjacent to easements which are not covered by paving or other improvements. An acceptable stand of grass free of eroded or bare areas as defined in paragraph 4.10(e) of these Regulations must be achieved before the City will consider dedication.

## Section 5.3 Utility Line Extension Requirements

If existing water mains and or sanitary sewers must be extended to serve a development, the developer shall install or have installed the necessary extensions at no cost to the City under the existing City policy and procedures at plan approval time.

## Section 5.4 Water Distribution System Design Criteria

(a) Pressure: All water mains, including those not designed to provide fire protection, shall be sized after hydraulic analysis to maintain a minimum pressure of 20 psi at ground level under all conditions of design flow.

(b) Design flow: The design flow is to consist of projected peak demand plus fire flow (where applicable). To determine projected peak flow for residential developments, utilize values in Table 5.1. For developments other than residential, utilize AWWA "Manual of Water Supply Practices M22, Sizing Water Service Lines and Meters" to estimate peak demand. For fire flow, select proper value from Table 5.2.

(c) Sprinkler connections: For each fire protection sprinkler connection to the City's water system, the developer must provide a double detector check valve installation consisting of not less than two detector check valves with by-pass meter on the second unit and two gate valves all enclosed in an accessible concrete pit. The pit is to have a double leaf aluminum access hatch.

(d) State Approval: It is the developer's responsibility to obtain the approval of the Environmental Protection Division of the Georgia Department of Natural Resources of all water distribution system additions and extensions. In addition to the other requirements, the City must receive a copy of the approval before the developer will be allowed to proceed with construction.

## Section 5.5 Location of Watermains, Fire Hydrants and Other Fixtures.

(a) Water Mains: Locate water mains along City or County streets on the south and west side of the street, five feet from the back of the curb or along ditch centerline where there is no curb. The minimum cover is to be 42 inches. Locate water service laterals

## TABLE 5.1

## PEAK WATER DEMANDS FOR RESIDENTIAL DEVELOPMENTS

| NUMBER OF DWELLING UNITS | GPM PER DWELLING UNIT |
|---|---|
| 5 | 8.0 |
| 10 | 5.0 |
| 20 | 4.3 |
| 30 | 3.8 |
| 40 | 3.4 |
| 50 | 3.0 |
| 60 | 2.7 |
| 70 | 2.5 |
| 80 | 2.2 |
| 90 | 2.1 |
| 100 | 2.0 |
| 150 | 1.6 |
| 200 | 1.3 |
| 300 | 1.2 |
| 400 | 0.9 |
| 500 | 0.8 |
| 750 | 0.7 |
| 1000 | 0.6 |

## TABLE 5.2

## MINIMUM DESIGN FIRE FLOWS [1]

| ZONING DISTRICT | | GPM |
|---|---|---|
| R-1 | Single Family Residential | 750 |
| R-2 | Single Family Residential | 1000 |
| R-3 | Single Family Residential | 1000 |
| R-4 | Single Family Residential | 1000 |
| R-6 | Single Family Residential | 1000 |
| RM | Multi Family Residential | 1500 |
| RMD-1 | Single Family Residential Medium Density | 1000 |
| MHP | Manufactured Home Park | 1000 |
| O&I | Office & Institutional | 1250 |
| NC | Neighborhood Commercial | 1250 |
| GC | General Commercial | 1250 |
| RSC | Regional Shopping Center | 1250 |
| M-1 | Light Industrial | 2250 |
| M-2 | Heavy Industrial | 2250 |

[1] Values given in this table represent minimum requirements. Should Fire Chief or Insurances Services Office, Inc. recommend higher fire flows, use the largest values.

with a minimum cover of 24 inches within street rights-of-way. Within 5 feet of the water meter, service lateral cover may be reduced to not less than 18 inches.

(b) Fire Hydrants Spacing: Provide fire hydrant spacing as requested by the Fire Chief and as follows:

(1) One and Two Family Residential: Space fire hydrants not more than 500 feet apart with additional fire hydrants located as necessary so that the maximum hose lay from a hydrant to the furthermost part of any building does not exceed 500 feet.

(2) Multiple-Unit Residential: Space fire hydrant not more than 500 feet apart with additional fire hydrants located as necessary so that the maximum hose lay from a hydrant to the farthermost part of any building does not exceed 400 feet.

(3) Office-Institutional, Commercial and Industrial: Space fire hydrants not more than 400 feet apart so all portions of buildings can be reached by hose lays of not more than 400 feet.

(4) Except when waived by the Fire Chief, a fire hydrant shall be located at all street intersections in all Zoning Districts.

(5) Locate fire hydrants between the water mains and right- of-way and within 5 feet of the right-of-way.

(c) Valves: Locate valves at not more than 1,000 foot intervals in residential areas and 500 foot intervals in non-residential areas. At water main junctions, the minimum number of valves to be provided shall equal the number of pipes extending from the junction minus one.

(d) Meters: Locate water meters in public rights-of-way within six inches of the right-of-way except where alternate location is approved by the Public Services Department. Water meters will be furnished and installed by the City upon payment of appropriate fees.

## Section 5.6 Sanitary Sewer Design Criteria

(a) Design Capacity: Design sewer systems for the estimated ultimate development tributary population and/or area. In establishing design capacity, the following factors must be considered.

(1) Maximum hourly residential sewage flow.
(2) Maximum hourly commercial/institutional sewage flow.
(3) Maximum hourly industrial sewage flow.
(4) Ground water infiltration.
(5) Topography of the area.
(6) Pumping requirements.

Design new sewers in residential areas on the basis of an average daily flow of sewage of not less than 400 gallons per household per day. A peaking factor of not less than 2.5 must be applied to the average daily flow to establish peak design flow. Sewers shall be designed to carry peak design flow when flowing one-half full.

In non-residential developments, base sewer design on the estimated peak flow from the development but in no case less than 0.4 gallon per square foot of gross building areas. Sewers shall be designed to carry peak flow when flowing one-half full.

(b) Size and Shape: The minimum size sanitary sewer shall be 8 inches. Design sewers to give mean velocities, when flowing half full, of not less than 2.0 feet per second based on the Manning formula using an "n" value of 0.013. Table 5.3

gives the minimum slopes which must be provided, however, where possible greater slopes are desirable.

Place sewers with a uniform slope between manholes.

(c) Manholes: Install manholes at the following locations:

(1) End of each sewer.
(2) At all changes in grade, size, or alignment.
(3) At all sewer intersections
(4) At distances not greater than 400 feet for sewer 15 inches and smaller.

When changing pipe sizes at a manhole, align the 0.8 depth point of both sewers at the same elevation. When the same size pipe enters and leaves a manhole, provide at least a 0.1 foot drop in elevation between the entering and the exiting inverts. Construct a U shaped flow channel through manholes.

(d) Relation to Water Mains: Whenever possible, lay sewers at least 10 feet horizontally from any existing or proposed water main. Should conditions prevent a separation of 10 feet, lay the lines in separate trenches. In either case, construct the elevation of the crown of the sewer at least 18 inches below the bottom of the water main.

When sewers cross under water mains, lay the sewer so that the top of the sewer is at least 18 inches below the bottom of the water main. Install the two pipes such that a full length of pipe will be centered over the crossing so that all joints will be separated as much as possible. Install ductile iron pipe for both lines when the crossing is less than two feet of separation.

## TABLE 5.3

## MINIMUM SEWER SLOPES

| NOMINAL SEWER SIZE IN INCHES | MINIMUM SLOPE IN FEET PER 100 FEET |
|---|---|
| 8 | 0.40 |
| 10 | 0.28 |
| 12 | 0.22 |
| 15 | 0.15 |
| 18 | 0.12 |
| 21 | 0.10 |
| 24 | 0.08 |
| 27 | 0.067 |
| 30 | 0.058 |
| 36 | 0.046 |

(e) When sewers are laid in public streets, construct the sewer along the centerline of the street at a depth of not less than 5 feet from the road surface to the top of the pipe. In curved streets, install the sewer between gutter lines to avoid conflicts with other utilities.

(f) State Approval: It is the developer's responsibility to obtain the approval of the Environmental Protection Division of the Georgia Department of Natural Resources for sanitary sewer collection system additions and extensions. In addition to other requirements, the City must receive a copy of the approval before the developer will be allowed to proceed with construction.

Section 5.7 (Reserved)

Section 5.8 Specifications for Utility Construction

Specifications for Utility construction are included herein as Appendix B, Specifications for Utility and Drainage Construction.

Section 5.9 Preparation of Utility Plans

Utility plans for all extensions, additions, improvements and/or modifications for the water distribution and sanitary sewer collection systems shall be prepared by a Georgia registered professional engineer.

At least three copies of the plans shall be submitted to the City for review and comment. Within thirty days of submittal of the plans, the City will either approve the plans or make comment on items requiring changes and/or additional information. When not approved, the cycle of plan submittal and review will be repeated until the plans can be approved by the City.

Information to be shown on the plans shall consist of not less than the following:

(a) Existing facilities and features in the vicinity of utility construction which affects or could be affected by such construction. Items include but are not limited to streets, rights-of-way, buildings, driveways, parking lots, fences, tree lines and railroads.

(b) All drainways, lakes, streams, creeks, channels, wetlands, and drainage facilities.

(c) All existing utilities and appurtenances in the vicinity of utilities construction which affect or could be affected by such construction. The utility type, size, depth, material and location in relation to utilities improvements should be indicated.

(d) Existing and proposed property and easement lines and land lot and land district lines intersecting utility line construction.

(e) New utilities construction including as applicable, but not limited to, pipelines, manholes, lift stations, force mains, valves, fittings, fire hydrants, meters, casings, services facilities, special construction and details for connections to existing utilities. Pipe sizes and materials shall be indicated on the plans. Include horizontal geometry as necessary to define location of new utilities.

(f) Profiles of sanitary sewers showing existing ground surface, sewers, manholes with top and invert elevations, line lengths and grades, crossing utilities, and limits for special construction.

(g) Benchmarks for vertical control.

(h) Name of the development, names, addresses and telephone numbers of developer and developer's engineer, engineer's seal, north arrow, scale and date.

Plans shall be prepared in conformance with the following:

(a) All elevations shall be based on and tied to U.S. Coast and Geodetic Survey mean sea level datum.

(b) Plan drawing shall be at a scale of at least 1 inch equals 100 feet. In developed or congested areas, a scale of 1 inch equals 20 feet or less shall be utilized.

(c) For profile drawings, the horizontal scale shall be the same as that used for associated plan drawings. The vertical scale shall be at least 1 inch equals 10 feet. A 1 inch equals 5 feet vertical scale is often necessary to properly depict pipeline conditions.

(d) The desired drawing size is 22 inches by 34 inches. In no case shall drawings be larger than 30 inches by 42 inches nor smaller than 11 inches by 17 inches.

(e) Utilities construction may be shown on street improvement plans provided the resulting drawings are clear, legible and plainly show all necessary information.

## Section 5.10 Construction Record Drawings

At the completion of utilities construction and before dedication to the City, the developer shall furnish two plots or electrostatic copies and CAD copy (in dwg or pdf format) of construction record drawings for the development to the City. The record drawings shall be made from the original drawings of the approved development drawings revised to reflect actual construction.

# ARTICLE VI
# GRADING AND DRAINAGE

## Section 6.1 Site Grading

Site grading shall be done in accordance with the finished grades shown on the approved development drawings. Site grades shall direct surface drainage away from buildings without causing adverse impact on adjacent properties.

The maximum slopes for soil cut or fill shall be two feet of horizontal run for each foot of vertical rise or fall except for stable rock slopes. If actual soils encountered require a flatter slope for stability, the lesser slope shall be used.

Soil erosion and sediment control measures shall be provided as required in the Soil Erosion and Sediment Control Ordinance.

## Section 6.2 Drainage

Provisions for storm water drainage and detention designs are given in the Georgia Stormwater Management Manual with Union City modifications. Those modifications are incorporated in these Regulations as Appendix A.

## Section 6.3 Specifications for Drainage Construction

Specifications for drainage construction are included herein as Appendix B, Specifications for Utility and Drainage Construction.

## Section 6.4 Preparation of Grading and Drainage Plans

Grading and drainage plans for all developments except individual one and/or two family dwelling units, shall be prepared by a Georgia registered professional engineer or landscape architect. At least three copies of the plans and detention study shall be submitted to the City

for review and comment. Within thirty days of submittal of the plans, the City will either approve the plans or make comment on items requiring changes and/or additional information. When not approved, the cycle of plan submittal and review will be repeated until the plans can be approved by the City.

Information to be shown on the plans shall consist of not less than the following:

(a) Topographic map of the existing conditions for the development showing existing facilities and features which affect or could be affected by grading and drainage improvements. Utilize a contour interval of not greater than two feet with spot elevations as necessary to define existing ground surfaces.

(b) All drainageways, lakes, streams, creeks, swales, ditches, channels, wetlands, and drainage facilities.

(c) All existing utilities and appurtenances which affect or could be affected by grading and drainage improvements. The utility type, size and location in relation to grading and drainage improvements should be indicated.

(d) Existing and proposed property and easement lines and land lot and land district lines intersecting or bounding grading and drainage improvements.

(e) Finished grades depicted by finished contours and/or spot elevations as necessary to define finished grade surfaces.

(f) New drainage improvements including, but not limited to, pipes, culverts, catch basins, area drains, drop inlets, junction boxes, headwalls, berms, dikes and detention basins with outlet works. The drainage areas tributary to each drainage structure, design flow, and time of concentration shall be indicated.

(g) Profiles of storm drains showing existing and finished ground surfaces, pipes, drainage structures with top and flow line elevations, distances from centerline

to centerline of drainage structures, pipe and ditch grades, crossing utilities, and limits of special construction.

(h) Benchmarks for vertical control.

(i) Name of the development, names, addresses and telephone numbers of developer and developer's design professional, design professional's seal, north arrow, scale and date.

Plans shall be prepared in conformance with the following:

(a) All elevations shall be based on and tied to U.S. Coast and Geodetic Survey mean sea level datum.

(b) Plan drawings shall be at a scale of at least 1 inch equals 100 feet. In developed or conjested areas, a scale of 1 inch equals 20 feet or less shall be utilized.

(c) For profile drawings, the horizontal scale shall be the same as that used for the associated plan drawings. The vertical scale shall be a the least 1 inch equals 10 feet. A 1 inch equals 5 feet vertical scale is often necessary to properly depict drainage conditions.

(d) The desired drawing size is 22 inches by 34 inches. In no case shall drawings be larger than 30 inches by 42 inches nor smaller than 11 inches by 17 inches.

(e) Drainage construction may be shown on street or utilities improvements plans provided the resulting drawings are clear, legible and plainly show all necessary information.

## ARTICLE VII
## SCHEDULE OF FEES

The schedule of fees for development plan review, copies of these Regulations, appeals, waivers, reinspections, and other items are on file with the City Clerk and may be altered or amended from time-to-time by the City Council to help defray the costs of the administration of these Regulations.

Development plan review fees, if any, shall be paid at the time development plans are submitted for review. A development plan review fee shall be paid each and every time development plans or parts thereof are submitted or resubmitted.

## ARTICLE VIII
## ADMINISTRATION, ENFORCEMENT, APPEAL, AND VIOLATIONS

### Section 8.1 Administration and Enforcement

These Development Regulations shall be administered, interpreted, and enforced by the City Administrator or the Administrator's designated representative.

In any case in which activities are undertaken in violation of these Regulations, not in compliance with the provisions of a permit issued by the City, or without authorization of a permit which would otherwise be required, the City Administrator is hereby authorized to order that all unauthorized or improper work be stopped, direct correction of deficiencies, or take any other legal or administrative action appropriate to the severity of the violation and degree of threat to the public health, safety and welfare.

It shall be the duty and responsibility of the City Administrator to maintain an accurate and up-to-date compilation of these Development Regulations, including Appendices, and all amendments, and to publish said compilation and make it available to the public for a fee set by the City Council.

## Section 8.2 Appeal and Waiver of the Regulations

It is the intention of this Ordinance that all questions arising in connection with the interpretation and enforcement of these Regulations first be presented to the City Administrator and that such questions shall be presented to the Board of Zoning Appeals only on appeal from the decision of the City Administrator.

Requests of waivers of the requirements of these Regulations shall be submitted in a form as prescribed by the City Administrator along with such fee as shall be established by the City Council. The City Administrator shall coordinate the review of each waiver request by all other affected City departments and shall summarize such comments and/or recommendations as may be received to the Board of Zoning Appeals for final action in their normal course of business.

## Section 8.3 Violation and Penalty

Any person, firm or corporation violating any provision of this Ordinance shall be guilty of a misdemeanor and, upon conviction, shall be fined as determined by the Judge of Criminal Court, of the City of Union City, for each offense. Each day such violations continues shall constitute a separate offense.

Nothing herein contained shall prevent the City from taking such other lawful action as is necessary to prevent or remedy any violation.

# ARTICLE IX
# APPEALS PROCEDURE

## Section 9.1 Appeals, Hearings, and Notice

Appeals to the Board may be taken by any person aggrieved or by any officer, department, board or bureau of the City. Such appeal shall be taken within a reasonable time, as provided by the rules of the Board by filing with the officer from whom the appeal is taken and with the Board of Zoning Appeals' notice of said appeal specifying the grounds thereof. The City Administrator shall forthwith transmit to the Board all papers constituting the record upon which the action appealed from was taken.

An appeal stays all legal proceeding in furtherance of the action appealed from , unless the officer from whom the appeal is taken certifies to the Board, after the notice of appeal shall have been filed with the officer, that by reason of facts stated in the certificate a stay would, in the officer's opinion, cause imminent peril to life and property. In such case, proceedings shall not be stayed otherwise than by a restraining order which may be granted by the Board or by a court of record on application, on notices to the officer from whom the appeal is taken, and on due cause shown.

The Board shall fix a reasonable time for the hearing of the appeal or other matter referred to it, and give public notice thereof, as well as due notice to the parties in interest, and decide the same within a reasonable time. At the hearing any party may appear in person or by agent or by attorney.

## Section 9.2 Powers and Duties

The Board of Zoning Appeals shall have the following powers and duties:

- To hear and decide appeals where it is alleged there is error in any order, requirement, decision, or determination made by the City Administrator in the enforcement of this Ordinance.

- To authorize, upon appeal, in specific cases a variance from the terms of this Ordinance as will not be contrary to the public interest, where, vowing to special conditions, a literal enforcement of the provisions of the Ordinance will in an individual case, result in unnecessary hardship, so that the spirit of the Ordinance shall be observed, public safety and welfare secured, and substantial justice done. Such variance may be granted in such individual case of unnecessary hardship upon a finding by the Board of Zoning Appeals that:

  (a) there are extraordinary and exceptional conditions pertaining to the particular piece of property in question because of its size, shape, or topography;

  (b) the application of the Ordinance to this particular piece of property would create an unnecessary hardship;

  (c) such conditions are peculiar to the particular piece of property involved; and

  (d) relief, if granted, would not cause substantial detriment to the public good or impair the purpose and intent of this Ordinance, provided, however, that no variance may be granted for a use of land or building or structure that is prohibited in a given district by the Zoning Ordinance.

- To decide on other matters where a decision of the Board of Zoning Appeals may be specifically required by the provisions of this Ordinance. In exercising these powers, the Board of Zoning Appeals may be reversed or affirm, wholly or in part, or may modify the order, requirements, decision, or determination, and to that end shall have all the powers of the officer from whom the appeal is taken and may issue or direct the issuance of a permit. The Board, in the execution of the duties for which appointed, may subpoena witnesses and in case of contempt may certify such fact to the Superior Court.

Section 9.3 Certiorari from Decisions

Any person aggrieved by any decision of the Board of Zoning of Appeals shall have the right of certiorari to the Superior Court within thirty (30) days after the decision of the Board is rendered.

# ARTICLE X
# AMENDMENTS

## Section 10.1 Authority

This Ordinance, including Appendices, may be amended from time-to-time by the City Council as herein specified, but no amendment shall become effective unless it shall have been proposed by or shall first have been submitted to the Board of Zoning Appeals for review and recommendation. For information, each member of the Board and Planning Commission will be provided with a copy of each amendment. The Board of Zoning Appeals shall have 30 days within which to submit its report after its first consideration. If the Board of Zoning Appeals fails to submit a report within the 30 day period, it shall be deemed to have approved the proposed amendment.

## Section 10.2 Requirements for Change

When the public necessity, convenience, general welfare, or good development practice justify such action, and after the required review and report by the Board of Zoning Appeals, the City Council may undertake the necessary steps to amend the Development Regulations.

## Section 10.3 Procedure for Amendments

Request to amend the Development Regulations shall be processed in accordance with the following requirements:

(a) Initiation of amendments: A proposed amendment to the Development Regulations may be initiated by the City Council, Board of Zoning Appeals, the Planning Commission, the City Administrator or by application filed with the City Administrator by a developer or citizen.

(b) Application Procedure. Each request for amendment of the Development Regulations shall be submitted in a form as prescribed by the City Administrator

along with such fee as shall be established by the City Council. Applications for amendments must be submitted in proper form at least 25 days prior to a Board of Zoning Appeals hearing in order to be heard at that meeting.

## ARTICLE XI
## LEGAL STATUS PROVISIONS

### Section 11.1 Conflict With Other Regulations

Whenever the regulations of this Ordinance require or impose more restrictive standards than are required in or under any other statutes, the requirements of this Ordinance shall govern. Whenever the provisions of any other statute require more restrictive standards than are required by this Ordinance, the provisions of such statute shall govern.

### Section 11.2 Severability

Should any section, subsection, sentence, clause, phrase or provision of this Ordinance be declared invalid or unconstitutional by any court of competent jurisdiction, such declaration shall not affect the validity of the Ordinance as a whole or any part thereof which is not specifically declared to be invalid or unconstitutional.

### Section 11.3 Effective Date

These Regulations shall be in full force and effective on _____, 1996, following adoption by the City Council and shall apply to any development for which the first submittal of development plans is received after the effective date of these Regulations.

# STANDARD SPECIFICATIONS

FOR THE

## City of Union City, Georgia

Prepared by

**KECK & WOOD, INC.**
2750 Premiere Pkwy
Suite 900
Duluth, GA 30097

## SECTION 00010 - TABLE OF CONTENTS



END SECTION 00010

# SECTION 02112 - ROUTE CLEARING

## PART I - GENERAL

### DESCRIPTION OF WORK:

The extent of route clearing is that minimum degree of clearing necessary to install utilities and appurtenances, and such additional clearing as shown on the drawings, required by other documents or necessary by actual physical conditions.

Route clearing operations include, but are not limited to, the following:

Protection of existing trees and other vegetation.

Removal of trees and other vegetation.

Clearing.

Removing above-grade improvements.

Removing underground improvements.

Restoring damaged improvements.

Protecting above-grade and underground improvements.

Erosion and sediment control measures for all disturbed areas.

### PROJECT CONDITIONS:

Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during route-clearing operations.

Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from City and/or other authorities having jurisdiction.

Provide alternate routes around closed or obstructed traffic ways if required by City and/or other authorities having jurisdiction.

Salvable Improvements: Carefully remove items indicated to be salvaged and store on City's premises where indicated.

Utility Locator Service: Before commencing any clearing, excavation or related work, notify the Utilities Protection Center “Call Before You Dig” telephone number 770-623-4344 to

permit marking existing utilities on the ground in advance of the work. Do not begin any such work until the required utility marking time has passed.

Do not commence route clearing operations until temporary erosion and sedimentation control measures are in place.

Whenever land disturbing activities are being conducted, Contractor shall have a Georgia Soil and Water Conservation Commission Level 1A certified representative at the site of the land disturbing activities who shall have responsible charge of erosion and sediment control measures.

Protection of Existing Improvements:

Provide barricades, coverings, or other types of protection necessary to prevent unnecessary damage to existing improvements.

Protect improvements on adjoining properties as well as those on the project route. Restore improvements damaged by this work to their original condition, as acceptable to the owners or other parties or authorities having jurisdiction. Have property line monuments (such as iron pins) removed or disturbed by clearing operations replaced by a Georgia registered land surveyor.

Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip lines, excess foot or vehicular traffic, or parking of vehicles or equipment within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing.

Provide protection for ornamental tree roots over l½ inches diameter that are cut during any construction operation. Temporarily cover all exposed roots of ornamental trees with wet burlap to prevent roots from drying out; provide earth cover as soon as possible.

Repair or replace unnecessarily damaged trees and vegetation, as determined by the City, resulting from any construction operation, in a manner acceptable to the property owner and the City. Tree damage repair shall be performed by a qualified nurseryman. Replace unnecessarily damaged trees which cannot be repaired and restored to full-growth status, as determined by the nurseryman.

Protection of Adjacent Property:

Protect improvements, trees and vegetation on adjoining property as well as those on property requiring route clearing work.

Execute work so as not to create a nuisance to persons utilizing adjacent property.

Use work methods and provide temporary facilities as necessary to prevent washing, erosion, siltation or dust damage, or hazard to persons and property, within and off the work route.

## PART 2 - PRODUCTS

Not applicable to work of this section.

## PART 3 - EXECUTION

### CLEARING:

Remove vegetation, trees, lawns, shrubbery, gardens and other plant growth to the minimum practicable extent. Limit clearing to a single lane work route without provision for construction vehicles to pass utility operation. Accurately determine limitations of construction easement or right-of-way, and keep construction activity within such limits.

Remove lawn sod by cutting into maximum size which can be handled without tearing, stripping sod and underlying topsoil, and stockpiling for use in restoring the surface area. Water sod and otherwise maintain sod in viable, growing condition.

Remove above-grade structures only where specifically authorized.

Remove conflicting fences and provide effective temporary measures to prevent stock, cattle or other domestic animals from wandering to other lands. Reconstruct fences promptly.

Remove abandoned underground facilities such as utilities and structures, walls, footings, basements, wells, septic tanks, underground pipe, and other items which conflict with construction.

### HOLES AND DEPRESSIONS:

Fill holes, depressions and voids created or exposed by clearing operations with non-organic soil material, unless further excavation or earthwork is indicated.

Place fill material in horizontal layers not exceeding six inches loose depth, and thoroughly compact to a density at least equal to adjacent original ground.

### DISPOSAL OF WASTE MATERIALS:

Disposal General Requirements:

Accomplish disposal of cleared matter daily so as to maintain site in a safe and neat condition throughout the contract period.

Burning of cleared materials on the work site is only allowed when authorized and permitted by the Fire Chief or the Chief's designated representative.

On-Site Disposal:

Unless property owner requests complete removal, cut tree trunks and limbs, over two inches in diameter, into 24 inch lengths and neatly stack within work limits having the same property ownership as that on which the tree originally grew.

On undeveloped property, distribute brush, trees and limbs less than two inches in diameter, within the work area from which cut, in such a way as not to be objectionable to the property owner. On developed property, remove all such clearing waste and properly dispose of it off-site.

END SECTION 02112

# SECTION 02204 - TRENCHING AND BACKFILLING

## PART I - GENERAL

### DESCRIPTION OF WORK:

Trenching and backfilling operations include, but are not limited to, all earthwork associated with installation, modification, or abandonment of underground utilities and appurtenances, and restoration of damaged improvements and disturbed surfaces. The work also includes installation and maintenance erosion and sediment control measures for all disturbed areas.

Related work specified elsewhere includes, but is not limited to, the following:

Route Clearing, Section 02112

### QUALITY ASSURANCE:

Codes and Standards: Perform trenching and backfilling work in compliance with applicable requirements of governing authorities having jurisdiction where such requirements exceed those specified in this section.

Sampling and Testing:

Provide quality control testing during construction as necessary to assure the entire earthwork including all fill layers, subgrades, and bases meets contract requirements. Remove and reconstruct, or otherwise correct work which falls below specified density or is outside other specified limits.

Employ, at Contractor's expense, an independent testing laboratory to perform quality control testing during trenching and backfilling operations.

The City may perform sampling, surveying, inspection or testing activity during construction for its use, but such activity does not relieve the Contractor from responsibility to achieve specified results.

### SUBMITTALS:

Quality Control Testing Reports: After completing utility earthwork construction and prior to acceptance by the City, the Contractor must file a copy of quality control test results demonstrating compliance with these specifications with the City. At any time during the construction process, representatives of the City may request to review and the Contractor shall provide quality control test results.

SITE INFORMATION:

Verify existing site grades to be substantially consistent with grades shown on the drawings before commencing work. Report any significant conflict in grades to the design engineer of record before proceeding.

Subsurface conditions presented, if any, are not intended as representations or warrants of continuity of such conditions between soil borings or pits. It is expressly understood that the Contractor is solely responsible for interpretations or conclusions drawn therefrom. Data are made available for the convenience of the Contractor who may, without cost to the City, perform additional test borings and other exploratory operations, provided such operations are acceptable to the City.

Existing Utilities: Locate all existing underground utilities in the areas of work including verification of nature and exact location of any utility indicated on drawings. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should unexpected piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with the City and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving existing facilities except when permitted in writing by the City and then only within time periods acceptable to the City.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Traffic Control: Schedule and conduct Work in a manner which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. When flaggers are utilized, individuals must hold a valid Georgia DOT flagging certificate. Maintain traffic on all roads and streets which must be crossed by trenching and making two separate cuts so that at least one traffic lane is open at all times. All traffic controls during construction must conform to Part VI of the *Manual on Uniform Traffic Control Devices*.

PART 2 - PRODUCTS

Not applicable to work in this Section.

PART 3 - EXECUTION

PROTECTION OF PERSONS AND PROPERTY:

Utility Locator Service: Before commencing any trenching, other excavation or related work, notify the Utilities Protection Center "Call Before You Dig" telephone number 770-623-4344 to permit marking existing utilities on the ground in advance of the work. Do not begin any such work until the required utility marking time has passed.

Do not commence trenching and backfilling operations until temporary erosion and sediment control measures are in place.

When ever land disturbing activities are being conducted, Contractor shall have a Georgia Soil and Water Conservation Commission Level 1A certified representative at the site of the land disturbing activities who shall have responsible charge of erosion and sediment control measures.

Barricade open excavations and post warning lights for safety of persons. Operate warning lights during hours from dusk to dawn each day.

Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations, from damage caused by settlement, lateral movement, undermining, washout and other hazards.

Take precautions and provide necessary bracing and shoring to guard against movement or settlement of existing improvements or new construction. Contractor is entirely responsible for strength and adequacy of bracing and shoring, and for safety and support of construction from damage or injury caused by the lack thereof or by movement or settlement.

Use work methods and provide temporary facilities as necessary to prevent washing, erosion, siltation or dust damage, or hazard to persons and property, within and outside the work area.

Place excavated material compactly alongside of the trench, and keep such material trimmed up so as to present the least practicable inconvenience to the public. Where necessitated by traffic conditions, remove from the roadway the first material excavated from a working length of trench so that further excavation is immediately used for backfilling, and thereby avoid stockpiling of material upon the roadway. Afterward, return first excavated material if needed for final backfilling.

Maintain all streets, sidewalks, pedestrian crossings, fire hydrants, water and gas valves, and other utilities accessible for their intended use except while the work is steadily advancing in the immediate vicinity of each such facility.

Keep every drain, gutter, culvert, sewer, and surface drainage route encountered, open for both temporary and permanent flow unless other effective provision for drainage is made.

Do not permit any hazardous condition to result from trenching and backfilling operations.

USE OF EXPLOSIVES:

Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction.

Use explosives only as legally permitted and when other work methods are impractical.

Do not permit explosives on the project site other than during the least practicable use period.

Assume sole responsibility for handling, storage, and use of any explosive materials.

TRENCHING:

Trenching consists of removal and disposal of material encountered to obtain required subgrade elevations, usually, but not necessarily limited to that incidental to installation or modification of underground pipelines and appurtenances.

Unauthorized trenching consists of removal of materials beyond indicated subgrade elevations or dimensions without specific authorization of the City.

Rock excavation consists of removal and disposal of natural material encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of a ripper or other special equipment. Intermittent drilling or blasting performed to increase production and unnecessary for excavation of material encountered will not be classified as rock excavation.

Stability of Excavation: Slope sides of excavations to comply with Subpart P of Part 1926 of the Occupational Safety and Health Act as amended. Shore and brace or use trench box where sloping is not possible either because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

Shoring and Bracing: Provide portable trench boxes and materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Maintain shoring and bracing and/or portable trench boxes in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

Provide trench boxes and/or shoring and bracing to comply with Subpart P of Part 1926 of the Occupational Safety and Health Act as amended.

Dewatering: Perform earthwork in a manner to prevent surface water and minimize subsurface or ground water from flowing into excavations, and to prevent water from flooding project work and surrounding area.

Do not allow water to accumulate in excavations. Remove water using dewatering methods which will prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Limit opening of additional trench length to that which can be dewatered with available equipment or methods.

Do not use trench as temporary drainage ditch.

Material Storage: Locate and retain materials away from edge of trench.

Dispose of excess soil material and waste materials, such as unsatisfactory excavated soil material, trash and debris, as specified hereinafter.

Excavating: Do not extend excavation below or wider than that which is necessary to construct work except as otherwise provided herein. Repair any unauthorized trenching as necessary to obtain an adequate subgrade.

Limit open trench excavation to a maximum of 300 feet ahead of completed backfill.

Where specific utility system elevations or depths are indicated on the drawings or elsewhere herein, accurately conform with such requirements. Otherwise, achieve a minimum earth and/or pavement cover of 30 inches above top of underground utilities being constructed unless a greater cover is made necessary by easement or permit requirement, by maintaining a minimum clearance of 18 inches below any existing or proposed structure or channel, or by achieving proper alignment with existing or proposed facilities.

Maintain a horizontal separation of at least 10 feet between sanitary sewers and any existing or proposed water main. A sewer may be laid closer than 10 feet to a water main if it is laid in a separate trench.

Maintain a vertical separation of at least 18 inches between the crown of sanitary sewers and the invert of existing or proposed water mains with the sewer located below the water main. Where a vertical separation of 18 inches cannot be provided and the water main cannot be relocated to provide adequate clearance, center one full length of water main over the sewer so that both joints of the water main will be as far from the sewer as possible.

Confine trench width from an elevation of one foot above top of underground pipe to the trench bottom, to that minimum which is necessary to pipe laying operations, but do not exceed maximum trench width determined by pipe foundation requirements.

Remove rock, masonry and concrete material to a distance of at least six inches from all parts of pipe and appurtenances being installed. Backfill and thoroughly compact to proper trench bottom elevation with select excavated material.

Do not mix excavated rock, masonry or concrete with backfill material placed within two feet of installed pipe, or within one foot of finished grade.

Pavement Removal: Remove all pavement, including curb and gutter, sidewalk and the like, which must be disturbed by trenching operations.

Saw cut edges of bituminous pavement. For concrete pavement, saw cut edges or remove and replace to nearest joint.

At sidewalks, curbs and gutters, and the like, remove entire width of damaged sections.

Extend pavement removal to the width required to accomplish trenching operations without damage to edge of remaining pavement. Correct any edge damage which occurs as requested by the City.

Removal of Unsatisfactory Soil Materials: To the extent authorized, over-excavate those soil materials which are unsatisfactory in the opinion of the City and backfill with approved materials.

COMPACTION:

General: Control soil compaction during construction providing minimum percentage of density specified for each area classification.

Percentage of Maximum Density Requirements: Achieve not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for each layer of soil material-in-place as determined by ASTM D 698 (Standard Proctor) test procedures:

Rights-of-Way: Conform with the more stringent requirements of the permit issuing authority and the requirements herein.

Roadways: Under and within five feet horizontal distance of traffic using surfaces, compact each layer of backfill and fill material to 95 percent of maximum dry density.

Walkways: Under and within two feet horizontal distance of paved walks, compact top six inches of subgrade and each layer of backfill and fill material to 95 percent of maximum dry density.

Driveways and Parking Lots: Under and within two feet horizontal distance of traffic using surfaces, compact each layer of backfill and fill material to 95 percent of maximum dry density.

Lawn or Unpaved Areas: Compact each layer of backfill or fill material to 85 percent of maximum dry density.

Spoil Areas: Compact each layer of backfill or fill material to 85 percent of maximum dry density.

Moisture Control: Where a layer of soil material is too dry to achieve required compaction, uniformly apply water to layer as necessary to bring moisture within limits which permit compaction to at least the specified densities.

Remove, dry and replace, or scarify and air dry in place, soil material that is too wet to achieve required compaction.

BACKFILL AND FILL:

General: Place acceptable soil material in uniform layers, to required elevations. Backfill excavations as promptly as work permits.

Backfill and Fill Materials: Use acceptable trench excavated soil material, free of stumps, trees, roots, muck, trash and other objectionable matter.

Placement and Compaction: Place backfill and fill materials in layers not more than eight inches in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Commence backfill and fill operations close behind utility laying operations. Take care to prevent wedging action of backfill or fill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.

GRADING:

General: Uniformly grade areas within limits of earthwork, including adjacent transition areas. Smooth and compact finished surface within specified tolerances, with uniform levels or slopes between points where elevations are shown, or between such points and existing grades, or between existing grades.

Grading Outside Structures: Grade finished areas adjacent to structures to drain away from structures (except drainage inlets), and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

Grassed or Landscaped Areas: Finish areas to within not more than 0.10 feet above or below the required elevations.

Walks and Pavements: Shape surface of areas under walks and pavements to line, grade and cross-section, with finish surface not more than ½ inch above or below the required subgrade elevation.

Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

RIP RAP SURFACE STABILIZATION:

General:

Prior to placing rip rap, bring ground surface to correct line and grades. Provide rip rap at all stream crossings, and/or at locations indicated on drawings or requested by the City.

Stone Rip Rap:

Hand place stone rip rap into final position to form a compact layer not less than six inches in-place thickness. Use well graded stone sizes to eliminate void spaces between stones. Place stones neatly and anchor units to be free of tendency to slip out of position. Place rip rap so that no more than three inches variation exists above or below the required plane.

MAINTENANCE:

Protection of Graded Areas: Protect newly graded areas from traffic and erosion, and keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified compaction and tolerances.

Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction, adverse weather, traffic, or other cause, scarify surface, re-shape, and compact to required density prior to further construction.

Maintain temporary erosion and sediment control measures until permanent measures become effective.

DISPOSAL OF EXCESS AND WASTE MATERIALS:

Disposal of Excess Excavation: Transport excess excavated material, including unsatisfactory soil material, to any designated spoil areas, and spread as specified; otherwise remove from the project work area and legally dispose of such material which cannot be acceptably distributed within project work area.

Disposal of Waste Material: Remove trash, debris, and waste materials from the project work area and legally dispose of such material.

RESTORATION:

Plan and execute total work so as to minimize damage to property. Restore all surface materials, shrubbery, fences, lawns, walls, structures and other improvements to a condition no less desirable than that which existed before construction operations began.

Conduct all construction operations such that upon completion of any part of the work, the contour and topography of the construction area has not been substantially altered. No alteration of previously established storm drainage patterns will be permitted unless such alteration can be proven to the City's satisfaction to substantially improve the drainage pattern.

Where necessary to temporarily remove or damage improvements of any significance, take professional quality photographs of such improvements before disturbing them. Make copies of such photographs available to the City on request.

Restore work area and accomplish site cleanup immediately after backfilling and fill operations.

Replace property line monuments which were damaged, removed or disturbed by trenching and backfilling operations. Employ, at Contractor's expense, a Georgia registered land surveyor for all property line monument replacement.

END SECTION 02204

# SECTION 02408 - TUNNELING

## PART I - GENERAL

### DESCRIPTION OF WORK:

Tunneling pertains to the installation of carrier pipe or tunnel liner below ground by means other than open cut excavation. The extent of tunneling is shown on the drawings. The work also includes erosion and sediment control measures for all disturbed areas.

Tunnel liner sizes indicated on the drawings are minimum nominal diameters. Use appropriate size and type of tunnel liner and construction methods as necessary to provide a complete tunnel liner installation.

### Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Water System, Section 02710

Sanitary Sewer System, Section 02720

Storm Sewer System, Section 02770

### PROJECT CONDITIONS:

#### Traffic Control:

Schedule and conduct Work in a manner which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. Flaggers, when utilized, must hold a valid Georgia DOT flagging certificate. Maintain traffic on all roads and streets which must be crossed by tunneling. All traffic controls during construction must conform to Part VI of the *Manual on Uniform Traffic Control Devices*.

#### Utility Locator Service:

Before commencing any tunneling, other excavation or related work, notify the Utilities Protection Center "Call Before You Dig" telephone number 770-623-4344 to permit marking existing utilities on the ground in advance of the work. Do not begin any such work until the required utility marking time has passed.

Land Disturbing Activities:

Do not commence tunneling operations until temporary erosion and sedimentation control measures are in place.

Whenever land disturbing activities are being conducted, Contractor shall have a Georgia Soil and Water Conservation Commission Level 1A certified representative at the site of the land disturbing activities who shall have responsible charge of erosion and sediment control measures.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the work being performed.

## PART 2 - PRODUCTS

### CARRIER PIPE:

Where carrier pipe is installed without tunnel liner by tunneling methods, conform with carrier pipe material specifications unless otherwise indicated.

### PIPE TUNNEL LINER:

Where tunnel liner is installed using jacking or boring construction methods, comply with the following material specifications for tunnel liner:

#### Steel Pipe Tunnel Liner:

Steel Pipe Tunnel Liner, 4 Inches and Smaller: Conform to ASTM A53 material specifications. Use galvanized steel, Schedule 40 minimum, with threaded couplings.

Steel Pipe Tunnel Liner, Larger Than 4 Inches: Conform to ASTM A53 or A139 material specifications, except hydrostatic testing is not required. Join pipe sections with full strength, continuous welds in accordance with procedures approved by the American Welding Society to obtain a watertight seal.

Unless otherwise indicated, use pipe meeting the following thickness requirements:

| Nominal Diameter Inches | Minimum Wall Thickness Inches |
|---|---|
| 12 or Smaller | 0.188 |
| 14 to 16 | 0.282 |
| 18 | 0.313 |
| 20 | 0.344 |
| 24 | 0.407 |
| 26 | 0.438 |
| 30 | 0.469 |
| 36 | 0.532 |
| 42 | 0.563 |

ACCESSORIES:

Grout: One part Portland Cement; two parts masonry lime; four parts mortar sand; two percent of an approved admixture of Bentonite, Septamin Stearex, or Hydrocide Liquid; and where required, a retardant. Use sufficient mixing water that will produce a workable mixture of grout capable of being pumped into the voids created by the tunneling.

End Seals: For pipe tunnel liner, provide end seal consisting of flexible synthetic rubber boot conforming to ASTM C-923 or Link Seal penetration seal with insulating plastic plate, galvanized bolts and nuts, and EPDM rubber element manufactured by Thunderline Corporation.

Concrete: Concrete conforming to ASTM C 94 having a minimum compressive strength of 2,000 psi at 28 days.

Clay Brick: ASTM C 32, Grade MS or ASTM C 32 sewer and manhole brick or ASTM C 216 facing brick, Grade MW or SW, of nominal size 8 x 2¼ x 3¾ inches.

Concrete Brick: ASTM C 55, Grade P-II, of nominal size 8 x 2¼ x 3¾ inches; gray-white concrete color with smooth formed natural texture.

Mortar Materials:

Cement: Portland Cement ASTM C 150, Type I or II.

Sand: ASTM C 144, well screened, clean, hard sharp, siliceous, free from loam, silt and other impurities. Provide the following grain size distribution:

#10 sieve, passing 95-100 percent

#50 sieve, passing 15-40 percent

#l00 sieve, passing 0-10 percent

Removal by decantation 0-5 percent

Water: Clean, fresh, free from oil, acid, organic matter and other deleterious substances.

Mortar Mix Proportions: Provide mortar mixed in the proportion of one part cement to three parts sand with only enough water to allow good workability of the mix. Hydrated lime may be added in amounts not exceeding 10 percent of the cement weight.

## PART 3 - EXECUTION

### GENERAL:

Carry out Work in a safe manner, taking all necessary precautions and measures necessary to maintain a stable construction system which does not weaken existing earth or structures nor cause settlement of the overpassing roadway or railway section.

When tunneling operations are carried out under railroad tracks, highways, streets, or any other existing thoroughfare, perform operations in such manner as not to interfere with nor in any way endanger the normal operation of such thoroughfares.

Complete all tunneling work at one particular location before starting work at another location.

### EXCAVATION:

The following requirements are supplemental to Section 02204, Trenching and Backfilling, of these specifications.

Maintain temporary erosion and sediment control measures until permanent measures become effective.

When required, excavate suitable pits or trenches for tunneling operations. Provide all necessary bracing, sheeting and/or other temporary means to insure safety of persons and property. Comply with Subpart P of Part 1926 of the Occupational Safety and Health Act as amended.

Maintain excavation free from water, mud and debris which will interfere with an efficient tunneling operation. Neatly dry-excavate material of whatever nature encountered within the tunnel. Do not use sluicing or jetting excavation techniques.

Limit excavation to the minimum diameter required for tunnel liner installation.

Pressure grout all excessive voids which may develop about the tunnel liner exterior.

Promptly backfill all pits and trenches.

JACKING:

When installing tunnel liner by jacking method, use guide rails or other jacking frame structure to effectively maintain tunnel liner at proper line and grade. Force tunnel liner into place with suitable jacks which apply uniform pressure around the tunnel liner end section. Excavate at the lead end of the tunnel as the jacking operation progresses, but do not excavate more than two feet in front of tunnel liner. Reduce the two feet distance where material character results in excess loss of soil. Remove excavated material through the tunnel liner. Once jacking is begun, continue operation without interruption to prevent the pipe from becoming firmly set in the embankment.

Perform tunneling such that the final tunnel liner position is within the following limits:

Lateral Alignment: Within two percent of tunnel liner length.

Vertical Elevation: Within one percent of tunnel liner vertical grade, provided that the final grade of flow line is in the direction indicated on the drawings.

BORING:

Mechanically bore by use of a cutting head on a continuous auger. Install tunnel liner in hole by jacking or other suitable methods. Accomplish boring of hole and tunnel liner installation simultaneously. Do not permit boring to proceed more than one foot in front of tunnel liner.

At Contractor's option and to minimize abandoned tunnel liner, conduct initial boring using a pilot hole approximately two inches in diameter for the entire installation length. Verify required line and grade and use pilot hole as the center line of the larger hole to be bored. If rock is encountered in pilot hole, withdraw equipment and relocate tunnel location. Conduct pilot hole installation in revised location and repeat procedure. No extra payment will be considered for installations that encounter rock and must be abandoned.

Perform tunneling such that the final tunnel liner position is within the following limits:

Lateral Alignment: Within two percent of tunnel liner length.

Vertical Elevation: Within one percent of tunnel liner vertical grade, provided that the final grade of flow line is in the direction indicated on the drawings.

ABANDONMENT:

Should it become necessary to abandon a tunnel for any reason, pressure grout the abandoned hole to prevent damage to surrounding earth and structures. When the tunnel liner is retained, fill entire tunnel with grout and pressure grout any voids about the tunnel liner exterior.

TUNNEL LOCATIONS:

Locate tunnels as indicated on the drawings or by the City.

To facilitate construction, changes in tunnel location may be permitted. Proposed changes must be submitted by the Contractor. Changes in location must be acceptable to the City, and any utility company or public agency having jurisdiction over the location.

END SEALS:

Seal ends of tunnel liner to prevent debris and moisture from entering the annular space between the carrier pipe and tunnel liner.

END SECTION 02408

# SECTION 02710 - WATER SYSTEM

## PART I - GENERAL

### DESCRIPTION OF WORK:

The extent of water system is shown on the drawings.

Water system work includes, but is not limited to, the following:

Foundation preparation.

Furnishing and laying water pipe.

Furnishing and installing water line appurtenances.

Furnishing and laying services and accessories.

Cleaning and sterilizing constructed work.

Testing constructed work.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Tunneling, Section 02408

Pavement Patching, Section 02528

### PROJECT CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. Flaggers, when utilized, must hold a valid Georgia DOT flagging certificate. Maintain traffic on all roads and streets which must be crossed by water lines and making two separate cuts so that at least one traffic lane is open at all times. All traffic controls during construction must conform to Part VI of the *Manual on Uniform Traffic Control Devices*.

Connection to Existing Pipework:

Where it is required that connection be made to existing pipework, expose existing piping and determine the exact fittings and/or other appurtenances necessary to make the connection. Connections to existing pipework indicated on drawings (if any) are shown only for the purpose of illustrating the general type of connection desired, and no assurance exists that such illustration can be followed precisely.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the work being performed.

QUALITY ASSURANCE:

Manufacturer:

Furnish manufactured items, fittings, valves, and service components, from manufacturers having regularly produced such items as specified herein which have proven satisfactory in actual service, over at least a two year period, as determined by the City.

Repairs:

Do not use patched or repaired pipe or appurtenances.

PART 2 - PRODUCTS

MATERIALS:

Provide all materials, products and accessories required for complete, properly functioning system. Use only those pipe, fitting, valve and accessory materials that meet National Sanitation Foundation Standard 61 (NSF 61) requirements. Furnish evidence of NSF 61 compliance with submittals required elsewhere.

DUCTILE IRON PIPING SYSTEMS:

Ductile Iron Piping System Type I (DIPW-I):

Pipe: For pipe with push-on joints or mechanical joints, provide ductile cast iron pipe conforming with ANSI/AWWA C151/A2l.5l for pressure class not less than required by Table 51.3 for minimum 250 psig rated working pressure, laying condition 2, and depth of cover for actual installation. For pipe with flanged joints or grooved joints, provide ductile iron cast pipe conforming with ANSI/AWWA C115/A21.15 for thickness class 53 in Table 15.1 for minimum 250 psig rated working pressure.

Pipe Lining: Provide standard cement mortar pipe lining complying with ANSI/AWWA C104/A21.4, and standard asphaltic coating over lining and pipe exterior. For piping that is exposed and receives a finish paint system, delete exterior asphaltic seal coat and provide a corrosion resistant universal phenolic primer that is lead and chromate free on pipe exterior. Do not use any material which imparts taste or odor to potable water, or which is toxic to humans.

Fittings: Use gray or ductile iron fittings complying with ANSI/AWWA C110/A2l.l0 and C111/A2l.ll for minimum 250 psig working pressure rating, lined and coated same as connecting pipe. At Contractor's option, ductile iron compact fittings complying with ANSI/AWWA C153/A21.53 for a minimum 350 psig working pressure rating, lined and coated same as connecting pipe may be used for pipe with push-on joints or mechanical joint.

Joints: For pipe, fittings and valves, use the following joint types indicated for the specified locations, unless otherwise specified or shown.

Flanged Joint (FJ): ANSI/AWWA C115/A21.15 ductile iron flanged joint complying with ANSI B16.l for class 125 pound drilling, unless class 250 pound drilling is indicated on Drawings or is required for connecting valves. Use corrosion resistant alloy steel bolts and nuts, and rubber gaskets complying with Appendix A to ANSI/AWWA C115/A21.15. Provide flanged joints for normally visible piping, unless noted otherwise.

Mechanical Joint (MJ): Mechanical joint complying with ANSI/AWWA C111/A2l.11. Use corrosion resistant alloy steel bolts and nuts. Provide mechanical joints for direct burial piping or concealed piping within structures, for piping installed in tunnel liner, or, at Contractor's option, for direct burial piping outside structures.

Push-On Joint (POJ): Push-on type joint complying with ANSI/AWWA C111/A21.11. Provide push-on joints for direct burial piping outside structures.

Grooved Joint (GJ): Where indicated on the drawings provide bolted coupling utilizing grooved and shouldered pipe ends complying with AWWA C606, and suitable for not less than 150 psig working pressure while permitting angular and restrained longitudinal flexibility of connecting pipe. Use corrosion resistant steel alloy bolts and nuts, molded or extruded elastomeric gasket material recommended by manufacturer for actual service application shown, and malleable or ductile iron housing with asphaltic outside coating.

Restrained Joint (RJ): Factory fabricated joint restraint system to resist pressurized pipe thrust forces. For push-on type joint, use boltless system of rubber gasket embedded with equally spaced stainless steel segments to grip the pipe, with allowance for joint deflection, and rated for 250 psig working pressure. For mechanical joint, use assembly of ductile iron retainer gland and corrosion resistant alloy steel bolts and nuts having a minimum 250 psig working pressure rating and permitting joint deflection. Provide restrained joints where indicated on the drawings and, at Contractor's option, for direct burial piping thrust restraint in lieu of concrete and metal tie rods and bands.

COPPER PIPING SYSTEMS:

Copper Tubing System (CuTW):

Tubing: Copper tubing complying with ASTM B88, Type K suitable for working pressures up to 200 psig at 200F water temperature. For underground direct burial installations, use soft annealed or hard drawn tubing and for all other installation use hard drawn tubing.

Fittings: For hard drawn tubing, use solder or brazing type wrought copper or cast bronze pressure fittings complying with ANSI B16.22 or B16.18. For soft annealed tubing use solder or brazing type wrought copper or cast bronze pressure fittings complying with ANSI B16.22 or B16.18 or flare type cast bronze fittings complying with ANSI B16.26.

Joints: Soldered, silver brazed or flared as appropriate and suitable for the following conditions:

Maximum working pressure: 150 psig
Service temperature: 100 F

NON-METALLIC PIPING SYSTEMS:

Polyvinyl Chloride Piping System Type I (PVCPW-I): (2½" to 4" diameters only)

Pipe: Non-toxic, polyvinyl chloride compound meeting ASTM D l784, Class 12454-A or B material specification, and further meeting requirements of the National Sanitation Foundation. Must conform with requirements of ASTM D 2241 for pressure rated pipe of the following class(es):

Class 200 (SDR 2l)

Furnish pipe with each section continuously and permanently marked with the following identifying data:

Nominal size and outside diameter.

Material code designation.

Dimension ratio number (SDR or DR).

Pressure class.

ASTM or AWWA specification designation.

Manufacturer's name or trademark and production record code.

National Sanitation Foundation Seal (NSF) verifying suitability of pipe material for potable-water service.

Fittings (PVC): Manufactured from same material compound as pipe, and in such configuration as necessary to achieve long term water pressure rating not less than the connecting pipe nor less than 160 psig at 73 F with a safety factor of 2.5:1.

Fittings: Gray or ductile iron fittings complying with ANSI A21.10 or A21.11 for minimum 250 psig pressure rating. At Contractor's option, ductile iron compact fittings complying with ANSI A21.53 for minimum 350 psig pressure rating may be used. Provide cement mortar interior lining complying with ANSI A21.4, and manufacturer's standard bituminous coating over lining and fitting exterior. Do not use any lining or coating which imparts taste or odor to potable water, or which is toxic to humans.

Joints (PVC Pipe): Unless otherwise shown or required, use flexible elastomeric seals conforming to ASTM D 3139 and ASTM F 477. Provide compatible gaskets or adapters as required when joining to different type pipe material.

Joints (PVC Fittings): Unless otherwise shown or required, use flexible elastomeric seals conforming to ASTM D 3139 and ASTM F 477.

Joints (Gray or D.I. Fittings): Comply with ANSI A21.11 and unless otherwise shown or required, use, at Contractor’s option, push-on type joint or mechanical joint utilizing corrosion resistant alloy bolts. Provide gaskets or adapters compatible with connecting pipe as required.

Polyvinyl Chloride Piping System Type 2 (PVCPW-2): (6” to 12” diameters only)

Pipe: Non-toxic, polyvinyl chloride compound meeting ASTM D 1784 and conforming with the requirements of AWWA C900, with ductile iron outside diameter, and of the following class:

Class l50 (SDR 18)

Fittings: Gray or ductile iron fittings complying with ANSI A21.10 or A21.11 for minimum 250 psig pressure rating. At Contractor’s option, ductile iron compact fittings complying with ANSI A21.53 for minimum 350 psig pressure rating may be used. Provide cement mortar interior lining complying with ANSI A21.4, and manufacturer's standard bituminous coating over lining and fitting exterior. Do not use any lining or coating which imparts taste or odor to potable water, or which is toxic to humans.

Joints (Gray or D.I. Fittings): Comply with ANSI A21.11, and unless otherwise shown or required, use, at Contractor’s option, push-on type joint or mechanical joint utilizing corrosion resistant alloy bolts.

Joints (PVC Pipe): Unless otherwise shown or required, use flexible elastomeric seals conforming to ASTM D3139.

Polyethylene or Polybutylene Tubing System Type 1 (PETW-1):

Tubing: Flexible polybutylene or polybutylene tubing complying with AWWA C902, suitable for working pressures up to 160 psig at 73 F water temperature and having a SDR not greater than 13.

Furnish tubing continuously and permanently marked with the following identifying data:

Nominal size and outside diameter.

Material code designation.

Dimension ratio number (SDR or DR).

Pressure class.

ASTM or AWWA specification designation.

Manufacturer's name or trademark and production record code.

National Sanitation Foundation Seal (NSF) verifying suitability of pipe material for potable water service.

Fittings and Adapters: Brass or bronze, and of the type and size required by the installation.

Joints: Metal to plastic tubing-compression type with stainless steel insert.

VALVES:

Gate Valves:

Gate Valve Type 2 (GVW-2):

Cast iron, resilient seated, AWWA C509 or ductile iron body, resilient seated, AWWA C515 gate valves, rated for 250 psig working pressure, with counterclockwise opening, manual operator unless another type operator is shown or specified. Interior and exterior valve coating system to be AWWA C550 NSF 61 fusion bonded epoxy. Valves under three inch size are not defined by AWWA C509 or C515 but, when required, shall be manufactured to those standards. Provide gate valves with the following features depending upon installed location of valve:

Direct burial locations: Mechanical joint ends, non-rising stem, O-ring seals and square wrench operating nut. All exposed nuts and bolts on the valve exterior, except those used in mechanical joints, must be 18-8 stainless steel. Utilize “Corten” bolts or approved equal for mechanical joints. Provide one operating wrench for each 10 valves furnished, or fraction thereof. Where depth of valve is too great for operation by standard wrench, provide suitable, permanently installed valve stem extension and guide. For each valve,

furnish two piece, cast iron or plastic roadway valve box with 5¼ inch minimum shaft size, cast iron top ring and drop type lid with "stay-put" features, and extensions as necessary to adjust top to finished grade.

All except direct burial locations: Flanged ends, non-rising stem, O-ring seals, and operating handwheel.

Gate Valve Type 4 (GVW-4):

Bronze body, threaded ends, complying with FS WW-V-54d, rising stem, handwheel operator, solid disc, rate for 200 psig working pressure.

Check Valves (CV/WL):

Cast iron body, bronze mounted, full opening, AWWA C508 swing check valve suitable for 175 psig working pressure for valves 12 inch size and smaller and 150 psig working pressure for valves larger than 12 inch size. Furnish valves with epoxy interior coating system having a minimum dry film thickness of four mils and complying with AWWA C550. Provide check valves with the following features depending upon installed location of valve:

Direct burial locations: Mechanical joint ends. All exposed nuts and bolts on the valve exterior, except those used in mechanical joints, must be 18-8 stainless steel. Utilize "Corten" bolts or approved equal for mechanical joints.

All except direct burial locations: Flanged ends. Provide outside weight and level or outside spring and level where indicated.

Double Detector Check Valve Assembly (DCVW):

Iron body, full opening detector check valve with flanged or grooved joint ends and by-pass meter complying with AWWA C510. Provide unit which is suitable for 175 psig working pressure. In addition to detector check valves, furnish gate valve on each side of check valves and on either side of meter. Complete assembly is to be UL listed and suitable for fire main service. Subject to compliance with requirements, manufacturers offering products to comply with these requirements include the following:

Hersey-Beeco
Zurn Industries (Wilkins Model 350 ADA)
Watts Regulator Company

Tapping Sleeves and Valves (TSVW):

Stainless steel tapping sleeve and gate valve assembly complying with AWWA C223 suitable for working pressures up to 150 psig and testing pressures up to 225 psig. Fabricate sleeve unit, including shell, lugs, nuts, bolts, flange and test plug, from 18-8 stainless steel. Provide sleeve lining gasket and flange gasket of styrene butadiene rubber suitable for potable water service.

Furnish gate valve complying with preceding gate valve type 2 specification except provide one valve end flanged as required for attachment to tapping sleeve.

Furnish one of the following tapping sleeve units:

| | |
|---|---|
| Ford Meter Box Company, Inc. | Style FAST |
| JCM Industries, Inc. | Style 432 |
| Power Seal Pipeline Products Corp. | Style 3490-AS |
| Romac Industries, Inc. | Style SST |
| Mueller Company | Model H304-SS |

ACCESSORIES:

Flexible Coupling (FCW):

Bolted couplings complying with AWWA C219 utilizing plain pipe ends, and suitable for not less than 150 psig working pressure while permitting angular flexibility without longitudinal restraint of connecting pipe. Fabricate body of welded rolled high strength steel of cylindrical shape with malleable or ductile iron flanges, coupling gaskets of molded synthetic rubber and bolts of corrosion resistant steel alloy. Use couplings compatible with pipe and fittings shown on drawings. Firms offering products complying with these specifications include the following:

Dresser (Style 38)

Smith-Blair, Inc. (Type 411)

Flange Adapter:

Ductile iron flanged joint adapter suitable for minimum 150 psig working pressure and complying with ANSI B16.1 for class 125 pound drilling, unless class 250 pound drilling is indicated on drawings or is required for connecting valves. Provide flanged adapter which utilizes ductile iron set screws and a standard mechanical joint gasket to join plain end pipe to integral flanged ends without welding or threading.

Firms offering products to comply with these requirements include:

| | |
|---|---|
| EBAA Iron Sales, Inc. | Megalug |
| NAPPCO, Inc. | Uni-Flange |

Fire Hydrants (FH):

Post style, 150 psig working pressure, traffic model ("breakable"), compression type, dry barrel fire hydrant complying with AWWA C502. Furnish hydrants with one 4½ inch pumper connection and two 2½ inch hose connections conforming with National Standard Fire-Hose Coupling Screw Thread. Supply cast iron cap and cap to hydrant securing chain for each connection. Provide cast iron body with harnessing lugs for optional reaction bracing, and with six inch size inlet connection compatible with connecting pipe. Shop paint hydrant above grade with red enamel. Apply one field finish coat of bright red enamel to hydrant barrel. Select depth of bury appropriate to actual hydrant installation (42 inches minimum unless otherwise indicated). Provide positive shut-off main valve whose minimum orifice diameter is at least 4¼ inches, and whose operation is accomplished by means of counter-clockwise opening stem fitted with National Standard pentagon operating nut. Utilize O-ring stem seals. Furnish one operating wrench for each 10 hydrants furnished, or fraction thereof.

For standardization of fire hydrants on the City system, furnish either of the following units:

M & H Traffic Model Style 129 Fire Hydrant

Mueller Company Centurion Fire Hydrant

Backflow Preventers (BFP):

Reduced pressure type suitable for 150 psig working pressure and complying with ASSE 1013 and AWWA C511 specifications. Use flanged cast iron body with bronze trim. Furnish complete unit including preventer, strainer, and test cocks.

Pipe Detection Tape:

Metal core enclosed three inch wide protective plastic jacket which can be readily detected by electronic pipe locator instruments in general use. Provide blue color jacket with block letters reading "Buried Water Line Below".

Coarse Granular Material For Pipe Bedding:

Crushed stone, crushed gravel, natural gravel, crushed shell, or similar material complying with ASTM C33, and having No. 67 gradation (¾ inch to No. 4 sieve).

SERVICE SYSTEM COMPONENTS:

Corporation Stops: Cast brass or bronze with end threads conforming with AWWA C800, and consisting of precision tapered, and individually lapped, key and body surfaces. Shop test each stop for leakproof shutoff at specified working pressure. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but are not limited to, the following:

Mueller Company

Hays Manufacturing Company

Service Saddles For Ferrous Pipe: Extra heavy, hot dipped galvanized malleable iron bodies with galvanized or cadmium plated double straps and nuts, retained neoprene gasket, and outlet threads mating those of corporation stops used. Provide assemblies suitable for 200 psig cold water working pressure. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but are not limited to, the following:

Mueller Company

Smith-Blair

Service Saddles For Non-Ferrous Pipe: Heavy cast bronze or waterworks brass body and straps, bronze, brass or stainless steel screws or nuts and bolts, retained O-rings seal, and outlet threads mating those of the corporation stop used. Provide assemblies suitable for 200 psig cold water working pressure. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but are not limited to, the following:

Mueller Company

Ford Meter Box Company

Clow Corporation

McDonald Manufacturing Company

Curb Stops: Brass or bronze body with resilient plug, permanently non-grease lubricated, and with end connections appropriate to connecting tubing or pipe. Use stops rated not less than 175 psig working pressure at 180 F.

Meter Boxes: High density, reinforced plastic body with one piece cast iron lid, unless otherwise indicated. Provide box of size and height appropriate to installation of meter and accessories required.

ANCHORAGE/SUPPORT MATERIALS:

Non-direct Burial Locations:

Piping Anchorage/Support: Factory fabricated hangers and supports conforming to Manufacturers Standardization Society (MSS) SP-58.

Metal Tie Rods, Bands and Accessories: 18-8 stainless steel or other acceptable corrosion resistant components which when combined as a system resist applied thrust at test and working pressures, with suitable allowance for water hammer.

Direct Burial Locations:

Concrete: Concrete conforming to ASTM C 94 having a minimum compressive strength of 2,000 psi at 28 days.

Metal Tie Rods, Bands and Accessories: 18-8 stainless steel or other acceptable corrosion resistant components which when combined as a system resist applied thrust at test and working pressures, with suitable allowance for water hammer.

## PART 3 - EXECUTION

### GENERAL:

Drawings are generally schematic, and it is required that the Contractor extend and/or modify construction details, as approved by the City, when field conditions necessitate such changes to achieve a safe and properly functioning system.

Construct and, if necessary, reconstruct water system work as necessary to obtain system free of breaks or excessive leakage.

Unless otherwise indicated, lay and join pipe in trenches and on foundations complying with methods proposed by the pipe manufacturer in writing and approved by the City. Methods will not be approved which are likely to result in lower quality of installation than that afforded by requirements contained in the following articles.

Install PVC pipe with rubber ring joints in accordance with ASTM D 2774.

Install ductile iron pipe in accordance with AWWA C600.

### PIPE FOUNDATION AND LAYING:

Clean interior of pipe and all joints before laying. When pipe laying activity is not in actual progress, tightly cover open ends of pipe. Avoid permitting dirt, mud, or other material from entering pipe at any time.

Avoid damage or shock in handling pipe and accessories. Inspect each length of pipe and reject any defective piece. Carefully protect pipe in place from damage or displacement until backfilling operations are complete.

Cut pipe in a manner to avoid damage to pipe or lining, leaving a smooth end at right angles to pipe axis. Smooth and bevel edges of cut pipe for push-on, gasket type joints.

Lay pipe at depth dictated by field conditions, but with distance from top of pipe to finished grade not less than 42 inches unless otherwise shown or specified.

Found pipe on firm soil or coarse granular material in flat bottom trench with entire pipe barrel bearing uniformly on trench bottom, except for an approximately 18 inch gap at pipe balance point for sling removal. Hand excavate and backfill as required to provide uniform and continuous bearing and support for the pipe. Do not support pipe on hubs or end bells. Consolidate soil under and around pipe up to pipe centerline by tamping.

Join pipe with bells facing direction in which laying operation is progressing. Lay pipe upgrade wherever line grade exceeds 10 percent.

Control geometric position of pipe to ensure that pipe and fittings accurately conform with grade and alignment requirements. Lay pipe in a straight line or with uniform sweeping horizontal and vertical curves for proper alignment. Do not exceed manufacturer's recommended maximum joint deflection.

Prevent water from accumulating or running in trench during pipe laying operations or before the trench has been backfilled.

Adjust pipe depth or alignment to accommodate valve, hydrant or fitting setting, and as necessary to meet tie-in requirements or to avoid obstructions.

SERVICE TUBING INSTALLATION:

At roads, paved drives, retaining walls, and other paved areas, install service tubing by pushing, pulling, or augering techniques. Do not cut any paved surface without authorization of City.

At all other locations, install service tubing by trenching and backfilling, unless otherwise noted.

Lay tubing at depth dictated by field conditions, but with not less than 18 inches cover.

Bed tubing on firm soil. Remove any rocks, masonry, or any other objectionable material which could damage tubing.

Lay tubing in compliance with manufacturer's recommendations.

Restore ground surface to original condition. Replace or repair any damaged improvements.

PIPE CONNECTIONS:

Make all pipe connections with standard factory fabricated fittings except where special connection details (if any) are shown on drawings.

INSTALLING WATER PIPE IN TUNNEL LINER:

Tunnel Liner, 4 Inches or Smaller:

Insert water tubing into tunnel liner using methods which prevent damage to tubing.

Tunnel Liner, 6 Inches to 42 Inches:

Insert water pipe concentrically into tunnel liner by securing factory fabricated molded polyethylene casing spacers around water pipe at no more than 10 foot longitudinal intervals. Provide casing spacers with stainless steel nuts and bolts joining spacer segments.

Plug ends of tunnel with factory fabricated synthetic rubber casing seals secured with stainless steel bands and clamps.

VALVES, FITTINGS AND HYDRANTS:

Provide valves, fire hydrants, fittings and other appurtenances as indicated on the drawings, specified herein, and as requested by the City. Comply with applicable provisions of AWWA C600.

Set fire hydrants plumb and with ground line index within 0.1 foot of actual final ground level. When fire hydrants are installed adjacent to streets, set pumper connection perpendicular to curb or edge of pavement.

Set valves and valve boxes plumb, with valve box cover level with surface. Set lower section of valve box concentric with valve operating stem. Avoid contact at lower end of valve box with valve body or pipe.

ANCHORAGE:

General:

Anchorage detailed on drawings, if any, represents minimum anchorage to be installed. Field or operating conditions may require additional anchorage, and it is the Contractor's responsibility to recognize such additional requirements and to provide appropriate additional anchorage.

Non-direct Burial Locations:

Place hangers, anchors and other supports as required to prevent excessive sagging or undue strain on joints or equipment. Use factory fabricated hangers only, sized amply for imposed loads.

Provide effective anchorage for all pressure piping as necessary to resist thrust caused by unbalanced pressure, giving due allowance for test pressures and water hammer.

Install hangers and support in accordance with MSS SP-69 and SP-80.

Direct Burial Locations:

Anchor all bends, valves, tees, fire hydrants, reducers and other points of unbalanced pressure as necessary to resist thrust at test and working pressures, with suitable allowance for water-hammer. Also anchor piping system installed on steep slopes where gravitational force might otherwise cause piping displacement. Accomplish piping system anchorage by use of concrete reaction bracing, metal tie rods and bands, and/or restrained joint systems. When using concrete reaction bracing, pour concrete against firm earth and allow it to cure for at least five days before placing main under pressure. Position concrete blocks of sufficient size to counteract the magnitude and direction of the resultant thrust force.

Accomplish fire hydrant assembly anchorage by use of metal tie rods and bands and/or restrained joint systems. Keep joints and hydrant drain openings clear and accessible. Provide special support blocks at plastic pipes according to manufacturer's recommendation. When using bands and tie rods in conjunction with reaction bracing, provide a separate band for each tie rod. Use corrosion resistant materials throughout. When using restrained joint systems, utilize methods and place these special joints at appropriate fittings and pipe joints in accordance with manufacturer's recommendation.

SPECIAL CONSTRUCTION:

Where constructing on piers, supporting pipe on bridges, or for other special work, use safe and generally accepted construction methods to accomplish the required work.

SERVICE SADDLES:

Cast Iron and Ductile Iron Mains:

Install ¾ and one inch size corporation stops directly into tapped holes in water main. Use service saddles for all taps larger than one inch size.

PVC Mains:

Use service saddles for all service taps.

PIPE DETECTION TAPE:

Install pipe detection tape in trench, approximately two feet above pipe. Provide pipe detection tape for all non-ferrous water mains unless otherwise directed by the City.

LINE CLEANING:

Avoid permitting dirt, rubbish, construction materials, etc. to enter lines and appurtenances during construction. Use whatever means are necessary to obtain a clean and internally smooth system prior to final acceptance.

Limit use of flushing water to rates and quantities which will not interfere with service to water customers.

WATER LEAKAGE:

General Leakage Requirements:

Make entire water line system as near watertight as practicable. Eliminate all detectable leakage regardless of test results hereinafter required.

Testing:

Furnish and use appropriate test equipment and methods. Include gage, meter, pump and connections.

Bleed all air from system prior to testing, providing any necessary corporation stops and piping installations.

Pressure test all elements of the piping system. Where piping is buried or otherwise concealed, maintain the pressure test for not less than six hours. Visible piping may be tested for a lesser time period, if approved by the City. Conduct pressure testing at 200 psig unless a lower pressure is recommended by a manufacturer of an element of the system. When a manufacturer does recommend a lower test pressure, furnish the City with a detailed written explanation before commencing test work. In no event may the lower test pressure be less than 110 percent of the nominal working pressure of the pipe comprising the system.

Measure pressure for testing referred to the elevational datum of the lowest pipe of the line section being tested.

Where possible, use methods and perform construction work in such sequence as necessary to accomplish pressure testing as work progresses. Do not pressure test more than a one mile length of pipe at one time. Provide temporary piping and accessories if required to isolate test sections.

Makeup water required to maintain test pressure in gallons per hour per l,000 feet of pipe under test, over the test period may not exceed the quantities shown in the following table:

| Pipe Size Inches | Quantity Gal. per Hour | Pipe Size Inches | Quantity Gal. per Hour |
|---|---|---|---|
| 2 | 0.16 | 16 | 1.26 |
| 3 | 0.24 | 18 | 1.42 |
| 4 | 0.32 | 20 | 1.58 |
| 6 | 0.47 | 24 | 1.89 |
| 8 | 0.63 | 30 | 2.37 |
| 10 | 0.79 | 36 | 2.84 |
| 12 | 0.95 | 42 | 3.31 |
| 14 | 1.10 | 48 | 3.79 |

Repair all breaks, detectable leaks or other defects and retest as many times as necessary to obtain passing test.

DISINFECTING:

Chlorinate all potable water lines on completion of construction, after flushing and prior to placing in service. Use precaution to prevent backflow to supply system. Comply with AWWA C651, including Section 9 procedures on final connections to existing mains. At Contractor's option, accomplish chlorination by the tablet method, the continuous feed method or the slug method.

Fill lines with potable water containing sufficient chlorine to show a chlorine dose of at best 25 mg/l for the tablet method, a 10 mg/l minimum residual at the end of 24 hours retention period for the continuous feed method, or a 50 mg/l minimum residual at the end of three hours of exposure for the slug method.

Provide and operate all equipment and provide all materials necessary for disinfecting water mains. Draw off at taps and hydrants along the line until a DPD test or approved chlorine test kit shows a strong indication of residual chlorine.

Retain chlorinated water in the system for a period of twenty-four (24) hours for either tablet method or continuous feed method. Test for specified residual. If residual is as specified or greater, flush the system with potable water, otherwise repeat entire procedure until

satisfactory results are obtained. If the slug method of disinfection is used, dispose of heavily chlorinated water in a manner acceptable to Federal, state and local environmental regulatory agencies.

Demonstrate lines to be free of contamination by drawing samples therefrom on two successive days in the presence of the City. Deliver samples to a qualified laboratory for examination. On receipt of satisfactory test report from the foregoing laboratory, and with the approval of the City, the lines so tested are to be considered free of contamination and placed in service. In the event contamination persists, resterilize as necessary until receipt of satisfactory test report. All costs of disinfecting and bacteriological tests are to be paid by the Contractor.

END SECTION 02710

# SECTION 02720 - SANITARY SEWER SYSTEM

## PART 1 - GENERAL

### DESCRIPTION OF WORK:

The extent of sanitary sewer system is shown on the drawings.

Sanitary sewer system work includes, but is not limited to, the following:

Foundation preparation.

Furnishing and laying gravity sewer pipe.

Furnishing and/or constructing drainage structures and appurtenances.

Cleaning constructed work.

Testing constructed work.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Tunneling, Section 02408

Pavement Patching, Section 02528

Sewer Structures and Accessories, Section 02776

### PROJECT CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. Flaggers, when utilized, must hold a valid Georgia DOT flagging certificate. Maintain traffic on all roads and streets which must be crossed by sewer lines and make two separate cuts so that at least one traffic lane is open at all times. All traffic controls during construction must conform to Part VI of the *Manual on Uniform Traffic Control Devices*.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the Work being performed.

QUALITY ASSURANCE:

Manufacturer Experience:

Furnish manufactured products produced by firms having regularly produced such items specified herein which have proven satisfactory in actual service, over at least a two year period, as determined by the City.

Imperfections:

Regardless of tolerances permitted by industry standards specified herein, the City may reject pipe or precast structures at the project site, which have cracks, chips, blisters, lack of smooth interior or exterior surface, evidence of structural weakness, porosity, joint defect, significant variation from theoretical shape, or other imperfection which might, in the opinion of the City, contribute to a reduced functional capability, accelerated deterioration, or reduced structural strength.

Repairs: Do not use patched or repaired precast structures unless each individual element has been approved and marked for repair by the City.

PART 2 - PRODUCTS

Concrete Pipe (CPS):

Basic specification, nominal 15 inch size and over: ASTM C 76, reinforced sewer pipe furnished in not less than eight foot lengths with thickness class as determined from embedment tables for bedding class and trench width and depth for actual installation.

Identification: Stamp each length or joint of concrete pipe at the plant of manufacture, showing strength or reinforcement class, wall thickness designation, date of manufacture, and manufacturer symbol.

Joints: ASTM C 361 O-ring rubber gasket style suitable for 25 feet hydrostatic pressure head above pipe centerline with smooth and accurately formed, concrete bell and spigot surfaces. Joints may also use galvanized steel bell and spigot joint rings on the gasket side of the joint.

Plastic Solid Wall Pipe Type 1 (PVCS-1):

Basic specification for pipe diameters less than 18 inches: ASTM D 3034 type PSM or ASTM D 3033 type PSP PVC bell and spigot sewer pipe with ratio of barrel outside diameter to wall thickness (SDR) no greater than 35.0, with pipe material meeting ASTM D 1784 12454 B or C and pipe stiffness at five percent deflection per ASTM D 2412, no less than 46.0 psi.

Basic specification for pipe diameters 18-inch through 30-inches: Provide ASTM F 679 PVC bell and spigot sewer pipe with T-1 wall thickness and pipe stiffness at five percent deflection per ASTM D 2412, no less than 46.0 psi.

For sewer depths greater than 20 feet use PVCS-2, Plastic Solid Wall Pipe Type 2, and accomplish pipe material change within one pipe joint of sewer depth category change.

Couplings and adaptors: Provide standard couplings and adaptors specifically designed to connect the PVC pipe to manholes or to other pipe materials. Manhole adaptors must provide a positive bond between the piping system and the mortar or concrete of the manhole structure. Protect all couplings and adaptors by fully encasing in concrete.

Joints: ASTM D 3212 elastomeric gasket system comprised of material suitable for use with domestic sewage and conforming to ASTM F 477.

Subject to compliance with requirements, manufacturing offering products which may be incorporated in the work include, but are not limited to the following:

IPEX, Inc.

NAPCO

Plastic Solid Wall Pipe Type 2 (PVCS-2):

Basic specification for pipe diameters 18-inch through 30-inches: Conform to AWWA C905, SDR 25 PVC bell and spigot pressure pipe, with outside diameters suitable for joining with ASTM F679, SDR 35 bell and spigot PVC sewer pipe.

Couplings and adaptors: Provide standard couplings and adaptors specifically designed to connect the PVC pipe to manholes or to other pipe materials. Manhole adaptors must provide a positive bond between the piping system and the mortar or concrete of the manhole structure. Protect all couplings and adaptors by fully encasing in concrete.

Joints: ASTM D 3212 elastomeric gasket system comprised of material suitable for use with domestic sewage and conforming to ASTM F 477.

Subject to compliance with requirements, manufacturing offering products which may be incorporated in the work include, but are not limited to the following:

IPEX, Inc.

NAPCO

Ductile Iron Pipe (DIPS):

Basic specification: For pipe with push-on joints or mechanical joints, provide ANSI/AWWA C151/A21.51 ductile iron pipe having pressure class as determined from embedment tables

for bedding class and trench depth for actual installation. For pipe with flanged joints or grooved joints, provide ANSI/AWWA C115/A21.15 ductile iron pipe having minimum thickness class 53.

Coatings: Cement mortar lining per ANSI/AWWA C104/A2l.4 with standard asphaltic coating over lining and pipe exterior.

Joints: Rubber push-on type (ANSI/AWWA C111/A21.11) except where mechanical joint (ANSI/AWWA C110/A21.10 and C111/A21.11) with corrosion resistant alloy bolts, or flanged (ANSI/AWWA C115/A21.15 and ANSI B16.1, Class 125) with corrosion resistant alloy bolts and red rubber gasket joints are indicated.

Fittings: Same design strength, lining, coating and joint as connecting ductile iron pipe.

Coarse Granular Material For Pipe Bedding:

Crushed stone, crushed gravel, natural gravel, or crushed shell meeting ASTM D 448, and having No. 67 gradation (¾ inch to No. 4 sieve).

Fine Granular Material For Pipe Bedding:

Uniformly graded natural or manufactured sand composed of hard, durable particles with 100 percent passing a No. 4 sieve, not more than 25 percent passing a No. 100 sieve, and containing no more than 25 percent total of silt and clay.

Flexible Pipe Bedding Materials: Select natural, manufactured, or processed aggregates and soils free of debris, frozen lumps, and rock or stones larger than 1½ inch in any dimension and meeting the following classifications.

Class IA consist of manufactured open graded, non-plastic, clean, angular crushed stone, rock, or gravel with large void content that contains little or no fines; and less than or equal to 10 percent passing No. 4 sieve. (Class suitable only when authorized by City)

Class IB consist of manufactured dense graded, non-plastic, clean, angular crushed stone, rock, or gravel and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines; and less than or equal to 50 percent passing No. 4 sieve.

Class II consist of coarse grained, non-plastic, clean soil materials complying with ASTM D 2487 soil classification groups GW, GP, SW, SP, or borderline between clean and with fines materials and with less than five percent passing No. 200 sieve.

Class III consist of coarse grained clean soil materials with fines complying with ASTM D 2487 soil classification groups GM, GC, SM, or SC with 12 to 50 percent passing No. 200 sieve.

Class IVA consist of fine grained inorganic soil materials complying with ASTM D 2487 soil classification groups ML or CL of silts and very fine sands or clays of low to medium plasticity with 100 percent passing No. 4 sieve. (Class suitable only when authorized by City)

Class IVB consist of fine grained inorganic soil materials complying with ASTM D 2487 soil classification groups MH or CH of silts and fine sandy silts or clays of high plasticity with 100 percent passing No. 4 sieve. (Class not suitable for bedding material)

Class V consist of organic soil materials complying with ASTM D 2487 soil classification groups OL, OH, or PT. (Class not suitable for bedding material)

Pipe Detection Tape and Wire:

Metal core enclosed three inch wide protective plastic jacket which can be readily detected by electronic pipe locator instruments in general use. Provide color jacket with block letters reading "Buried Sewer Line Below". Provide wire of solid copper, electrical conductor size No. 12 AWG with Type THWN or THW insulation.

## PART 3 - EXECUTION

### PIPE EMBEDMENT:

Concrete Pipe Embedment:

Unless otherwise indicated, lay pipe in trenches and embedments prepared as selected by the Contractor in conformance with ASTM C 1479 and the bedding class, trench width and depth, and pipe size tabulated below.

| Pipe Size Inches | Maximum Trench Width Ft-in. | Maximum Trench Depth in Feet | | | | | |
|---|---|---|---|---|---|---|---|
| | | Class C Bedding | | | Class B Bedding | | |
| | | Conc. Cl. 3 | Conc. Cl. 4 | Conc. Cl. 5 | Conc. Cl. 3 | Conc. Cl. 4 | Conc. Cl. 5 |
| 15 | 2-6 | 15 | 40 | 40 | 27 | 40 | 40 |
| | 3-0 | 10 | 19 | 40 | 14 | 37 | 40 |
| | Over 3-0 | 9 | 13 | 19 | 12 | 17 | 25 |
| 18 | 3-0 | 13 | 28 | 40 | 19 | 40 | 40 |
| | 3-6 | 10 | 17 | 40 | 13 | 27 | 40 |
| | 4-0 | 8 | 13 | 24 | 10 | 18 | 40 |
| | Over 4-0 | 7 | 12 | 19 | 9 | 15 | 23 |
| 21 | 3-0 | 17 | 40 | 40 | 28 | 40 | 40 |
| | 3-6 | 12 | 22 | 40 | 17 | 40 | 40 |
| | 4-0 | 10 | 16 | 35 | 13 | 24 | 40 |
| | Over 4-0 | 9 | 14 | 21 | 12 | 17 | 25 |
| 24 | 3-6 | 15 | 30 | 40 | 21 | 40 | 40 |
| | 4-0 | 12 | 20 | 40 | 16 | 31 | 40 |
| | 4-6 | 10 | 16 | 30 | 13 | 22 | 40 |
| | Over 4-6 | 9 | 14 | 21 | 12 | 17 | 25 |
| 27 | 3-6 | 17 | 40 | 40 | 18 | 40 | 40 |
| | 4-0 | 13 | 24 | 40 | 18 | 40 | 40 |
| | 4-6 | 11 | 18 | 39 | 15 | 27 | 40 |
| | 5-0 | 10 | 15 | 27 | 13 | 21 | 40 |
| | Over 5-0 | 9 | 14 | 21 | 12 | 17 | 25 |
| 30 | 4-0 | 15 | 29 | 40 | 22 | 40 | 40 |
| | 4-6 | 13 | 21 | 40 | 17 | 33 | 40 |
| | 5-0 | 11 | 17 | 33 | 14 | 24 | 40 |
| | Over 5-0 | 9 | 14 | 21 | 12 | 17 | 25 |
| 36 | 4-6 | 17 | 30 | 40 | 23 | 40 | 40 |
| | 5-0 | 14 | 23 | 40 | 19 | 33 | 40 |
| | 6-0 | 11 | 27 | 29 | 14 | 23 | 40 |
| | Over 6-0 | 10 | 15 | 22 | 13 | 18 | 26 |

Thermoplastic Pipe Embedment:

Unless otherwise indicated, lay pipe in trenches and embedments complying with ASTM D 2321 and the following requirements. Bed pipe in carefully placed and compacted Class IB, II, or III flexible pipe bedding materials placed on a stable flat trench bottom and under the pipe haunches. Thickness of flexible pipe bedding must be at least one-eighth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least halfway up

the pipe barrel at the sides. Spade and shovel-slice embedment material to fill and support pipe haunch area. Achieve compaction not less than 85 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all bedding and haunching material. Place initial backfill of compacted Class IB, II, or III flexible pipe bedding material to a minimum depth of six inches over the top of pipe. Achieve compaction not less than 85 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all Class IB and II initial backfill material and not less than 90 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all Class III initial backfill material. Use only Class IA or IVA flexible pipe bedding materials where authorized by the City. Do not use Class IVB or V flexible pipe bedding materials for pipe embedment under any circumstances.

Provide trench width sufficient to place and compact embedment material, but not less than the values tabulated below. If trench width at top of pipe is greater than six pipe diameters, compact embedment material below the pipe springline for a distance at least 2.5 pipe diameters each side of pipe for 10 inch size pipe or less and at least one pipe diameter or two feet (whichever is greater) each side of pipe for 12 inch size pipe and larger.

| Pipe Size, In. | Minimum Trench Width, Ft.-In. |
|---|---|
| 8 | 2-2 |
| 10 | 2-4 |
| 12 | 2-6 |
| 15 | 2-9 |
| 18 | 3-0 |

Ductile Iron Pipe Embedment:

Unless otherwise indicated, lay pipe in trenches and embedments prepared as selected by the Contractor in conformance with the pressure class, laying condition type, trench depth, and pipe size tabulated below. Provide trench width sufficient to place and compact embedment material, but not less than nominal pipe diameter plus two feet. If trench width at top of pipe is greater than six pipe diameters, compact embedment material below the pipe springline for a distance at least 2.5 pipe diameters each side of pipe for 10 inch size pipe or less and at least one pipe diameter or two feet (whichever is greater) each side of pipe for 12 inch size pipe and larger.

| | Maximum Trench Depth in Feet Type 5 Laying Condition | | | | |
|---|---|---|---|---|---|
| Pipe Size Inches | Pressure Class 150 | Pressure Class 200 | Pressure Class 250 | Pressure Class 300 | Pressure Class 350 |
| 8 | -- | -- | -- | -- | 51.6 |
| 10 | -- | -- | -- | -- | 46.2 |
| 12 | -- | -- | -- | -- | 46.0 |

| | | | | | |
|---|---|---|---|---|---|
| 14 | -- | -- | 37.6 | 43.4 | 45.9 |
| 16 | -- | -- | 35.7 | 40.5 | 46.0 |
| 18 | -- | -- | 32.7 | 38.4 | 43.0 |

Maximum Trench Depth in Feet
Type 4 Laying Condition

| Pipe Size Inches | Pressure Class 150 | Pressure Class 200 | Pressure Class 250 | Pressure Class 300 | Pressure Class 350 |
|---|---|---|---|---|---|
| 8 | -- | -- | -- | -- | 35.1 |
| 10 | -- | -- | -- | -- | 29.5 |
| 12 | -- | -- | -- | -- | 29.2 |
| 14 | -- | -- | 25.0 | 27.7 | 29.1 |
| 16 | -- | -- | 25.5 | 27.8 | 30.2 |
| 18 | -- | -- | 24.5 | 28.0 | 30.1 |

Maximum Trench Depth in Feet
Type 2 Laying Condition

| Pipe Size Inches | Pressure Class 200 | Pressure Class 250 | Pressure Class 300 | Pressure Class 350 |
|---|---|---|---|---|
| 8 | -- | -- | -- | 21.4 |
| 10 | -- | -- | -- | 16.4 |
| 12 | -- | -- | -- | 16.0 |
| 14 | -- | 12.0 | 14.8 | 16.1 |
| 16 | -- | 12.2 | 14.9 | 16.8 |
| 18 | -- | 12.6 | 15.0 | 17.0 |

Definition of Pipe Foundation Terms:

Trench depth is the vertical distance from pipe invert or flow line to finished ground surface.

Trench width is the horizontal distance between trench walls at any point from one foot above top of pipe to trench bottom.

Rigid Pipe Bedding: Use rigid pipe bedding embedment of one of the following classes in compliance with ASTM C 12 for clay pipe and ASTM C 1479 for concrete pipe. Do not use Class D bedding (pipe placed on trench bottom with only bell holes provided) under any circumstances. Use Class A bedding where indicated on the drawings.

Class A Bedding consist of either of the following methods:

Concrete Cradle: Bed pipe in a monolithic cradle of reinforced concrete having a thickness at least one-fourth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least one-fourth of the outside

diameter up the pipe barrel haunches at the sides. Provide cradle width at least one and one fourth times the outside diameter of the pipe, but not less than four inches plus the outside pipe diameter. Carefully place compacted select backfill material or coarse granular material above the concrete cradle up to a minimum depth of 12 inches over the top of pipe. Select backfill material is finely divided material free of debris, organic material, and large stones. Achieve compaction not less than 85 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all material.

Concrete Arch: Bed pipe in carefully placed compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-eighth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least halfway up the pipe barrel at the sides. Spade and shovel-slice embedment material to fill and support pipe haunch area. Cover top half of the pipe with monolithic reinforced concrete arch having a thickness at least one-fourth the outside pipe diameter, but not less than four inches thick over the top of the pipe. Provide arch width at least one and one fourth times the outside diameter of the pipe, but not less than four inches plus the outside pipe diameter. Achieve compaction not less than 85 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all material.

Class B Bedding consist of the following construction method: Bed pipe in carefully placed compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-eighth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least halfway up the pipe barrel at the sides. Spade and shovel-slice embedment material to fill and support pipe haunch area. Place compacted select backfill material or coarse granular material above the coarse granular material up to a minimum depth of 12 inches over the top of pipe. Select backfill material is finely divided material free of debris, organic material, and large stones. Achieve compaction not less than 85 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all material.

Class C Bedding consist of the following construction method: Bed pipe in carefully placed compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-eighth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least one-sixth of the outside diameter up the pipe barrel haunches at the sides. Spade and shovel-slice embedment material to fill and support pipe haunch area. Place compacted select backfill material or coarse granular material above the coarse granular material up to a minimum depth of 12 inches over top of pipe. Select backfill material is finely divided material free of debris, organic material, and large stones. Achieve compaction not less than 85 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all material.

Ductile Iron Pipe Bedding: Use ductile iron pipe bedding embedment of one of the following laying condition types in compliance with ANSI/AWWA C600. Do not use Laying Condition Type 1 (pipe placed on trench bottom with only bell holes provided) under any circumstances.

Type 5 consist of the following construction method: Bed pipe in carefully placed compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-eighth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least halfway up the pipe barrel at the sides. Spade and shovel-slice embedment material to fill and support pipe haunch area. Place compacted select backfill material or coarse granular material above the coarse granular material up to the top of the pipe. Select backfill material is native soil excavated from the trench that is free of foreign material, frozen earth, organic material, and large stones. Achieve compaction not less than 90 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all material.

Type 4 consist of the following construction method: Bed pipe in carefully placed compacted coarse or fine granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-eighth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least one-sixth of the outside diameter up the pipe barrel haunches at the sides. Spade and shovel-slice embedment material to fill and support pipe haunch area. Place compacted select backfill material or coarse granular material above the granular material up to the top of the pipe. Select backfill material is native soil excavated from the trench that is free of foreign material, frozen earth, organic material, and large stones. Achieve compaction not less than 80 percent of maximum dry density per ASTM D 698 (Standard Proctor) for all material.

Type 2 consist of the following construction method: Bed pipe on a flat trench bottom with select backfill lightly consolidated to centerline of pipe. Spade and shovel-slice backfill material to fill and support pipe haunch area. Select backfill material is native soil excavated from the trench that is free of foreign material, frozen earth, organic material, and large stones.

PIPE LAYING:

Clean interior of pipe and all joints before laying. When pipe laying activity is not in actual progress, tightly cover open ends of sewer. Avoid permitting mud or other material from entering sewer at all times.

Avoid damage or shock in handling pipe and accessories. Inspect each length of pipe, and reject any defective piece. Carefully protect pipe in place from damage or displacement until backfilling operations are complete.

Lay and joint pipe in strict conformance with manufacturer's written recommendations as submitted to and accepted by the City. Lay all pipe upgrade with spigots pointing downgrade.

Control geometric position of pipe as necessary to ensure that pipe and fittings accurately conform with required grade and alignment after sewer is completed.

Prevent water from accumulating or running in trench during pipe laying operations, and until the trench or excavation has been backfilled.

Remove and re-lay any length of pipe which does not accurately conform with required line or grade, is crushed, or is excessively deflected.

Install piping with 48 inches minimum cover depth. Where cover depth less than 48 inches is unavoidable, provide ductile iron pipe material for segments having less than 48 inches of cover depth.

Maintain a vertical separation of at least 18 inches between the crown of sanitary sewers and the invert of existing or proposed water mains with the sewer located below the water main. When a vertical separation of 18 inches cannot be provided and the water main cannot be relocated to provide adequate clearance, utilize one full length of ductile iron pipe for sewer construction such that the pipe length is centered on the water main.

## PIPE CONNECTIONS:

Make all pipe connections with standard fittings, manholes, structures, or special construction detailed on drawings. Locate building services and connect thereto with standard fittings as authorized.

At manholes and structures, neatly cut all connecting pipe flush with inside surface, and provide flexible pipe joint within 18 inches of outer surface. Make pipe connections to manholes and structures by laying pipe in mortar bed or concrete. Use supplemental materials and techniques as required to obtain watertightness.

Do not connect any sewage flow to new work until authorized by the City.

## INSTALLING SANITARY SEWER IN TUNNEL LINER:

### Tunnel Liner, 6 Inches to 42 Inches:

Insert sewer pipe concentrically into tunnel liner by securing factory fabricated molded polyethylene casing spacers around sewer pipe at no more than 10 foot longitudinal intervals. Provide casing spacers with stainless steel nuts and bolts joining spacer segments.

Plug ends of tunnel with factory fabricated synthetic rubber casing seals secured with stainless steel bands and clamps.

SEWER STRUCTURES:

Conform with applicable provisions of the following sections:

Sewer Structures and Accessories, Section 02776

WYES, TEES AND SERVICES:

Provide wyes and/or service tees at points indicated on drawings, specified herein, and as requested by the City. If wyes or service extensions are not to be connected to a building sewer under this work, close end of pipe with removable factory fabricated plug or stopper.

When replacing an existing sewer, connect all existing service lines to the new sewer.

Service lines, unless otherwise shown on the drawings or requested by the City, are to be run to suit field conditions at a minimum grade of two percent and with a minimum pipe cover of 30 inches.

Provide cleanouts in service lines at not more than 75 foot intervals and where pipe horizontal deflection exceeds 45 degrees. Unless noted otherwise, furnish cleanouts consisting of wye and 45 degree fittings, vertical pipe and threaded brass or plastic removal plug. Arrange cleanout to permit cleaning in the direction of flow.

PIPE DETECTION TAPE AND WIRE:

Install pipe detection tape in trench, approximately two feet above pipe. Install continuous, uncut pipe detection wire in trench, approximately six inches above pipe. At manholes provide at least 36 inches of coiled wire from each direction placed in the manhole. At pipe terminations, tape wire to pipe and carry ends to above grade near pipe for future use by maintenance personnel. Provide pipe detection tape and wire for all non-ferrous sanitary sewers, unless otherwise noted. Install detection tape and wire so that sewer line can be located with a pipe detector after burial.

LINE CLEANING:

Avoid permitting dirt, rubbish, surplus construction material, and other foreign matter to enter structures or pipe during construction. Use whatever means may be necessary to obtain a clean and internally smooth sewer system prior to final acceptance.

FIELD QUALITY CONTROL:

General Leakage Requirements:

Make entire sewer line system as near watertight as practicable. Eliminate all visible points of ground water infiltration, and any other significant points of leakage which can be located, regardless of test results obtained as hereinafter required.

Upon completion of pipe installation and trench backfilling to within one foot of finished grade, perform system installation acceptance tests using infiltration or exfiltration testing for all piping with a visible flow of water and piping or joint low pressure air testing for all work constructed. Conduct final acceptance test witnessed by the City.

Installation acceptance testing is required on all new sewer line segments extending completely from manhole to manhole unless waived by the City due to unreasonable service shutdown demands.

An acceptable low pressure air test is interpreted as an installation acceptance test in lieu of infiltration or exfiltration testing of pipelines only where flow of water is not visible in the pipe.

Take whatever action may be necessary to permanently reduce infiltration from all water sources to less than the maximum allowable leakage limits established below for all constructed work.

System Exfiltration or Infiltration Acceptance Testing:

Infiltration testing is only applicable if the ground water table is at least two feet above the crown of the new sewer pipeline being tested. Exfiltration testing will be used when the ground water table is less than two feet above the crown of the new sewer. Perform infiltration or exfiltration acceptance testing in accordance with ASTM C 1091 or ASTM C 969 guidelines for new sewers using the following general procedures:

Plug the upper (inlet) end of the test section including laterals.

At the lower (outlet) end, collect the water and measure the quantity collected within a specific time in a calibrated container after a constant flow is generated at the pipe section outlet.
An alternate measurement method is to use a calibrated weir installed at the outlet.

System Exfiltration Testing:

The maximum allowable leakage is 25 gallons/(inch of internal diameter)(mile of sewer)(day) when the average head of the test section is three feet or less. When the average head on the test section is greater than three feet, the allowable leakage shall be multiplied by the ratio of the square root of the average test head over the square root of the base head of three feet.

System Infiltration Testing:

The maximum allowable leakage limit is 25 gallons/(inch of internal diameter)(mile of sewer)(day) when the average head on the test section is six feet or less. When the average groundwater head on the test section is greater than six feet, the allowable leakage shall be increased in proportion to the ratio of the square root of the average groundwater head over the square root of the base head of six feet.

Air Testing:

Nominal 4 Inch to 24 Inch Pipe: After completing backfill of a sewer line section, conduct a low pressure air test depending on pipe material in accordance with ASTM C 924, ASTM C 828, ASTM F 1417, or UNI-B-6 guidelines for installation acceptance. Ductile iron pipelines shall be tested in accordance with ASTM F 1417 or UNI-B-6 requirements. Perform such tests using the following general procedures:

Temporarily plug line segment between two manholes using plugs having air tight fittings through which low pressure air can be introduced into the pipe segment being tested.

Introduce low pressure air into the test pipe segment until the internal air pressure reaches four psig above ground water pressure, if any.

Wait at least two minutes for air temperature in the test segment to stabilize while internal air pressure remains no less than 3.5 psig above ground water pressure.

Accurately determine the elapsed time for internal pressure to drop one psig.

The air test is acceptable if elapsed time for an internal pressure drop of one psig is no less than shown in the following tables:

For Concrete Sewer Lines:

| Pipe Diameter Inches | Seconds Per 100 Feet of Pipe |
|---|---|
| 15 | 126 |
| 18 | 144 |

Air leakage time is based on pipe being damp. If pipe and joints are dry, dampen line if helpful in meeting air test time requirement.

For Thermoplastic or Ductile Iron Sewer Lines:

| Pipe Diameter (inches) | Minimum Time (min:sec) | Maximum Length for Minimum Time (ft) | Minimum Time for Longer Length (sec) L = Total Length |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 4 | 3:46 | 597 | 0.380 L |
| 6 | 5:40 | 398 | 0.854 L |
| 8 | 7:34 | 298 | 1.520 L |
| 10 | 9:26 | 239 | 2.374 L |
| 12 | 11:20 | 199 | 3.218 L |
| 15 | 14:10 | 159 | 5.342 L |
| 18 | 17:00 | 133 | 7.692 L |

Deflection Testing:

Conduct internal deflection testing on all installed gravity sewer lines six inch size and larger, no sooner than 30 days after completion of trench backfilling and after pipeline is completely cleaned and flushed. Deflection testing consists of pulling an approved solid pointed mandrel through the completed pipeline from manhole to manhole without using mechanical pulling devices. Mandrel testing is successful when the mandrel device can be pulled through the pipe between manholes in a continuous operation, without interruption. Repair or replace all defective pipe found during mandrel testing and conduct another deflection test to determine the extent and necessary repair of any additional deficiencies. After repairing all defects, perform successful mandrel testing no less than 30 days after completion of trench backfilling in the presence of the City.

Use a rigid, non-adjustable mandrel with odd number of legs or runners (not less than nine legs) and a length at least 75 percent of the inside diameter of the pipe being tested. Furnish mandrels sized as tabulated below using base inside diameters complying with ASTM D 3034 and F 679:

5 PERCENT DEFLECTION MANDREL

(ASTM D 2412)

| Nominal Size, In | Mandrel O.D., In | Tolerance In | Nearest 1/16" |
|---|---|---|---|
| 6 | 5.45 | 0.01 | 5-7/16 |
| 8 | 7.28 | 0.01 | 7-4/16 |
| 10 | 9.08 | 0.01 | 9-1/16 |
| 12 | 10.79 | 0.01 | 10-13/16 |
| 15 | 13.20 | 0.01 | 13-3/16 |
| 18 | 16.13 | 0.01 | 16-2/16 |

Upon request by the City, certify the accuracy of the mandrel test gauges by sliding proving rings to an accuracy of 0.05 inches over the mandrel. Use proving rings complying with ASTM F 679 and ASTM D 3034.

Internal Television Inspection:

Conduct internal television inspection on all installed gravity sewer lines eight inch size and larger, after trench backfilling to within one foot of finished grade. Repair or replace all visible defects found and conduct another internal television inspection to determine the extent and necessary repair of any additional deficiencies. Repeat the inspection and correction process until the entire work shall be free from any visible defects. After repairing all visible defects, perform successful air test on each sewer segment before conducting final television inspection for the record. Provide City with color VHS format video record tapes and supporting written location records of the final condition of each completed and tested sewer segment.

END SECTION 02720

# SECTION 02770 - STORM SEWER SYSTEM

## PART I - GENERAL

### DESCRIPTION OF WORK:

The extent of storm sewer system is shown on the drawings.

Storm sewer system work includes, but is not limited to, the following:

Foundation preparation.

Furnishing and laying gravity drainage pipe.

Furnishing and/or constructing drainage structures and appurtenances.

Cleaning constructed work.

Related Work Specified Elsewhere:

Route Clearing, Section 02112

Trenching and Backfilling, Section 02204

Tunneling, Section 02408

Pavement Patching, Section 02528

Sewer Structures and Accessories, Section 02776

### PROJECT CONDITIONS:

Traffic Control:

Schedule and conduct Work in a manner which will minimize inconvenience to vehicular and pedestrian traffic. Provide flaggers, barricades, warning signs, warning lights, and other warning means as appropriate. Flaggers, when utilized, must hold a valid Georgia DOT flagging certificate. Maintain traffic on all roads and streets which must be crossed by sewer lines and make two separate cuts so that at least one traffic lane is open at all times. All traffic controls during construction must conform to Part VI of the *Manual on Uniform Traffic Control Devices*.

Weather Limitations:

Conduct all operations during weather conditions appropriate to the Work being performed.

QUALITY ASSURANCE:

Furnish manufactured products produced by firms having regularly produced such items specified herein which have proven satisfactory in actual service, over at least a two year period, as determined by the City.

Imperfections:

Regardless of tolerances permitted by industry standards specified herein, the City may reject pipe or precast structures at the project site, which have cracks, chips, blisters, lack of smooth interior or exterior surface, evidence of structural weakness, porosity, joint defect, significant variation from theoretical shape, or other imperfection which might, in the opinion of the City, contribute to a reduced functional capability, accelerated deterioration, or reduced structural strength.

Repairs: Do not use patched or repaired precast structures unless each individual element has been approved and marked for repair by the City.

PART 2 - PRODUCTS

Concrete Pipe (RCP):

Basic specification, nominal 15 inch size and over: ASTM C 76, reinforced sewer pipe furnished in not less than eight foot lengths.

Identification: Stamp each length or joint of concrete pipe at the plant of manufacture, showing strength or reinforcement class, wall thickness designation, date of manufacture, and
manufacturer symbol.

Joints: At Contractor's option use one of the following jointing systems. Once a system is selected, utilize system for entire project unless specified or authorized otherwise.

Cement grout type which results in entire joint annular space being filled with grout and inside of each joint being wiped smooth. Use grout mixture consisting of not more than five gallons of water per sack of cement. Utilize cement conforming to AASHTO M85 or MI50.

AWWA C 302 O-ring rubber gasket style in which the completed joint confines the O-ring on four sides with nominal clearance not to exceed 1/16 inch between smooth, accurately formed, bell and spigot surfaces.

Elliptical Concrete Pipe (ECPD):

Basic specification: ASTM C 507, reinforced elliptical sewer pipe furnished in not less than eight foot lengths.

Additional Specification Requirements: Maximum absorption by standard ASTM test may not exceed 7.0 percent, and pipe must aged at manufacturing plant for not less than five days.

Identification: Stamp each length or joint of concrete elliptical pipe at the plant of manufacture, showing strength or reinforcement class, wall thickness designation, date of manufacture, manufacturer's symbol and quadrant reinforcing symbol.

Joints: At Contractor's option use one of the following jointing systems. Once a system is selected, utilized system for entire project unless specified or authorized otherwise.

Cement grout type which results in entire joint annular space being filled with grout and inside of each joint being wiped smooth. Use grout mixture consisting of not more than five gallons of water per sack of cement. Utilize cement conforming to AASHTO M85 or M150.

Preformed flexible pipe joint compound to be confined in the tongue and groove joint, meet Federal Specification SS-S-00210.

Corrugated Plastic Pipe (CPPD):

Corrugated flexible conduit with slip-on joints made of polyethylene conforming with ASTM F 405 and F 449

Subject to compliance with requirements, firms offering products which may be used include, but are not limited to, the following:

ADS Inc.

Hancor, Inc.

Pipe Fittings:

Use standard, factory fabricated adapters, wyes, tees, and other necessary fittings comparable to pipe with which connected.

Coarse Granular Material For Pipe Bedding:

Crushed stone, crushed gravel, natural gravel, or crushed shell meeting ASTM C 33, and having No. 67 gradation (¾ inch to No. 4 sieve).

Fine Granular Material For Pipe Bedding:

Uniformly graded natural or manufactured sand composed of hard, durable particles with l00 percent passing a No. 4 sieve, not more than 25 percent passing a No. l00 sieve, and containing no more than 25 percent total of silt and clay.

Sewer System Structures: Conform with applicable provisions of the following sections:

Sewer Structures and Accessories, Section 02776

PART 3 - EXECUTION

PIPE FOUNDATION:

Concrete Pipe Foundation:

Unless otherwise indicated, lay pipe in trenches and on foundations prepared as selected by the Contractor in conformance with the bedding class, trench width and depth, and pipe size tabulated below:

| Pipe Size Inches | Maximum Trench Width Ft-in. | Maximum Trench Depth in Feet — Class C Bedding — Conc. Cl. 3 | Conc. Cl. 4 | Conc. Cl. 5 | Class B Bedding — Conc. Cl. 3 | Conc. Cl. 4 | Conc. Cl. 5 |
|---|---|---|---|---|---|---|---|
| 15 | 3-0 | 8 | 13 | 30 | 11 | 21 | 30 |
| 18 | 3-3 | 9 | 15 | 30 | 12 | 24 | 30 |
| 21 | 3-6 | 9 | 16 | 30 | 13 | 26 | 30 |
| 24 | 4-0 | 10 | 16 | 30 | 13 | 23 | 30 |
| 27 | 4-0 | 11 | 19 | 30 | 15 | 29 | 30 |
| 30 | 4-6 | 11 | 18 | 30 | 14 | 25 | 30 |
| 36 | 5-6 | 11 | 17 | 29 | 14 | 23 | 30 |
| 42 | 6-0 | 12 | 16 | 26 | 15 | 21 | 30 |
| 48 | 7-0 | 12 | 18 | 28 | 15 | 23 | 30 |
| 54 | 7-6 | 13 | 18 | 29 | 16 | 24 | 30 |
| 60 | 8-6 | 13 | 19 | 28 | 16 | 23 | 30 |
| 66 | 9-6 | 13 | 18 | 27 | 16 | 25 | 30 |
| 72 | 10-0 | 14 | 19 | 28 | 17 | 24 | 30 |

Corrugated Plastic Pipe Foundation:

Unless otherwise approved, lay corrugated plastic pipe in trenches, or fills using not less thant Class C Modified Bedding and in conformance with the maximum fill depth and pipe size tabulated below:

| Pipe Size Inches | Maximum Fill Depth For Corrugated Plastic Pipe In Feet |
|---|---|
| 18 | 11 |
| 24 | 7 |

Definition of Pipe Foundation Terms:

Trench depth is the vertical distance from pipe invert or flow line to finished ground surface.

Trench width is the horizontal distance between trench walls at any point from one foot above top of pipe to trench bottom.

Class B Bedding may be achieved by either of the following two construction methods.

(l) Shaped Bottom with Tamped Backfill: Shape bottom of trench excavation to conform to a cylindrical surface with a radius at least two inches greater than the radius to the outside of the pipe and with a width sufficient to allow six-tenths of the width of the pipe barrel to be bedded in fine granular material fill placed in the shaped excavation. Carefully place and compact backfill at sides of pipe to a thickness of at least 12 inches above top of pipe. Limit use of this bedding method to trenches with firm bottom and sides.

(2) Compacted Coarse Granular Bedding With Tamped Backfill: Bed pipe in compacted coarse granular material placed on a flat trench bottom. Thickness of granular bedding must be at least one-fourth the outside pipe diameter, but not less than four inches thick under pipe barrel, and extend at least halfway up the pipe barrel at the sides. Carefully place compacted backfill above the granular material up a minimum depth of 12 inches over the top of pipe.

Class C Bedding may be achieved by either of the following two construction methods:

(l) Shaped Bottom: Bed pipe with ordinary care in an earth foundation formed in the trench bottom by a shaped excavation which fits the pipe barrel with reasonable closeness for a width of at least 50 percent of the outside pipe diameter. Place compacted fill to a minimum depth of six inches above top of pipe.

(2) Compacted Coarse Granular Bedding with a Tamped Backfill: Bed pipe in compacted granular material placed on a flat trench bottom. Thickness of granular material must be at least 4 inches under the barrel and must extend one-tenth to one-sixth of the outside diameter up the pipe barrel at the sides. Place compacted backfill above the granular material to a minimum depth of six inches over top of pipe.

PIPE LAYING:

Clean interior of pipe and all joints before laying. When pipe laying activity is not in actual progress, tightly cover open ends of sewer. Avoid permitting mud or other material from entering sewer at all times.

Avoid damage or shock in handling pipe and accessories. Inspect each length of pipe, and reject any defective piece. Carefully protect pipe in place from damage or displacement until backfilling operations are complete.

Lay and joint pipe in strict conformance with manufacturer's written recommendations as submitted to an accepted by the City. Where cement joints are used, provide wet burlap or earth protective cover for joints immediately after initial grout set. Maintain protective cover until joint is covered by backfilling. Lay all pipe upgrade with spigots pointing downgrade.

Control geometric position of pipe as necessary to ensure that pipe and fittings accurately conform with required grade and alignment after sewer is completed.

Prevent water from accumulating or running in trench during pipe laying operations, and until the trench or excavation has been backfilled.

Remove and re-lay any length of pipe which does not accurately conform with required line or grade, is crushed, or is excessively deflected.

PIPE CONNECTIONS:

Make all pipe connections with standard fittings, or special construction detailed on drawings.

At manholes and structures, neatly cut all connecting pipe flush with inside surface, and provide flexible pipe joint within 18 inches of outer surface. Make pipe connections to manholes and structures by laying pipe in mortar bed or concrete. Use supplemental materials and techniques as required to obtain watertightness.

Do not connect any flow to new work until authorized by the City.

INSTALLING STORM SEWER IN TUNNEL LINER:

Tunnel Liner, 6 Inches to 42 Inches:

Insert sewer pipe concentrically into tunnel liner by securing factory fabricated molded polyethylene casing spacers around water pipe at no more than 10 foot longitudinal intervals. Provide casing spacers with stainless steel nuts and bolts joining spacer segments.

Plug ends of tunnel with factory fabricated synthetic rubber casing seals secured with stainless steel bands and clamps.

Tunnel Liner, 48 Inches and Larger:

Use the following procedure for installing sewer pipe in tunnel when adequate working room is available, otherwise follow same procedures as specified for tunnel liner, 6 inches to 42 inches.

Insert sewer pipe into tunnel liner after having grouted bottom of tunnel to exact grade required to support pipe in proper position.

Permanently secure sewer pipe in position by blocking each pipe length at top and sides with brick and mortar, followed by bedding sewer pipe to a depth equal to one-fourth the pipe outside diameter, with concrete.

Plug ends of tunnel with 12 inch thickness of masonry, leaving weep holes at lower end of tunnel.

SEWER STRUCTURES:

Conform with applicable provisions of the following sections:

Sewer Structures and Accessories, Section 02776

LINE CLEANING:

Avoid permitting dirt, rubbish, surplus construction material, and other foreign matter to enter structures or pipe during construction. Use whatever means may be necessary to obtain a clean and internally smooth sewer system prior to final acceptance.

SEWER LEAKAGE:

General Leakage Requirements:

Make entire sewer line system as near watertight as practicable. Eliminate all visible points of ground water infiltration, and any other significant points of leakage which can be located.

END SECTION 02770

# SECTION 02776 - SEWER STRUCTURES AND ACCESSORIES

## PART I - GENERAL

### DESCRIPTION OF WORK:

The extent of drainage structures is shown on the drawings.

Related Work Specified Elsewhere:

Trenching and Backfilling, Section 02204

Sanitary Sewer System, Section 02720

Storm Sewer System, Section 02770

## PART 2 - PRODUCTS

### MATERIALS:

Clay Brick: ASTM C 32, Grade MS or ASTM C32 sewer and manhole brick or ASTM C216 facing brick, Grade MW or SW, of nominal size 8 x 2¼ x 3¾ inches.

Concrete Brick: ASTM C 55, Grade P-II, of nominal size 8 x 2¼ x 3¾ inches; gray-white concrete color with smooth formed natural texture.

Rubble Stone: Provide stone not less than six inches thick nor 12 inches wide, and of proper shape to bring masonry structures to true lines, shapes, and elevations; smaller stones may be used to fill interior of walls. Provide stone, free of rounded, worn, weathered and scarred surfaces, and also free of segregation, seams, cracks, pyrite intrusions and other defects tending to reduce weather resistance. Select stone having not less than 65 percent wear in accordance with AASHTO T 96, and having a loss not exceeding 15 percent after five cycles of the magnesium sulfate soundness test in accordance with AASHTO T 104.

Precast Concrete Drainage Structures:

Use precast concrete drainage structures, including precast concrete pipe sections, flared end sections, adjustment rings, tapered sections, drop inlets, manholes, and other related products which conform to the requirements of ASTM C 478 and/or C 1433. Furnish structure having a minimum wall thickness of four inches or one-twelfth the interior diameter, whichever is greater. Accurately cast openings to meet specific project requirements.

Sewer Structure Steps:

Use steps conforming with applicable government safety regulations and the requirements stated below.

Provide individual steps, mortared or cast into walls and conical tops of all manholes and similar structures. Align steps so as to form a continuous ladder with steps equally spaced vertically, no more than 16 inches apart, using steps having a minimum length of 10 inches and which project a minimum clear distance of four inches from the wall. Use steps designed to prevent the foot from sliding off the end, and whose exposed parts are free of any hazardous sharp edges, burrs or projections.

Steps, fastenings and installation must be capable of supporting a single concentrated load of 300 pounds. Use designs based on imposed loads being concentrated at such points as will cause maximum stresses in the structural element being considered.

Plastic coated steel meeting requirements of ASTM C 478, D 2146 and A 615 grade 60.

Metal Castings:

Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion or other significant defects, and having smooth surfaces free of casting sand, fins and burrs. Use component parts which fit together uniformly, in a secure fashion. Where castings have lids or covers, make provisions for non-rocking fit.

Use following casting material:

Gray Iron Castings: ASTM A 48, Class 30.

Shop paint all casting surfaces with not less than one coat of asphaltic paint.

Mortar Materials:

Cement: Portland Cement ASTM C 150, Type I or II.

Sand: ASTM C 144, well screened, clean, hard sharp, siliceous, free from loam, silt and other impurities. Provide the following grain size distribution:

#10 sieve, passing 95-100 percent

#50 sieve, passing 15-40 percent

#l00 sieve, passing 0-10 percent

Removal by decantation 0-5 percent

Water: Clean, fresh, free from oil, acid, organic matter and other deleterious substances.

Mortar Mix Proportions: Provide mortar mixed in the proportion of one part cement to three parts sand with only enough water to allow good workability of the mix. Hydrated lime may be added in amounts not exceeding 10 percent of the cement weight.

## PART 3 - EXECUTION

### Excavation and Backfill:

Conform with applicable provisions of the following:

Trenching and Backfilling, Section 02204

### Pre-Cast Concrete Units:

Set precast units plumb and to exact grade on approximately three inch thickness of compacted sand bedding.

In the event field conditions necessitate additional pipe connections for which no holes have been cast, neatly chip necessary holes, being careful not to crack portions of unit to remain. Replace any units excessively damaged as a result of field modification.

For storm sewer units constructed of more than one precast element, fill all joints solidly with mortar. Use mortar or concrete to seal joints between units and connecting pipe.

For sanitary sewer manholes, fill joints between sections with butyl based sealant especially formulated for sewer service. Use mortar or concrete to seal joints between units and connecting pipe. Supplement connecting joints with manufactured waterstops or seals when recommended by pipe manufacturer or necessary to minimize leakage.

### Metal Castings:

Examine each casting before installation, and reject all castings which are cracked, damaged or in any other way fail to meet the Specifications.

Clean castings of dirt, mud and grease before installation.

Set castings according to location and arrangement shown on the drawings; rigidly support castings to maintain true alignment and elevation. Where castings are located in concrete or mortar construction, thoroughly work concrete or mortar around the casting so as to eliminate voids and provide solid bearing surfaces and rigid construction.

Make frames, subject to traffic, firm and stable under actual traffic conditions. When constructed in paved areas, set frames to conform with exact pavement surface including tilting frame where necessary to match pavement surface.

### Sanitary Sewer Manholes:

Shape inverts and channels neatly so as to permit smooth hydraulic flow.

Use whatever care, materials and construction technique may be required to achieve permanent watertight joints and connections.

FIELD QUALITY CONTROL:

General Leakage Requirements:

Make all sewer structures as near watertight as practicable. Eliminate all visible points of ground water infiltration and any other significant points of leakage which can be located regardless of test results obtained as hereinafter required.

Upon completion of sanitary sewer manhole installation and prior to acceptance and payment for completed work, perform manhole vacuum acceptance test for each newly installed precast concrete manhole.

Manhole Vacuum Testing:

Where adjustment to grade using bricks and mortar is required, test manholes prior to placement of final elevation adjustment and castings.

Perform manhole vacuum tests, using the following general procedures:

Plug all lift holes with a non-shrink grout.

Temporarily plug all pipes entering the manhole and securely brace each plug to prevent them from being pulled into the manhole.

Place the vacuum testing equipment test head at the top of the manhole in accordance with the testing equipment manufacturer's recommendations.

Draw a vacuum of 10 inches of mercury on the manhole and close the valve on the vacuum line of the testing equipment and shot off the vacuum pump. Measure the time for the vacuum to drop to nine inches of mercury.

The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to nine inches of mercury meets or exceeds the values indicated in the following table.

| Depth | Time (Seconds) Per Manhole Diameter | | |
|---|---|---|---|
| | 48" Dia | 60" Dia | 72" Dia |
| 0'- 8' | 20 | 26 | 33 |
| 8'-10' | 25 | 33 | 41 |
| 10'-12' | 30 | 39 | 49 |

| | | | |
|---|---|---|---|
| 12'-14' | 35 | 46 | 57 |
| 14'-16' | 40 | 52 | 67 |
| 16'-18' | 45 | 59 | 73 |
| 18'-20' | 50 | 65 | 81 |
| 20'-22' | 55 | 72 | 89 |
| 22'-24' | 59 | 78 | 97 |
| 24'-26' | 64 | 85 | 105 |
| 26'-28' | 69 | 91 | 113 |
| 28'-30' | 74 | 98 | 121 |

If the manhole fails the initial test, permanently correct excessive leakage determined by manhole vacuum testing and repeat vacuum test until the City witnesses a successful test.

END SECTION 02776

# DRAINAGE MANUAL

FOR THE

## City of Union City, Georgia

Prepared by

KECK & WOOD, INC.
2750 Premiere Pkwy
Suite 900
Duluth, GA 30097

APRIL 1995

# INTRODUCTION

As the use and character of land changes due to the growth of Union City, it is important to recognize the adverse effects those changes can have on natural and man-made systems. Applying reasonable solutions project by project is much easier and more cost effective than ignoring negative impacts until they become monumental problems.

Drainage affords an excellent example of this point. Up until the early 1970's, urban growth was accomplished without consideration that storm water runoff and soil erosion were dramatically increased by development. The result of this approach was often heavy siltation and flooding. Even though modern detention and erosion control regulations have eased the problems, many cities still suffer drainage woes stemming from years of poor storm water management.

The purpose of this manual is to establish criteria for dealing with drainage for all projects within the City of Union City. Set forth herein are policies, methods and techniques to be used in developing drainage improvements on a consistent basis throughout the City.

It must be recognized that this manual is not intended to be a complete reference on drainage nor is it expected to cover every situation which may arise. The manual is to serve as a guide to engineers versed in drainage analysis and design. Unique circumstances requiring special or alternative design methods should be brought to the attention of the City early in project life so that agreement on problem approach can be reached without impacting project progress.

Manual users are encouraged to comment on its contents so that it may be made as useful and applicable as possible.

# CHAPTER 1

# DESIGN POLICY

## Hydrology

For drainage areas containing 50 acres or less, designs are to be based on the Rational Method. Designs for areas containing more than 50 acres are to be based on a method approved by the City Engineer for the specific basin. Normally, the Soil Conservation Service method or the U.S.G.S. Flood Frequency Relation Method may be used.

Within the City of Union City, Georgia, the Burkli-Ziegler formula and the Talbot formula are not considered appropriate.

## Culverts and Piped Systems

1. Culverts are to be designed for a 50 year frequency flood event. The area inundated by the design event is to be contained in a drainage easement.

2. Piped storm drainage systems are to be designed for a 25 year frequency storm event in non-residential areas and for a 10 year frequency storm event in residential areas. Catch basins are to be spaced so that the maximum gutter spread is six feet or less for the design storm event.

3. The minimum pipe size to be used as a culvert or in a piped system is 15 inch diameter.

4. Under City streets, all pipe used for culverts and storm drainage systems is to be reinforced concrete. Corrugated plastic pipe may also be used for culverts and storm drainage systems not under City streets. Pipe class for reinforced concrete is to be determined for actual conditions anticipated for each specific application but not less than class III. The designer may select round pipe conforming to ASTM C76, arch pipe conforming to ASTM C506 or elliptical pipe conforming to ASTM C507.

5. For concrete culvert and pipe systems, a roughness coefficient (Manning's n) of 0.012 is to be used. For corrugated plastic culvert and pipe systems a roughness coefficient (Manning's n) of 0.020 is to be used.

6. The minimum velocity in a pipe flowing full is to be 2.0 feet per second. The maximum velocity in a pipe flowing full is to be 12.0 feet per second. The exit velocity of culvert and pipe systems is to be controlled and modified to prevent channel erosion or scour.

7. The absolute minimum clearance between the bottom of the paving base or subbase and the exterior crown of the storm drain pipe or culvert is to be 1.0 foot. A clearance of 2.0 feet is considered more desirable and should be achieved if possible.

Detention Facilities

1. Detention facilities are required for any project when the runoff is increased by more than 1.0 cubic foot per second for a 10 year frequency storm event.

2. The peak release rate of storm water from a project is not to be increased from the pre developed state for all intensities up to and including the 100 year event. Specific storm events to be examined include the 2, 5, 10, 25, 50 and 100 year return frequency.

3. Detention facilities located on paved areas used for parking or vehicular access are discouraged. The depth of water in a detention facility located on paved areas also used for vehicular purposes is limited to six inches. The depth of water in a detention facility located on paved areas also used for parking is limited to two inches.

# CHAPTER 2

# DATA COLLECTION

## Drainage Basin Size

The size of drainage basin(s) for a project is to be determined from:

1. Field survey using conventional topographic techniques,

2. Aerial topographic maps of the project,

3. Aerial topographic maps available through Fulton County,

4. Other maps acceptable to the City.

## Land Use

In drainage basins having limits beyond the boundaries of a project, land use outside the project will be considered as either 1) the existing development or 2) natural undeveloped as appropriate.

## Soil Conditions

The soil conditions for a project are to be determined from:

1. Field survey of project site soils.

2. Soil Survey of Fulton County, Georgia
   U. S. Department of Agriculture
   Soil Conservation Service

Existing Storm Drains

Careful field investigation is required to locate existing storm drains which drain into or are located within a project. Data on pipe or culvert material, size, slope, entrance and exit conditions should be recorded. Any construction record information on existing storm drains will be made available at City Hall through the Public Works Department. This data must be field verified as the City cannot assure correctness or accuracy of record information.

# CHAPTER 3

# RATIONAL METHOD

## Rational Method Formula

The rational method provides a means to relate rainfall to storm water runoff. The formula, expressed below, gives peak runoff in cubic feet per second from a drainage basin.

$Q = CIA$

- Q = the peak runoff in cubic feet per second.
- C = a coefficient representing the ratio of runoff to rainfall.
- I = the average rainfall intensity in inches per hour for a duration equal to the time of concentration (Tc).
- A = the drainage area in acres.

## Runoff Coefficient

The selection of a runoff coefficient (C) is judgmental. To choose a realistic valve, the engineer must consider soil type and moisture content, topography, land use and imperviousness of the drainage area. Table 3-1 presents typical values which are characteristic of the Fairburn (Palmetto, Union City) area.

## Time of Concentration

The time of concentration (Tc) is the time in minutes required for runoff to flow from the most hydraulically remote point in the drainage area to the point under investigation. It is taken as the sum of the inlet time and the travel time. Inlet time is the time storm water is flowing overland to the nearest pipe, channel or natural waterway. Figure 3-2, taken from the U.S.D.A., is to be used to establish overland flow velocities for calculating inlet time.

TABLE 3-1

RUNOFF COEFFICIENTS FOR VARIOUS LAND-USES

| Slope | Land-Use | Sandy Soils Min. | Sandy Soils Max. | Clay Soils Min. | Clay Soils Max. |
|---|---|---|---|---|---|
| Flat (0-2%) | Woodlands | 0.10 | 0.15 | 0.15 | 0.20 |
| | *Pasture, grass & farmland | 0.15 | 0.20 | 0.20 | 0.25 |
| | Rooftops and pavement | 0.95 | | 0.95 | |
| | Single family residential: | | | | |
| | 1/2 acre lots & larger | 0.30 | 0.35 | 0.35 | 0.45 |
| | Smaller lots | 0.35 | 0.45 | 0.40 | 0.50 |
| | Multi-family residential: | | | | |
| | Duplexes | 0.35 | 0.45 | 0.40 | 0.50 |
| | Apartments, townhouses, and condominiums | 0.45 | 0.60 | 0.50 | 0.70 |
| | Commercial and Industrial | 0.50 | 0.95 | 0.50 | 0.95 |
| Rolling (2-7%) | Woodlands | 0.15 | 0.20 | 0.20 | 0.25 |
| | *Pasture, grass & farmland | 0.20 | 0.25 | 0.25 | 0.30 |
| | Rooftops and pavement | 0.95 | | 0.95 | |
| | Single family residential: | | | | |
| | 1/2 acre lots & larger | 0.35 | 0.50 | 0.40 | 0.55 |
| | Smaller lots | 0.40 | 0.55 | 0.45 | 0.60 |
| | Multi-family residential: | | | | |
| | Duplexes | 0.40 | 0.55 | 0.45 | 0.60 |
| | Apartments, townhouses, and condominiums | 0.50 | 0 70 | 0.60 | 0.80 |
| | Commercial and Industrial | 0.50 | 0.95 | 0.60 | 0.95 |
| Steep (7%+) | Woodlands | 0.20 | 0.25 | 0.25 | 0.30 |
| | *Pasture, grass & farmland | 0.25 | 0.35 | 0.30 | 0.40 |
| | Rooftops and pavement | 0.95 | | 0.95 | |
| | Single family residential: | | | | |
| | 1/2 acre lots & larger | 0.40 | 0.55 | 0.50 | 0.65 |
| | Smaller lots | 0.45 | 0.60 | 0.55 | 0.70 |
| | Multi-family residential: | | | | |
| | Duplexes | 0.45 | 0.60 | 0.55 | 0.70 |
| | Apartments, townhouses, and condominiums | 0.60 | 0.75 | 0.65 | 0.85 |
| | Commercial and Industrial | 0.60 | 0.95 | 0.65 | 0.95 |

* Coefficients assume good ground cover.

Travel time is the time storm water is flowing a pipe, channel or natural waterway. Velocities determined from the Manning Equation are to be used for calculating travel times.

The minimum time of concentration which can be used for any drainage basin is to be 5 minutes.

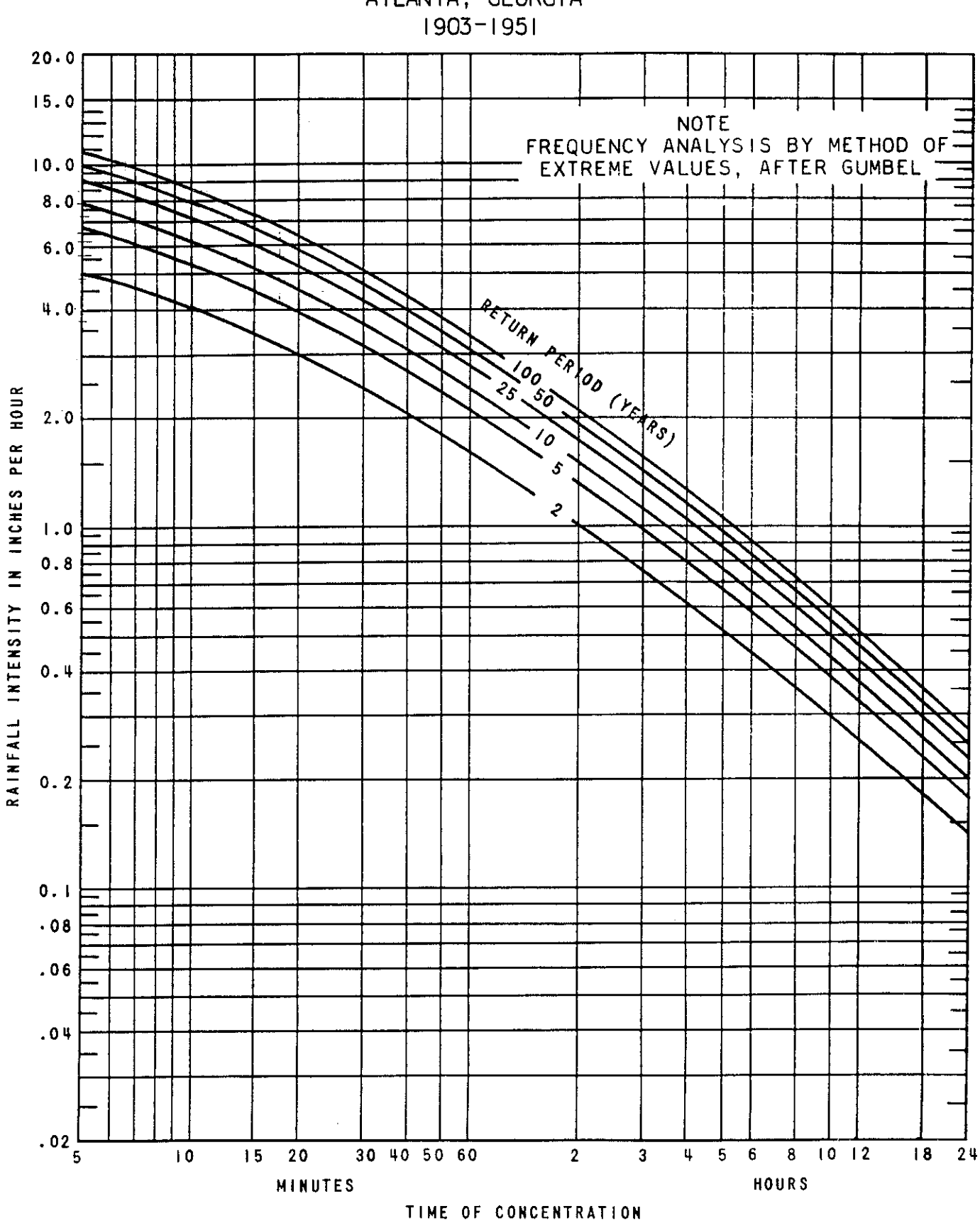
## Rainfall Intensity

Intensities (I) to be used in the Rational Formula are to be selected from Figure 3-1 for the appropriate time of concentration. This family of intensity-frequency-duration curves was developed from Weather Bureau Technical Paper No. 25.

## Drainage Area

The drainage area (A) in acres should be determined from field verified topographic maps and/or surveys of the drainage basin.

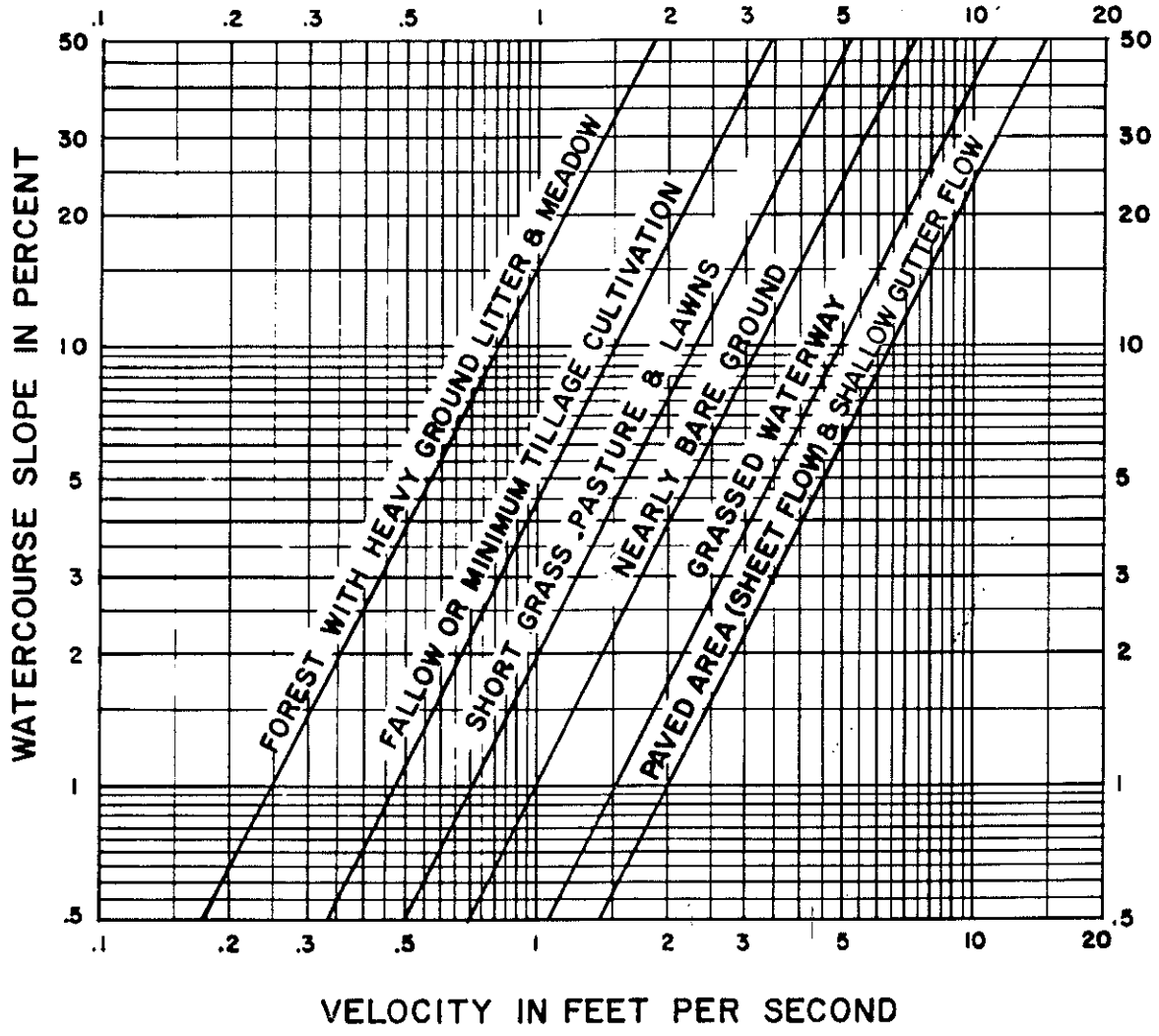
# FIGURE 3-1




WEATHER BUREAU
TECHNICAL PAPER 25

## FIGURE 3-2

### AVERAGE VELOCITIES FOR ESTIMATING OVERLAND FLOW TIME




URBAN HYDROLOGY FOR SMALL WATERSHEDS
TECHNICAL RELEASE NO. 55
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
JANUARY 1975

# EXAMPLE NO. 1

Compute the peak runoff rate expected from a 50 year frequency storm event at a cross drain entrance in a proposal single family subdivision utilizing the Rational Formula.

## Information from Data Collection Activities

| | | |
|---|---|---|
| Drainage Area | = | 54 acres |
| Average Slope of Drainage Area | = | 3% |
| Length of Overland Flow | = | 560' at 6% slope |
| Ground Cover | = | Minimum Tillage |
| Length of Drainage Ditch | = | 200' at 1% slope |
| Predominant Soil Type | = | Loamy Sand |
| Exist Land Use | | |
| Woodland | | 15 acres |
| Farmland and Pasture | | 7 acres |
| Single Family Residential (3/4 acre lots) | | 11 acres |
| Single Family Residential (1/3 acre lots) | | 17 acres |
| Commercial | | 4 acres |

## Composite "C" Value

| Land Use | Area - A | C* | CXA |
|---|---|---|---|
| Woodland | 5 | 0.20 | 3.00 |
| Farmland & Pasture | 7 | 0.25 | 1.75 |
| SFR (3/4 acre lots) | 11 | 0.50 | 5.50 |
| SFR (1/3 acre lots) | 17 | 0.55 | 9.35 |
| Commercial | 4 | 0.75 | 3.00 |
| | 54 acres | | 22.60 |

$$\text{Composite C} = \frac{CXA}{A} = \frac{22.60}{54} = 0.42$$

* Based on Table 3-1 and site investigation.

Time of Concentration

Time of Concentration (Tc) = Inlet Time + Travel Time

$$\text{Inlet Time} = \frac{\text{Length of Travel}}{\text{Average Velocity}} = \frac{560 \text{ ft.}}{1.2 \text{ fps}} = 467 \text{ sec.}$$

$$\text{Travel Time} = \frac{\text{Length Drainage Ditch}}{\text{Average Velocity}} = \frac{1300 \text{ ft.}}{3 \text{ fps}} = 400 \text{ sec.}$$

Tc = 467 + 400 = 867 sec. = 14.5 min.

Rainfall Intensity

$I_{50}$ = 8.0 in/hr From Figure 3-1

Peak Run-off

Q = CIA
= 0.42 x 8.0 x 54
= 181.4 cubic feet per second

# CHAPTER 4

# DETENTION FACILITIES

## Design Methods

Small Drainage Areas (3 acres or less):

To determine detention requirements for small drainage areas of 3 acres or less, the "bowstring" method may be used. By this method, storage required is equal to the maximum difference between the total inflow (based on post development conditions) less the total outflow (based on natural undevelopment conditions). Example No. 2 at the end of this chapter illustrates the "bowstring" method. The designer may also use the reservoir routing method.

Drainage Areas Over 3 Acres:

For drainage areas over 3 acres in size, the reservoir routing method is to be used to establish detention requirements. The basic technique of this method calls for repetitive solution to the continuity equation. The formula of the equation utilized is:

$$I_1 + I_2 + \frac{2S_1}{t} - O_1 = \frac{2S_2}{t} + O_2$$

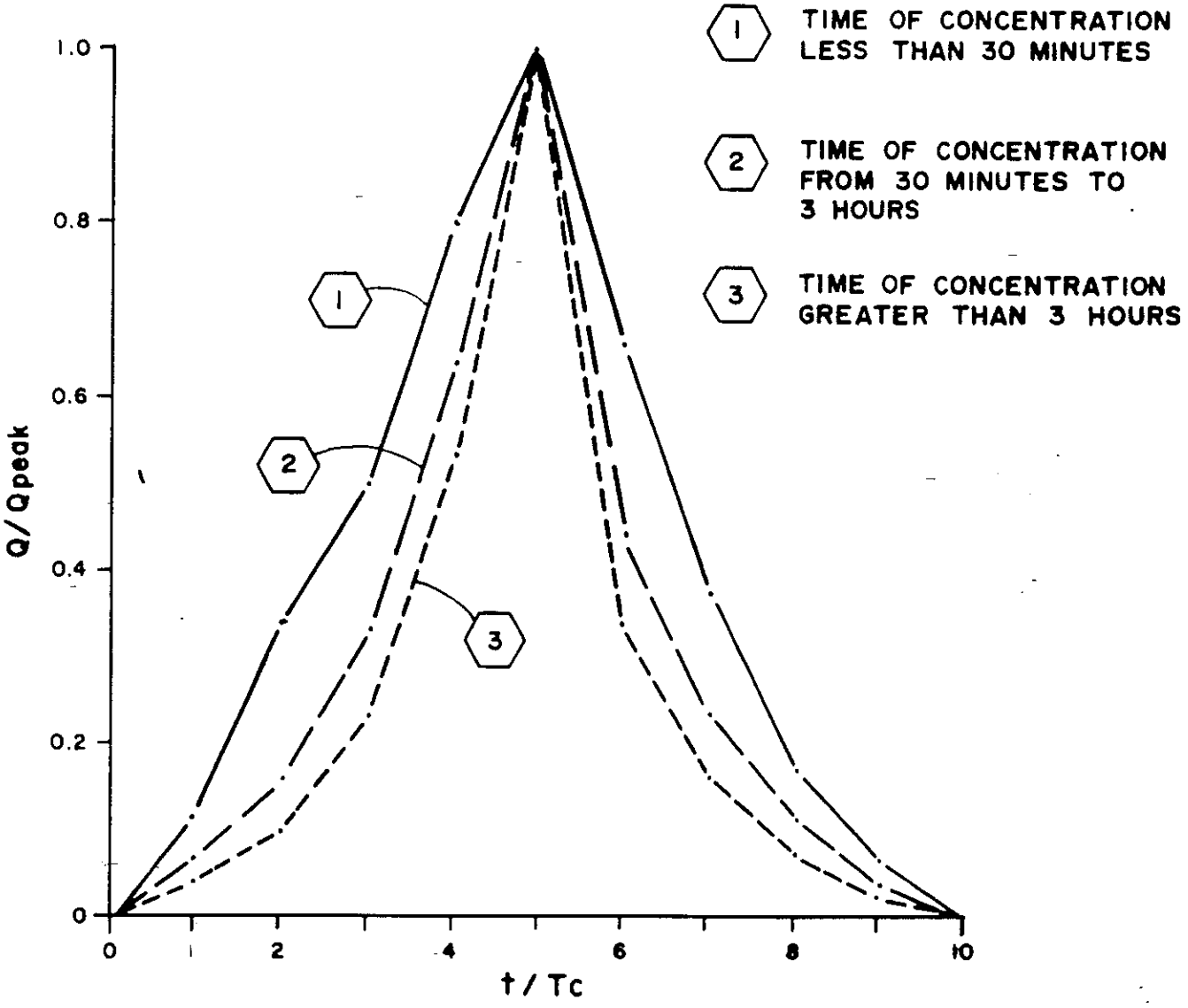
Where

| | | |
|---|---|---|
| $t$ | = | a selected time interval |
| $I_1$ | = | inflow at the start of the time interval |
| $O_1$ | = | outflow at the start of the time interval |
| $S_1$ | = | storage at the start of the time interval |
| $I_2$ | = | inflow at the end of the time interval |
| $O_2$ | = | outflow at the end of the time interval |
| $S_2$ | = | storage at the end of the time interval |

The inflow hydrograph for the reservoir routing metered is to be developed from the appropriate unit hydrograph on Figure 4-1.

The reservoir routing method is illustrated by Example No. 3 at the end of this chapter.

# FIGURE 4-1
# DIMENSIONLESS HYDROGRAPHS FOR DETENTION FACILITY DESIGN RESERVOIR ROUTING METHOD




| t/Tc | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.12 | 0.34 | 0.50 | 0.80 | 1.00 | 0.66 | 0.37 | 0.17 | 0.06 | 0.00 |
| 2 | 0.07 | 0.16 | 0.33 | 0.64 | 1.00 | 0.44 | 0.23 | 0.11 | 0.03 | 0.00 |
| 3 | 0.04 | 0.10 | 0.23 | 0.53 | 1.00 | 0.34 | 0.16 | 0.07 | 0.02 | 0.00 |

## Design Storms

In determining detention design, the engineer must evaluate the 2, 5, 10, 25, 50 and 100 year return frequency storm events. Under all events analyzed, the peak natural undeveloped runoff is not to be exceeded. In determining the peak natural undeveloped runoff, a runoff coefficient (c) not exceeding 0.3 must be used unless a higher coefficient can be demonstrated by fact. All such higher values must have the written concurrence of the City Engineer.

## Emergency Overflow

Detention facilities should be suitable for storing excessive post development runoff for all storm events through the 100 year frequency. Because, however, the 100 year event can be exceeded and because outlet works can become partially or totally blocked, the design engineer must provide an emergency overflow for all detention facilities. The emergency overflow should direct flows to minimize property damage and avoid risk to people.

## Freeboard

Detention facilities for sites of 2 acres or less should have a freeboard of not less than six inches. For sites exceeding 2 acres, the freeboard should be not less than one foot. Freeboard is defined as the difference between the detention facility water surface elevation for the 100 year frequency storm event and the lowest elevation of the detention basin, excluding the emergency overflow.

# EXAMPLE NO. 2

Design the detention facility required to serve a 12,000 square foot neighborhood shopping center located on a square 1.4 acre site. For purposes of this example consider only a 5 year frequency storm. The existing site is a wooded lot.

## Allowable Release Rate

| | | |
|---|---|---|
| Time of concentration (Tc) | = | 11 minutes |
| Intensity (5) | = | 6.5 in/hr. (From Figure 3-1) |
| C factor | = | 0.20 (From Table 3-1) |
| Allowable Release Rate | = | CIA |
| | = | 0.20 x 6.5 x 1.4 |
| | = | 1.82 cfs |

## Inflow

Determine post development "C" factor.

| Use | Area | C | CXA |
|---|---|---|---|
| Roof or Paving | 0.64 | 0.95 | 0.61 |
| Grassed Lawn | 0.33 | 0.30 | 0.10 |
| Undisturbed Natural | 0.43 | 0.20 | 0.09 |
| | 1.43 acres | | 0.08 |

$$\text{Composite C} = \frac{CXA}{A} = \frac{0.80}{1.40} = 0.57$$

$$\text{Inflow} = C \times A \times I_t \times 60_t$$

| t<br>min | $60_t$<br>sec | $I_t$<br>in/hr | CXA | Inflow<br>C.F. |
|---|---|---|---|---|
| 0 | 0 | 0 | 0.82 | 0 |
| 5 | 300 | 8.5 | 0.82 | 2091 |
| 10 | 600 | 6.5 | 0.82 | 3198 |
| 15 | 900 | 5.4 | 0.82 | 3985 |
| 20 | 1200 | 4.8 | 0.82 | 4723 |
| 30 | 1800 | 3.9 | 0.82 | 5756 |
| 40 | 2400 | 3.2 | 0.82 | 6298 |
| 50 | 3000 | 2.8 | 0.82 | 6888 |
| 60 | 3600 | 2.5 | 0.82 | 7380 |

Outflow

Outflow = Allowable Release Rate x $60_t$

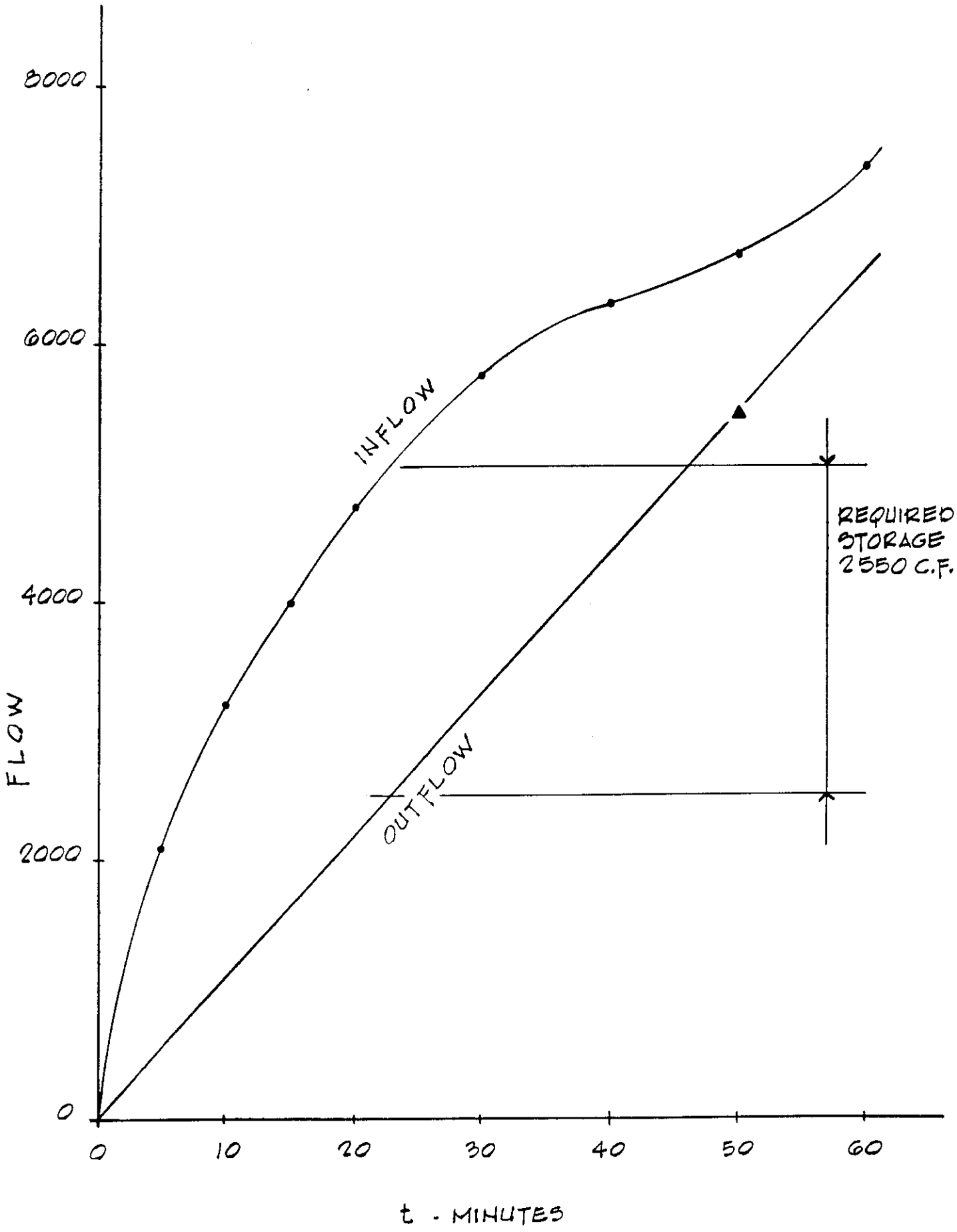
| t<br>min | $60_t$<br>sec | ARR<br>C.F.S. | Outflow<br>C.F.S. |
|---|---|---|---|
| 0 | 0 | 1.82 | 0 |
| 50 | 3000 | 1.82 | 5460 |

Plot inflow and outflow on graph. Maximum difference between two plots represents required storage.

Assume maximum storage depth of 3.0 feet.

$$\frac{\text{Required Storage}}{\text{Depth}} = \text{Surface Area at mid depth}$$

$$\frac{2400}{3} = 800 \text{ SF}$$


8000
6000
4000
2000
0
FLOW
INFLOW
OUTFLOW
REQUIRED
STORAGE
2550 C.F.
0
10
20
30
40
50
60
t - MINUTES

Select 20' x 40' x 3.0' deep pond with 3:1 side slopes for maintenance. Allow 1.0' freeboard except an emergency spillway, where 0.5' freeboard is to be used.

Outlet Device Design

Select "V" notch weir box. (Design engineer may choose any outlet device which properly regulates discharge from detention facility)

$H_{max} = 3.0$ ft, $Q_{max} = 1.82$ cts

$$Q = 2.5 \tan \frac{\varnothing}{2} H^{5}/2$$

$$1.82 = 2.5 \tan \frac{\varnothing}{2} 3^{5}/2$$

$$\frac{1.82}{2.5} = \tan \frac{\varnothing}{2} 15.59$$

$$\frac{0.728}{15.59} = \tan \frac{\varnothing}{2}$$

$$0.04669 = \tan \frac{\varnothing}{2}$$

$$2.7^{\circ} = \frac{\varnothing}{2}$$

$$\varnothing = 5.4^{\circ}$$

Use $5^{\circ}$ "V" notch weir.

# EXAMPLE NO. 3

Design the detention facility required to serve a 102 unit motel located on a 7.9 acre site. For purposes of this example consider only a 50 year frequency storm. The existing site consist of 2.7 acres of wooded area and the remainder is pasture.

## Allowable Release Rate

Time of concentration = 20 minutes
Intensity (I50) = 6.7 in/hr (From Figure 3-1)
C factor =

| Use | Area | C | CXA |
|---|---|---|---|
| Woodland | 2.7 | 0.20 | 0.54 |
| Pasture | 5.2 | 0.25 | 1.30 |
| | 7.9 | | 1.84 |

$$C = \frac{CXA}{A} = \frac{1.84}{7.9} = 0.23$$

Allowable Release Rate = CIA
= 0.23 x 6.7 x 7.9
= 12.17 cfs

## Inflow

Determine time of concentration and peak flow for developed condition.

Time of concentration = 10 minutes
Intensity ($I_{50}$) = 9.2 in/hr (From Figure 3-1)

C factor =

| Use | Area | C | CXA |
|---|---|---|---|
| Building & Paving | 2.2 | 0.95 | 2.09 |
| Lawn | 3.1 | 0.25 | 0.78 |
| Natural | 2.6 | 0.15 | 0.39 |
| | 7.9 acres | | 3.26 |

$$C = \frac{CXA}{A} = \frac{3.26}{7.9} = 0.41$$

Peak Runoff = Q = CIA
= 0.41 x 9.2 x 7.9
= 29.80 cfs

Using unit hydrograph 1 on Figure 4-1, develop inflow hydrograph.

| t/Tc | t minutes | Q/Q peak | Q CFS |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 | 10 | 0.12 | 4 |
| 2 | 20 | 0.34 | 10 |
| 3 | 30 | 0.50 | 15 |
| 4 | 40 | 0.80 | 24 |
| 5 | 50 | 1.00 | 30 |
| 6 | 60 | 0.66 | 20 |
| 7 | 70 | 0.37 | 11 |
| 8 | 80 | 0.17 | 5 |
| 9 | 90 | 0.06 | 2 |
| 10 | 100 | 0.00 | 0 |

Storage Approximation

Determine approximate storage volume required by the "bowstring" method or by:

Storage = (Qdev. - Qundev.) x 300 Tc
= (29.8 - 12.2) x 300 x 10
= 52,800 c.f.

Assume 3 foot depth
Pond area = 52,800/3
= 17,600 S.F.

Because this is approximate, select 150' x 150' pond (at mid depth) with 3 on 1 side slopes. (Note: At this point, designer may select any type or shape storage facility).

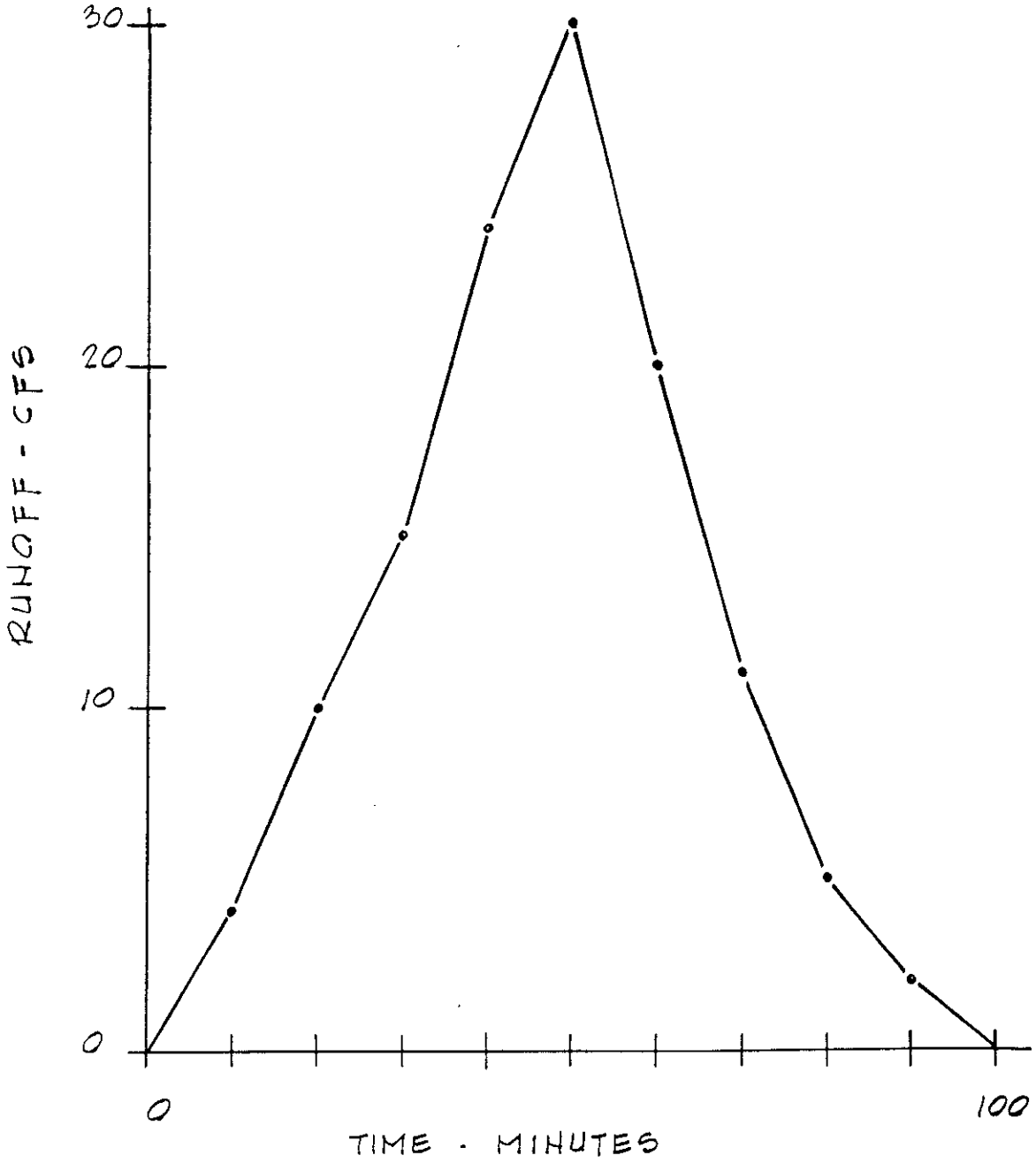
Stage Storage Curve:

Based on storage facility, prepare a stage - storage curve.

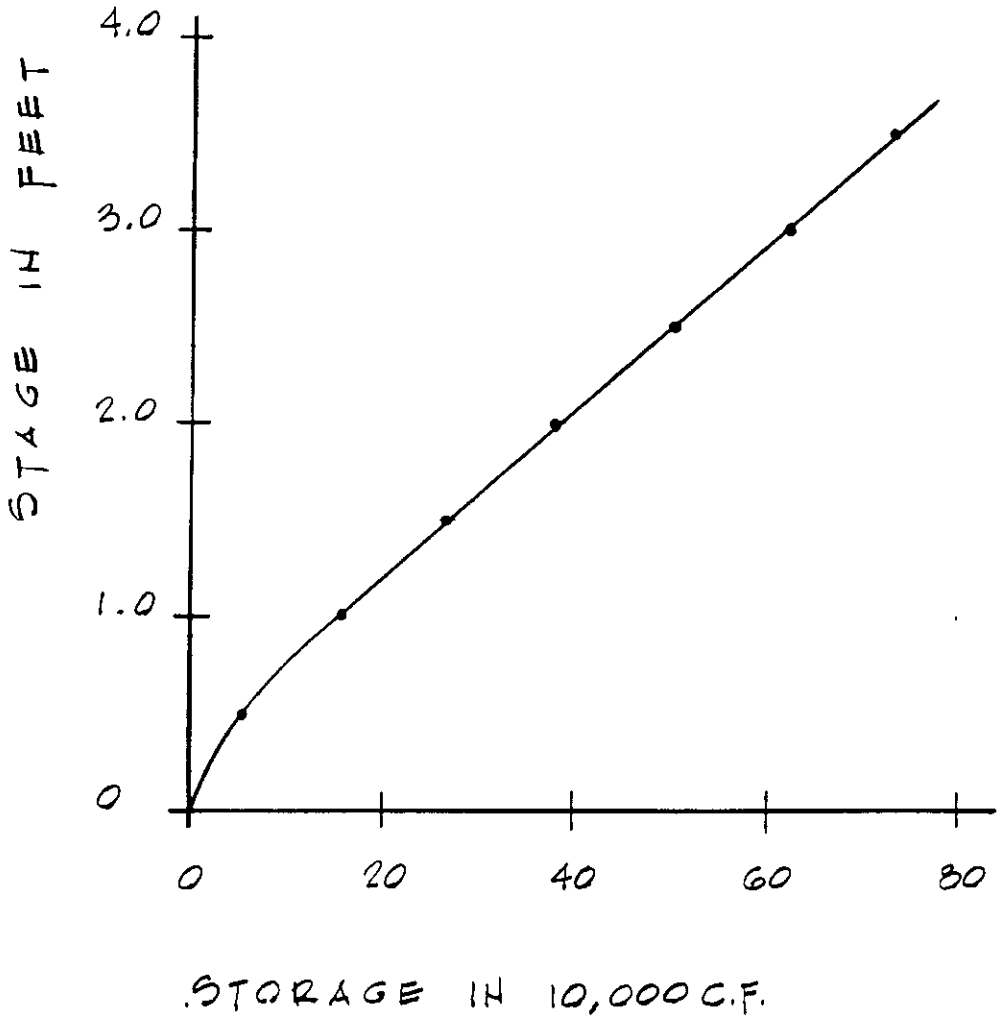
Stage - Discharge Curve:

Select trial discharge control structure. For this example, a 20° "V" notch weir box is chosen.

| Depth Ft | Outflow Cfs |
|---|---|
| 0.0 | 0.00 |
| 0.5 | 0.07 |
| 1.0 | 0.44 |
| 1.5 | 1.21 |
| 2.0 | 2.49 |
| 2.5 | 4.35 |
| 3.0 | 6.87 |
| 3.5 | 10.10 |
| 4.0 | 14.10 |


30
20
10
0
RUNOFF - CFS
0
100
TIME - MINUTES

Insert Storage in 10,000 cfs chart



| Stage ft | Area sf | Volume cf | Storage cf |
|---|---|---|---|
| 0 | 0 | | 0 |
| | | 5,184 | |
| 0.5 | 20,736 | | 5,184 |
| | | 10,586 | |
| 1.0 | 21,609 | | 15,770 |
| | | 11,027 | |
| 1.5 | 22,500 | | 26,797 |
| | | 11,477 | |
| 2.0 | 23,409 | | 38,274 |
| | | 11,936 | |
| 2.5 | 24,336 | | 50,210 |
| | | 12,404 | |
| 3.0 | 25,281 | | 62,614 |
| | | 12,881 | |
| 3.5 | 26,244 | | 75,495 |

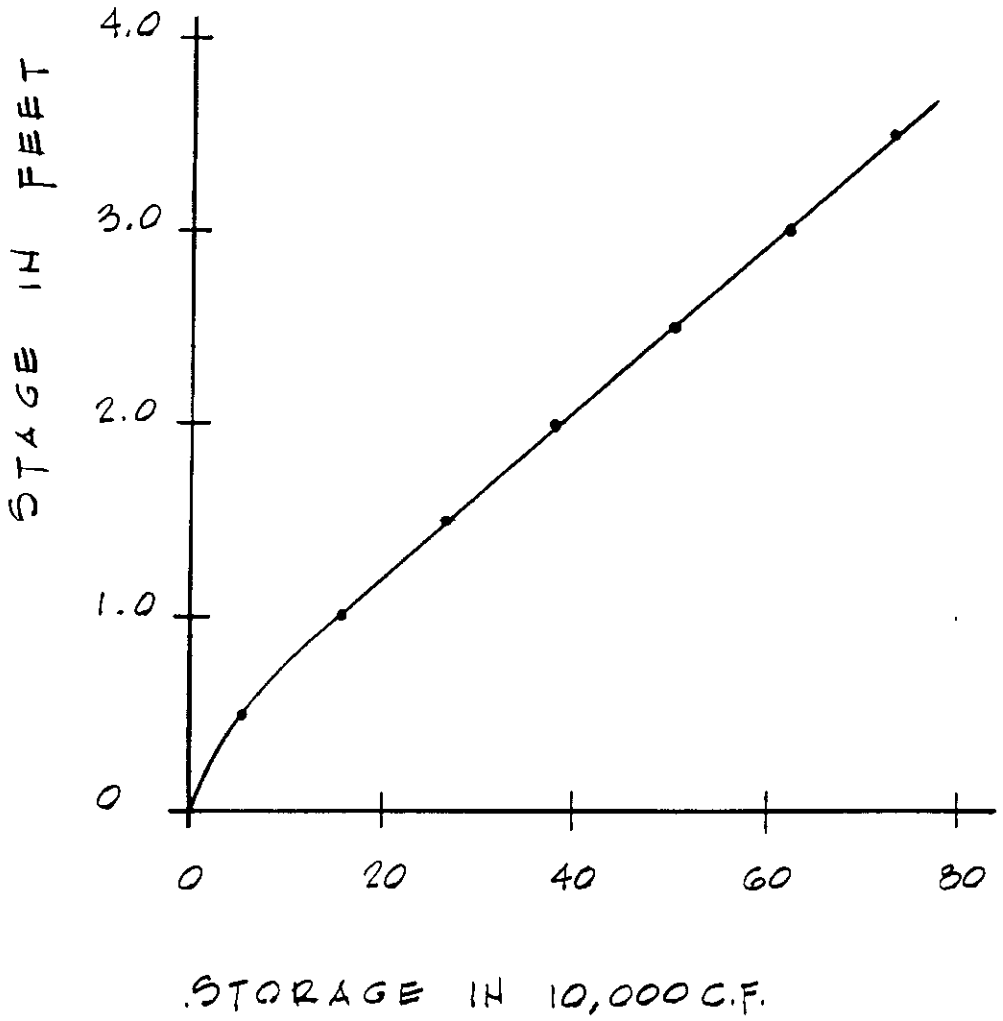
Routing Curve

Prepare a routing curve from stage discharge and stage-storage curves. Use a routing period equal to half of the time of concentration.

Routing Period (t) = Tc/2 = 10/2 = 5 min. = 300 sec.

| Stage ft | Storage cf | 2S/t cfs | 0 cfs | 25/t + 0 cfs |
|---|---|---|---|---|
| 0.0 | 0 | 0 | 0 | 0 |
| 0.5 | 5,184 | 34.6 | 0.1 | 34.7 |
| 1.0 | 15,770 | 105.1 | 0.4 | 105.5 |
| 1.5 | 26,797 | 178.6 | 1.2 | 179.8 |
| 2.0 | 38,274 | 255.2 | 2.5 | 257.7 |
| 2.5 | 50,210 | 334.7 | 4.4 | 339.1 |
| 3.0 | 62,614 | 417.4 | 6.9 | 424.3 |
| 3.5 | 75,495 | 503.3 | 10.1 | 513.4 |

Insert Storage in 10,000 cfs chart



Routing Calculations

$I_1 + I_2 + (2S_1/t - O_1) = 2S_2/t + O_2$

| t | $I_1$ | $I_2$ | $2S_1/t$ | $O_1$ | $2S_2/t$ | $O_2$ | $2S_2/t$ |
|---|---|---|---|---|---|---|---|
| min | cfs | cfs | cfs | cfs | cfs | cfs | cfs |
| 5 | 0 | 2 | 0 | 0 | 2 | 0 | 2 |
| 10 | 2 | 4 | 2 | 0 | 8 | 0 | 8 |
| 15 | 4 | 7 | 8 | 0 | 19 | 0 | 19 |
| 20 | 7 | 10 | 19 | 0 | 36 | 0.1 | 35.9 |
| 25 | 10 | 13 | 35.9 | 0.1 | 58.8 | 0.2 | 58.6 |
| 30 | 13 | 15 | 58.6 | 0.2 | 86.4 | 0.3 | 86.1 |
| 35 | 15 | 20 | 86.1 | 0.3 | 120.8 | 0.6 | 120.2 |
| 40 | 20 | 24 | 120.2 | 0.6 | 163.6 | 1.0 | 162.6 |
| 45 | 24 | 27 | 162.6 | 1.0 | 212.6 | 1.8 | 210.8 |
| 50 | 27 | 30 | 210.8 | 1.8 | 266.0 | 2.8 | 263.2 |
| 55 | 30 | 25 | 263.2 | 2.8 | 315.4 | 3.9 | 311.5 |
| 60 | 25 | 20 | 311.5 | 3.9 | 352.6 | 4.9 | 347.7 |
| 65 | 20 | 16 | 347.7 | 4.9 | 378.8 | 5.7 | 373.1 |
| 70 | 16 | 11 | 373.1 | 5.7 | 394.4 | 6.2 | 388.2 |
| 75 | 11 | 8 | 388.2 | 6.2 | 401.0 | 6.4 | 394.6 |
| 80 | 8 | 5 | 394.6 | 6.4 | 401.2 | 6.4 | 394.8 |
| 85 | 5 | 3 | 394.8 | 6.4 | 396.4 | 6.3 | 390.1 |
| 90 | 3 | 2 | 390.1 | 6.3 | 383.8 | 5.9 | 377.9 |
| 95 | 2 | 1 | 377.9 | 5.9 | 375.0 | 5.6 | 369.4 |
| 100 | 1 | 0 | 369.4 | 5.6 | 364.8 | 5.3 | 359.5 |

Maximum release rate is 6.4 cfs at 80 min which is less than allowable release rate of 12.17 cfs. The proposed design is therefore acceptable. (NOTE: At this point, engineer can 1) proceed to verify other frequency storm events or 2) refine design to get maximum release rate closer to allowable release rate.

# CHAPTER 5

# OPEN CHANNELS

## Design

Improved open channels used as a part of a storm drainage system should be sized to accommodate flows for the storm events given in Chapter 1 of this manual. Flow velocities and depths should be determined from the Manning equation.

A channel system consist of its 1) cross section configuration, 2) horizontal alignment, 3) slope or grade and 4) surface materials. These components must be combined so that the resulting system prevents erosion. The actual selection of system components is left to the design engineer.

The minimum channel conditions the design engineer must achieve are 1) not less than an established grass lining and 2) a lined freeboard of at least 6 inches above the 10 year frequency storm flow.

## Manning "n"

For channel calculations, select the appropriate roughness coefficient from the chart at the end of this chapter. The chart was taken from the Georgia Department of Transportation Manual on Drainage Design for Highways.

## Allowable Velocities

The maximum permissible velocities in channels lined with uniform stands of various grass covers, are not to exceed the values given in the table on the following page. This table is from the Manual for Erosion and Sediment Control in Georgia.

## MANNING'S ROUGHNESS COEFFICIENTS "n"

| Channel Description | "n" Range Construction 1/ Good | Fair |
|---|---|---|
| CLOSED CONDUITS | | |
| a. Concrete Pipe | 0.012 | 0.015 |
| b. Corrugated Metal Pipe or Pipe-Arch | | |
| (1) 2-2/3" x 1/2" Corrugation (Riveted) | | |
| (a) Plain or coated | 0.024 | |
| (b) Paved invert | | |
| Flowing full under pressure | 0.021 | 0.018 |
| Part full, depth 0.8 D | 0.021 | 0.016 |
| (2) 6" x 2" Corrugation (Field-Bolted) | | |
| (a) Plain or coated | 0.03 | |
| c. Vitrified Clay Pipe | 0.012 | 0.014 |
| d. Cast Iron Pipe, Uncoated | 0.013 | |
| e. Steel Pipe | 0.009 | 0.011 |
| f. Brick | 0.014 | 0.017 |
| g. Monolithic Concrete | | |
| (1) Wood forms, rough | 0.015 | 0.017 |
| (2) Wood forms, smooth | 0.012 | 0.014 |
| (3) Steel forms | 0.012 | 0.013 |
| h. Cemented Rubble Masonry Walls | | |
| (1) Concrete floor and top | 0.017 | 0.022 |
| (2) Natural floor | 0.019 | 0.025 |
| OPEN CHANNELS, LINED 3/ | | |
| Straight Alignment 4/ | | |
| a. Concrete surfaces | | |
| (1) Formed, no finish | 0.013 | 0.017 |
| (2) Trowel finish | 0.012 | 0.014 |
| (3) Float finish | 0.013 | 0.015 |
| (4) Gunite, good section | 0.016 | 0.019 |
| (5) Gunite, wavy section | 0.018 | 0.022 |
| b. Concrete bottom float-finished, sides of | | |
| (1) Dressed stone in mortar | 0.015 | 0.017 |
| (2) Random stone in mortar | 0.017 | 0.020 |

| | | | |
|---|---|---|---|
| (4) | Dry rubble (riprap) | 0.020 | 0.030 |
| c. | Gravel bottom, sides of | | |
| (1) | Formed Concrete | 0.017 | 0.020 |
| (2) | Random stone in mortar | 0.020 | 0.023 |
| (3) | Dry rubble (riprap) | 0.023 | 0.033 |
| d. | Brick | 0.014 | 0.017 |
| e. | Asphalt | | |
| (1) | Smooth | 0.013 | |
| (2) | Rough | 0.016 | |
| f. | Concrete lined excavated rock | | |
| (1) | Good section | 0.017 | 0.020 |
| (2) | Irregular section | 0.022 | 0.027 |
| g. | Flumes (steep slope) 5 / | | |

OPEN CHANNELS – EXCAVATED 3 /
Straight alignment 4 / Natural lining

**Channel Description**

| | | | |
|---|---|---|---|
| a. | Earth, uniform section | | |
| (1) | Clean, recently completed | 0.016 | 0.018 |
| (2) | Clean, after weathering | 0.018 | 0.020 |
| (3) | With short grass, few weeds | 0.022 | 0.027 |
| (4) | Gravel, uniform section, clean | 0.022 | 0.027 |
| b. | Earth, fairly uniform section | | |
| (1) | No vegetation | 0.022 | 0.025 |
| (2) | Grass, some weeds | 0.025 | 0.030 |
| (3) | Dense weeds or aquatic plants in deep channels | 0.030 | 0.035 |
| (4) | Sides clean, gravel bottom | 0.025 | 0.030 |
| (5) | Sides clean, cobble bottom | 0.030 | 0.040 |
| c. | Dragline excavated or dredged | | |
| (1) | No vegetation | 0.028 | 0.033 |
| (2) | Light brush on banks | 0.035 | 0.050 |
| d. | Rock | | |
| (1) | Based on design section | 0.035 | |
| (2) | Based on actual mean section | | |
| (a) | Smooth and uniform | 0.035 | 0.040 |
| (b) | Jagged and irregular | 0.040 | 0.045 |

e. Channels not maintained, weeds and brush uncut

| | | |
|---|---|---|
| (1) Dense weeds, high as flow depth | 0.08 | 0.12 |
| (2) Clean bottom, brush on sides | 0.05 | 0.08 |
| (3) Same, highest stage of flow | 0.07 | 0.11 |
| (4) Dense brush, high stage | 0.010 | 0.014 |

HIGHWAY DITCHES AND SWALES WITH MAINTAINED VEGETATION

| Depth of Flow<br>Velocity in fps | "n" Range<br>0.1′ – 0.7′<br>2′ to 6′ | | 0.7′ – 1.5′<br>2′ to 6′ | |
|---|---|---|---|---|
| a. Bermuda, Kentucky bluegrass, buffalo | | | | |
| (1) Mowed to 2″ | 0.07 | 0.045 | 0.05 | 0.035 |
| (2) Length 4″ – 6″ | 0.09 | 0.05 | 0.06 | 0.04 |
| b. Good stand any grass | | | | |
| (1) Length 12″ | 0.18 | 0.09 | 0.12 | 0.07 |
| (2) Length 24″ | 0.30 | 0.15 | 0.20 | 0.10 |
| c. Fair Stand any grass | | | | |
| (1) Length 12″ | 0.14 | 0.08 | 0.10 | 0.06 |
| (2) Length 24″ | 0.25 | 0.13 | 0.17 | 0.09 |

STREET AND EXPRESSWAY GUTTERS

| | Manning's n |
|---|---|
| a. Concrete gutter, troweled finish | 0.012 |
| b. Asphalt pavement | |
| (1) Smooth texture | 0.013 |
| (2) Rough texture | 0.016 |
| c. Concrete gutter with asphalt pavement | |
| (1) Smooth | 0.013 |
| (2) Rough | 0.015 |
| d. Concrete pavement | |
| (1) Float finish | 0.014 |
| (2) Broom finish | 0.016 |

For gutter with small slope where sediment may accumulate, increase all above values of "N" by 0.002.

## NATURAL STREAM CHANNELS 6 /

| Channel Description | "n" Range | |
|---|---|---|
| a. Minor Streams 7 / (Surface width at flood stage 100 ft.) | | |
| (1) Fairly regular section | | |
| (a) Some grass and weeds little or no brush | 0.030 | 0.035 |
| (b) Dense growth of weeds depth of flow materially greater than weed height | 0.035 | 0.05 |
| (c) Some weeds light brush on banks | 0.035 | 0.05 |
| (d) Some weeds heavy brush on banks | 0.05 | 0.07 |
| (e) Some weeds dense willows on banks | 0.06 | 0.08 |
| (f) For trees within channel with branches submerged at high stage, increase all above values by | 0.01 | 0.02 |
| (2) Irregular section with pools, slight channel meander | | |
| (a) Channels (a) to (e) above increased all values about | 0.01 | 0.02 |
| (3) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage. | | |
| (a) Bottom; gravel, cobbles and few boulders | 0.04 | 0.05 |
| (b) Bottom; cobbles with large boulders | 0.05 | 0.07 |
| b. Flood Plains (Adjacent to Natural Streams) | | |
| (1) Pasture, no brush | | |
| (a) Short grass | 0.030 | 0.035 |
| (b) High grass | 0.035 | 0.05 |
| (2) Cultivated areas | | |
| (a) No crop | 0.03 | 0.04 |
| (b) Mature row crops | 0.035 | 0.045 |
| (c) Mature field crops | 0.04 | 0.05 |
| (3) Heavy weeds, scattered brush | 0.05 | 0.07 |
| (4) Light brush and trees | | |
| (a) Winter | 0.05 | 0.06 |
| (b) Summer | 0.06 | 0.08 |
| (5) Medium to dense brush | | |
| (a) Winter | 0.07 | 0.11 |
| (b) Summer | 0.10 | 0.16 |
| (6) Dense willows, summer, not bent over by current | 0.15 | 0.20 |
| (7) Cleared land with tree stumps 100-150 per acre | | |
| (a) No sprouts | 0.04 | 0.05 |
| (b) With heavy growth of sprouts | 0.06 | 0.08 |

| | | |
|---|---|---|
| (a) Flood depth below branches | 0.10 | 0.12 |
| (b) Flood depth reaches branches ("n" increased with depth) 3 / | 0.12 | 0.16 |

c. Major Streams (Surface width at flood stage 100 ft.)

Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of "n" may be somewhat reduced. Follow recommendation of note 6 / if possible. The value of "n" for larger streams of most regular section, with no boulders or brush, may be in the range from 0.028 to 0.033.

NOTES

1 / For poor quality construction, use larger values of "n".

2 / Estimated by Federal Highway Administration (unless otherwise noted)

3 / For important work and where accurate determination of water profiles is necessary, the designer is urged to consult the references cited and to select "n" by comparison of the specific conditions with the channels tested.

4 / With channel of alignment other than straight, loss of head by resistance forces will be increased. A small increase in value of "n" may be made to allow for the additional loss of energy.

5 / With steep slopes, depth of flow will generally be greater than computed by the usual methods for open channels due to air entrainment and additional resistance offered by air in contact with the high velocity flow. An approximate depth may be calculated by increasing "n" for the chute material involved by 20 to 30 percent.

6 / For calculations of stage or discharge in natural stream channels, it is recommended that the designer consult the local District Office of the U.S. Geological Survey to obtain data regarding values of "n" applicable to streams of any specific region. Where the recommended procedure is not followed, the above values may be used as a guide.

The values of "n" tabulated have been derived by the Federal Highway Administration from data presented by C. E. Ramser and from other incomplete data. See Hydraulic Design Series No. 3 for additional references.

7 / The tentative values of "n" cited are principally derived from measurements made on fairly short but straight reaches of natural streams. Where slopes calculated from flood elevations along a considerable length of channel, involving meanders and bends, are to be used in velocity calculations by the Manning formula, the value of "n" must be increased to provide for the additional loss of energy caused by bends. All values stated above must be so increased. The increase may be in the range of perhaps 3 to 15 percent.

| Cover | Permissible velocity[1] | | |
|---|---|---|---|
| | Slope range[2] (percent) | Erosion resistant soils (ft. per sec.) | Easily eroded soils (ft. per sec.) |
| Bermudagrass | 0-5<br>5-10<br>over 10 | 8<br>7<br>6 | 6<br>5<br>4 |
| Bahia<br>Buffalograss<br>Kentucky bluegrass<br>Smooth brome<br>Blue grama<br>Tall fescue | 0-5<br>5-10<br>over 10 | 7<br>6<br>5 | 5<br>4<br>3 |
| Grass mixtures<br>Reed canarygrass | 0-5<br>5-10[2] | 5<br>4 | 4<br>3 |
| Lespedeza sericea<br>Weeping lovegrass<br>Yellow bluestem<br>Redtop<br>Alfalfa<br>Red fescue | 0-5[3] | 3.5 | 2.5 |
| Common lespedeza[4]<br>Sudangrass[4] | 0-5[5] | 3.5 | 2.5 |

[1]Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained.

[2]Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

[3]Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

[4]Annuals — use on mild slopes or as temporary protection until permanent covers are established.

[5]Use on slopes steeper than 5 percent is not recommended.

**Table E-2. — Permissible velocities for channels lined with vegetation.**

# CHAPTER 6

# CULVERTS

## Design

The design of culverts in Union City is to be based on Chapters 6 and 7 of the Georgia Department of Transportation Manual on Drainage Design for Highways.

## Plan Data

Construction plans for culverts presented to the City for review should contain at least the following data for each culvert:

1. Drainage area.

2. Design Discharge and Flood Frequency.

3. Water surface elevation at Design Discharge.

4. Culvert size and slope.

# CHAPTER 7

# STORM DRAINS

## Inlet Spacing

Catchbasins, drop inlets and similar structures for removing storm runoff from streets are to be spaced as necessary to keep gutter spread at or less than the maximum value identified in Chapter 1. The procedure and design aid charts contained in Chapter 10 of the Georgia Department of Transportation Manual on Drainage Design for Highway is an acceptable method for use in the City of Union City.

## Piped Systems

Piped storm drain systems should be designed using the Manning equation.

# CHAPTER 8

## SEDIMENT AND EROSION CONTROL

The control of sedimentation and erosion is an important element in the construction process. Measures must be taken to assure that soil from construction and land clearing sites does not pollute waterways. To accomplish this goal, the Manual for Erosion and Sediment Control in Georgia by the State Soil & Water Conservation Committee of Georgia is incorporated as the design guide for developing erosion and sediment control plans in the City of Union City.

# STANDARD DETAILS

FOR THE

## City of Union City, Georgia

Prepared by

KECK & WOOD, INC.
2750 Premiere Pkwy
Suite 900
Duluth, GA 30097

## STANDARD DRAWINGS INDEX

| STREET STANDARD | DWG. NO. | REV. DATE |
|---|---|---|
| Major Thoroughfare with Median | R010 | 02/17/05 |
| Collector "A" Street (Commercial) | R020-C | 08/20/14 |
| Collector "A" Street (Industrial) | R020-I | 08/20/14 |
| Collector "B" Street | R030 | 02/17/05 |
| Local (Minor) Street | R040 | 02/17/05 |
| Cul-de-Sacs | R080 | 02/17/05 |
| Curved Entrances for Driveways | R100 | 02/17/05 |
| Tapered Entrances for Driveways | R110 | 02/17/05 |
| Curb and Gutter | R120 | 02/17/05 |
| Curb Cut Ramp – Type 1 | R130 | 02/17/05 |
| Curb Cut Ramp - Type 2 | R135 | 02/17/05 |
| Curb Cut Ramp – Type 3 | R140 | 02/17/05 |
| Sidewalk Plan, Section and Details | R150 | 02/17/05 |
| Pavement Patch Detail | R180 | 02/17/05 |
| Heavy Duty Catch Basin Top | R200 | 08/20/14 |
| Heavy Duty Catch Basin Front and Side Views | R201 | 08/20/14 |

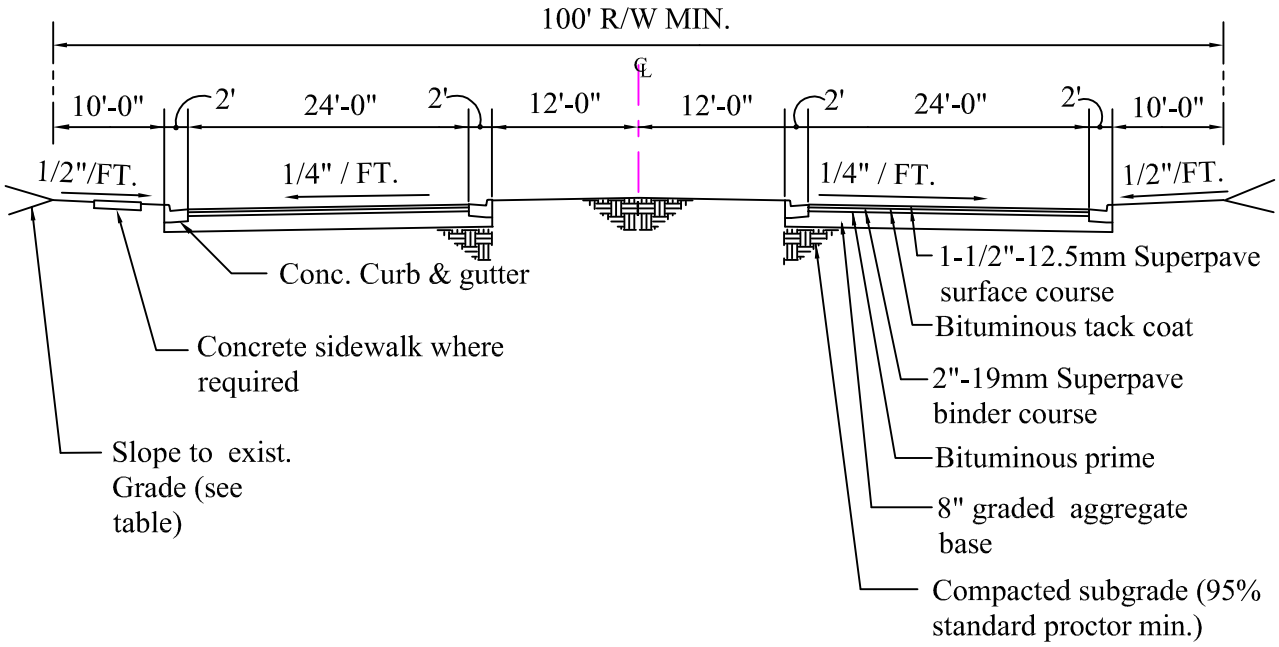
| WATER SYSTEM STANDARD | DWG. NO. | REV. DATE |
|---|---|---|
| Typical Hydrant Installation | W001 | 02/17/05 |
| Service Meter Installation | W002 | 02/17/05 |
| Service Connection | W003 | 02/17/05 |
| Gate Valve Installation | W004 | 02/17/05 |
| Water Vault Top Plan & Hatch | W005 | 02/17/05 |
| Water Vault Plan | W006 | 02/17/05 |
| Water Vault Section | W007 | 02/17/05 |

| **MANHOLE STANDARD** | **DWG NO.** | **REV. DATE** |
|---|---|---|
| Precast Manhole – 4' Inside Diameter | M001 | 02/17/05 |
| Large Diameter Precast Manhole | M002 | 02/17/05 |
| Manhole Frame & Cover Casting | M004 | 02/17/05 |

| **SANITARY SEWER STANDARD** | **DWG NO.** | **REV. DATE** |
|---|---|---|
| Outside Drop Connection Detail | S001 | 02/17/05 |
| Sewer Service Cleanout | S002 | 02/17/05 |
| Sewer Service Connection | S003 | 02/17/05 |
| Transition Collar | S004 | 02/17/05 |
| Lateral Stub-out Location | S006 | 02/17/05 |

## SLOPE TABLE

| DEPTH OF CUT OR FILL | MAXIMUM CUT SLOPES | MINIMUM FILL SLOPES |
|---|---|---|
| 0 ft. to 8 ft. | 3 to 1 | 3 to 1 |
| 8 ft. to 12 ft. | 2 to 1 | 2 to 1 |
| Over 12 ft. | 1 to 1 | 2 to 1 |




## MINIMUM STREET SECTION

N.T.S.

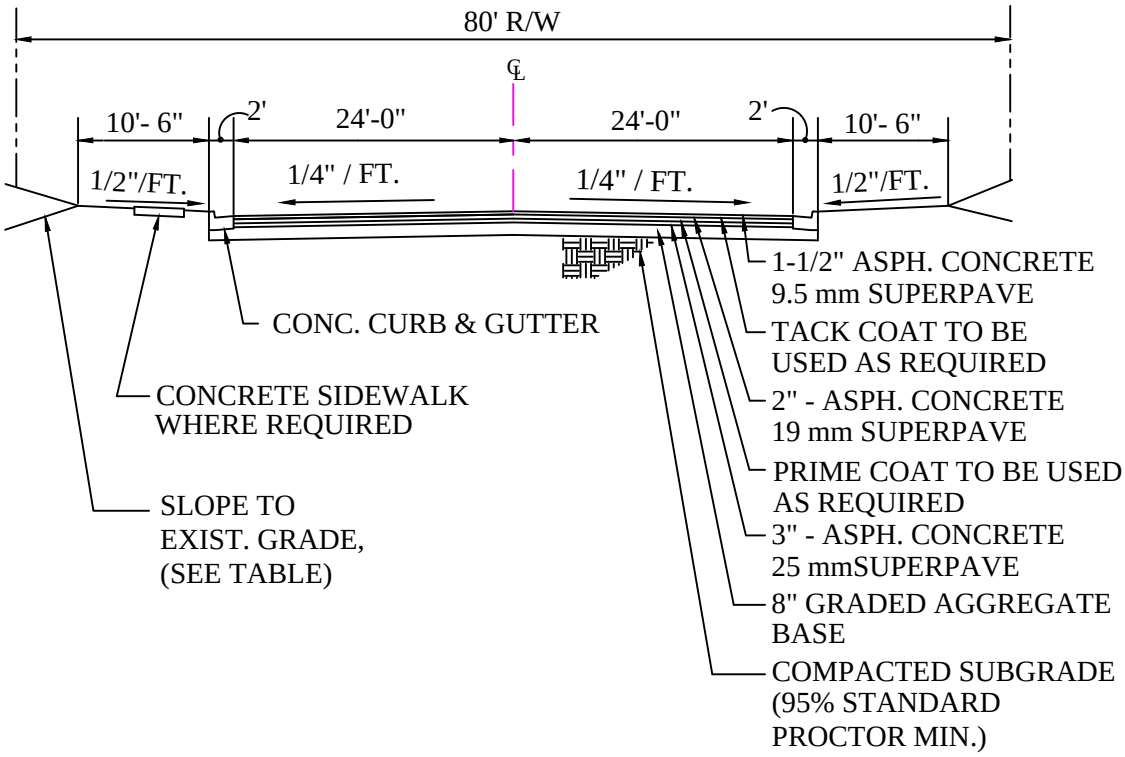
NOTES:

1. Materials to conform to Georgia Department of Transportation specifications -- latest edition.

| | | |
|---|---|---|
| | MAJOR THOROUGHFARE WITH MEDIAN STREET STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | R010 |

## SLOPE TABLE

| DEPTH OF CUT OR FILL | MAXIMUM CUT SLOPES | MINIMUM FILL SLOPES |
|---|---|---|
| 0 FT. TO 8 FT. | 3 TO 1 | 3 TO 1 |
| 8 FT. TO 12 FT. | 2 TO 1 | 2 TO 1 |
| OVER 12 FT. | 1 TO 1 | 2 TO 1 |




## MINIMUM STREET SECTION

N.T.S.

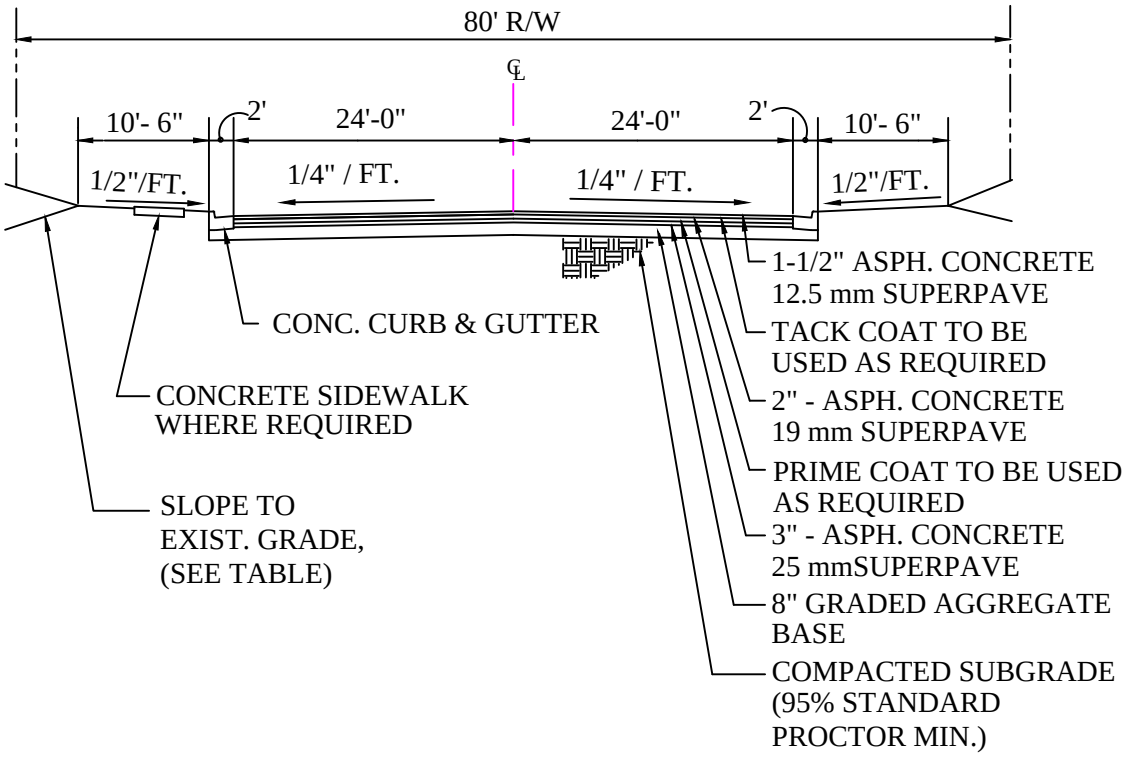
NOTES:

1. MATERIALS TO CONFORM TO GEORGIA DEPARTMENT OF TRANSPORTATION SPECIFICATIONS -- LATEST EDITION.
2. THE DIRECTOR OF PUBLIC SERVICES DUE TO TRAFFIC CHARACTERISTICS MAY REQUIRE A HEAVIER PAVEMENT SECTION.
3. PAVING SECTION TO BE APPROVED BY DEPARTMENT OF PUBLIC SERVICES.
4. RAISED PAVEMENT MARKERS TO BE USED AS REQUIRED AND MUST BE APPROVED BY CITY INSPECTOR.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | COLLECTOR "A" STREET (COMMERCIAL) STREET STANDARD | STANDARD DETAIL |
| | | DATE 05/09/14 |
| | THE CITY OF UNION CITY, GEORGIA | R020-C |

## SLOPE TABLE

| DEPTH OF CUT OR FILL | MAXIMUM CUT SLOPES | MINIMUM FILL SLOPES |
|---|---|---|
| 0 FT. TO 8 FT. | 3 TO 1 | 3 TO 1 |
| 8 FT. TO 12 FT. | 2 TO 1 | 2 TO 1 |
| OVER 12 FT. | 1 TO 1 | 2 TO 1 |




## MINIMUM STREET SECTION

N.T.S.

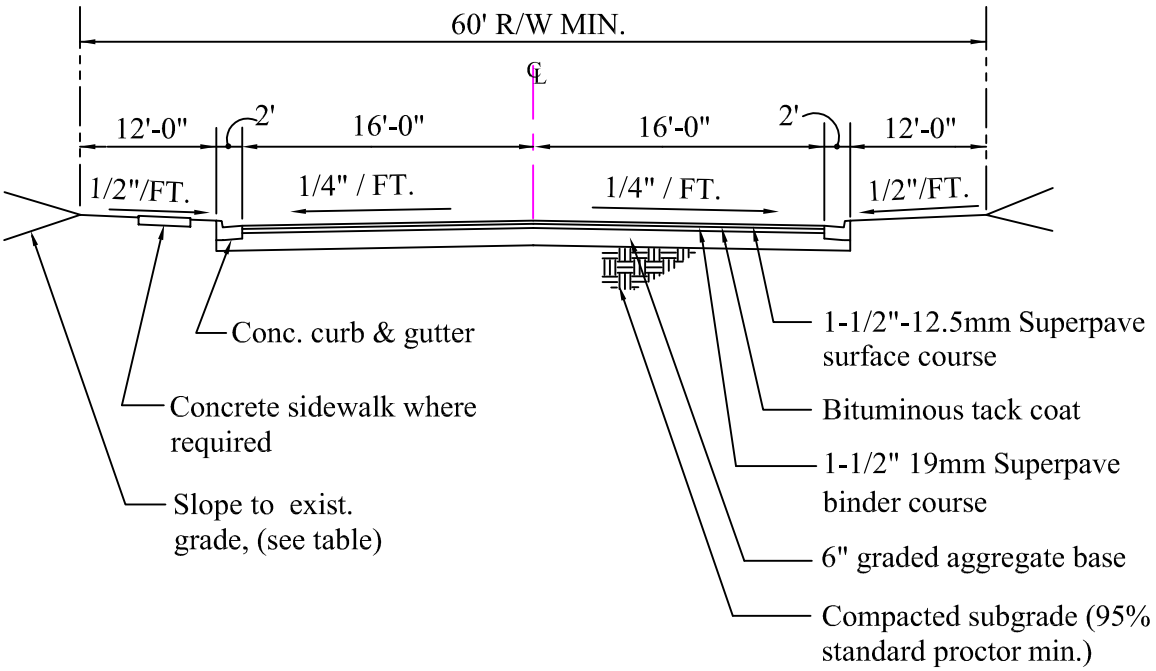
NOTES:

1. MATERIALS TO CONFORM TO GEORGIA DEPARTMENT OF TRANSPORTATION SPECIFICATIONS -- LATEST EDITION.
2. THE DIRECTOR OF PUBLIC SERVICES DUE TO TRAFFIC CHARACTERISTICS MAY REQUIRE A HEAVIER PAVEMENT SECTION.
3. PAVING SECTION TO BE APPROVED BY DEPARTMENT OF PUBLIC SERVICES.
4. RAISED PAVEMENT MARKERS TO BE USED AS REQUIRED AND MUST BE APPROVED BY CITY INSPECTOR.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | COLLECTOR "A" STREET (INDUSTRIAL) STREET STANDARD | STANDARD DETAIL |
| | | DATE 05/09/14 |
| | THE CITY OF UNION CITY, GEORGIA | R020-I |

## SLOPE TABLE

| DEPTH OF CUT OR FILL | MAXIMUM CUT SLOPES | MINIMUM FILL SLOPES |
|---|---|---|
| 0 ft. to 8 ft. | 3 to 1 | 3 to 1 |
| 8 ft. to 12 ft. | 2 to 1 | 2 to 1 |
| Over 12 ft. | 1 to 1 | 2 to 1 |




## MINIMUM STREET SECTION

N.T.S.

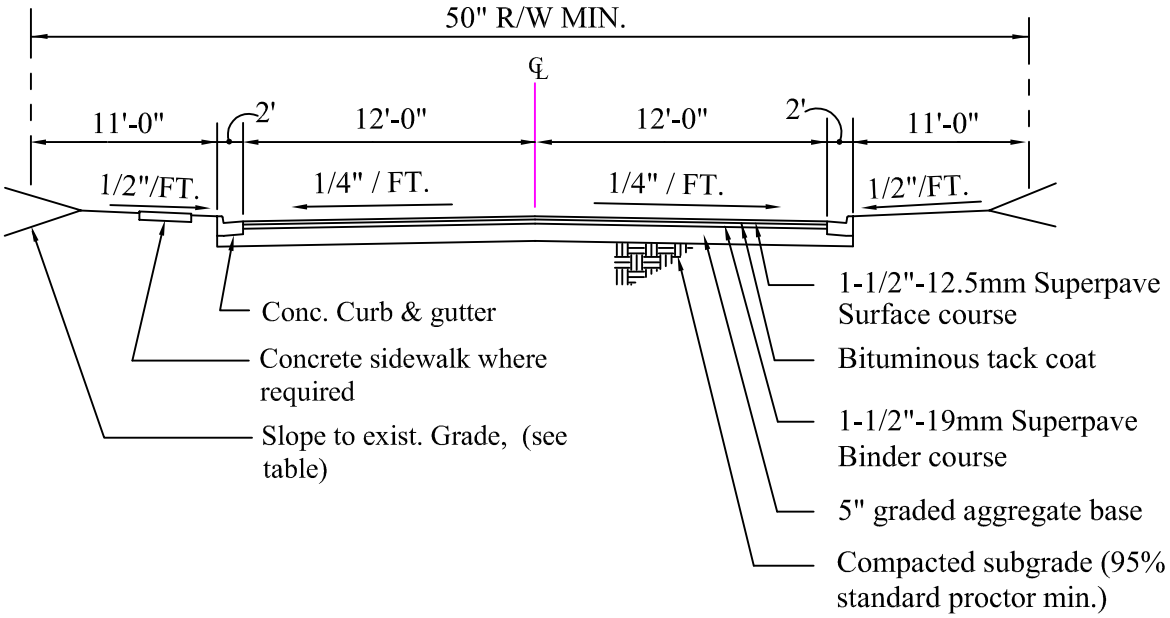
NOTES:

1. Materials to conform to Georgia Department of Transportation specifications -- latest edition.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | COLLECTOR "B" STREET STREET STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | R030 |

## SLOPE TABLE

| DEPTH OF CUT OR FILL | MAXIMUM CUT SLOPES | MINIMUM FILL SLOPES |
|---|---|---|
| 0 ft. to 8 ft. | 3 to 1 | 3 to 1 |
| 8 ft. to 12 ft. | 2 to 1 | 2 to 1 |
| Over 12 ft. | 1 to 1 | 2 to 1 |



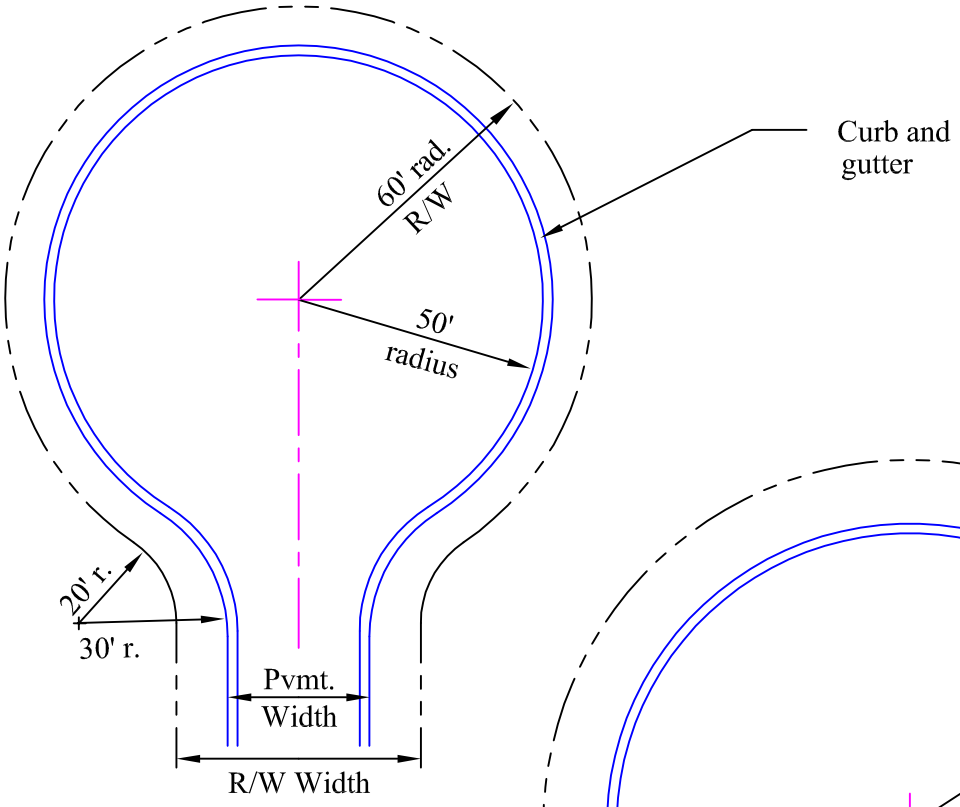

# MINIMUM STREET SECTION

N.T.S

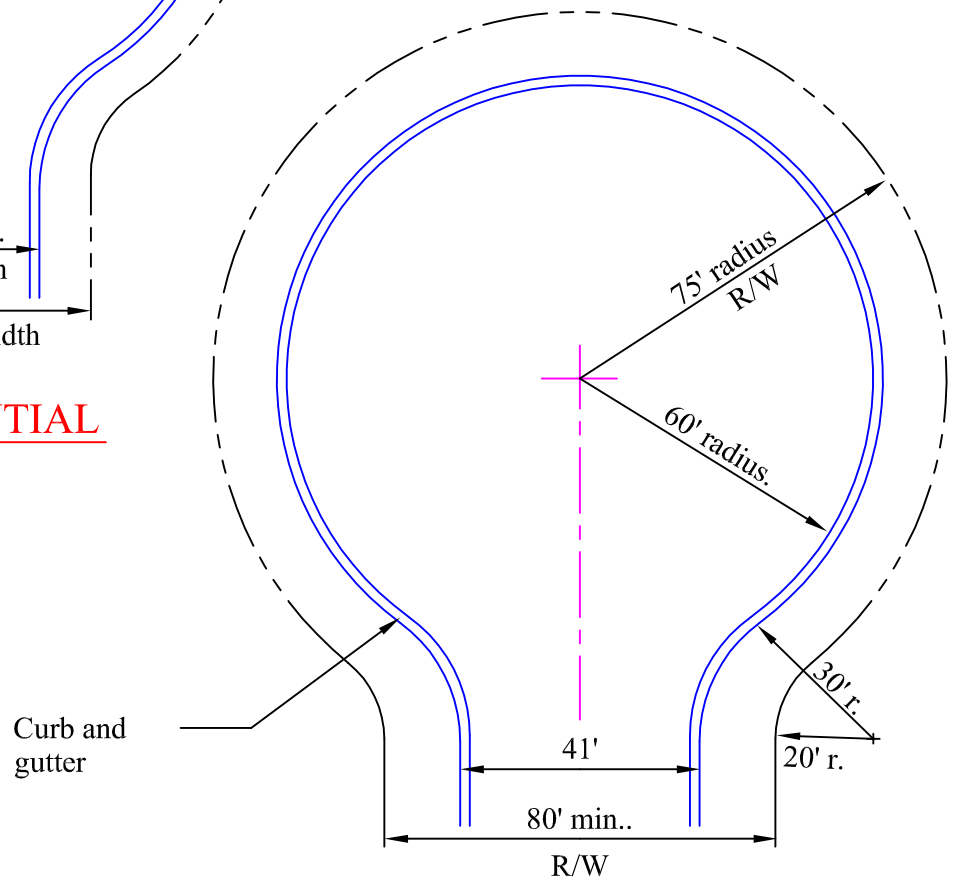
NOTES:

Materials to conform to Georgia Department of Transportation Specifications -- latest edition.

| | | |
|---|---|---|
| | LOCAL (MINOR) STREET<br>STREET STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | R040 |




RESIDENTIAL

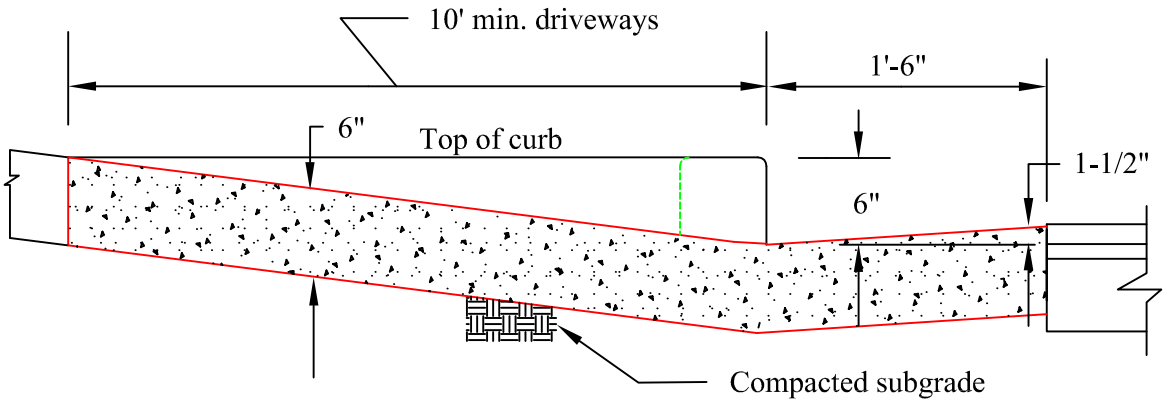



COMMERCIAL/INDUSTRIAL

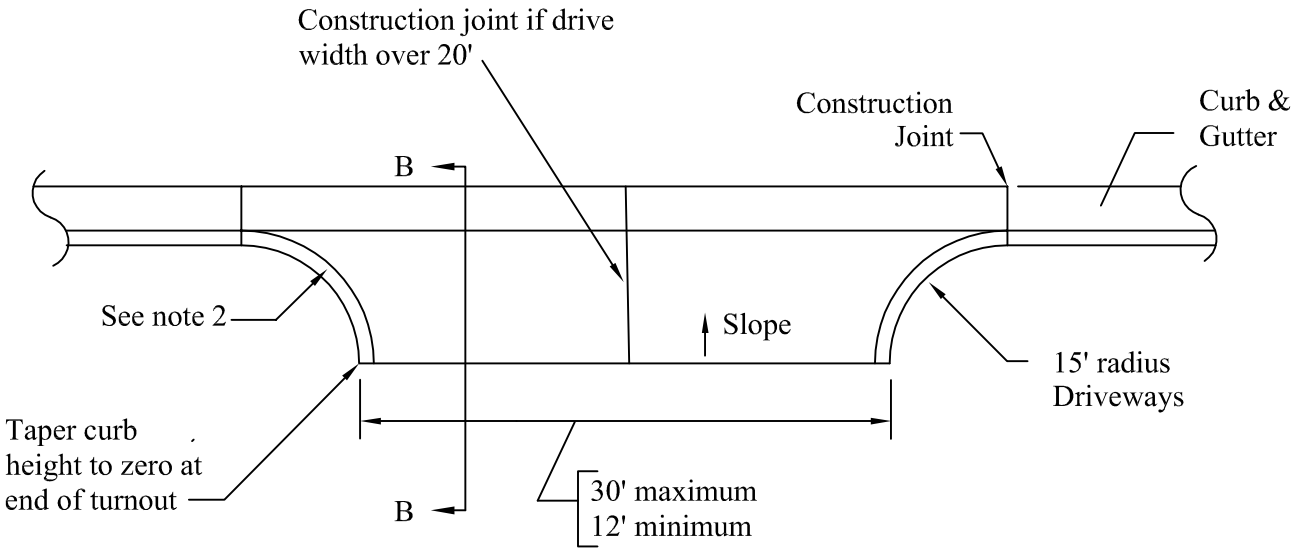
NOTES:

1. Pavement dimensions are to back of curb.
2. Center islands are not permitted.

| | | |
|---|---|---|
| | CUL-DE-SACS<br>STREET STANDARD | STANDARD<br>DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | R080 |




## SECTION "B-B"

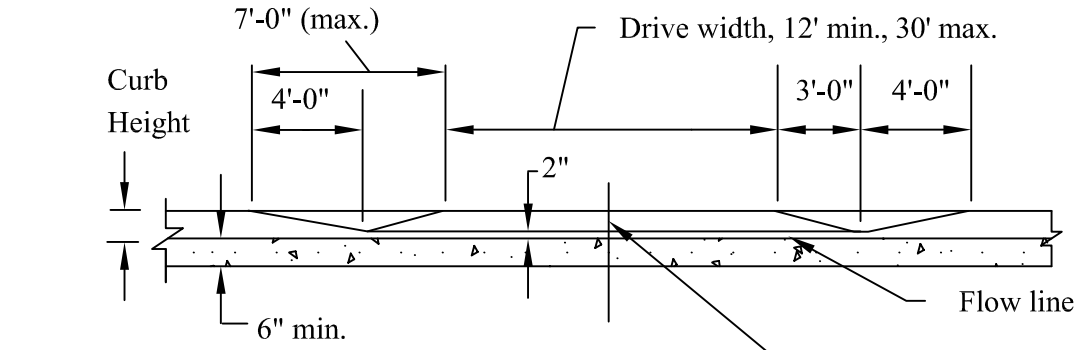



## PLAN

NOTES:

1. At petitioner's option, use tapered or curved entrance detail.
2. Where drive abuts sidewalk, provide curb ramps.

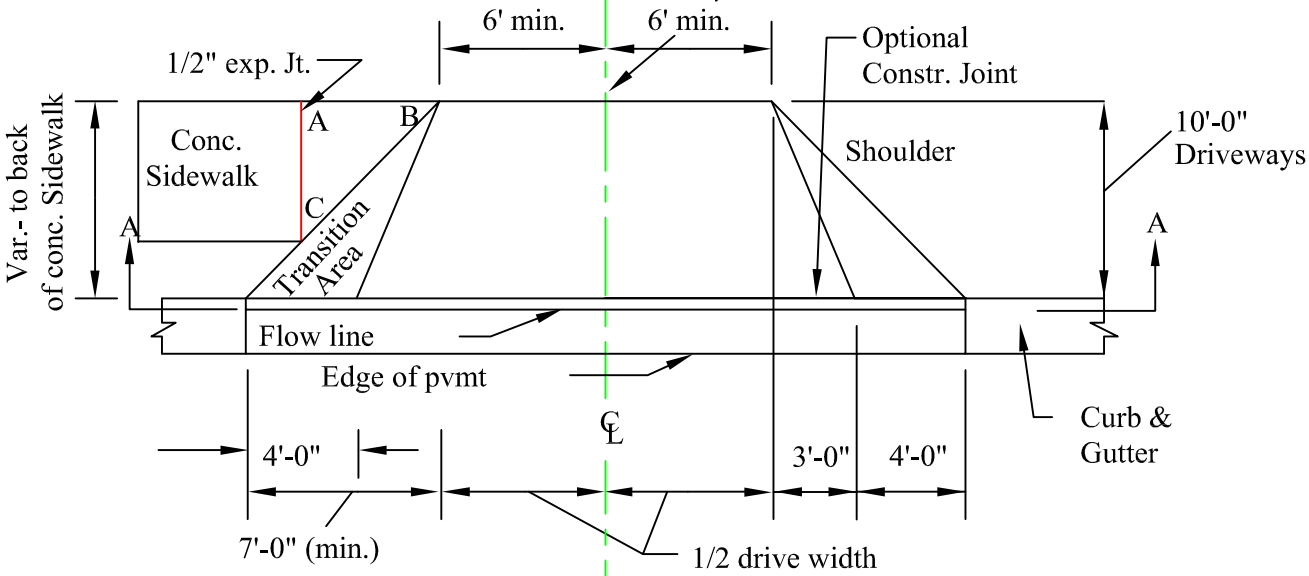
| | | |
|---|---|---|
| | CURVED ENTRANCES FOR DRIVEWAYS STREET STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | R100 |




## SECTION A-A

Construction joint if Drive width over 20'.

Sidewalk surface grades & finish will extend to include triangle abc.




### HALF SECTION

Symmetrical about this side of centerline where concrete sidewalk occurs.

### HALF SECTION

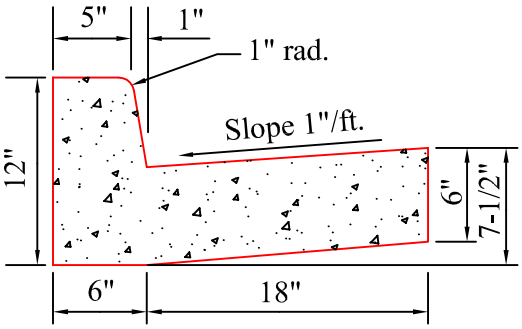
Symmetrical about this side of centerline where no concrete sidewalk occurs.

## PLAN

NOTES:

At petitioner's option, use tapered or curved entrance detail.

| | | |
|---|---|---|
| | TAPERED ENTRANCES FOR DRIVEWAYS STREET STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | R110 |




# STANDARD

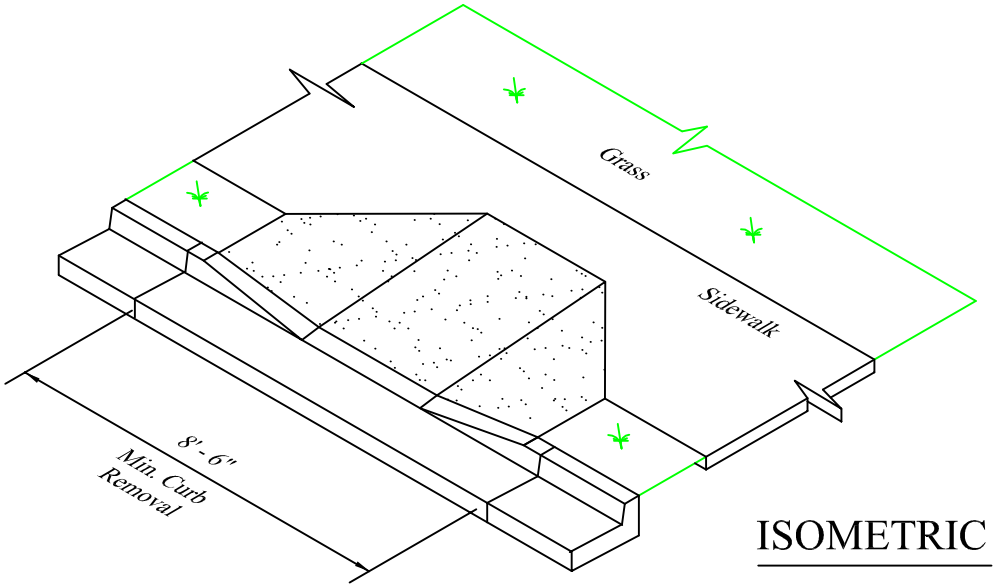
NOTES:

1. Provide contraction joints at intervals of 10 feet. Form or saw contraction joints to a depth not less than 1.5 inches.

2. Provide expansion joints where curb and gutter abuts structures. Form expansion joints with full depth, 1/2 inch thick pre- molded joint filler.

3. Provide final concrete surface having stiff bristle broom finish transverse to the line of traffic.

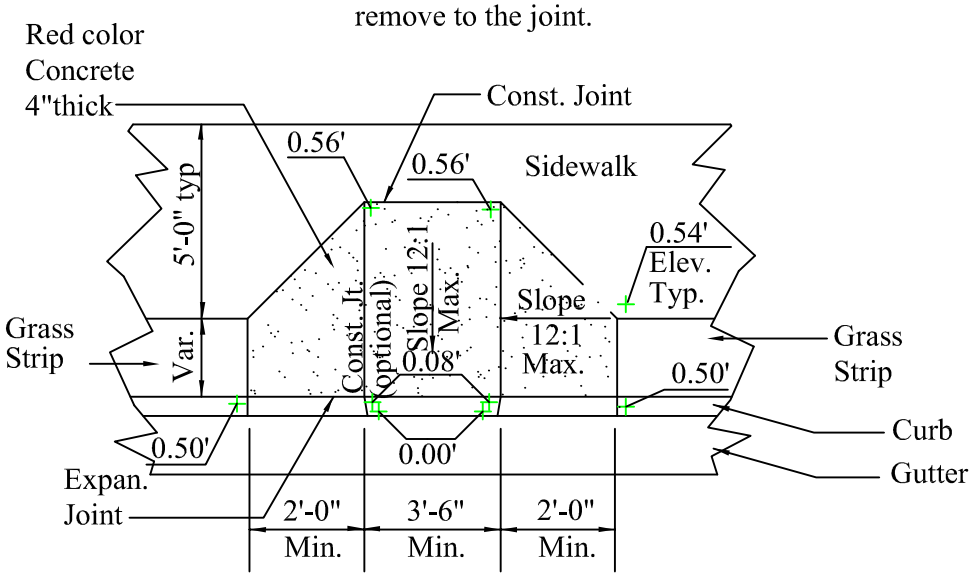
| | | |
|---|---|---|
| | CURB AND GUTTER<br>STREET STANDARD | STANDARD<br>DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | R120 |




ISOMETRIC

## NOTES:

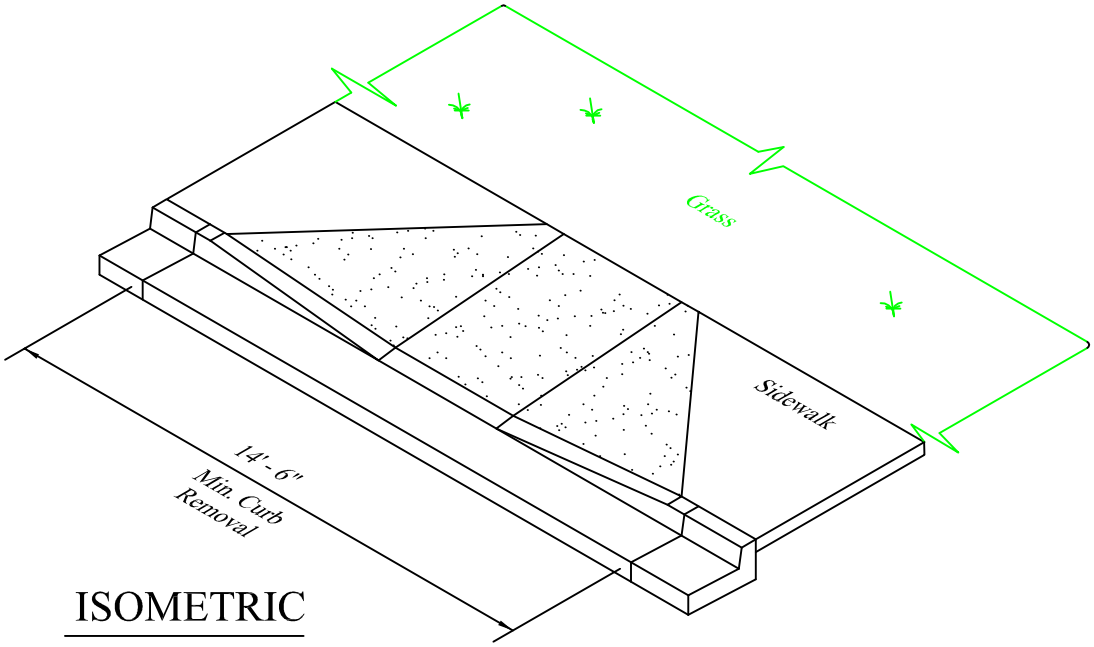
1. When removing existing sidewalk and/or curb and gutter for ramp installation, saw cut existing concrete.
2. Dimensions indicated in details are nominal. Field conditions may require differences in order to maintain 12:1 maximum ramp slopes. No change in contract price will be considered due to such differences.
3. When removing existing sidewalk and/or curb and gutter, if two feet or less to a construction or expansion joint, remove to the joint.




## RAMP PLAN

N.T.S.

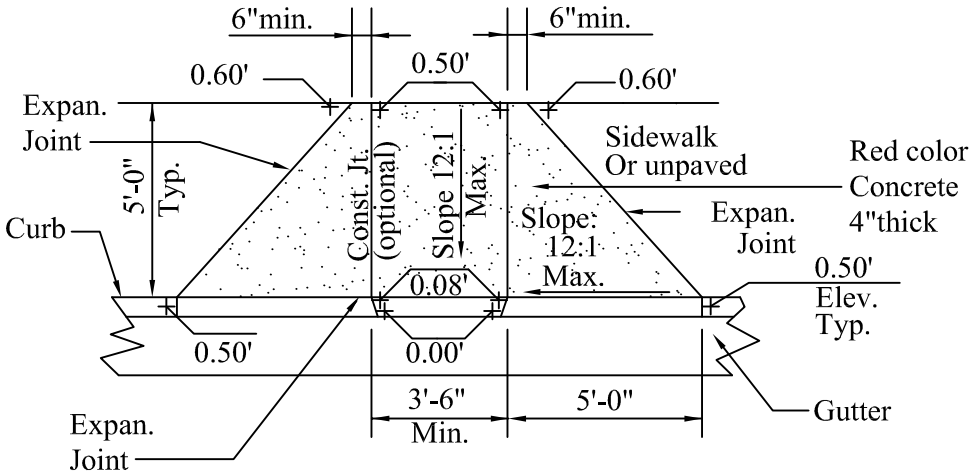
| | | |
|---|---|---|
| | CURB CUT RAMP - TYPE 2<br>STREET STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | R135 |




ISOMETRIC

## NOTES:

1. When removing existing sidewalk and/or curb and gutter for ramp installation, saw cut existing concrete.
2. Dimensions indicated in details are nominal. Field conditions may require differences in order to maintain 12:1 maximum ramp slopes. No change in contract price will be considered due to such differences.
3. When removing existing sidewalk and/or curb and gutter, if two feet or less to a construction or expansion joint, remove to the joint.




RAMP PLAN

N.T.S.

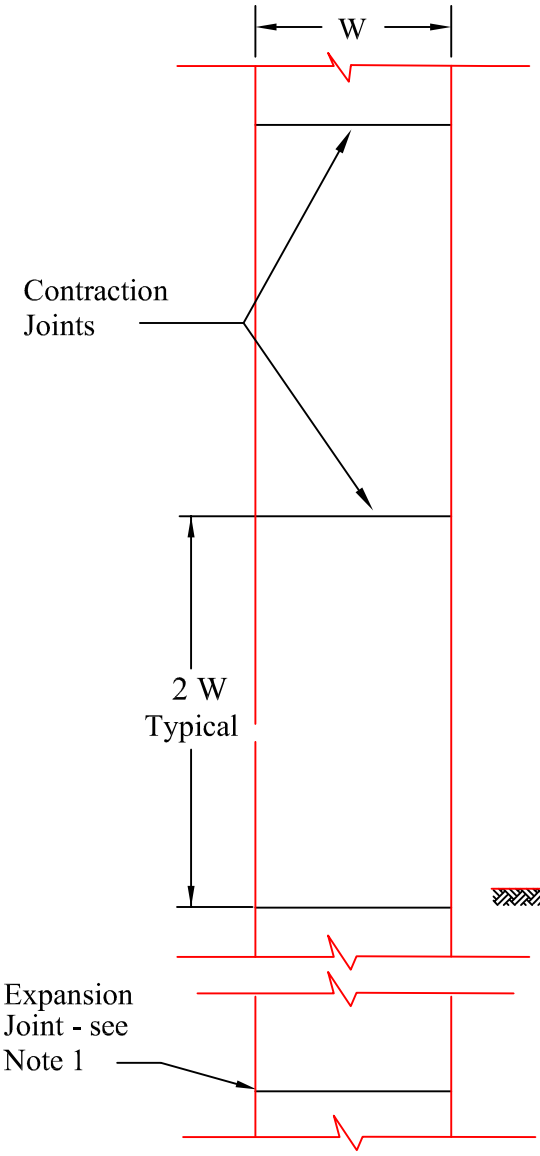
# CURB CUT RAMP - TYPE 3
# STREET STANDARD

STANDARD DETAIL

DATE 02/17/05

THE CITY OF
UNION CITY, GEORGIA

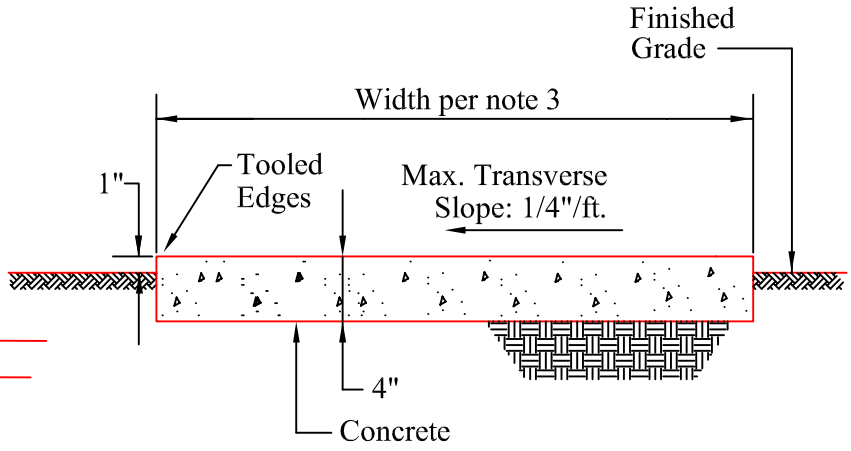
R140



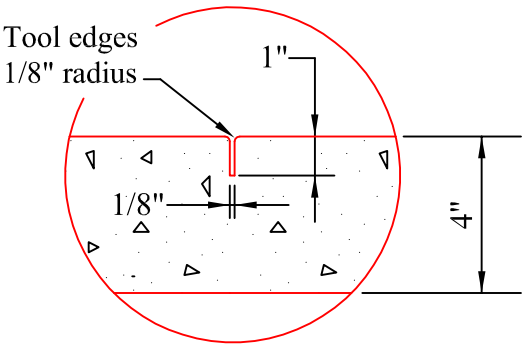

SIDEWALK PLAN

NOTES:

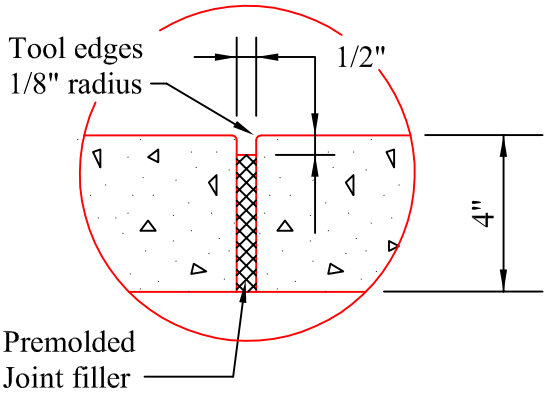
1. Provide expansion joints where sidewalk abuts curb, structures, and at 200 ft. Intervals.
2. Provide final concrete surface having stiff bristle broom finish transverse to sidewalk centerline.
3. Provide sidewalk width of w = 5 ft. In commercial/industrial areas. Provide sidewalk width of w = 4 ft. In residential areas.




SIDEWALK SECTION

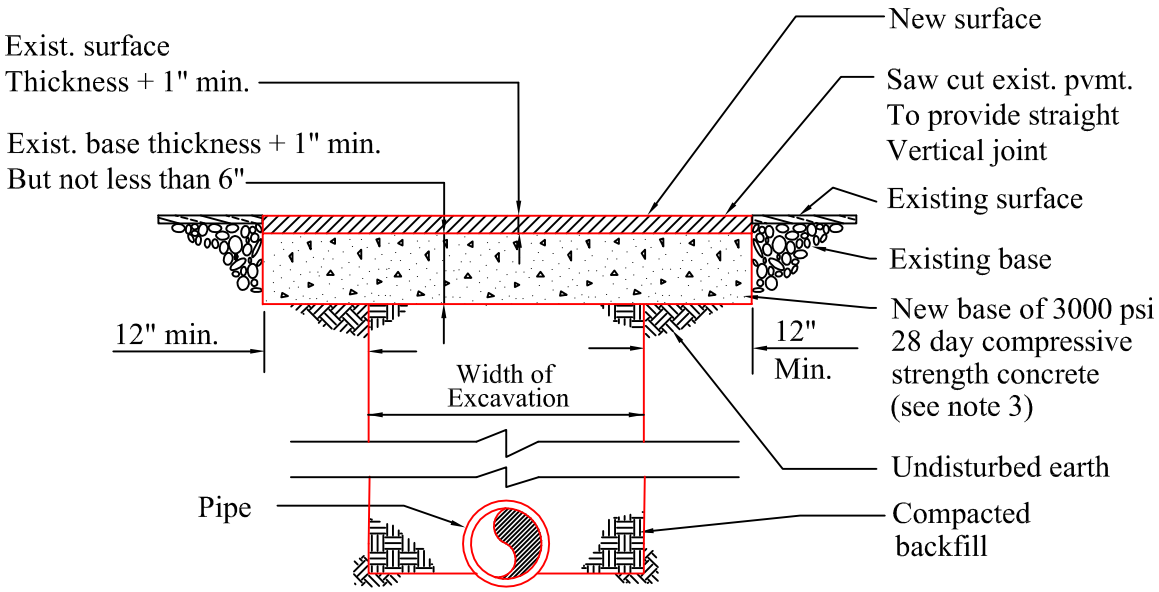



CONTRACTION JOINT




EXPANSION JOINT

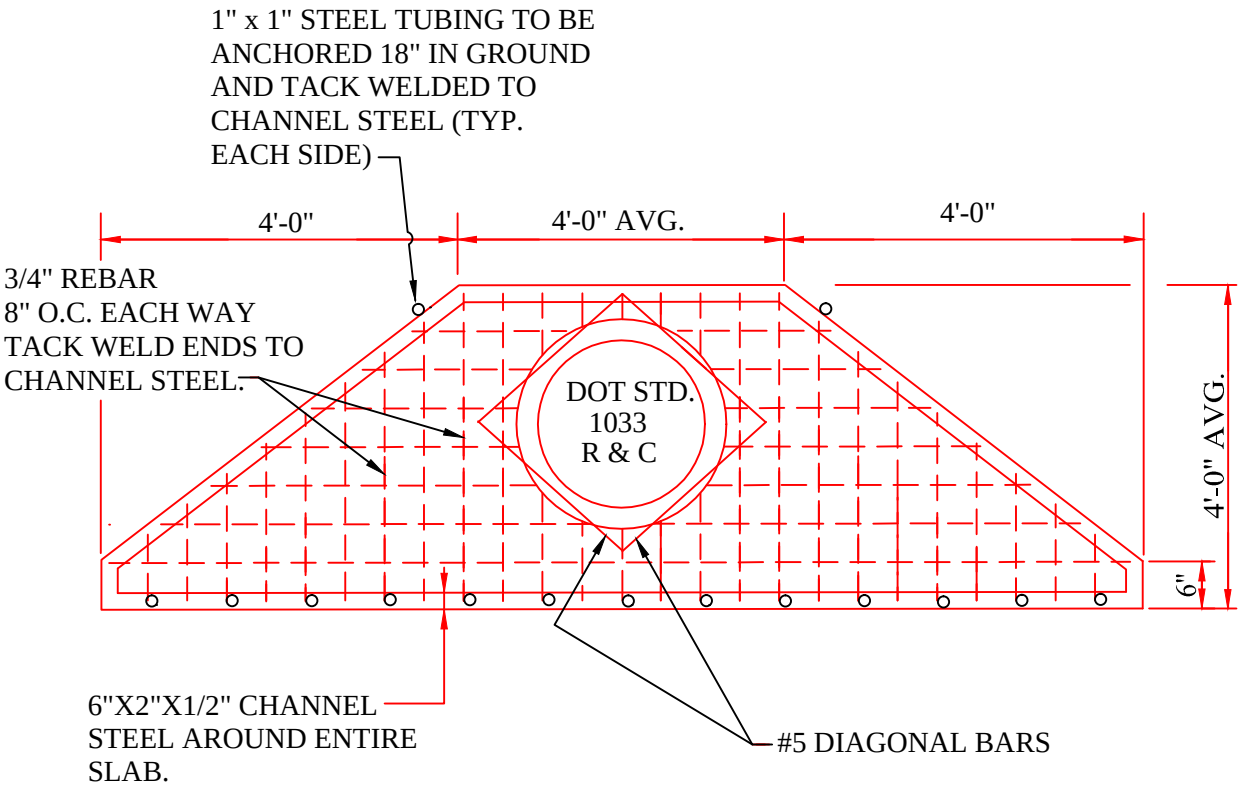
| | | |
|---|---|---|
| | TYPICAL SIDEWALK PLAN SECTION AND DETAILS STREET STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | R150 |




NOTES :

1. For existing surface of asphaltic concrete, furnish new surface conforming to Georgia D. O. T. Specifications, superpave hot plant mix
2. For existing surface of portland cement concrete, furnish new surface of 3000 psi compressive strength concrete.
3. New base for driveway, sidewalk or parking lot repair to consist of graded aggregate.
4. For asphaltic pavement repair apply bituminous tack coat before placement of new asphaltic surface.

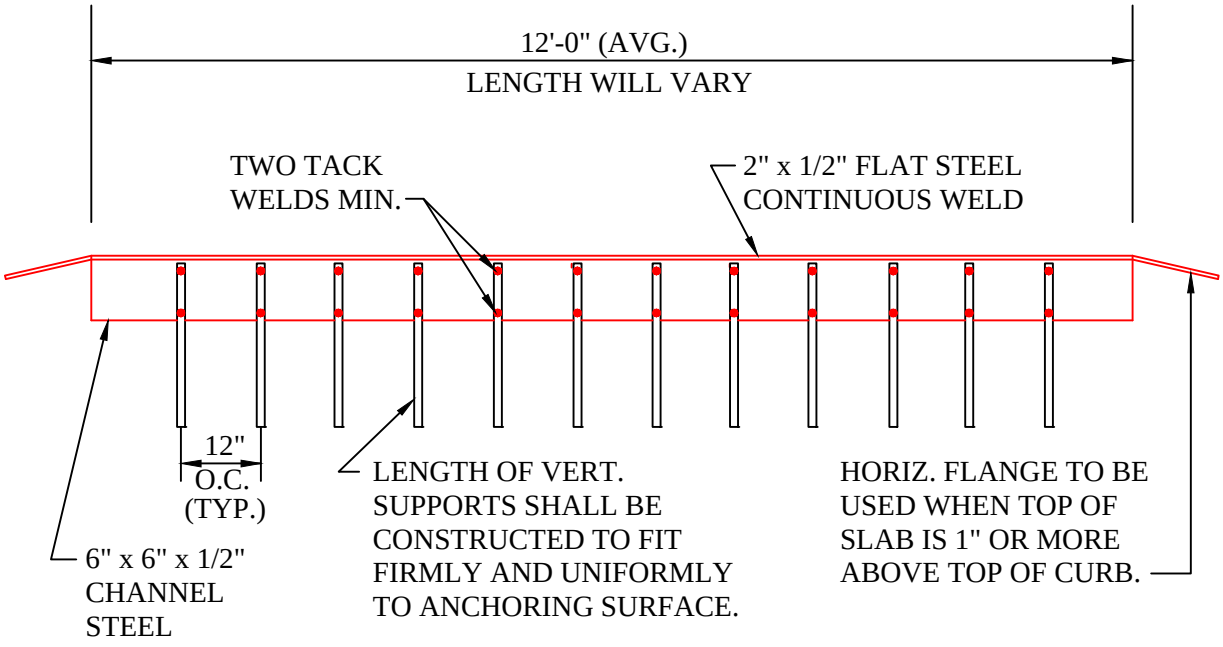
| | | |
|---|---|---|
| | PAVEMENT PATCH DETAIL<br>STREET STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | R180 |



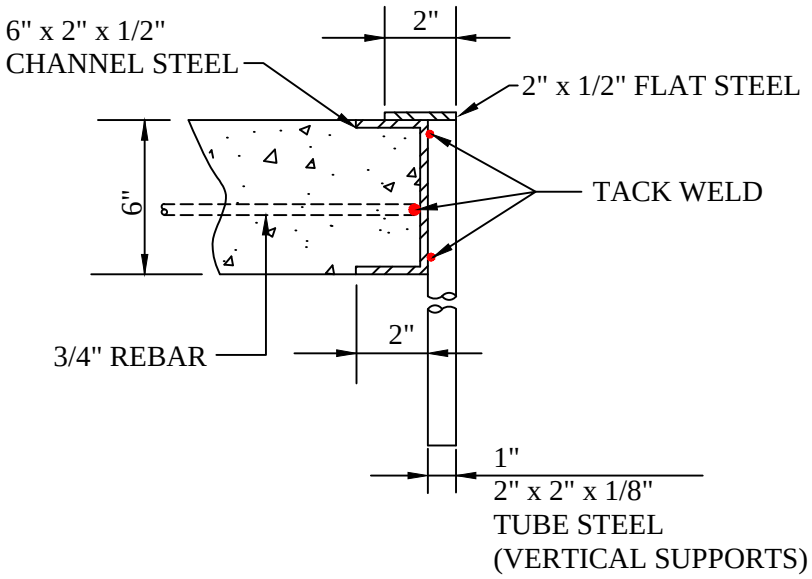

## TOP VIEW

NOTE: USE HEAVY DUTY CATCH BASIN TOP ALONG INDUSTRIAL COLLECTOR TYPE A STREETS AND WHERE REQUIRED BY THE CITY.

| | | |
|---|---|---|
| | HEAVY DUTY CATCH BASIN TOP STREET STANDARD | STANDARD DETAIL |
| | | DATE 08/21/14 |
| | THE CITY OF UNION CITY, GEORGIA | R200 |




## FRONT VIEW




## SIDE VIEW

FRONT

NOTE: USE HEAVY DUTY CATCH BASIN TOP ALONG INDUSTRIAL COLLECTOR A STREETS AND WHERE REQUIRED BY THE CITY.

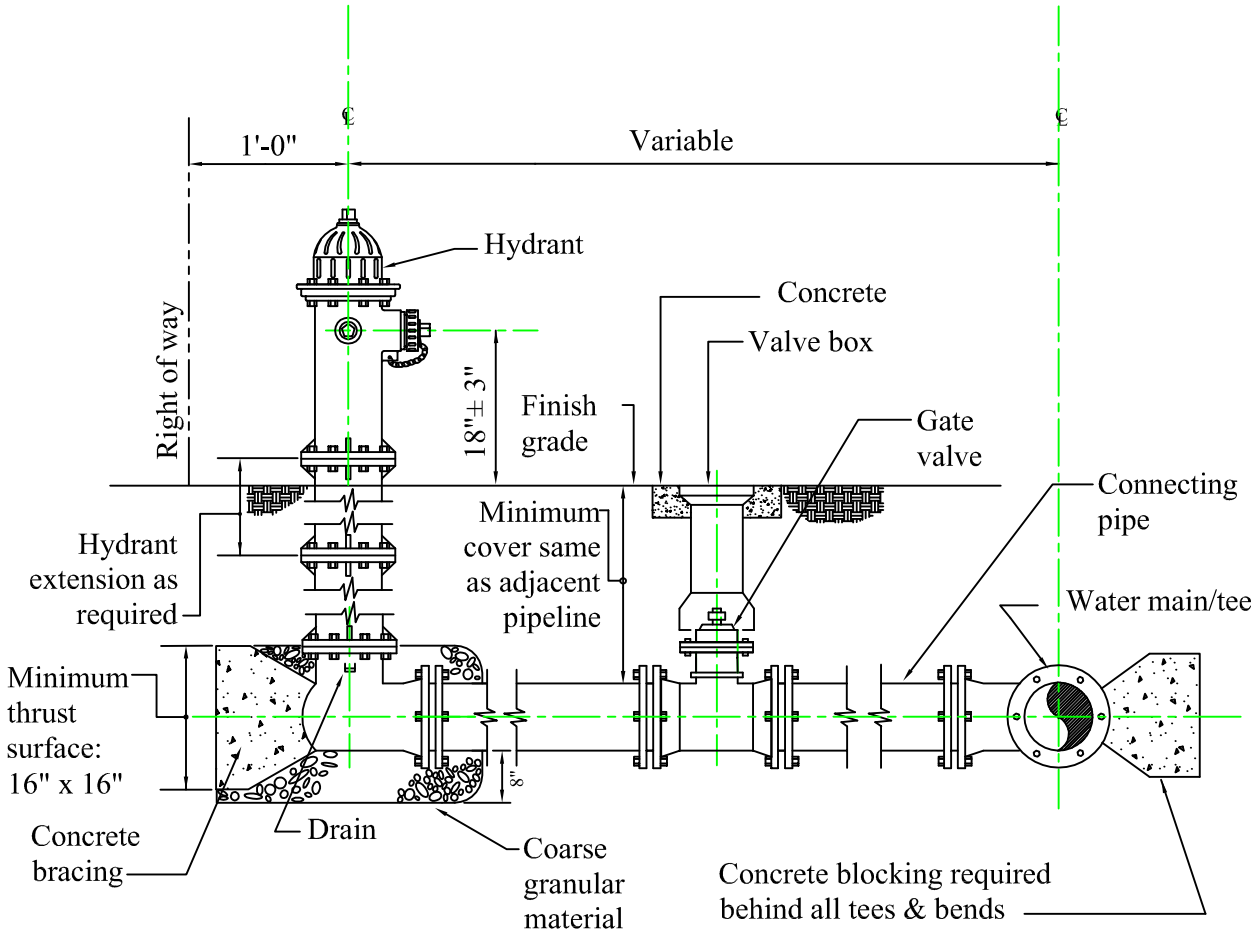
# HEAVY DUTY CATCH BASIN FRONT AND SIDE VIEWS STREET STANDARD

THE CITY OF
UNION CITY, GEORGIA

STANDARD DETAIL

DATE
08/21/14

R201




NOTES:

1. Hydrant lugs and stainless steel tie rods may be used in lieu of concrete reaction bracing at contractor's option.

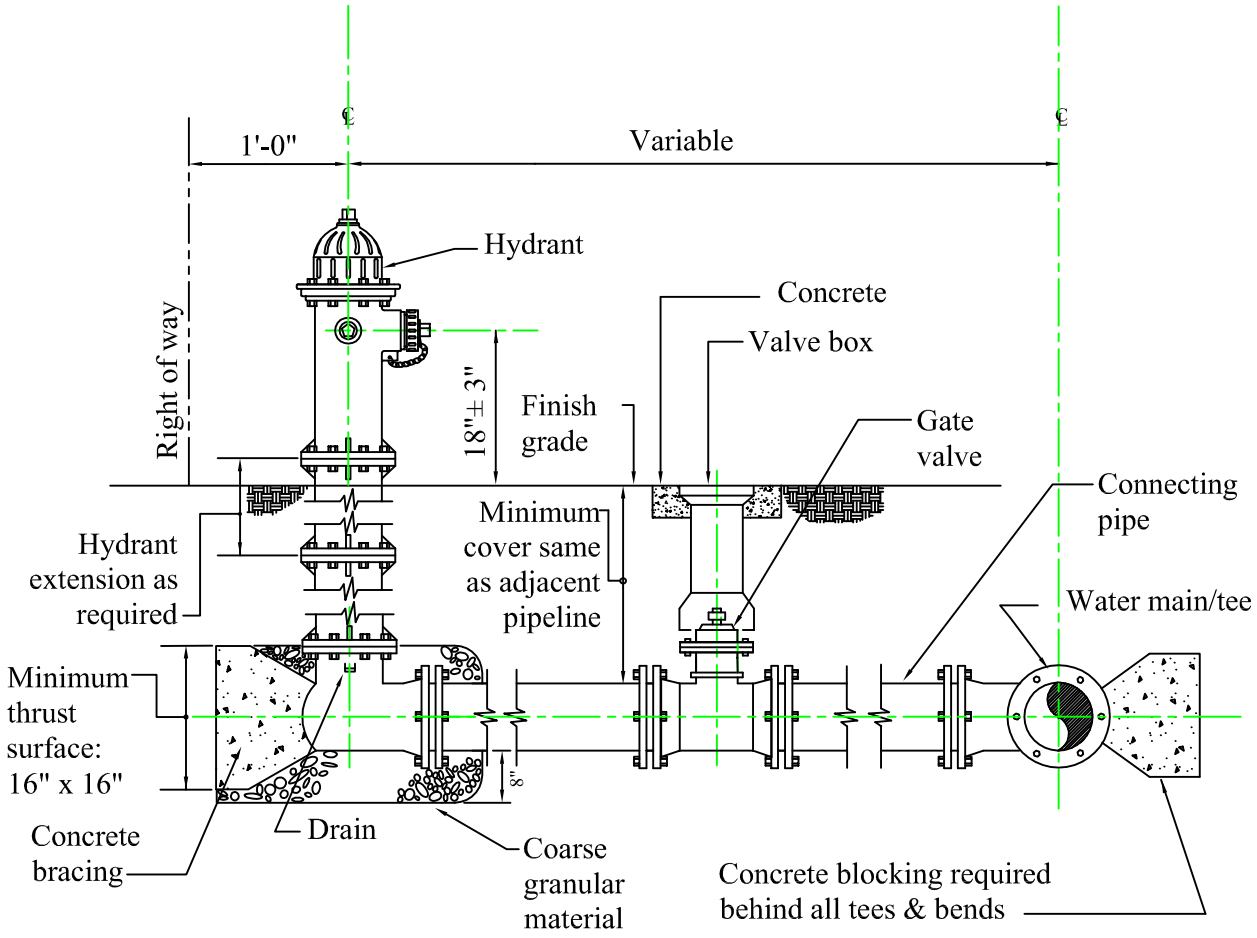
2. For standardization with existing system, provide three way fire hydrant of one of the following types: m&h valve co. Traffic model (style 129) or mueller centurion model (a-421).

3. Paint hydrant in accordance with A.W.W.A. C502, color: red.

## HYDRANT DETAIL

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | TYPICAL HYDRANT INSTALLATION WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | W001 |




NOTES:

1. Hydrant lugs and stainless steel tie rods may be used in lieu of concrete reaction bracing at contractor's option.

2. For standardization with existing system, provide three way fire hydrant of one of the following types: m&h valve co. Traffic model (style 129) or mueller centurion model (a-421).

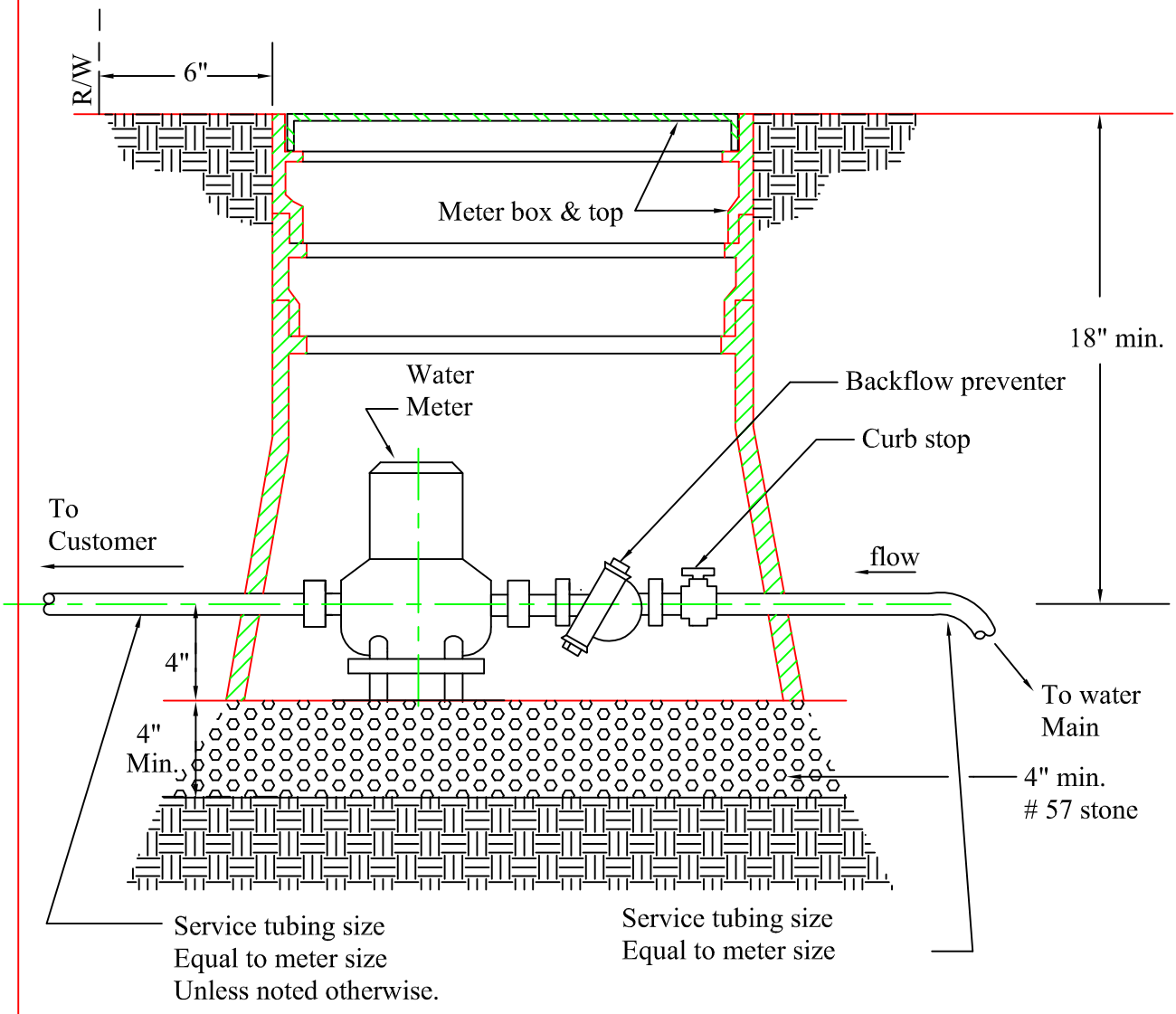
3. Paint hydrant in accordance with A.W.W.A. C502, color: red.

## HYDRANT DETAIL

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | TYPICAL HYDRANT INSTALLATION WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | W001 |

Is the BFP located on the correct side of the meter?
Other details have a min. of 12" from bottom of unit.
z
w

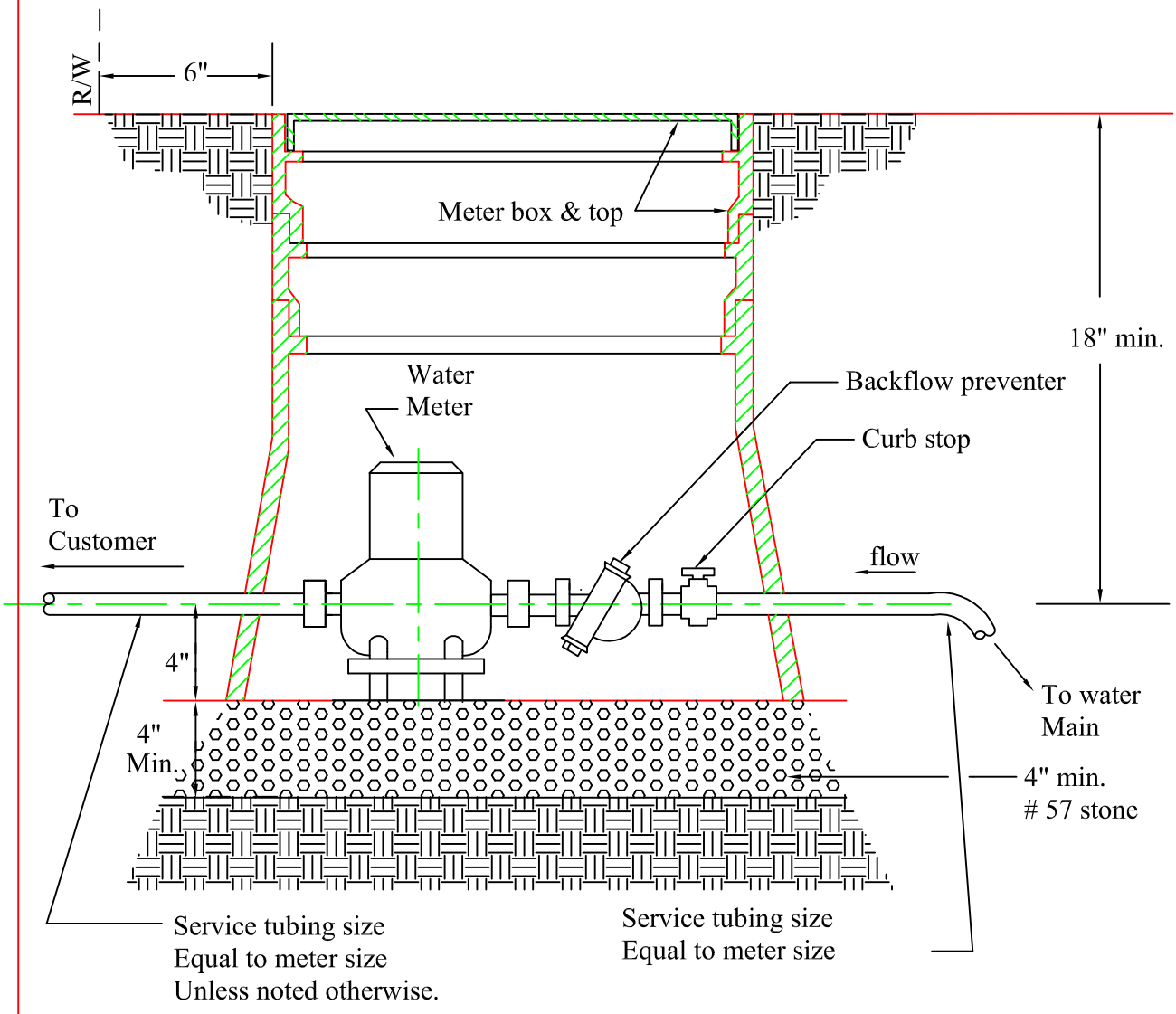



# TYPICAL SERVICE METER INSTALLATION

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | SERVICE METER INSTALLATION<br>WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W002 |

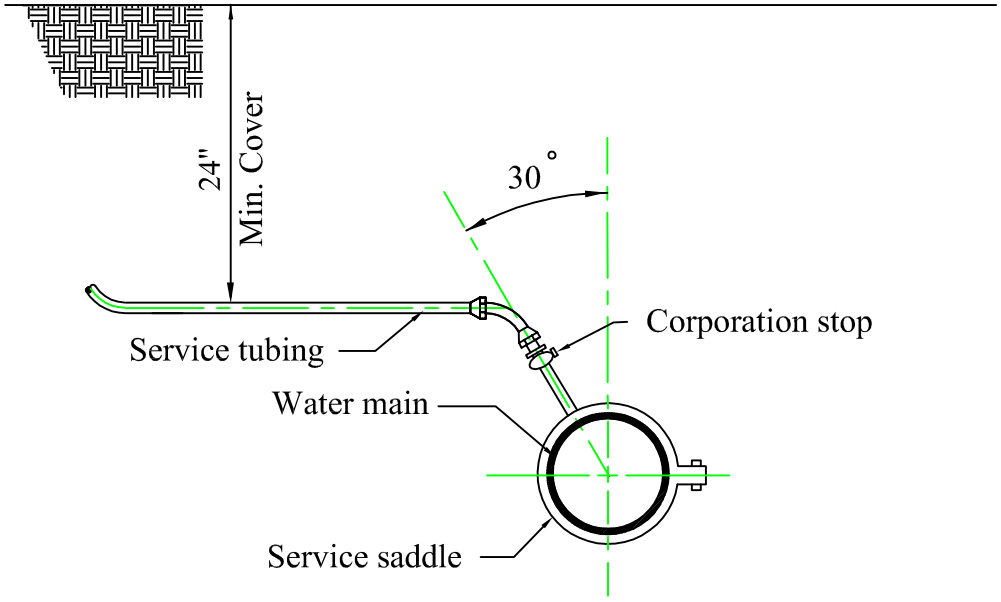
Is the BFP located on the correct side of the meter?
Other details have a min. of 12" from bottom of unit.
z
w




# TYPICAL SERVICE METER INSTALLATION

N.T.S.

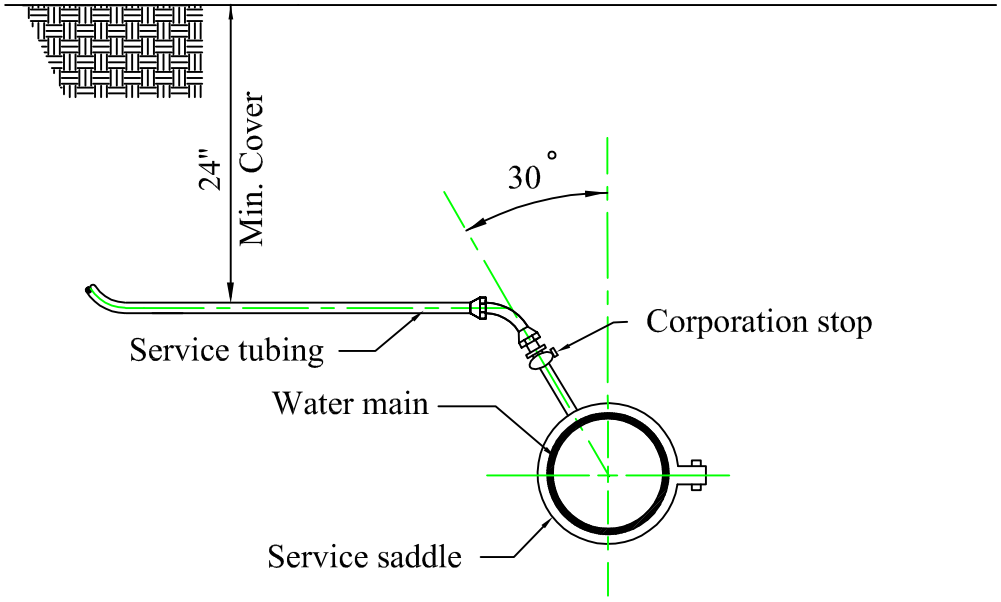
| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | SERVICE METER INSTALLATION<br>WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W002 |




# SERVICE CONNECTION DETAIL

N.T.S.

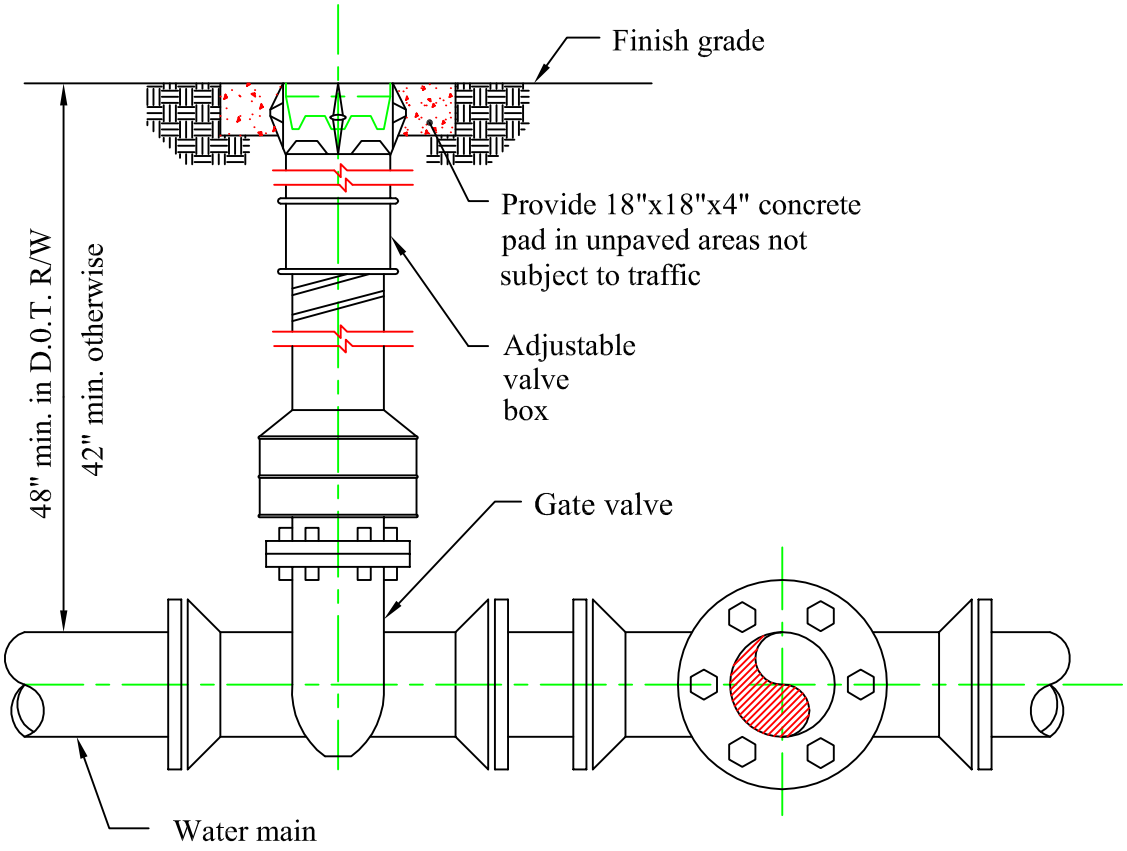
| | | |
|---|---|---|
| | SERVICE CONNECTION<br>WATER SYSTEM STANDARD | STANDARD<br>DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W003 |




# SERVICE CONNECTION DETAIL

N.T.S.

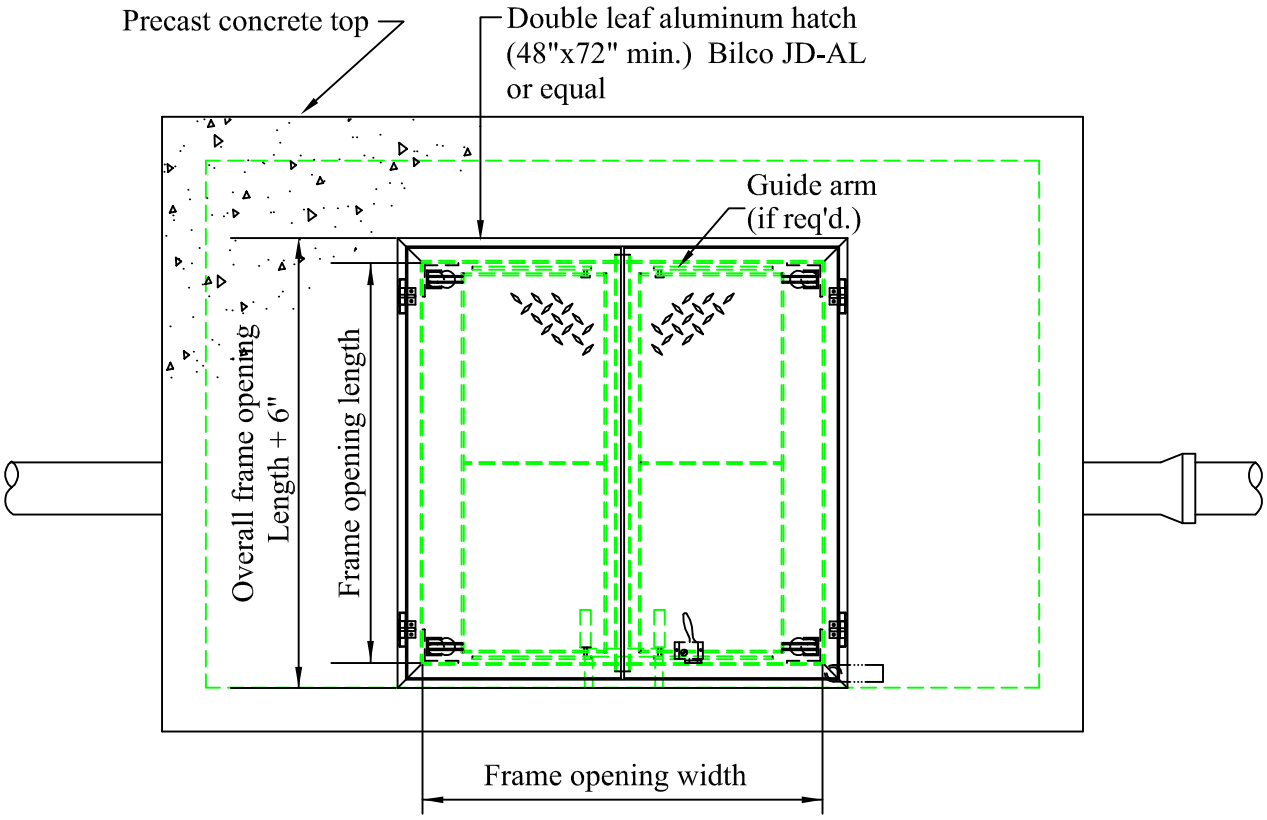
| | | |
|---|---|---|
| | SERVICE CONNECTION<br>WATER SYSTEM STANDARD | STANDARD<br>DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W003 |

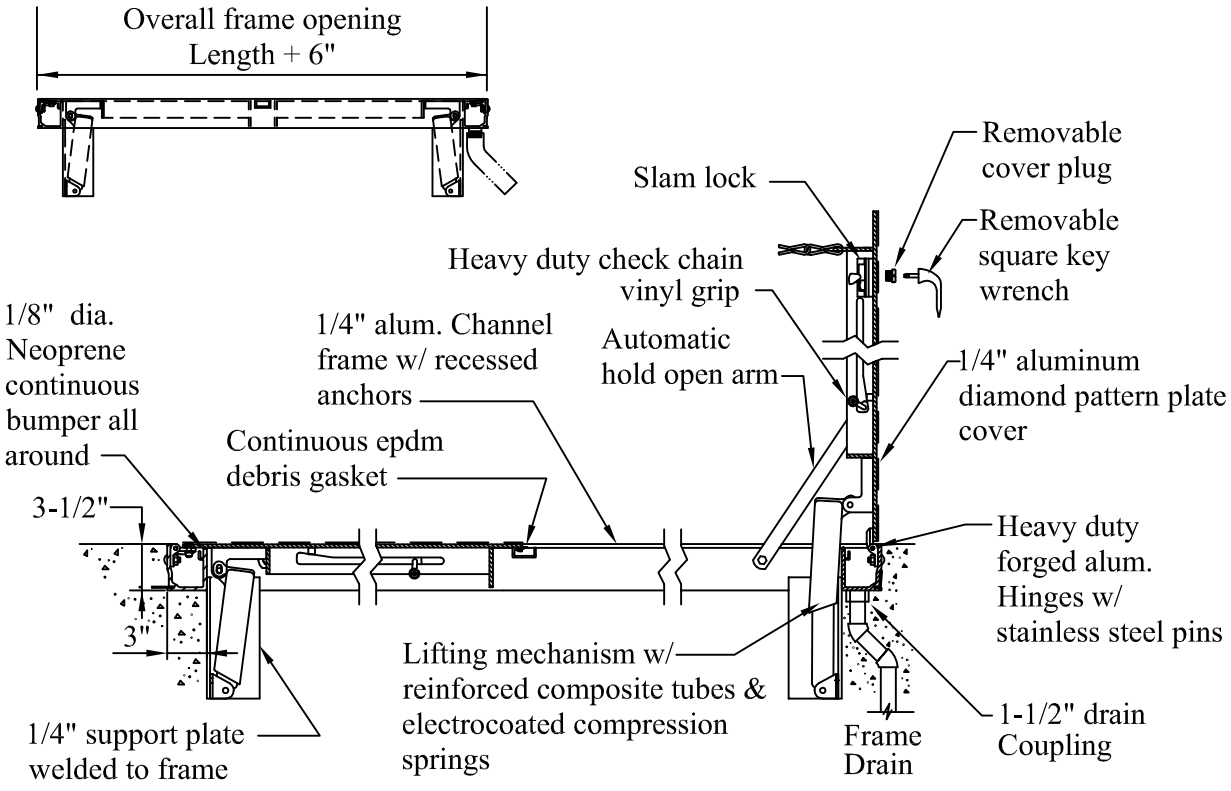



# TYPICAL GATE VALVE INSTALLATION

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | GATE VALVE INSTALLATION<br>WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W004 |



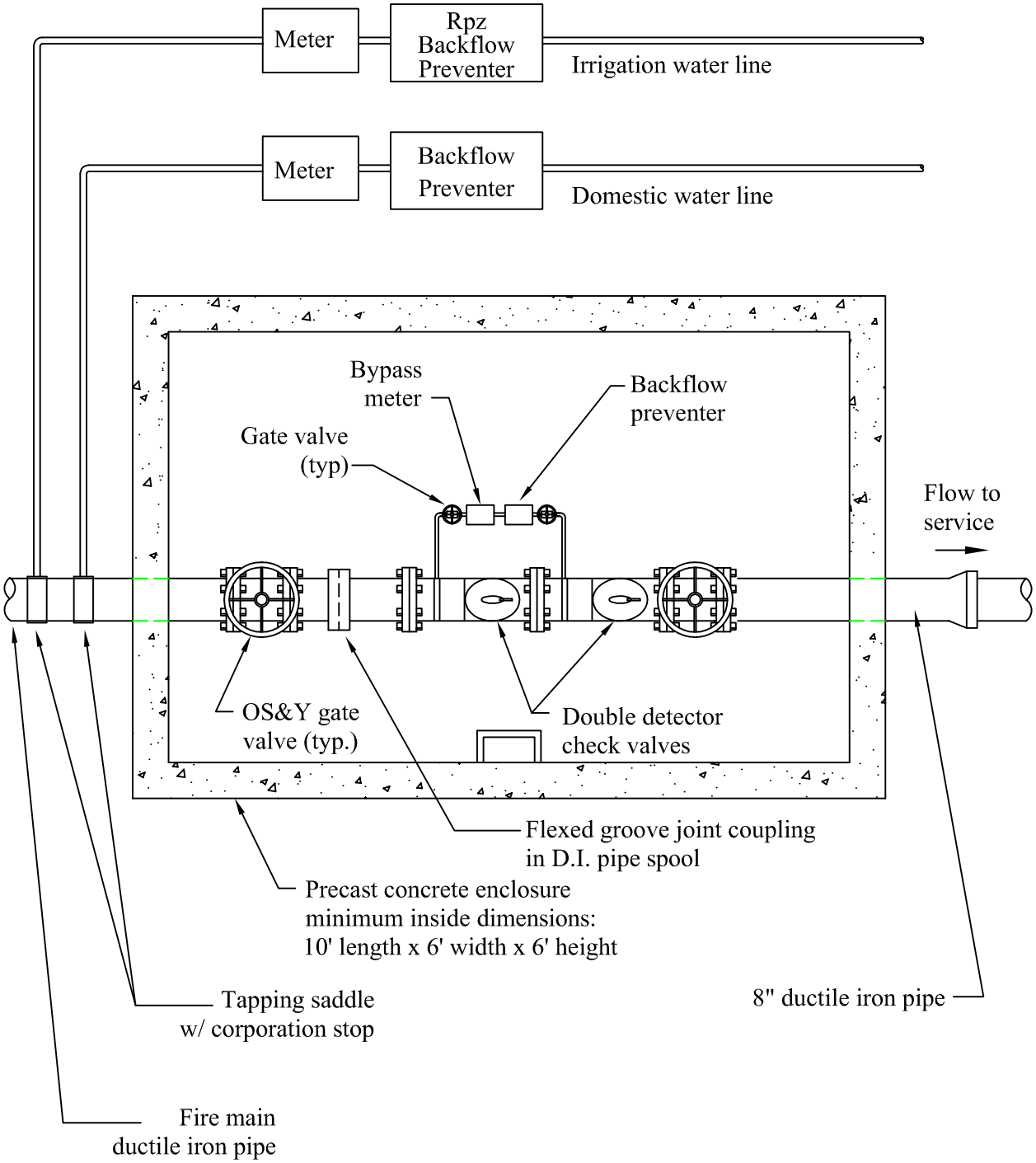

# FIRE MAIN AND WATER VAULT DETAIL TOP PLAN & HATCH DETAILS

STANDARD DETAIL

DATE 02/17/05

THE CITY OF
UNION CITY, GEORGIA

W005



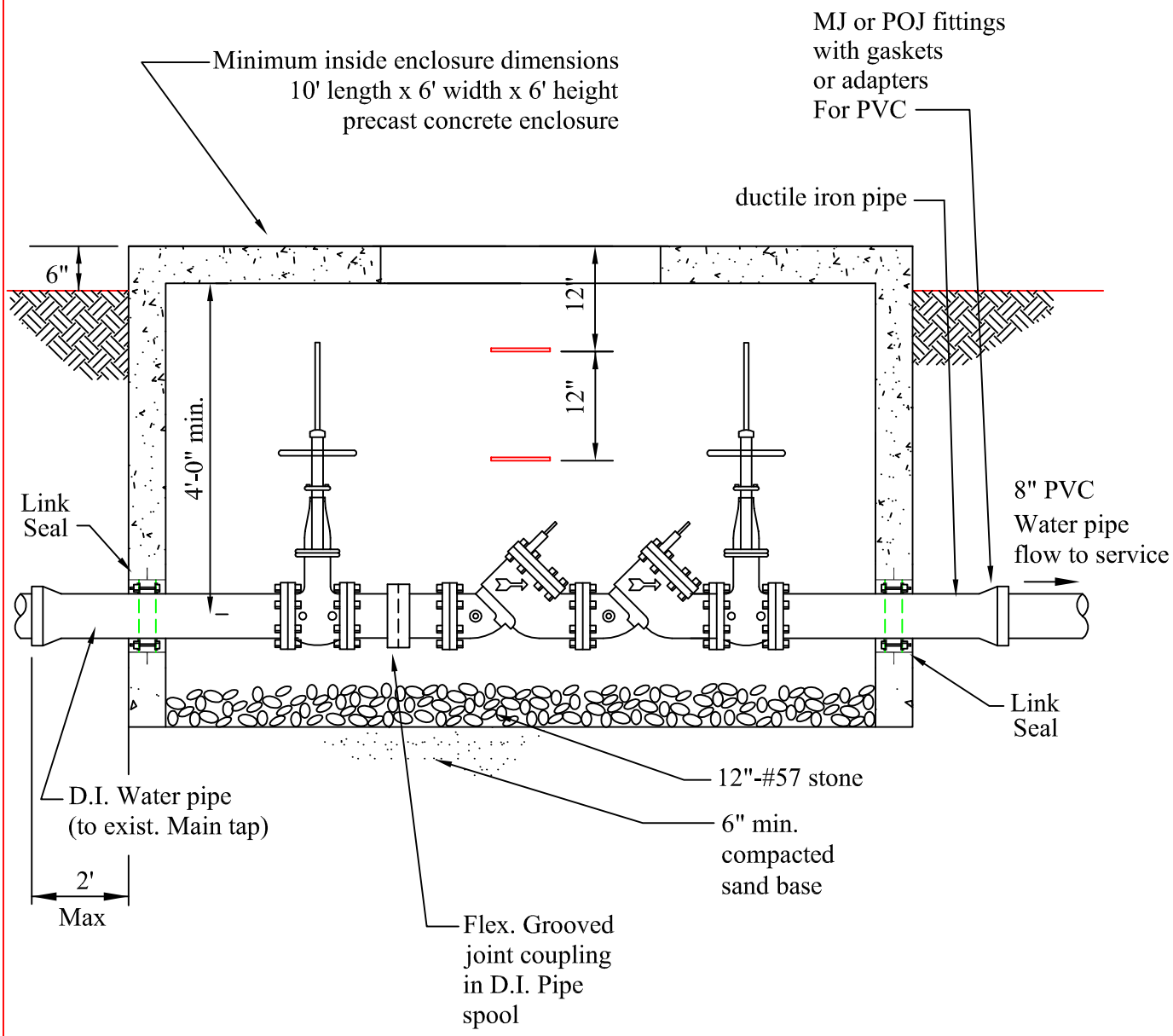

# FIRE MAIN AND WATER VAULT DETAIL PLAN

STANDARD DETAIL

DATE 02/17/05

THE CITY OF
UNION CITY, GEORGIA

W006

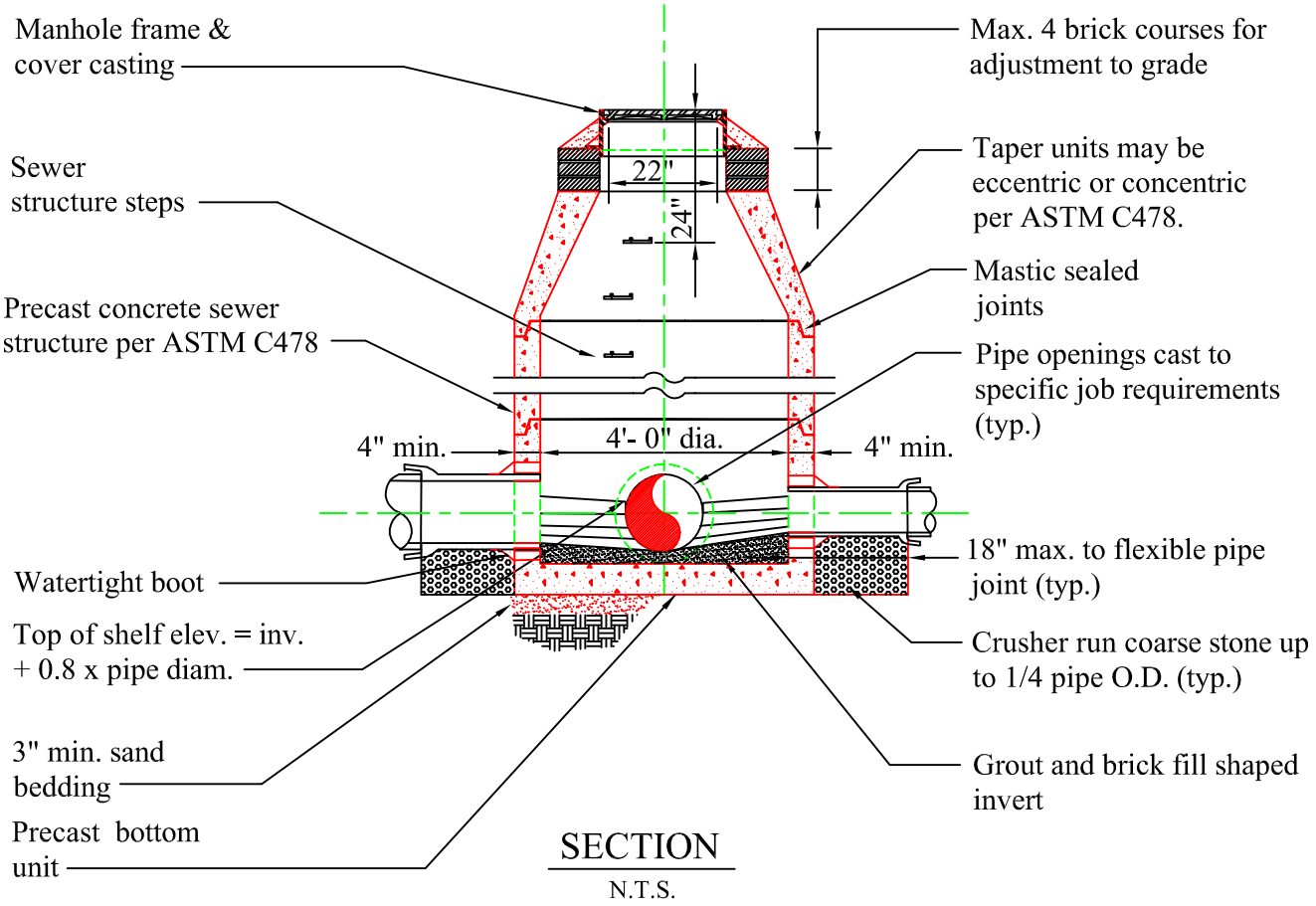



NOTES:

1. For backflow prevention device, provide 8" internally loaded double check assembly complete with os&y gate valves and bronze body ball valve test cocks fitted with bronze plugs and conforming with AWWA C510 and ASSE std. 1048.

2. Provide concrete supports for pipe & assembly to eliminate Any strain on all pipe joints per mfg. Recommendations.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | FIRE MAIN AND WATER VAULT DETAIL SECTION | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | W007 |




SECTION

N.T.S.

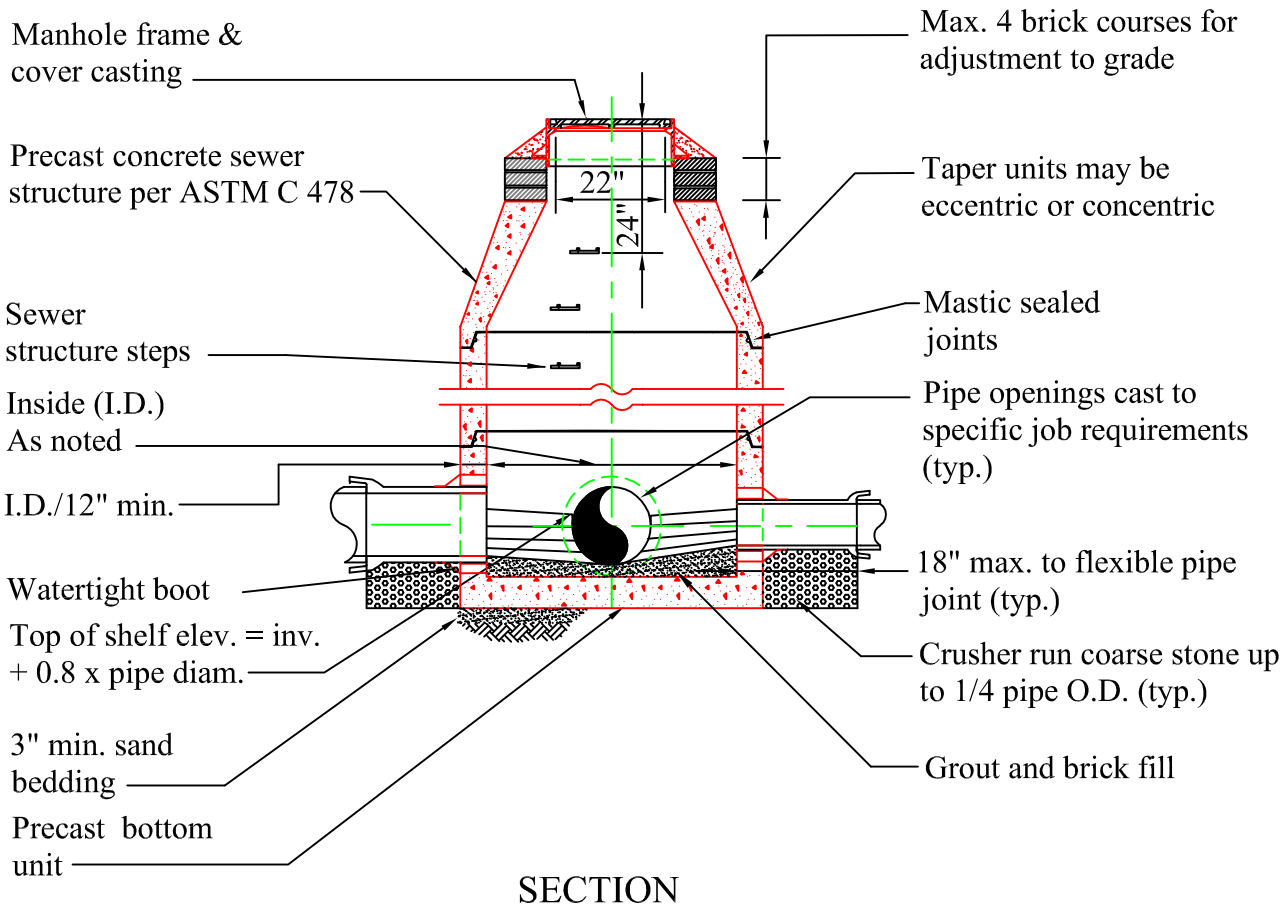
## NOTES:

1. SEWER STRUCTURE STEP REQUIREMENTS:

   Provide individual steps, mortared or cast into walls and conical tops of all manholes and similar structures. Align steps so as to form a continuous ladder with steps equally spaced vertically, no more than 16 inches apart, using steps having a minimum length of 10-inches and which project a minimum clear distance of four inches from the wall. Steps, fastenings and installation must be capable of supporting a single concentrated load of 300 pounds. Use designs based on imposed loads being concentrated at such points as will cause maximum stresses in the structural element being considered. Construct individual steps as one piece, ferrous casting or plastic coated steel meeting requirements of ASTM D4101-95b and A 615 grade 60.

2. Provide watertight boot sleeve of high quality synthetic rubber. Terminate the sleeve at one end in a substantial serrated flange of the same material and cast into the wall of the manhole base to form a water stop. Embed the flange in the wall no less than 4-inches around the entire pipe. Fit the other end of the sleeve around the outside of the pipe and secure to the pipe by means of a stainless steel strap clamp, draw bolt and nut. Furnish synthetic rubber suitable for use in sewage service.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | PRECAST MANHOLE<br>4-FOOT INSIDE DIAMETER<br>MANHOLE STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | M001 |



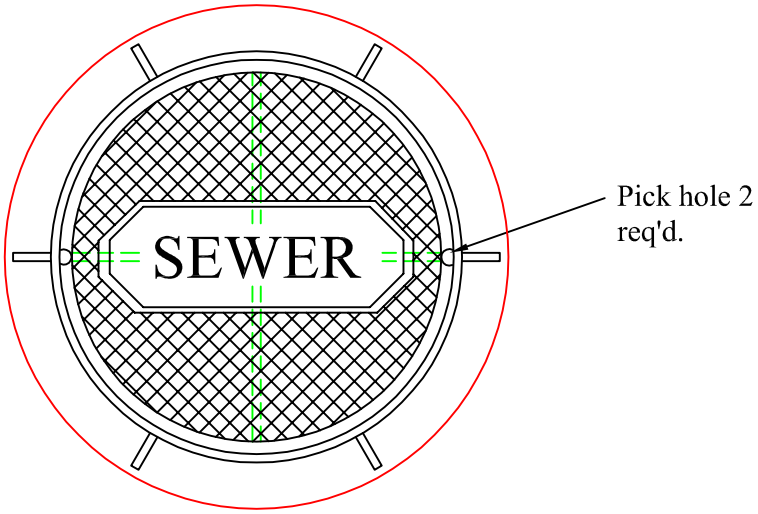

SECTION

N.T.S.

NOTES:

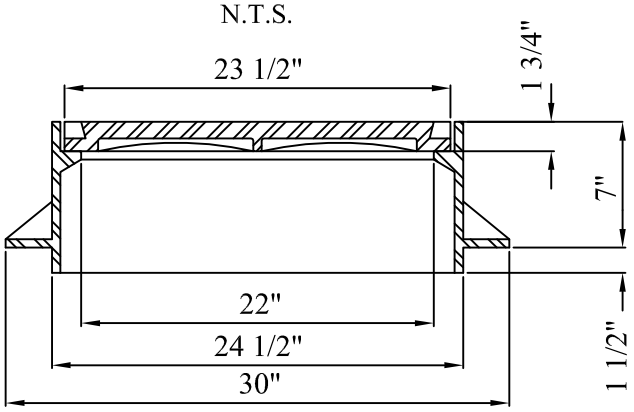
1. Provide steps and watertight boot complying with requirements on dwg. No. M001.
2. Use this detail for manholes with inside diameter greater than 4 feet.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | LARGE DIAMETER PRECAST MANHOLE MANHOLE STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | M002 |




PLAN

N.T.S.




SECTION

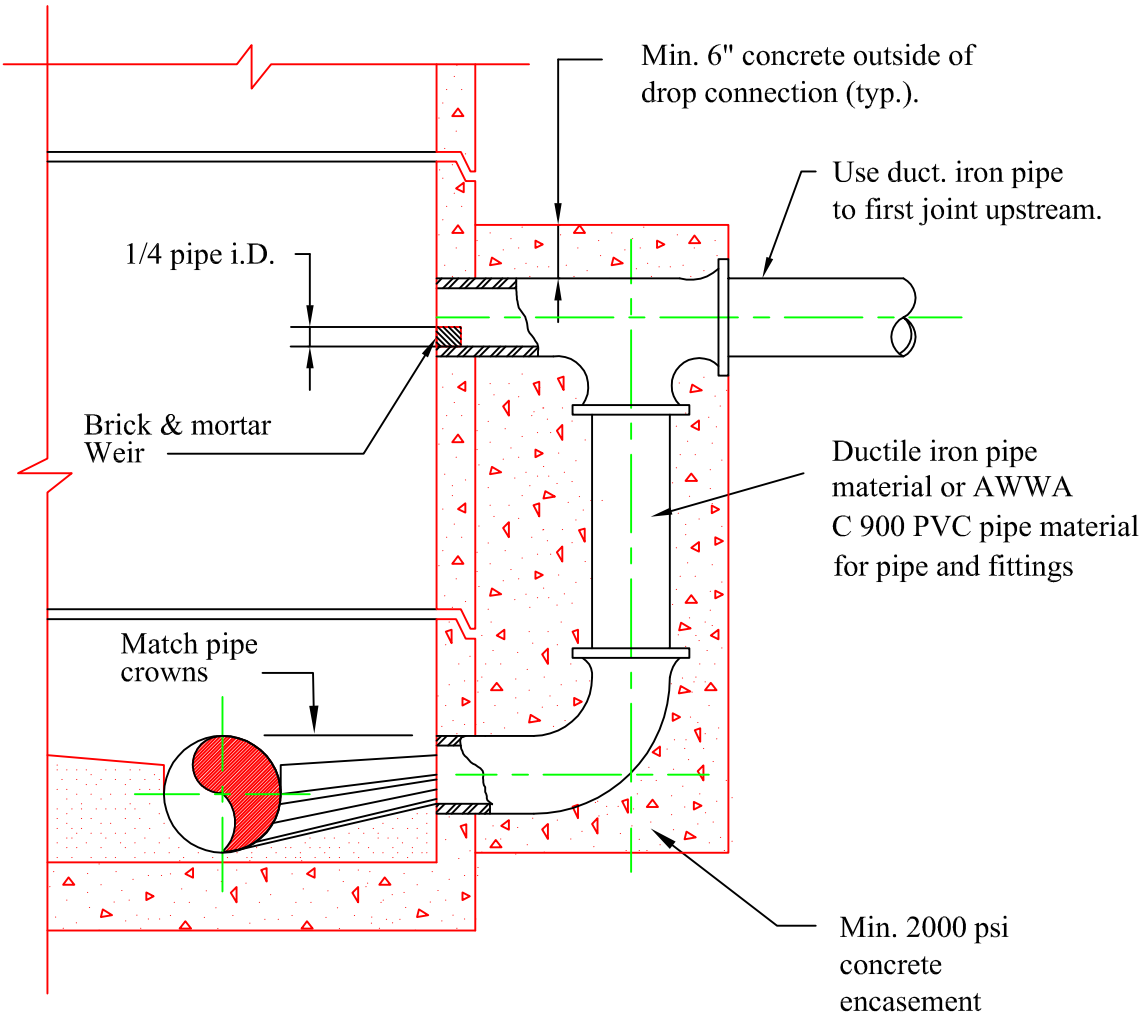
N.T.S.

NOTES:

1. Frame & cover machined for non-rocking fit.
2. Approx. Wt. Of frame = 180#.
3. Approx. Wt. Of cover = 135#.
4. Provide watertight bolt down type cover secured with 4 std. Hex head bronze or st. Stl. cap screws and gasket, where manholes occur outside road rights-of-way or otherwise indicated.
5. METAL CASTING REQUIREMENTS:

   Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion or other significant defects, and having smooth surfaces free of casting sand, fins and burrs. Use component parts which fit together uniformly, in a secure fashion. Use gray iron casting material complying with ASTM A 48, class 30.

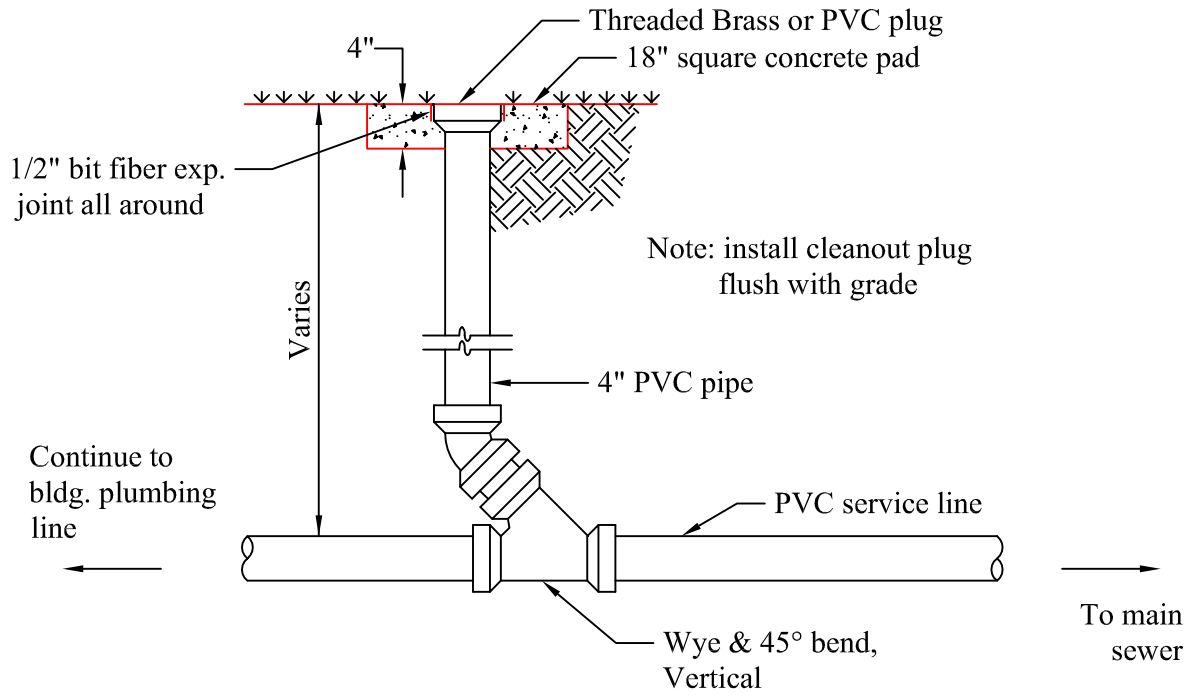
| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | MANHOLE FRAME & COVER CASTING MANHOLE STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | M004 |




## PARTIAL SECTION

N.T.S.

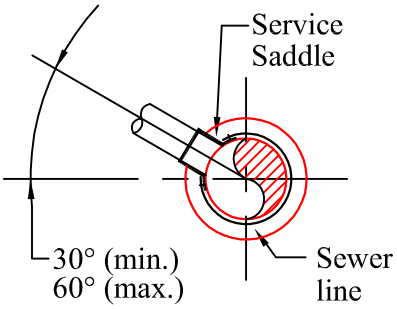
| | | |
|---|---|---|
| | DROP CONNECTION DETAIL<br>SANITARY SEWER STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | S001 |



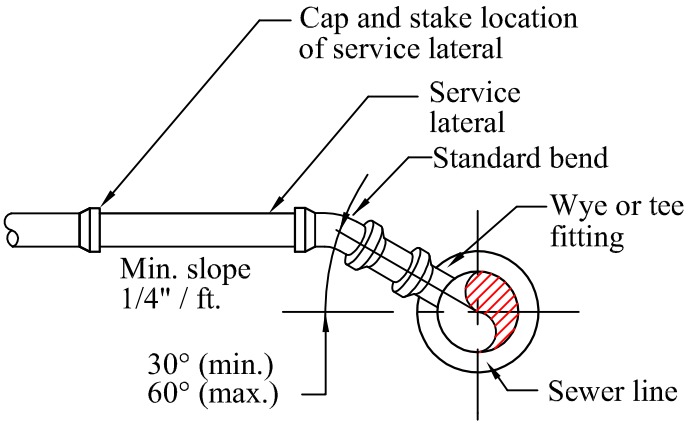

# SEWER SERVICE CLEANOUT

N.T.S.

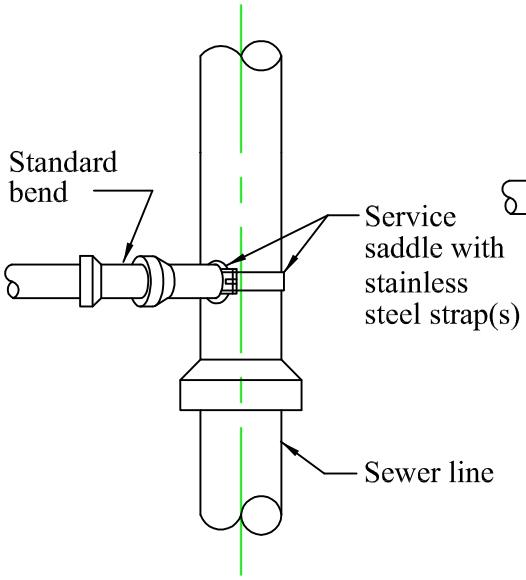
| | | |
|---|---|---|
| UNION CITY GEORGIA SEAL | SEWER SERVICE CLEANOUT<br>SANITARY SEWER STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | S002 |



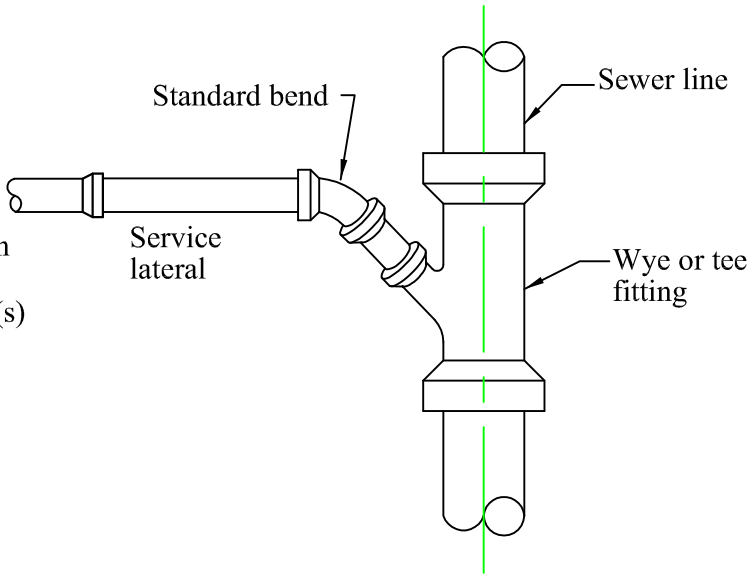

SECTION




SECTION




PLAN

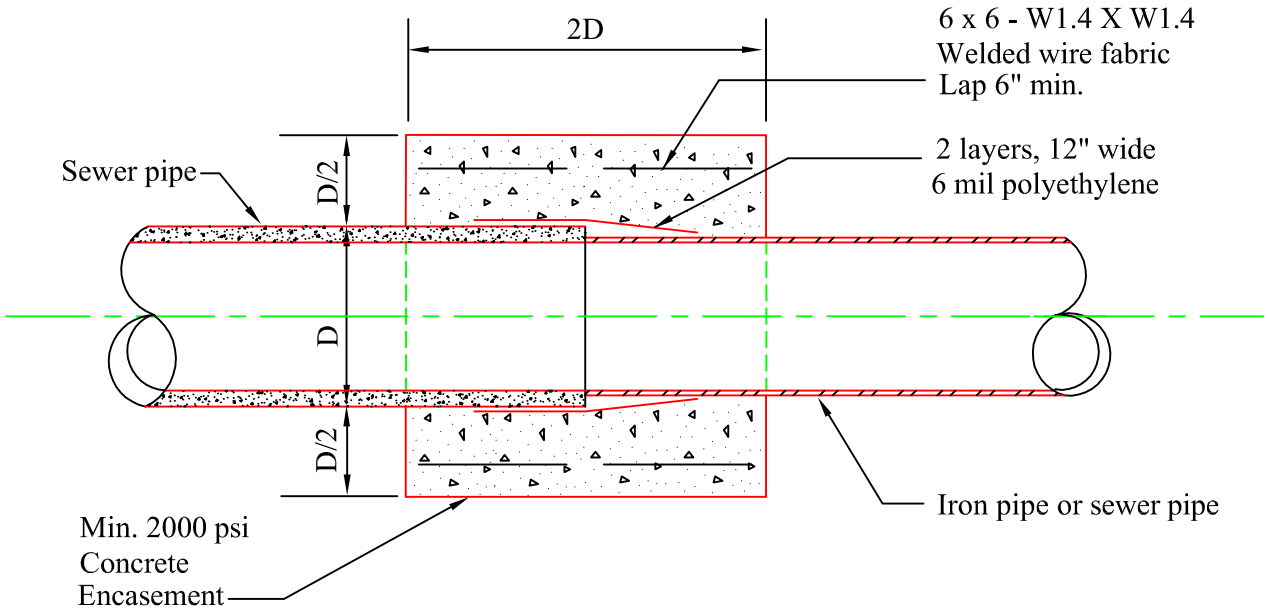



PLAN

# SEWER SERVICE CONNECTION DETAIL

N. T. S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | SEWER SERVICE CONNECTION<br>SANITARY SEWER STANDARD | STANDARD DETAIL<br>DATE 02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | S003 |



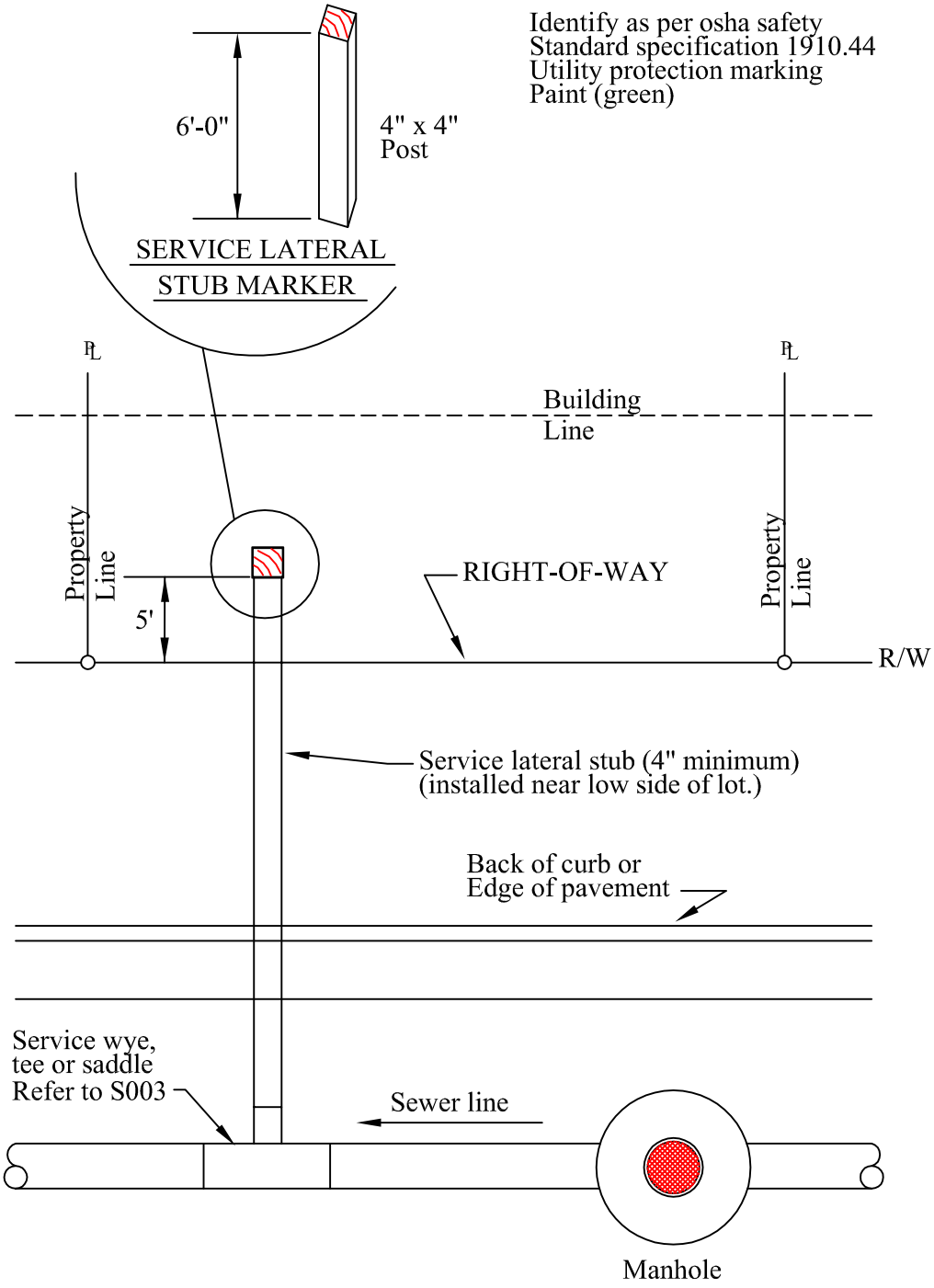

# COLLAR DETAIL

N.T.S.

## NOTE:

At contractor's option, flexible pvc couplings, conforming to ASTM C-564, with #305 stainless steel bands may be used instead of concrete collar. When used, bedding and installation must conform to manufacturer's published recommendations.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | TRANSITION COLLAR<br>SANITARY SEWER STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | S004 |



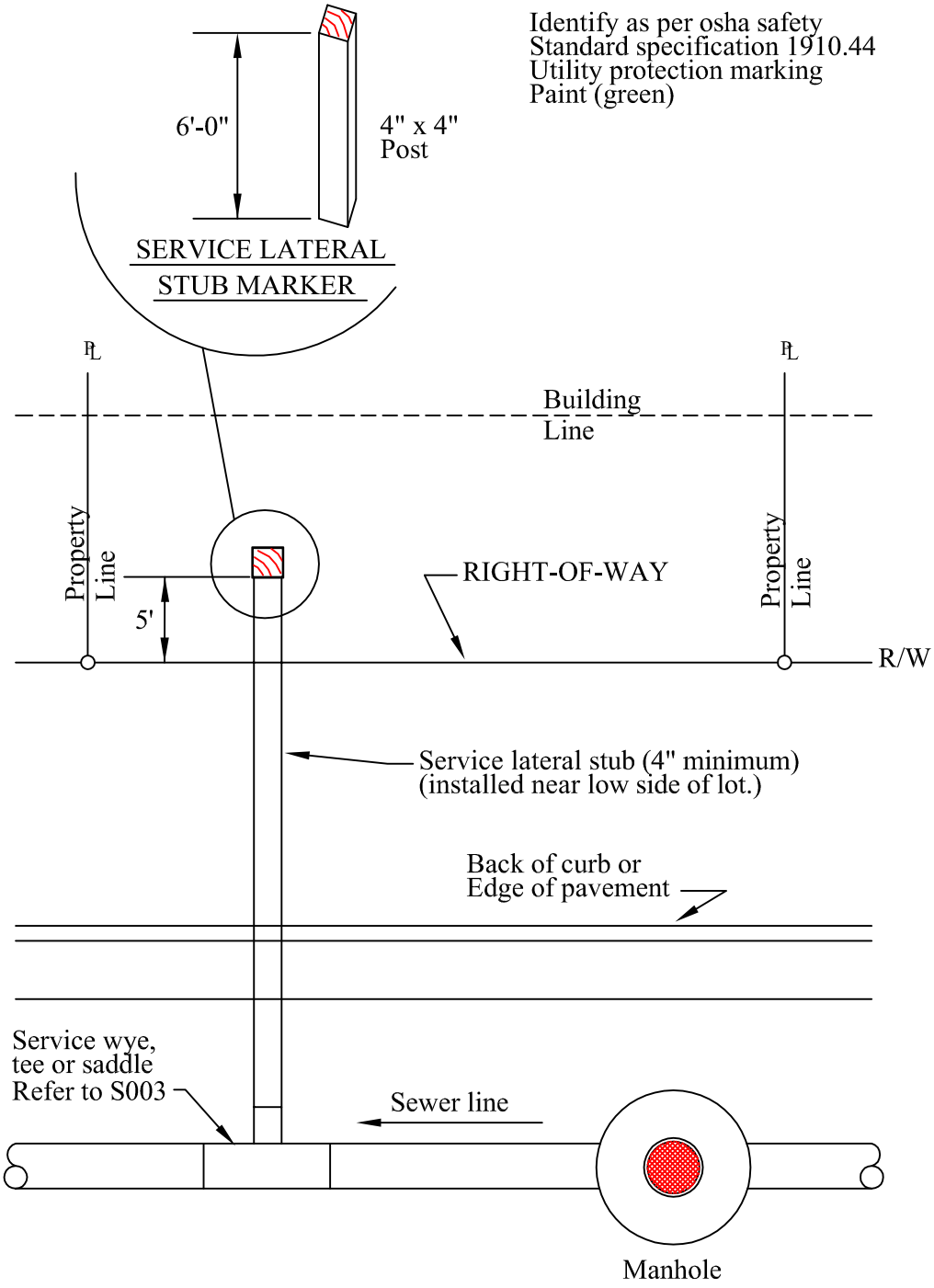

# SANITARY SEWER SERVICE LATERAL STUB LOCATION MARKER SANITARY SEWER STANDARD

THE CITY OF
UNION CITY, GEORGIA

STANDARD
DETAIL

DATE
02/17/05

S006



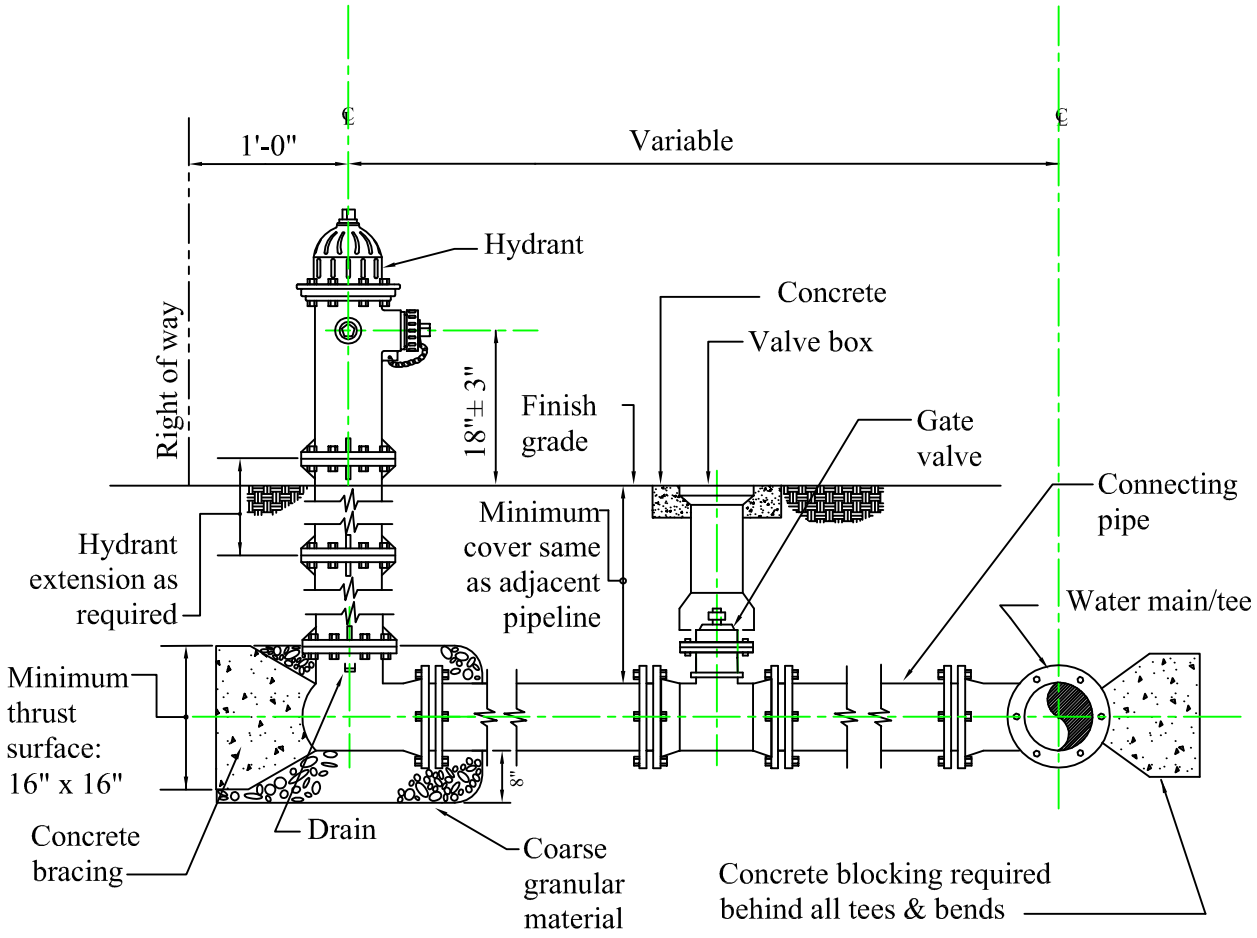

# SANITARY SEWER SERVICE LATERAL STUB LOCATION MARKER SANITARY SEWER STANDARD

THE CITY OF
UNION CITY, GEORGIA

STANDARD
DETAIL

DATE
02/17/05

S006




NOTES:

1. Hydrant lugs and stainless steel tie rods may be used in lieu of concrete reaction bracing at contractor's option.

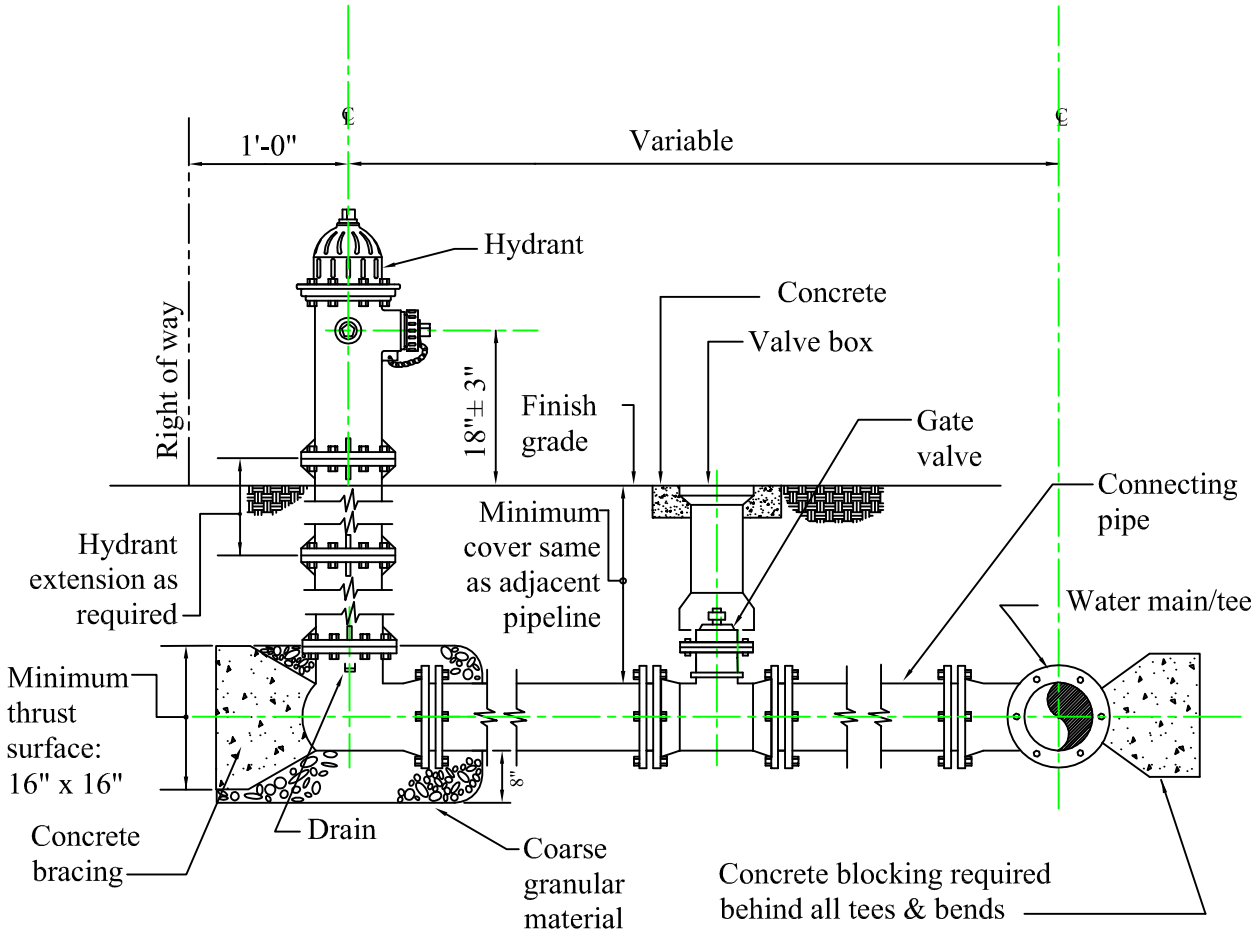
2. For standardization with existing system, provide three way fire hydrant of one of the following types: m&h valve co. Traffic model (style 129) or mueller centurion model (a-421).

3. Paint hydrant in accordance with A.W.W.A. C502, color: red.

## HYDRANT DETAIL

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | TYPICAL HYDRANT INSTALLATION WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | W001 |




NOTES:

1. Hydrant lugs and stainless steel tie rods may be used in lieu of concrete reaction bracing at contractor's option.

2. For standardization with existing system, provide three way fire hydrant of one of the following types: m&h valve co. Traffic model (style 129) or mueller centurion model (a-421).

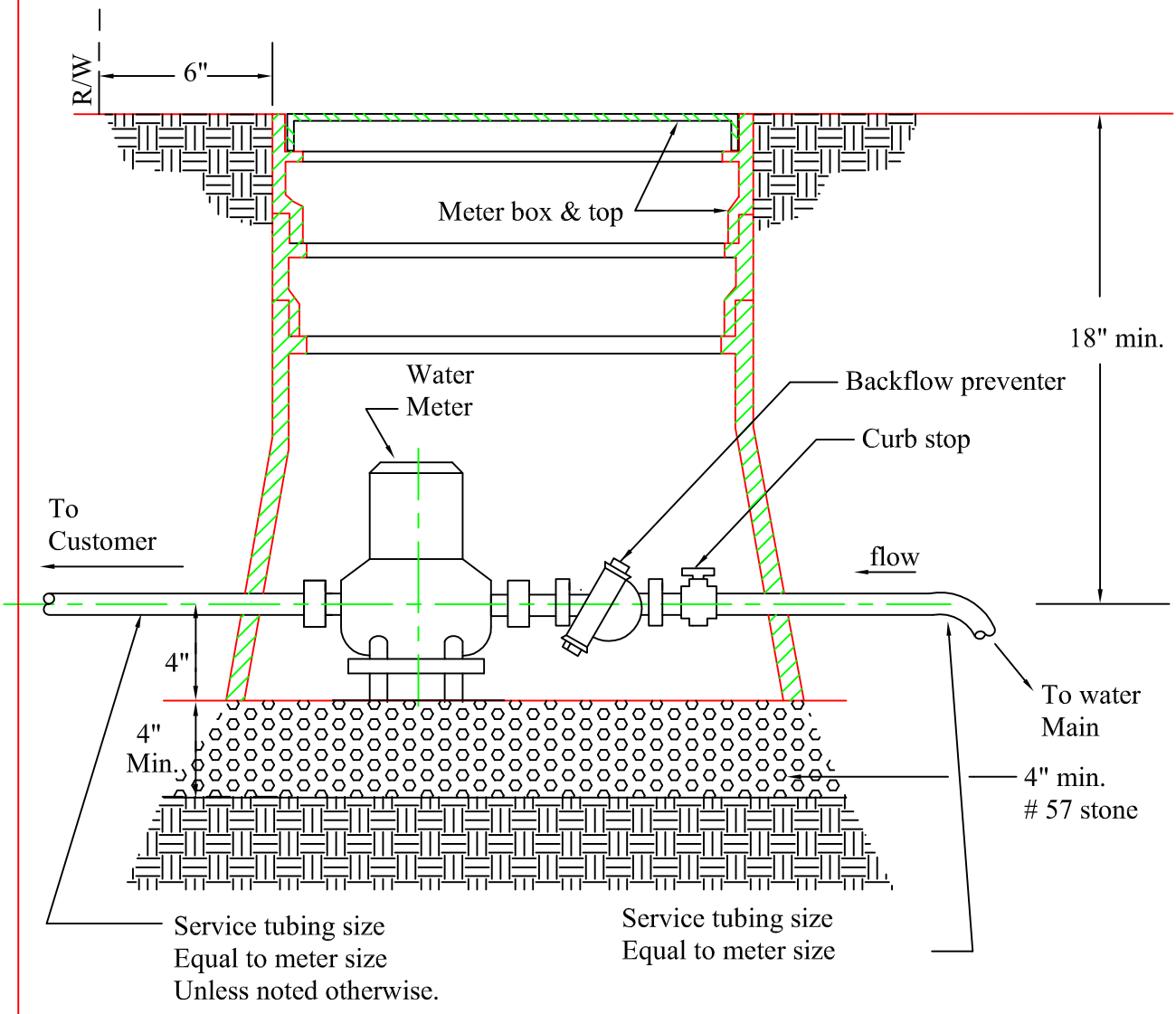
3. Paint hydrant in accordance with A.W.W.A. C502, color: red.

## HYDRANT DETAIL

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | TYPICAL HYDRANT INSTALLATION WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | W001 |

Is the BFP located on the correct side of the meter?
Other details have a min. of 12" from bottom of unit.
z
w

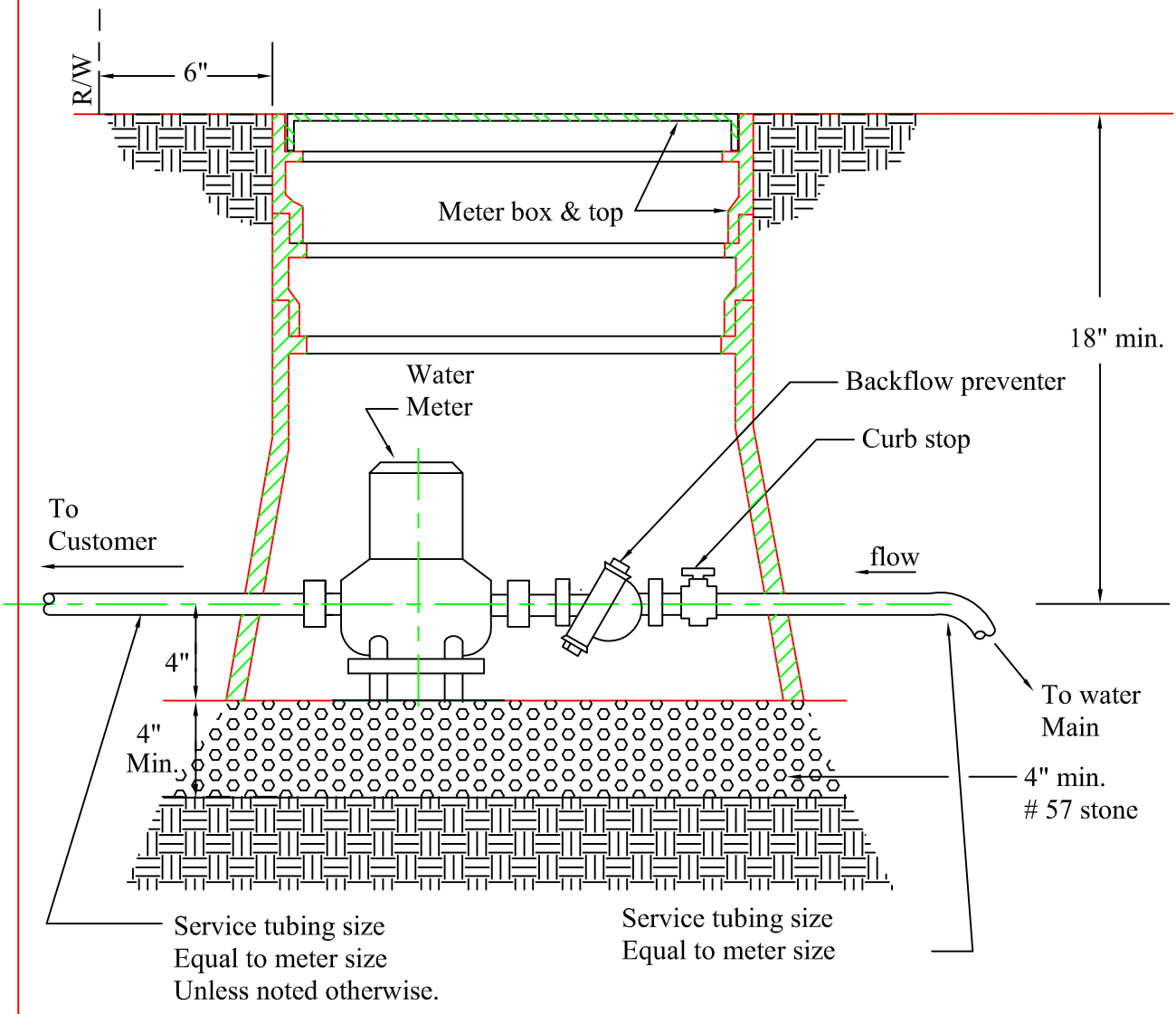



# TYPICAL SERVICE METER INSTALLATION

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | SERVICE METER INSTALLATION<br>WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W002 |

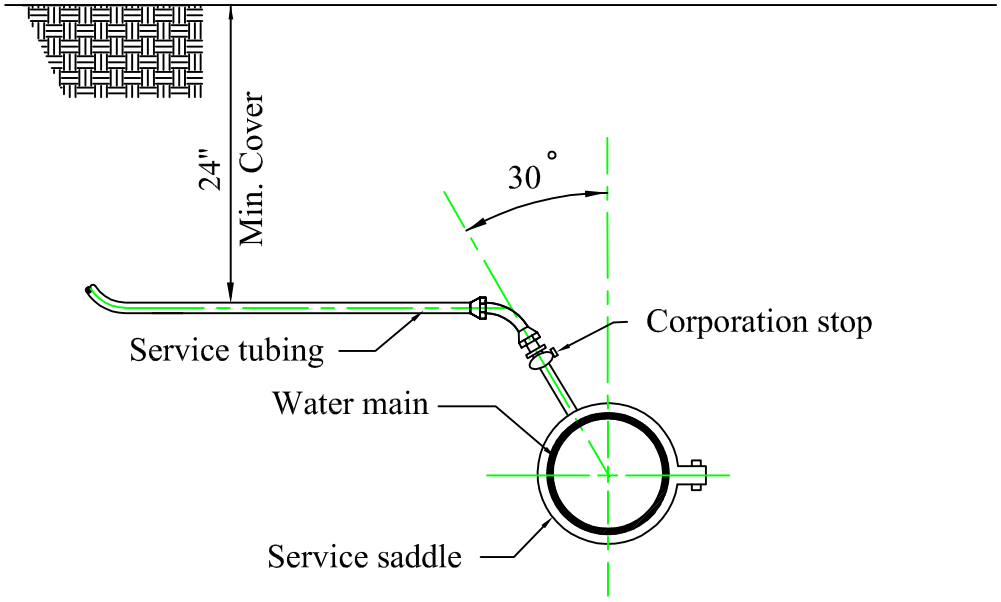
Is the BFP located on the correct side of the meter?
Other details have a min. of 12" from bottom of unit.
z
w




# TYPICAL SERVICE METER INSTALLATION

N.T.S.

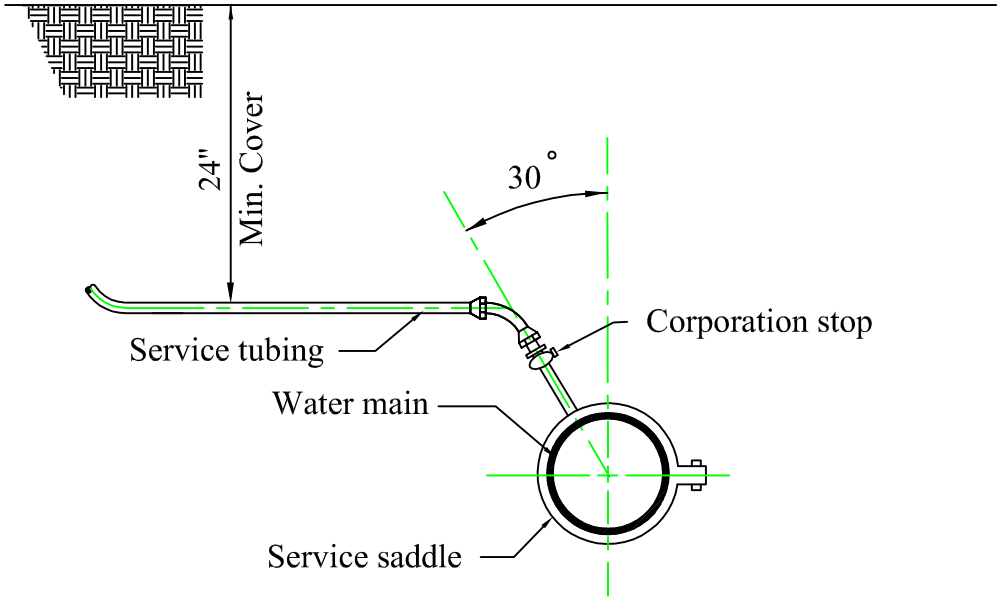
| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | SERVICE METER INSTALLATION<br>WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W002 |




# SERVICE CONNECTION DETAIL

N.T.S.

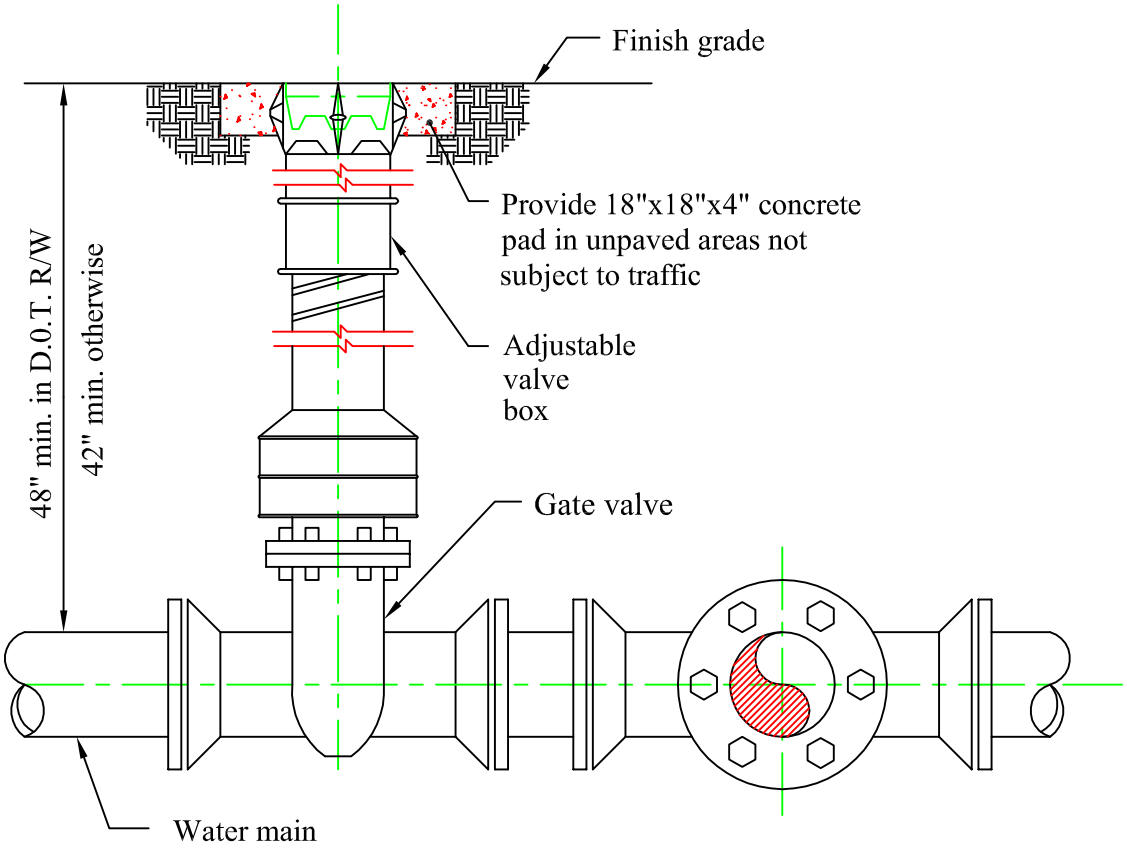
| | | |
|---|---|---|
| | SERVICE CONNECTION<br>WATER SYSTEM STANDARD | STANDARD<br>DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W003 |




# SERVICE CONNECTION DETAIL

N.T.S.

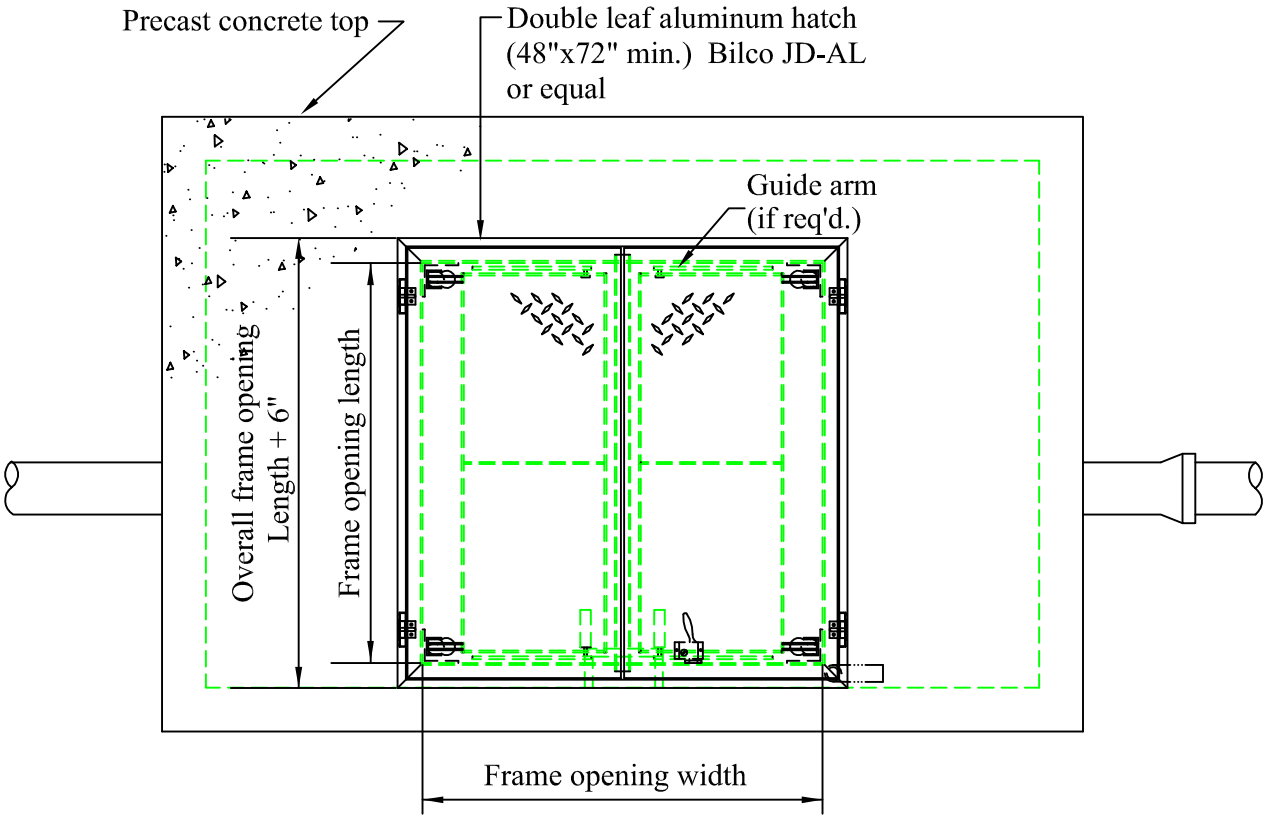
| | | |
|---|---|---|
| | SERVICE CONNECTION<br>WATER SYSTEM STANDARD | STANDARD<br>DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W003 |

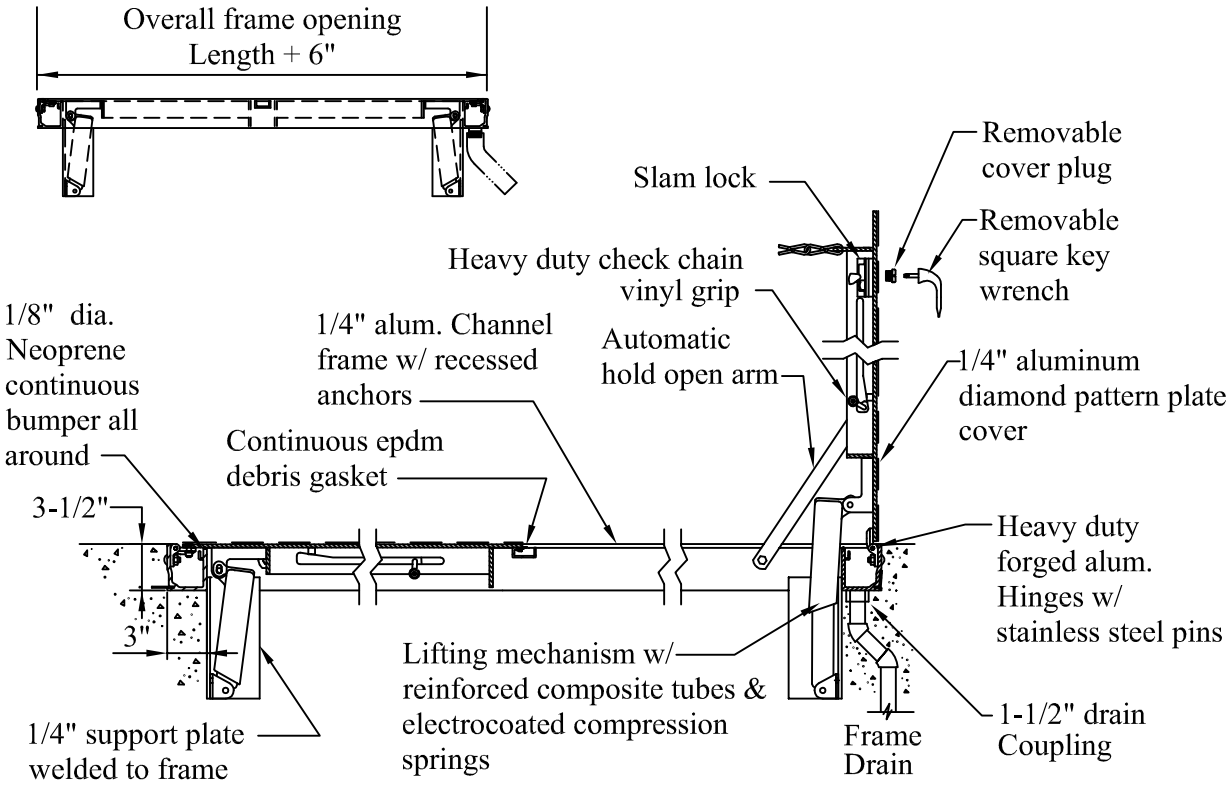



# TYPICAL GATE VALVE INSTALLATION

N.T.S.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | GATE VALVE INSTALLATION<br>WATER SYSTEM STANDARD | STANDARD DETAIL |
| | | DATE<br>02/17/05 |
| | THE CITY OF<br>UNION CITY, GEORGIA | W004 |



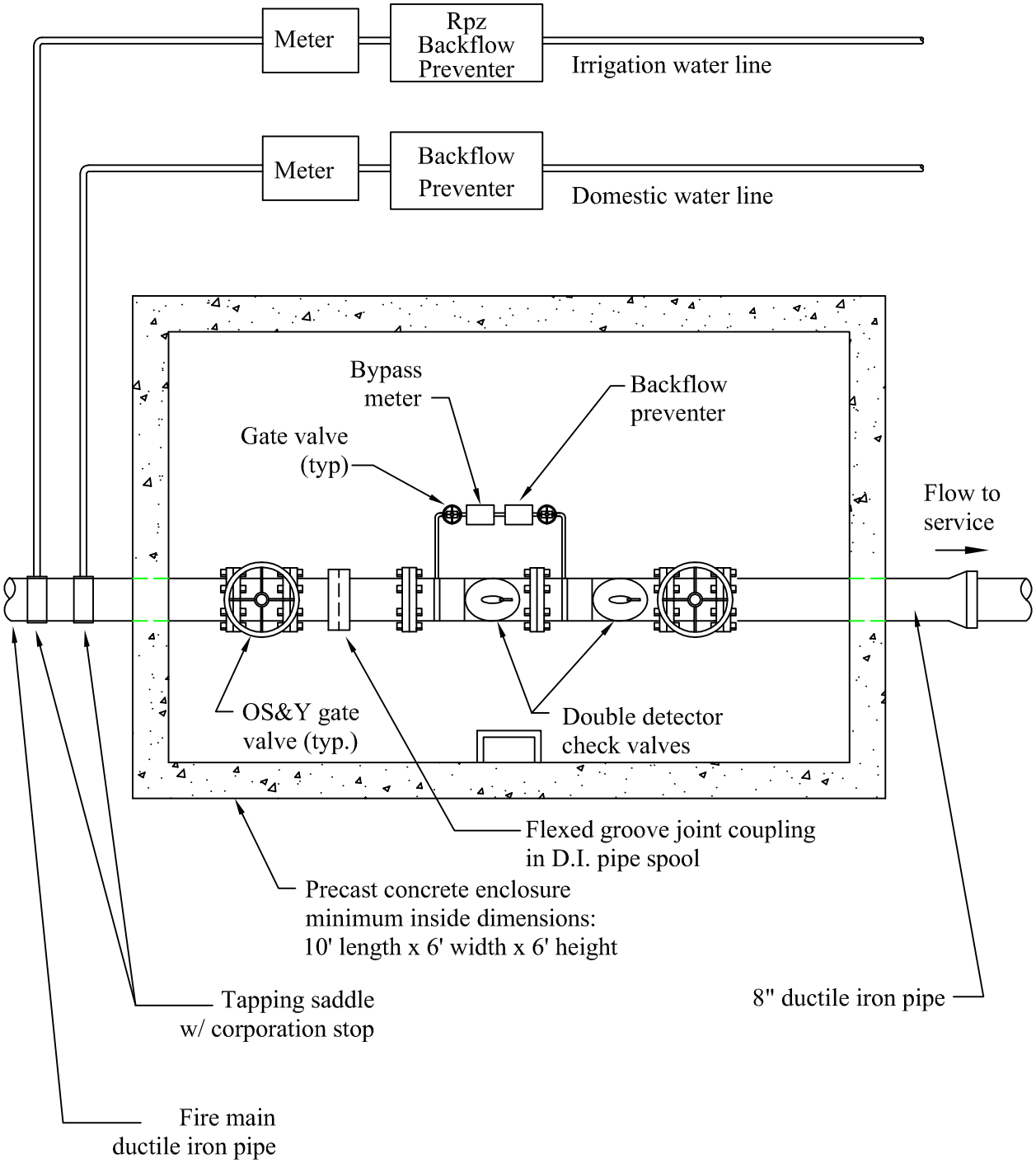

# FIRE MAIN AND WATER VAULT DETAIL TOP PLAN & HATCH DETAILS

STANDARD DETAIL

DATE 02/17/05

THE CITY OF
UNION CITY, GEORGIA

W005



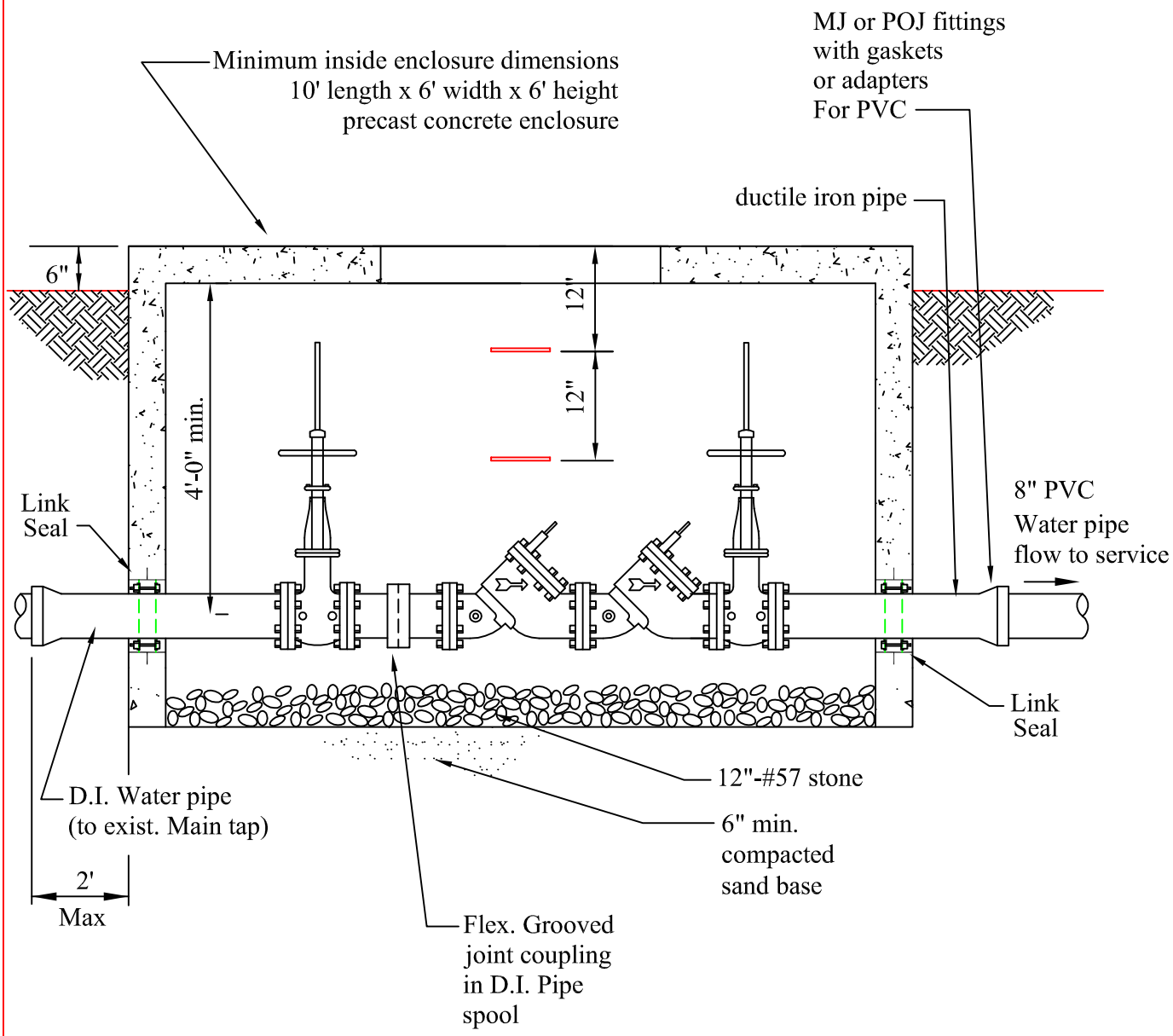

# FIRE MAIN AND WATER VAULT DETAIL PLAN

STANDARD DETAIL

DATE 02/17/05

THE CITY OF
UNION CITY, GEORGIA

W006




NOTES:

1. For backflow prevention device, provide 8" internally loaded double check assembly complete with os&y gate valves and bronze body ball valve test cocks fitted with bronze plugs and conforming with AWWA C510 and ASSE std. 1048.

2. Provide concrete supports for pipe & assembly to eliminate Any strain on all pipe joints per mfg. Recommendations.

| | | |
|---|---|---|
| UNION CITY THE PROGRESSIVE CITY 1908 SEAL GEORGIA | FIRE MAIN AND WATER VAULT DETAIL SECTION | STANDARD DETAIL |
| | | DATE 02/17/05 |
| | THE CITY OF UNION CITY, GEORGIA | W007 |