

CITY OF WOODLAND PARK
RESOLUTION NO. 724, SERIES 2011

A RESOLUTION REVISING THE CITY OF WOODLAND PARK ENGINEERING SPECIFICATIONS.

WHEREAS, the City of Woodland Park has heretofore adopted a document known as the City of Woodland Park Engineering Specifications; and

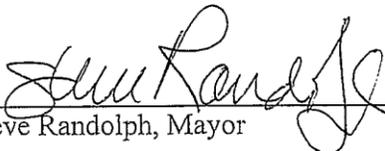
WHEREAS, the City of Woodland Park has reviewed and updated the Engineering Specifications with comments and inputs from local developers, builders, engineers, surveyors and contractors; and

WHEREAS, it is the desire of the City Council of the City of Woodland Park to revise these specifications so as to provide more current specifications to regulate the design, materials and construction practices for all public infrastructure,

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF WOODLAND PARK, COLORADO, THAT:

The City of Woodland Park hereby adopts the City of Woodland Park Engineering Specifications jointly compiled by the City of Woodland Park Departments of Public Works and Utilities. Said specifications shall be subject to review for updates, amendments and additions as needed. Updates, amendments and additions shall be approved by City Council by Resolution.

The foregoing Resolution was adopted at a regular meeting of the City Council, held in Woodland Park, Colorado on the 3rd day of February, 2011.



Steve Randolph, Mayor

ATTEST:



Cindy Morse, City Clerk



City of
Woodland Park
Engineering Specifications

Adopted
February 3, 2011



CITY OF WOODLAND PARK, COLORADO

TITLE 1

**POLICIES AND PROCEDURES FOR INFRASTRUCTURE
IMPROVEMENT PROJECTS**

TABLE OF CONTENTS

SECTION	1.1	PURPOSE	1-1
	1.1.1	ADOPTED STANDARDS	1-1
SECTION	1.2	DESIGN POLICY	1-2
	1.2.1	GENERAL	1-2
	1.2.1.1	SUBDIVISION FLOW CHART	1-3
	1.2.1.2	SITE PLAN REVIEW FLOW CHART	1-4
	1.2.2	PREAPPLICATION CONFERENCE CONCEPT/SKETCH PLAN	1-5
	1.2.3	PRELIMINARY PLANS AND REPORTS	1-5
	1.2.4	CONSTRUCTION PLANS	1-8
	1.2.5	CONSTRUCTION DRAWINGS	1-9
	1.2.6	EASEMENTS	1-11
SECTION	1.3	CONSTRUCTION POLICY	1-11
	1.3.1	ENGINEERED AND APPROVED PLANS	1-11
	1.3.2	CONTRACTOR LICENSES REQUIRED	1-11
	1.3.3	PERMITS	1-11
	1.3.4	PRE-CONSTRUCTION CONFERENCE	1-11
	1.3.5	INSPECTION, TESTING, STOP WORK ORDERS	1-12
	1.3.5.1	RE-INSPECTIONS	1-13
	1.3.5.2	INSPECTIONS OUTSIDE NORMAL INSPECTION HOURS	1-13
	1.3.5.3	STOP WORK ORDERS	1-13
	1.3.6	“AS-BUILT” DRAWINGS	1-14
	1.3.6.1	RESPONSIBILITIES	1-15
	1.3.6.2	SPECIFIC “AS-BUILT” REQUIREMENTS	1-15
	1.3.6.3	SUBMITTAL OF CERTIFIED “AS-BUILT” PLANS AND DOCUMENTS	1-17
	1.3.7	ACCEPTANCE AND WARRANTY	1-17
	1.3.7.1	PRE-ACCEPTANCE INSPECTION AND PUNCH LIST	1-17
	1.3.7.2	INITIAL ACCEPTANCE	1-18
	1.3.7.3	FINAL ACCEPTANCE	1-19

1.1 PURPOSE

The purpose of these Engineering Specifications is to provide minimum standards to safeguard life and limb, health, property and public welfare by regulating the design of, construction of, choice of materials used for, location of, and maintenance and use of all public improvements and common facilities. These include, but are not limited to, sanitary sewer systems, water supply systems, private utility services lines to water and sewer, public and private storm drainage systems, public and private streets, open space, parks and recreation facilities, traffic signals and devices, public and private parking lots and appurtenances thereto. All equipment and material shall be new unless approved by the City.

These Engineering Specifications and the various authorities reserved for the City herein shall be administered by the City Engineer or appointed representative. Responsibilities and authority to administer various aspects of these Engineering Specifications may be delegated by the City Engineer or appointed representative to other City employees (appointed representative) who shall conduct their related work under the supervision and coordination of the City Engineer or appointed representative.

These Engineering Specifications represent minimum requirements and design standards. Additional requirements of stricter design standards, or deviations from these specifications, commensurate with conditions, may be required by the Design Engineer or City Engineer or appointed representative if, in his judgement, they are appropriate for the project or in the best interest of the City.

1.1.1 ADOPTED STANDARDS

All applicable specifications of agencies or organizations listed below are made a portion of these Engineering Specifications by reference and shall be the latest edition or revision thereof.

A.A.N.	American Association of Nurseryman
A.A.S.H.T.O.	American Association of State Highway and Transportation Officials
A.C.I.	American Concrete Institute
A.D.A.	Americans with Disabilities Act Regulations
A.I.S.C.	American Institute of Steel Construction
A.N.S.I.	American National Standards Institute
A.P.W.A.	American Public Works Association
A.S.L.A.	American Society of Landscape Architects
A.S.T.M.	American Society of Testing Materials
A.T.S.S.A.	American Traffic Safety Services Association
A.W.S.	American Welding Society
A.W.W.A.	American Water Works Association
C.D.O.T.	Colorado Department of Transportation
C.D.P.H.E.	Colorado Department of Public Health and Environment
E.D.L.A.	Equivalent Daily Load Application
F.E.M.A.	Federal Emergency Management Agency
F.H.W.A.	Federal Highway Administration

I.B.C.	International Building Code
I.R.C.	International Residential Code
I.T.E.	Institute of Traffic Engineers
M.U.T.C.D.	Manual on Uniform Traffic Control Devices
N.A.C.E	NACE International (formerly National Association of Corrosion Engineers)
U.P.C.	Uniform Plumbing Code

Whenever a conflict exists between any of the above standards, the City Engineer or appointed representative shall decide which shall govern.

1.2 DESIGN POLICY

1.2.1 GENERAL

The City of Woodland Park shall review and accept or approve the plans and specifications for all items included in these Engineering Specifications and to coordinate the approvals of various other City departments and public agencies prior to the beginning of any construction. These design criteria have been compiled to ensure that plans and specifications are reviewed and approved on an equal basis and that uniformity exists in construction of the system. It is not the intent of these criteria to regulate the design engineer, but instead, to provide minimum design standards that should be used in normal situations.

All plans and specifications submitted for checking and acceptance for construction must have been prepared by or under the direct supervision of a Professional Engineer/Land Surveyor/Licensed Architect duly registered and licensed to practice in the State of Colorado.

A Professional Engineer is allowed to prepare Site Plans; Landscape Plans; and all Infrastructure Engineering Plans to include streets, stormwater, erosion control, grading, water, sewer, trails, parking lots, and sidewalks. All plans for residential driveways, water and sewer service lines, and dry utilities (gas, cable, phone and electric) shall be submitted to the City for review. These items must meet current City specifications and will be subject to City inspection. A Licensed Architect is allowed to prepare Site Plans and Landscape Plans. A Professional Land Surveyor is allowed to prepare Site Plans. Erosion and Sediment Control Plans may be prepared by a Professional Engineer or a Certified Professional in Erosion and Sediment Control (CPESC) when approved by the City Engineer or appointed representative.

1.2.2.1 SUBDIVISION FLOW CHART

PREAPPLICATION CONFERENCE/VICINITY SKETCH PLAN
Code Chapter 17.16
 Prior to preparing a Subdivision Plat, the applicant/developer shall meet with Staff and provide a vicinity sketch plan to identify critical design elements which will include utilities, streets, drainage, manmade features, open space, uses, etc.

MAJOR SUBDIVISION APPLICATION

PRELIMINARY PLAT—Code Chapter 17.20

- Plat with 2" contour Intervals, streets, easements, slopes, parks, trails, utilities, etc.
- A Master Plan of area is needed if developer has contiguous holdings.
- Supplemental Materials:
 - Layout of existing and proposed water and sewer.
 - Preliminary Utilities Report
 - Street Grades
 - Drainage Plan
 - Traffic Report if required
 - Others per Code Chapter 17.20

PUBLIC HEARINGS WITH PLANNING COMMISSION AND CITY COUNCIL

Construction Drawings are prepared prior to Final Plat. Code title 17 and 18.

- Streets (plans and profiles)-Engr. Specs. Title 5
- Utilities (plans and profiles).
- Grading/Erosion control-Engr. Specs. Title 4
- Others as required.

Final Plat prepared with SDA cost estimate and security. Code Chapter 17.28 and 17.44

Public Hearings with Planning Commission and City Council.

Fees are collected and Final Plat is recorded.

ZDP submitted.

Preconstruction Meeting. Notice to Proceed.

Construction

ZDP to install infrastructure submitted.

Preconstruction Meeting. Notice to Proceed

Construction

Final Plat prepared. Code Chapter 17.24.

Public Hearings with Planning Commission and City Council.

Fees are collected and Final Plat is recorded.

As-Builts submitted. Initial Acceptance and Warranty.

One Year Warranty (or Two Years for Drainage).

Final Acceptance

MINOR SUBDIVISION APPLICATION

FINAL PLAT—Code Chapter 17.24
 If no public infrastructure is extended into the property or a replat of previously subdivided property is proposed then a Final Plat is submitted pursuant to Chapter 17.24.

- Utility Service Plan
- Site Drainage Plan

PUBLIC HEARINGS WITH PLANNING COMMISSION AND CITY COUNCIL

Fees are collected and Final Plat is recorded.

SUBDIVISION EXEMPTION PLAT APPLICATION

EXEMPTION PLAT—Code Chapter 17.52
 An Exemption Plat is a Final Plat which does not increase the number of lots, meets the definition pursuant to 17.08.360, and is designed according to 17.52.030.

Surrounding property notification and posting.

If adjoining property owners are aggrieved and resolution is not reached the Plat is sent to Public Hearings.

No issues with adjoining property owners.

Administrative Approval

Final Plat is recorded.

Public Hearings with Planning Commission and City Council.

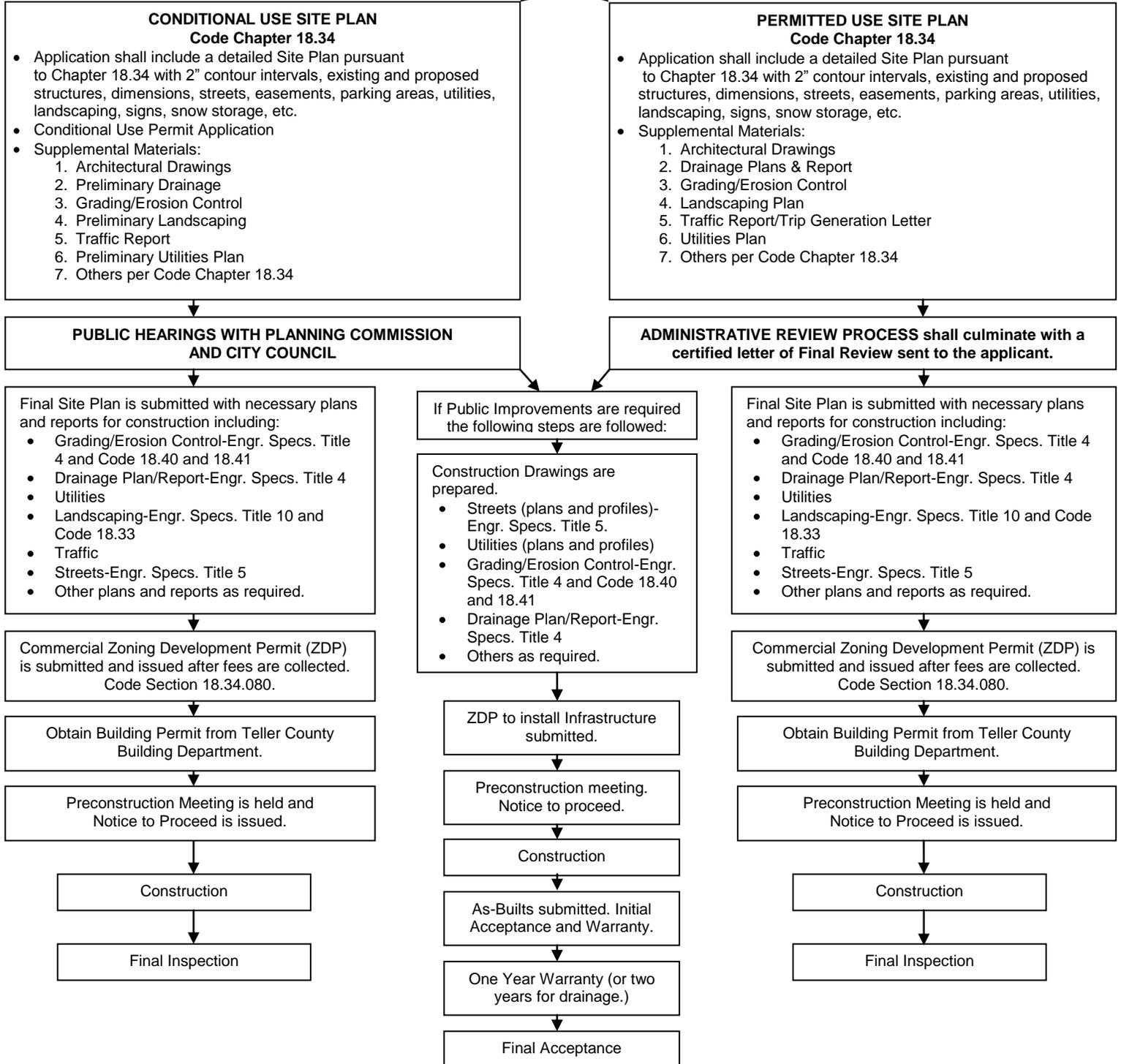
Final Plat is recorded.

DISCLAIMER: This flow chart is not intended to provide all the Information necessary to submit an application for Site Plan Review. The applicant/developer must refer to the applicable Municipal Codes and Engineering Specifications to prepare complete plans and drawings.

1.2.1.2 SITE PLAN REVIEW FLOW CHART

PREAPPLICATION CONFERENCE AND SKETCH PLAN

Prior to submittal of a Site Plan/Conditional Use Permit application the applicant/developer shall meet with the Staff and provide a sketch plan of the proposed development to determine the feasibility and critical design elements pursuant to Engineering Specifications Section 1.2.2 and Municipal Code Chapter 18.34.



DISCLAIMER: This flow chart is not intended to provide all the information necessary to submit an application for Site Plan Review. The applicant/developer must refer to the applicable Municipal Codes and Engineering Specifications to prepare complete plans and drawings.

1.2.2 PREAPPLICATION CONFERENCE CONCEPT/SKETCH PLAN

Prior to preparing a plat for the subdivision of land or a site plan for new development, the subdivider or developer shall make his intention known to the City by holding a preapplication conference and preparing a concept/sketch plan. This plan shall be submitted showing the proposed subdivision or development with the adjacent properties at a scale sufficient to provide enough detail to determine the feasibility of the development proposal and critical design elements. This concept/sketch plan shall include but not be limited to:

- Existing and proposed uses for residential, commercial, industrial, or public purposes.
- Existing and proposed streets, trails and sidewalks.
- Existing and proposed wet utilities for water and sewer lines and associated appurtenances and a general location of the dry utilities for electric, gas, phone and cable.
- Natural drainage courses and proposed drainage improvements including storm water and detention facilities.
- Types of vegetation and major natural or manmade features of the area.

The developer may also be required to provide a letter of intent with the concept/sketch plan to describe the feasibility and design of the project. The City will provide comments regarding the concept/sketch plan and subsequent report requirements to the developer.

1.2.3 PRELIMINARY PLANS AND REPORTS

As a minimum, Preliminary Plans and Reports are required when new development is proposed for a major subdivision or site development of vacant land for commercial or other purposes except for single-family homes. A major subdivision means all subdivisions, commercial or residential, not classified as a minor subdivision including any size subdivision requiring any extension of public improvements. A minor subdivision means any re-subdivision of any existing subdivision fronting on an existing street not involving any new street, or road or the extension of municipal facilities, or the creation of any public improvements, and not adversely affecting the remainder of the parcel or adjoining property. A major subdivision requires the submittal of the Preliminary Plat according to the criteria described in Section 17.20 of the Municipal Code, which includes preliminary utilities, drainage, grading, erosion control, traffic and landscaping. All proposed developments shall make a submittal when required, which shall include the following information:

A. PRELIMINARY UTILITIES PLAN AND REPORT:

The Preliminary Utilities Plan shall show the location and size of the existing water and sewer lines within or adjacent to the tract and the proposed layout of the water and sewer system, with the proposed size of all mains and proposed location of valves, hydrants, and manholes. For most projects, the Preliminary Utilities Plan shall consist of a 24 inch x 36 inch plan sheet using proposed rights-of-way, lot configuration, and easements as the base. For a single commercial building, the Preliminary Utilities Plan shall typically be included on the site plan.

A Preliminary Utilities Report is a concise narrative describing the development's utility needs and the methods proposed to meet those utility needs. The volume of engineering calculations attached shall depend on the complexity of the service.

The report must cover water, sewer, natural gas, electricity, telephone, and cable TV/Data. The fundamental information required is the identification of existing locations of each utility that will be extended to serve the subject project. Some utility companies, such as telephone, may not provide specifics but an indication they know where and what is proposed. This acknowledgement accompanied by a commitment to serve the project, will be sufficient.

The primary emphasis of the Preliminary Utilities Report should be on water and wastewater services. The Preliminary Utilities Report shall include information defining the projected water demand. For all residential projects the number of single-family residential units and the number of multi-family residential units will provide adequate definition. Multi-family units must be distinguished as rental unit buildings or private ownership dwellings.

Fire flow requirements shall be included based on the latest adopted Fire Code, proposed land uses, building sizes, and building types.

For non-residential development, the water demand must be defined by building square footage or acreages of land use types and standard unit demands. The source of unit demands must be referenced.

The report shall identify which City water pressure zone the project is within and what range of water pressures will exist in the project area based on the range of project elevations. Special needs including all fire flows required above 1000 gpm or pressure-regulating stations shall be identified. Water main looping is required unless in a cul-de-sac that serves less than twelve (12) dwelling units and required fire flows are met without looping. Plans for looping shall be described. Detailed hydraulic analyses are required except where eight (8) inch minimum diameter water mains are proposed and the City determines that the size of projected fire flow demands, water main looping and service elevations within the appropriate water pressure zone indicate adequate service is provided without detailed analysis.

Wastewater service shall be provided to the project by gravity flow to existing mains. Additional public pump stations will only be allowed if absolutely necessary. The minimum allowable sewer main diameter is eight (8) inches and all mains shall have adequate capacity for anticipated project extensions. Locations of proposed connections to existing mains and identification of any lots or areas not to be provided gravity sewer service are key wastewater elements of the Preliminary Utilities Report. Where, in the opinion of the City, utility service is not complex, the Preliminary Utilities Report shall consist of a letter narrative and a concept sketch showing the project, key water and sewer

tie-ins, and the range of static water pressures within the project. For difficult-to-serve projects the report shall include the engineering basis for water storage tanks, distribution system hydraulic analyses, wastewater pump station design parameters and similar detailed components.

The apparent scope of the Preliminary Utilities Report shall be determined to the greatest extent possible by the applicant and the City at the preapplication conference. The initial scope of the Preliminary Utility Report shall be supplemented with additional engineering or information if further needs are identified.

B. PRELIMINARY DRAINAGE PLAN AND REPORT:

The Preliminary Drainage Plan shall show the concept and method of achieving Woodland Park standards for drainage improvements. It shall include a general layout of the proposed system for collection, conveyance, and release of stormwater utilizing such structures as curb and gutter, crosspans, culverts, inlets, swales, and detention facilities. If the development is to be phased, then the drainage plan shall show how the system will be a complete, functioning drainage system at the completion of each phase.

The Preliminary Drainage Report shall have sufficient information and calculations to support the concept and method given in the Preliminary Drainage Plan.

C. EROSION AND SEDIMENTATION CONTROL PLAN:

An Erosion and Sedimentation Control Plan is required for all land-disturbing activities of 7,500 square feet or more or if construction of either a temporary or permanent road is part of the land-disturbing activity pursuant to Section 18.40.140 of the Municipal Code.

D. GRADING PLAN:

A Grading Plan is required for all land-disturbing activity greater than 7,500 square feet and shall include the criteria pursuant to Section 18.41.070 of the Municipal Code. Grading Plan review and approval is necessary before the issuance of a Zoning Development Permit for grading.

E. PRELIMINARY LANDSCAPE PLAN:

A Preliminary Landscape Plan is a plan that shows the areas proposed for landscaping as a part of a site specific development. The Preliminary Plan shall provide a general description of planted material proposed for each planted area. Detailed information such as plant type, size, number, maintenance and tree protection measures, etc., shall be part of the Final Landscape Plan submitted prior to issuance of a Zoning Development Permit.

F. TRAFFIC REPORT:

A Traffic Report is a written document to assess the development impacts on the capacity, safety and operations of adjacent streets and US/State Highways as applicable. The Traffic Report is required if the proposed subdivision is larger than ten (10) residential lots or the traffic counts exceed 100 average daily trips (ADT). A detailed traffic study which includes intersection analysis is required for projects either adjacent to or in the proximity of US Highway 24 and/or State Highway 67.

G. UTILITY COORDINATION:

Early in the planning process, the Owner/Developer or engineers shall contact the non-municipal utility companies to coordinate the location of the dry utilities with the wet utilities. The site plan or subdivision utilities plan shall include the existing and proposed dry utilities such as natural gas, electricity, telephone and cable TV/Data.

These reports shall be approved by the City prior to the preparation of final construction drawings and shall be submitted with the subdivision preliminary plat.

1.2.4 CONSTRUCTION PLANS

All grading, erosion control, drainage, utility, and street plans shall conform to the minimum design criteria set forth in these specifications. Four (4) complete sets of plans on 24" x 36" sheets and one (1) set on 11" x 17" shall be submitted for review and comment. Once the plans have been reviewed, written comments shall be returned to the applicant for amending the plans.

Construction plans shall consist of the following:

A. COVER SHEET OR FIRST PAGE OF PLANS:

1. Project Name/Subdivision Name
2. Owner's/Developer's name, address, phone number
3. Vicinity Map
4. Index
5. Signature Block
6. Vertical Datum

B. OVERALL SITE PLAN

C. STREET PLAN AND PROFILE AND TRAFFIC CONTROL MEASURES

D. SANITARY SEWER PLAN AND PROFILE

E. WATER PLAN AND PROFILE

F. STORM SEWER AND/OR SURFACE DRAINAGE PLAN AND PROFILE

- G. GRADING AND EROSION CONTROL PLAN
- H. LANDSCAPING, LIGHTING AND TREE PRESERVATION PLANS
- I. CONSTRUCTION DETAILS AND NOTES

1.2.5 CONSTRUCTION DRAWINGS

Construction drawings shall consist of the following:

- A. DRAFTING STANDARDS:
 - 1. Plans shall be 24" x 36" and one (1) set on 11" x 17". Final "As-Built" plans shall be Mylar, clear and clean from objectionable background. Also, one (1) blue line shall be submitted.
 - 2. Information for "as-builts" will also be submitted in electronic file format (e.g. ArcView shapefile, DXF file or DWG file with a description of the geographic coordinate system).

- B. THE FOLLOWING SHALL BE SHOWN ON EACH AND EVERY PAGE OF ALL DRAWINGS:
 - 1. Title Block (right margin of sheet preferred).
 - 2. North Arrow. North shall point to the top or to the right margin of the sheet; other details and drawings on the sheet shall be oriented consistently with the North arrow.
 - 3. Scale:
 - a. Vertical: 1" = 5' (1" = 10' may be used in areas that have average slopes over 5%).
 - b. Horizontal: 1" = 50' standard for Plan & Profile.
 - 4. Date and Revisions. The original date of the plans and any subsequent revisions shall be shown in the title block.
 - 5. Name, address, and telephone number of a licensed professional or firm.
 - 6. Professional Seal and Signature. Standard City of Woodland Park approval block in the lower right-hand corner of the sheet

Prepared for construction under my direct supervision:	
_____ (Affix Seal, Expiration Date and PE Signature)	_____ Date
_____ Approved for Construction City Engineer or appointed representative	_____ Date
----- "As-Built" Certified by:	
_____ (Affix Seal, Expiration Date and PE Signature)	_____ Date
_____ Approved for "As-Built" Record City Engineer or appointed representative	_____ Date

C. PLAN:

1. Property lines, easement lines and lot numbers.
2. Street names and easements with all dimensions including lot dimensions.
3. Utilities and Structures:
 - a. Water – Show location of valves, fire hydrants, and fittings by station. Standard position for locating mains, unless some major interference prevents it, is six (6) feet off the centerline of the street. Show main sizes on all drawings. Minimum depth of water line is seven (7) feet.
 - b. Sanitary Sewer – Number and show location of manholes and appurtenances. Standard position for locating mains, unless some major interference prevents it, is six (6) feet off the centerline of the street and twelve (12) feet from water main. Show main sizes on drawings. Minimum depth is six (6) feet but typical installation is eight (8) to 14 feet deep.
 - c. Gas – Standard position for location of gas mains is 20 feet off the center of the road.
 - d. Storm Sewer – Standard position for location of storm sewer mains is under and/or behind curb and gutter.
 - e. Telephone, Electric and Other Cable – Standard position for location of utility cables is within the six (6) foot bench behind top back of curb. Joint trenches are encouraged. Electric is in the bottom of the shared trench.
 - f. Minimum depth for all dry utilities is 36 inches.
4. The plan shall show sufficient adjacent area to give relation of new facilities to existing facilities.
5. The plans shall be made from actual field surveys referred to land corners and other official survey control points. Fences shall not be used as the basis of surveys.

D. PROFILE:

1. Finished surface (existing and proposed).
2. Existing and proposed utility line crossings.
3. Benchmarks will be on U.S.G.S. Datum. Monument locations shall be shown and described.

E. FIELD CONTROL:

It is the responsibility of the developer or his authorized representative to survey the proposed installation and set control stakes in accordance with approved plans. Installation of lines shall not be allowed where in the opinion of the City Engineer or appointed representative proper control has not been furnished. The contractor shall be responsible for preserving all permanent benchmarks and survey monuments.

1.2.6 EASEMENTS

All public improvements shall be in platted street rights-of-way or easements. Easements for water and sewer must have a width of at least two (2) times the depth to the invert, with a minimum width of 20 feet.

See: City of Woodland Park Municipal Code Title 17.40.170.

1.3 CONSTRUCTION POLICY

1.3.1 ENGINEERED AND APPROVED PLANS

Construction shall be done in accordance with City accepted/approved construction plans for the work prepared under the direction of a professional licensed in the State of Colorado. Plans shall conform to the City of Woodland Park Engineering Specifications. Plans approved by the City are valid for a period of two (2) years, after which the plans shall be resubmitted for review, as if they were a new submittal, to verify conformance to current City requirements. Construction of improvements shall not begin without approved construction plans and a written notice to proceed from the City in the form of a Zoning Development Permit. After the 3rd review the City Engineer or appointed representative may determine that a recovery fee is necessary for excessive plan review.

1.3.2 CONTRACTOR LICENSES REQUIRED

All contractors and sub-contractors must be licensed by the appropriate agencies. All excavation greater than one foot (1') in depth within existing or proposed rights-of-way and infrastructure easements shall be done by a contractor holding a "Full Excavator" License issued by the Teller County Building Department. All contractors and sub-contractors must have a City of Woodland Park Business License and Street Cut Permit prior to the start of work.

1.3.3 PERMITS

All permits required from other agencies must be approved in writing and provided to the City Engineer or appointed representative prior to construction. Examples of this requirement include access or utility permit from Colorado Department of Transportation, Section 404 Wetlands Permit from the U.S. Army Corps of Engineers, and Colorado Discharge Permit System – Stormwater, from the State of Colorado Department of Public Health and Environment.

1.3.4 PRE-CONSTRUCTION CONFERENCE

Prior to commencement of construction, the Contractor/Developer shall arrange a conference with the City for the following:

- A. The purpose of the pre-construction conference is to become familiar with applicable City of Woodland Park Engineering Specifications and to identify any critical or unusual items on the project.

- B. To make application for a Zoning Development Permit.
- C. The following procedures shall also be discussed:
 - 1. The day prior to beginning construction, the contractor shall call the City for notification of commencement of work.
 - 2. The Owner/Developer/Contractor shall call the Construction Inspector for any required inspections, including witnessing of required tests. To ensure an inspection time the Inspector should be called at least 24 hours in advance.
 - 3. The contractor shall notify the City for a final inspection when work is completed. The contractor shall meet with the City Engineer or authorized representative on location for said final inspection. Final inspection shall not take place until street or easement is at final grade and all manholes, valve covers, etc., are brought to final grade.
 - 4. Traffic control devices, either temporary or permanent, must be installed before Initial Acceptance. The City will not be responsible for installation or maintenance of any barricades or warning signs to protect the public because of phased construction of streets.

1.3.5 INSPECTION, TESTING, STOP WORK ORDERS

All construction work covered by these Engineering Specifications is subject to inspection by the City and certain types of construction shall have continuous inspections.

It shall be the responsibility of the Owner/Developer/Contractor to notify the City that such work is ready for inspection. The Construction Inspector may be available for same day inspections during normal business hours by calling him at City Hall or on his cell phone. To ensure a specific time for an inspection a call shall to be placed to the City 24 hours prior to the requested time. It shall also be the responsibility of the person requesting inspections required by these Engineering Specifications to provide access to and means for proper inspection of all work. Subsequent inspections shall be coordinated with the City by telephone.

An authorized City representative shall have the authority to halt construction when these specifications or standard construction practices are not being adhered to. Whenever any portion of these specifications is violated, the City may order further construction to cease until all deficiencies are corrected. The notice to cease construction shall be in writing (Stop Work Order). The contractor will pay for all required tests.

See Section 1.3.5.3

The City Engineer or appointed representative may require additional inspections of any work as deemed necessary to ascertain compliance with the provisions of these Engineering Specifications and other provisions of the City Code.

1.3.5.1 RE-INSPECTIONS

A re-inspection fee may be assessed for each inspection or re-inspection when such portion of work for which inspection is called is not complete or when corrections called for have not been made.

The fee for re-inspection will be \$30.00 per hour or the total hourly cost to the City, whichever is greater. This cost shall include supervision, overhead, equipment, hourly wages and fringe benefits of the employee involved.

This subsection is not to be interpreted as requiring re-inspection fees the first time a job is rejected for failure to comply with City requirements, but as controlling the practice of calling for inspections before a job is ready for such inspections or re-inspection. Re-inspection fees may be assessed when the permit is not in the possession of the permit holder, when the approved plans are not readily available to the inspector, failure to provide access at the time for which inspection is requested, or for deviating from plans approved by the City Engineer or appointed representative.

To obtain a re-inspection, the applicant must call the Construction Inspector who may be available for same day re-inspections during normal business hours by calling him at City Hall or on his cell phone. To ensure a specific time for a re-inspection a call shall be placed to the City 24 hours prior to the requested time and pay a fee as determined by the City. In instances where re-inspection fees have been assessed, no additional inspection of the work shall be performed until the required fees have been paid.

1.3.5.2 INSPECTIONS OUTSIDE NORMAL INSPECTION HOURS

Inspections performed outside the normal inspection hours of the City (8:00 AM – 4:00 PM), Monday through Friday, shall be assessed a fee as determined by the City. These inspection fees are to be paid on a monthly basis and prior to project acceptance.

The fee for after hour inspection will be \$45.00 per hour (two (2) hour minimum) or the total hourly cost to the City, whichever is greater. This cost shall include supervision, overhead, equipment, hourly wages and fringe benefits of the employee involved.

1.3.5.3 STOP WORK ORDERS

The Inspector or other authorized City Representative may issue a Stop Work Order to the Contractor/Developer for any of the following circumstances:

- The Contractor/Developer has not applied for or received all appropriate licenses and permits and is working in the public right-of-way or on projects not approved by the City.
- The Contractor/Developer is working on an approved project that is not being constructed in conformance with City specifications or approved plans.
- The Contractor/Developer is working on an approved project that has a public health or safety problem (e.g., but not limited to, deficient traffic control, deficient erosion and sediment control, unsafe trenching operations, dangerous obstructions in the public right-of-way, improper use of equipment, use of alcohol or drugs).

Upon issuance of a Stop Work Order, the Contractor/Developer shall, except for emergency repairs by same, immediately discontinue work until such time as:

- Proper permits are issued.
- Mitigation of non-conformance items has been properly addressed.
- Mitigation of health or safety issues has been properly addressed.

If the Contractor/Developer, or agent of the developer, does not immediately discontinue work upon the issuance of a Stop Work Order, the Contractor/Developer shall be subject to fines up to \$1,000.00 and imprisonment up to one (1) year.

In the event where the City deems it necessary to affect a remedy or repair to mitigate any of the above-mentioned circumstances (due to emergencies or untimely performance), the cost plus 15 percent of the work shall be paid by the Contractor/Developer.

1.3.6 “AS-BUILT” DRAWINGS

As-Built Drawings shall be submitted by the Owner/Developer and approved by the City Engineer or appointed representative as a condition of City Initial Acceptance of every public infrastructure project. “As-Built” Drawings shall accurately reflect the as-constructed condition of the installed infrastructure using drawings approved for construction as the base and adding notes and corrections to accurately reflect materials provided, field changes to design and locations of critical underground elements.

It is the duty of the Contractor/Developer to record and document the physical dimensions and any changes on a set of “as-builts” drawings and to certify their accuracy. A licensed professional in the State of Colorado per Section 1.2.1 of these specifications shall certify/stamp the “as-builts.” The certification shall also have the date of certification by the Licensed Professional.

The standard certification statement and signature block is:

Prepared for construction under my direct supervision:	
_____	_____
(Affix Seal, Expiration Date and PE Signature)	Date
_____	_____
Approved for Construction City Engineer or appointed representative	Date

“As-Built” Certified by:	
_____	_____
(Affix Seal, Expiration Date and PE Signature)	Date
_____	_____
Approved for “As-Built” Record City Engineer or appointed representative	Date

“These drawings are a correct “as-built” representation of the final construction improvements, as per the Engineering Specifications for the City of Woodland Park.”

1.3.6.1 RESPONSIBILITIES

Owner/Developer has ultimate responsibility to insure that accurate “as-builts” are prepared, submitted and approved.

Contractor has the responsibility during construction to keep an up-to-date “red-line” set of approved construction drawings showing field modifications, materials of construction, tie-downs to underground locations and other notes from which “as-builts” can be prepared.

The Engineer has the responsibility to convert contractor’s red-line drawings to reproducible “as-built” drawings, which meet the general standards of the industry and all specific requirements of the City of Woodland Park.

1.3.6.2 SPECIFIC “AS-BUILT” REQUIREMENTS

- A. Major changes to designed pipeline alignments shall be shown with a new line showing the new pipeline alignment. Minor changes to locations of bends, valves, manholes and other appurtenances shall be recorded by crossing out the designed station and showing the “as-built” station. Major changes shall be re-drawn to show the “as-built” location.
- B. Changes from designed vertical elevations, such as manhole rims and sewer inverts shall be shown by crossing off the designed elevation and adding the “as-built” elevation. Adjusted slopes of sewers and other design information, which are changed during construction, shall be crossed out with as-installed information added.
- C. Horizontal distances from surface features to buried water lines shall be included at a minimum of every 300 feet and at every fire hydrant and every sanitary sewer manhole cover. Distance shall be from center of fire hydrant or manhole cover to center of water main.
- D. Information on the location of each water and sewer stubout to each lot shall be on the “as-builts.”
 - 1. Tie-Down Method (projects without curb and gutter): A minimum of two (2) tie-down distances shall be given from permanent ground features to the end of each stubout. Permanent ground features shall include, but not limited to, fire hydrants, valve boxes, manhole covers, electrical transformers, etc. A table of information shall be created to minimize clutter on the “as-built” drawings.
 - 2. Flowline Method (projects with curb and gutter): This method uses a distance along the flowline of the street gutter from a point perpendicular to a permanent ground feature to the location where the service stubout crosses under the curb and gutter and a distance from back of curb to the end of the constructed service line. A table of information shall be created to minimize clutter on the “as-built” drawings. (Refer to Figure 1-A)

- E. The exact end locations of water or sewer main installations provided for future main extensions shall be identified with a minimum of three (3) tie-down dimensions to permanent surface features. “As-builts” shall include a description of water and sewer main endings planned for future extension. Said description shall include all information needed to design and prepare for an extension, including at least: depth to main invert, pipe type and size, type of anchorage, and type of pipe cap or plug.

The following measurements use the flowline, a fixed point, and the object being located. The first measurement is taken along the flowline starting at a known point (A) looking at a fixed object (hydrant, meter, etc.) 90 degrees from the flowline and then moving to a point (B) that is 90 degrees from the object being located. The second measurement is taken from the top back of curb (TBC) at point (B) to the object being located. All measurements are taken from the center of objects.

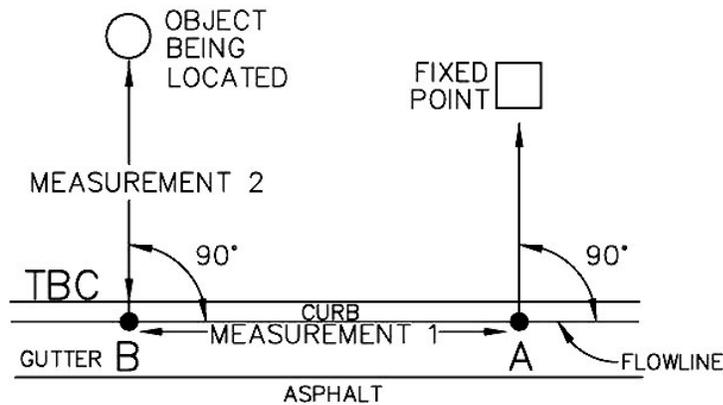


Figure 1-A

Lot Number		Fixed Object	Distance in flowline A to B	Distance from TBC to object located.
	Water			
	Sewer			
	Water			
	Sewer			
	Water			
	Sewer			

- F. All significant materials of underground construction shall be identified on “as-built” drawings. This shall include but is not limited to Megalugs, type of anchor, type of pipe, class of pipe, type and locations of imported bedding.
- G. All changes in approved street design shall be indicated with particular attention to flowline elevations and street design cross section.

- H. Locations and descriptions of all utility crossings (not including service lines) and utility conflicts shall be included. This shall include but not be limited to fiber optics, gas lines, cable TV, water mains, sanitary sewers and storm sewer. Utilities that are not crossing, but are running parallel within three (3) feet of the installed pipeline shall also be included.
- I. Name, address and telephone number of the Developer or Owner’s representative who coordinated and reviewed contractor’s work shall be included on the cover page.
- J. Names, addresses and telephone numbers of all significant contractors and subcontractors shall be added to the cover page of each project “as-builts.”
- K. Names and telephone numbers of City inspectors and/or engineer’s inspectors on the job shall be added to the cover page.
- L. Descriptions, locations and elevations of permanent and temporary benchmarks used for vertical control on the project shall be included.
- M. Easements required for utilities shall be shown out of the street right-of-way.

1.3.6.3 SUBMITTAL OF CERTIFIED “AS-BUILT” PLANS AND DOCUMENTS

Three copies of the “as-built” plans shall be submitted prior to approval for review. Once approved by the City one (1) complete set of full-size Mylar plans and two (2) sets of blue lines or photo copies shall be submitted. Information for “as-builts” shall also be submitted in electronic file format (e.g. ArcView shapefile, DXF file or DWG file with a description of the geographic coordinate system).

1.3.7 ACCEPTANCE AND WARRANTY

1.3.7.1 PRE-ACCEPTANCE INSPECTION AND PUNCH LIST

When the development is complete the Owner/Developer shall request an inspection, which may result in a pre-acceptance punch list. An on-site meeting is held with the Owner/Developer and the City Inspector to review the items on the punch list and establish a timetable to rectify punch list deficiencies. Prior to requesting Initial Acceptance, the Owner/Developer shall complete the punch list items and submit “as-built” drawings for review and approval by the City Engineer or appointed representative and other necessary documentation listed below.

Inspections and punch lists for the initial acceptance of public improvements may include utilities not owned or operated by the City but are allowed in the Public Rights of Way (ROW) (e.g. gas, electric, cable TV, data, etc.). Installation of these utilities, not owned or operated by the City, shall also be installed in accordance with these Engineering Specifications and acceptance of the ROW may not be granted if there are deficiencies with the installation of those utilities.

1.3.7.2 INITIAL ACCEPTANCE

The Owner/Developer shall send a letter to the City Engineer or appointed representative requesting Initial Acceptance of the public improvements. The letter shall designate a contact person for the Owner/Developer, including address and telephone number. The letter shall also include a statement signed by the Owner/Developer stating: “I hereby affirm that the public improvements for (name of subdivision or project) have been constructed in substantial compliance with the construction plans approved by the City of Woodland Park”. Such verification shall include visual observation by the Owner/Developer, and acceptance of destructive or nondestructive tests with an evaluation report based on those tests, which substantiate compliance to the approved plans.

Within ten (10) working days following the request for Initial Acceptance, an inspection shall be conducted by the City to insure that all improvements associated with the project are clean, free from dirt and debris, and in compliance with City Engineering Specifications and approved plans. Also in order to consider authorizing Initial Acceptance the City shall be in receipt of the following items:

- Results of all required tests (soils, concrete, asphalt, and camera sewer inspection).
- Statements of compliance from suppliers for all materials used.
- Operations manuals where necessary for proper operation and maintenance.
- Certified sets of “as-builts.”
- Any additional requirements of the City Engineer or appointed representative or these specifications.

The City Engineer or appointed representative will review all public or private improvements and revise list of outstanding punch list items if necessary. All items noted in the revised punch list shall be rectified prior to Initial Acceptance or completion of selected items as approved by the City Engineer or appointed representative may be included in the warranty period. An irrevocable letter of credit, escrow agreement, or cash shall secure any punch list items included in the warranty period.

A letter of Initial Acceptance and Start of Warranty is issued by the City Engineer or appointed representative and signed by the Owner/Developer. Upon Initial Acceptance the City shall be responsible for the routine maintenance of the public infrastructure (e.g. snow plowing, maintain and test fire hydrants, clean sewer lines, etc.) and operation and maintenance of the water and sewer system. The Owner/Developer shall agree to warrant the infrastructure improvements and repair all major defects according to the paragraphs below. Also the letter of Initial Acceptance and Warranty will acknowledge the conveyance/dedication of said public infrastructure to the City’s ownership.

A one (1) year warranty period shall commence on the date of Initial Acceptance. A two (2) year or extended warranty period may be necessary as determined by the City Engineer or appointed representative especially as it relates to drainage facilities, revegetation and erosion control, or when construction failures have occurred during the one (1) year warranty period.

The Owner/Developer shall warrant all work to be free of defects in workmanship and materials throughout this period. In the event deficiencies are discovered during the warranty period, the Owner/Developer's contractor shall correct them within a reasonable time period. The determination of the necessity during the warranty period for the Owner/Developer to repair or replace the work in part shall rest with the City whose decision in the matter shall be final and obligatory upon the Owner/Contractor.

If within 72 hours after the City gives the Owner/Developer notice of a defect, failure, or abnormality of the work and the Owner/Developer neglects to make, undertake with due diligence, or coordinate with the City, to make the necessary repairs or adjustments, the City is hereby authorized to make repairs or adjustments or order the work to be done by a third party, and the cost of the work will be paid by the Owner/Developer, plus 15 percent.

In the event of an emergency where, in the judgment of the City, delay would cause serious loss or damage, repairs or adjustments may be made by the City, or a third party chosen by the City, without giving notice to the Owner/Developer. The Owner/Developer shall pay the cost of the work plus 15 percent.

1.3.7.3 FINAL ACCEPTANCE

Prior to the end of the warranty period, the City Engineer or appointed representative will review the site for any defects in the work. If no defects exist, the City Engineer or appointed representative will recommend the improvements for Final Acceptance by the City at the end of the specified warranty period. Conversely, if defects exist, the City Engineer or appointed representative will develop a written list of defects to be repaired or replaced prior to Final Acceptance.

After all warranty period defects are repaired and/or replaced, the City Engineer or appointed representative will send a letter of Final Acceptance to the Owner/Developer.

CITY OF WOODLAND PARK, COLORADO

TITLE 2

WATER SYSTEM SPECIFICATIONS

TABLE OF CONTENTS

SECTION	2.1	DESIGN	2-3
	2.1.1	GENERAL	2-3
	2.1.2	MAIN SIZE, WATER PRESSURE	2-6
	2.1.3	FIRE HYDRANTS	2-7
	2.1.4	PUMP STATIONS, STORAGE TANKS, PRESSURE REDUCING STATIONS, HIGH PRESSURE MAINS	2-8
	2.1.5	ABOVE GROUND FACILITIES REQUIRED	2-9
	2.1.6	AIR VACUUM RELEASE VALVES	2-9
	2.1.7	LOCATION	2-9
	2.1.8	WATER AND SEWER SEPARATION	2-10
	2.1.9	AWWA STANDARDS	2-10
	2.1.10	BACKFLOW PREVENTION AND DEVICES	2-10
	2.1.11	CURVILINEAR WATER MAINS	2-11
SECTION	2.2	MATERIALS	2-11
	2.2.1	MAINS	2-11
	2.2.2	FIRE HYDRANTS	2-12
	2.2.3	VALVES	2-13
	2.2.4	FITTINGS	2-13
	2.2.5	SERVICES	2-13
	2.2.6	JOINT RESTRAINTS	2-15
	2.2.7	TRACER WIRE	2-16
	2.2.8	POLYETHYLENE WRAP	2-17
	2.2.9	PRESSURE REDUCING STATIONS	2-17
	2.2.10	ENCASEMENT AND BRIDGING OF PIPE	2-17
	2.2.11	PIPE BEDDING MATERIALS	2-18
	2.2.12	AWWA STANDARDS	2-18
	2.2.13	NEW PRODUCTS OR MATERIALS	2-18
SECTION	2.3	CONSTRUCTION	2-18
	2.3.1	RESPONSIBILITY FOR MATERIAL	2-18
	2.3.2	HANDLING AND STORAGE OF MATERIAL	2-19

	2.3.3	ALIGNMENT AND GRADE	2-20
	2.3.4	EXCAVATION AND PREPARATION OF TRENCH	2-21
	2.3.5	LAYING	2-21
	2.3.6	JOINING OF ANY MECHANICAL JOINT PIPE	2-24
	2.3.7	JOINING OF ANY PUSH-ON JOINT PIPE	2-25
	2.3.8	SETTING OF VALVES AND FITTINGS	2-26
	2.3.9	SETTING OF FIRE HYDRANTS	2-26
	2.3.10	ANCHORAGE	2-27
	2.3.11	BACKFILLING AND COMPACTION	2-29
	2.3.12	WATER SYSTEM REPAIRS	2-29
	2.3.13	SERVICE CONNECTIONS	2-29
	2.3.14	SERVICE LINE DISCONNECTIONS	2-29
SECTION	2.4	TESTING	2-30
	2.4.1	TESTING	2-30
	2.4.2	DISINFECTION	2-30
	2.4.3	FLUSHING THE LINE	2-31
	2.4.4	PRESSURE/LEAKAGE TEST	2-31
	2.4.5	BACTERIOLOGICAL TESTS	2-33
SECTION	2.5	FIGURES	
	2.5.1	TYPICAL TRENCH SECTION PIPE PROTECTION	
	2.5.2	FIRE HYDRANT INSTALLATION DETAIL	
	2.5.3	HYDRANT PROTECTION POST (BOLLARD) DETAIL	
	2.5.4	TYPICAL VALVE BOX SETTING	
	2.5.5	STANDARD BLOW-OFF INSTALLATION (TYPE 1)	
	2.5.6	STANDARD BLOW-OFF INSTALLATION (TYPE 2)	
	2.5.7	POURED CONCRETE THRUST REACTION BLOCK	
	2.5.8	REVERSE ANCHOR DETAIL	
	2.5.9	COPPER TRACER WIRE DETAILS	
	2.5.10	POLYETHYLENE WRAP	
	2.5.11	WATER AND SEWER CROSSING (TYPE I)	
	2.5.12	WATER AND SEWER CROSSING (TYPE II)	
	2.5.13	BRIDGING DETAIL	
	2.5.14	REINFORCED CONCRETE ENCASEMENT DETAIL	
	2.5.15	WATERLINE LOWERING DETAIL	
	2.5.16	WATERLINE STANDARD DETAIL PIPE CLAMP	
	2.5.17	REMOTE READING WATER METER, TYPICAL INSIDE SETTING	
	2.5.18	3/4" AND 1" SERVICE LINE DETAIL, INSIDE METER SETTING	
	2.5.19	AIR VACUUM RELEASE VALVE INSTALLATION	
	2.5.20	8-INCH PRESSURE REDUCING STATION (PAGE 1)	

2.5.21 PRESSURE REDUCING STATIONS (PAGE 2)
2.5.22 FIRE HYDRANT SPACING MEASUREMENTS

2.1 DESIGN

2.1.1 GENERAL

DOMESTIC WATER PLAN CHECKLIST. All drawings submitted must adhere to acceptable drafting standards. The following check list is provided to assist in the development of plans that meet minimum City requirements.

PLAN VIEW SHEET FORMAT

		Yes	No	N/A	Comments
1.	Title				
2.	North Arrow				
3.	Sheet size 24" X 36"				
4.	Horizontal Scale 1"= 50'				
5.	Professional Engineer Signature and Seal				
6.	City Approval Block				
7.	Bench Mark (USGS Datum)				
8.	Vicinity Map				
9.	Key Map				
10.	Legend of Symbols				
11.	Sheet Cross Reference				
12.	Title Block				
13.	Revision Blocks				
14.	Ownership and/or Subdivision Information				
15.	Street Names				
16.	Street Dimensions				
17.	Easements with Dimensions				
18.	Lot Lines				
19.	Lot Numbers (Location and Size)				
20.	Existing Utilities Shown				
	a. Water				
	b. Sanitary Sewer				
	c. Storm Sewer				
	d. Electric Service				
	e. Telephone				
	f. Irrigation				
	g. Gas				
	h. Cable Television				
21.	Join to Existing Water Line				
22.	Construction Details				

		Yes	No	N/A	Comments
23.	Construction Notes				
24.	Size and Type of Water Main				
25.	Minimum Clearance Between Water and Sewer				
26.	Location of Fire Hydrants				
27.	Location of Valves				
28.	Size of Valves				
29.	Size and Location of Fittings				
	a. Tees				
	b. Crosses				
	c. Reducers				
	d. Bends				
	e. Plugs				
30.	Location of Blow-offs				
31.	Thrust Blocks				
32.	Crossing of Utilities				
33.	Crossing Detail(s)				
34.	Location of Crossing(s)				
35.	Staking Information				
36.	Note on Standard Depth to Water Main				
37.	Removal of Existing Improvements				
38.	Sewer Service Locations				
39.	Water Service Locations				

PROFILE FORMAT

40.	Vertical and Horizontal Grids with Scales (Typically - V 1"= 5'; H 1"=50')				
41.	Datum Elevations				
42.	Datum Locations				
43.	Existing Ground Surface				
44.	Proposed Grade over Lines				
45.	Underdrain Note				
46.	Type, Size, and Length of Main				
47.	Utility Crossings Shown				
48.	Encasement Location				
49.	Can It Be Staked and Built?				

GENERAL NOTES: When applicable, the following notes shall be placed on all water utility plans.

1. The contractor shall be solely and completely responsible for conditions at and adjacent to the job site, including safety of all persons and property during the performance of work. This requirement shall apply continuously and not be limited to normal working hours. The duty of the City to conduct construction review of the contractor's performance is not intended to include review of the adequacy of the contractor's safety measures in, on, or near the construction site.
2. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) (811) or (1-800-922-1987) for the location of underground gas, electric, telephone, cable, water, sewer, and storm sewer three (3) business days prior to the commencement of construction. The contractor shall also be responsible for contacting any Tier II Utilities.
3. All materials and workmanship shall conform to the latest edition of the City of Woodland Park Engineering Specifications except where alternates have been designed into the project and approved by the City Engineer or appointed representative. All work shall be subject to inspection and approved by authorized City of Woodland Park personnel.
4. All new water mains twelve (12") inches or less shall be PVC pressure pipe with rubber ring joint gaskets or high density polyethylene (HDPE) with heat fusion welded joints, unless otherwise specified. PVC pipe shall conform to the latest edition of AWWA C900 and HDPE pipe shall conform to the latest edition of AWWA C906. Pipe O.D. shall be equivalent to ductile iron pipe sizes (DIP).
5. Fire hydrants shall be limited to the following manufacturers, or approved equal, approved in writing by the City Engineer or appointed representative, and shall be painted according to the latest edition of the City of Woodland Park Engineering Specifications prior to acceptance.
 - Waterous – 5¼ inch Pacer Fire Hydrant, with 7½ foot bury, conforming to AWWA C502 standards.
 - Mueller Company – 5¼ inch Centurion, with 7½ foot bury, conforming to AWWA C502 standards.
 - Clow – 5¼ inch Medallion, with 7½ foot bury, conforming to AWWA C502 standards.
6. The Contractor shall furnish to the Design Engineer all field modifications and other changes to the approved construction drawings for inclusion in the "as-built" drawings. The "as-built" drawings will be certified/stamped and signed by the Professional Engineer before submitting to the City of Woodland Park.

7. There shall be a minimum of seven (7') feet of cover over all water mains and service lines to finished grade.
8. A pre-construction meeting must be held between the Contractor and City of Woodland Park personnel prior to beginning any construction activities or after construction activities have been interrupted for three (3) months or longer or if there was a change of the Owner/Contractor.
9. The Owner/Contractor shall be responsible for cleaning nearby public streets of mud or debris due to construction activity initiated by said contractor on a daily basis or as otherwise directed by authorized City personnel.
10. All trenches and excavations must meet compaction requirements per Chapter 7 of the Engineering Specifications. Compaction testing shall be conducted by the contractor's geotechnical firm on all trenches and excavations. The frequency of the tests shall be as approved by the City Engineer or appointed representative.
11. The Contractor shall have one signed copy of these approved plans and one copy of the appropriate design and construction standards and specifications on jobsite at all time.
12. The Contractor shall coordinate with gas, electric, telephone and cable TV utility suppliers for installation of all utilities. Minimum cover for all non-City utilities in public rights-of-way shall be 30 inches.
13. The Contractor shall control the water installation using construction staking provided by a licensed surveyor. Water lines shall be staked for line and grade. Cut sheets shall be provided to the City inspector prior to construction of the waterline. The cut sheets shall include dimension ties to all valves.

2.1.2 MAIN SIZE, WATER PRESSURE

The water distribution system shall be designed to meet the maximum hourly water demand plus fire flow requirements. Fire flow requirements shall be determined in accordance with criteria in the latest City adopted edition of a nationally recognized fire code. Where in the opinion of the City Engineer or appointed representative and the Chief of the Northeast Teller County Fire Protection District (NETCFPD), other well-recognized criteria for determining fire flow requirements would result in a more accurate calculation of the requirement for a particular situation, such criteria may be accepted. Calculations using such criteria shall be prepared by a registered professional engineer in the State of Colorado competent in the field of fire protection and submitted to the City Engineer or appointed representative and the Chief of the NETCFPD for approval.

During peak demand and fire demand, the residual water pressure shall not be less than 20 psi at any point in the water distribution system. No main extensions shall be allowed which create or add to a situation where current demands do not maintain 20

psi, except where in the opinion of the City Engineer or appointed representative; such main extensions are not a primary contributor to an already substandard situation. The velocity of the water in the water system shall not exceed 15 feet per second. All fire hydrants are the property of the City of Woodland Park. No private fire hydrants will be acceptable. All fire hydrants shall be located within a street right-of-way or be provided with an appropriate easement. A complete Fire Flow Analysis shall be submitted for all water main extensions unless an exception is specifically approved by the City Engineer or appointed representative. That analysis shall show design parameters used to calculate maximum hourly flows and used to determine minimum fire flow requirements. The analysis shall include a plan drawn to scale of the study area showing existing and proposed mains and hydrants. A copy of the hydraulic computer program inputs and outputs shall be included. Design parameters, including pipe sizes, hydrant elevations, residual water pressures and fire flows available at each fire hydrant shall be presented in table or schematic format.

In addition to the critical condition design, the following minimum conditions shall be met:

- The minimum diameter for water mains in residential areas shall be six (6") inches. Schools, shopping centers and high-density residential areas shall be looped with at least eight (8") inch diameter lines. Larger diameter feeder mains shall be located between distribution mains in general conformance with the City's master plan for water system expansion. These mains shall be looped to provide water from more than one source. In no case shall a line of less than six (6") inches in diameter be used to serve a fire hydrant. All water main extensions shall be designed in loops. These loops may be constructed in stages, but in each stage of construction the water mains must be sized to meet the total flow requirements of the land uses served within that stage. The water system shall be looped in such a way that dead-end lines may only be used when serving not more than twelve (12) residential units.
- Normal operating pressure should be between 40 to 150 psi. High elevation areas which cannot maintain the minimum 20 psi pressure stated above shall be served by a pump station and storage tank. Area in-line service booster pump systems will not be permitted. Low elevation areas with normal operating pressure of over 150 psi shall be equipped with pressure reducing stations to reduce pressures into the normal operating range.

2.1.3 FIRE HYDRANTS

Normally, the number of fire hydrants required and the spacing of hydrants shall be determined by the criteria of the latest edition of the City approved fire code. Whenever possible, fire hydrants shall be placed on one side of the street, rather than on alternating sides. Fire hydrant locations shall be selected to maximize visibility whenever reasonable. It is preferable to install fire hydrants at street intersections. Fire hydrants shall not be located within ten (10') feet of a curb inlet, gas meter, telephone

pedestal, or electric pedestal. Whenever possible, fire hydrants should be located at least 40 feet from building walls.

The number and location of fire hydrants should be mutually agreed upon by the City Engineer or appointed representative and the Chief of the NETCFPD.

2.1.4 PUMP STATIONS, STORAGE TANKS, PRESSURE REDUCING STATIONS, HIGH PRESSURE MAINS

Pump stations, pressure reducing stations, water storage tanks, and mains which have static pressures of over 150 psi shall be considered as special features and will be dealt with on an individual case basis. The size, capacity, location, and type of each of these facilities shall be approved by the City Engineer or appointed representative. Telemetry equipment approved by the City and compatible within the current City system shall be required. Auxiliary chlorination equipment shall be included in the design and construction of new pump stations where determined to be appropriate by the City Engineer or appointed representative. The City will retain the option of requiring particular brands and models of equipment to reduce parts inventory and improve system efficiency and ease of operation.

Water storage tanks shall be sized based upon the following minimum residential design criteria:

Average Gallons Per Capita Per Day (GPCD)

Residential Density: 2.63 Persons/Dwelling Unit

Maximum Daily Usage: 2.2 x Average Daily Usage in the design area

Fire Flow: Usually 1000 to 3500 gpm. Flow shall be based on fire code criteria for the most critical structure in the design area.

Fire Flow Duration: For 1000 to 2499 gpm, 2 hours
For 2500 to 3500 gpm, 3 hours

Storage tanks shall be designed in accordance with the latest editions of AWWA D-100; AWWA D-103; AWWA D-110 or AWWA D-115. Tank storage capacity shall be equal to fire flow plus the maximum daily usage for emergency storage plus 30 percent of the maximum daily usage. The City Engineer or appointed representative shall approve acceptable usage estimates for non-residential water uses (office, retail, industrial, etc.) in the design area. These usage estimates shall be added into the average daily usage calculations. The minimum capacity for any tank storage facility in any pressure zone shall be 250,000 gallons. This capacity may be divided between more than one (1) tank. Two (2) tanks are encouraged in any pressure zone to provide duplicity during periods of tank maintenance. Three (3) or more tanks are normally discouraged to avoid duplication of telemetry equipment, maintenance requirements, etc. Steel tanks shall have internal and/or external cathodic protection designed by a NACE International certified Corrosion Specialist in accordance with the latest edition of AWWA D-104. Unless otherwise approved by the City Engineer or appointed representative, pump stations serving tank storage facilities shall be sized so that

average run time for one (1) of the two (2) pumps shall be between two (2) and three (3) hours per day.

Before the warranty period begins for pump stations, storage tanks, and pressure-reducing stations, the City Engineer or appointed representative shall be supplied with three (3) complete sets of equipment operation and maintenance instruction manuals. Manuals shall contain full information for each item of equipment, including instructions for installation, start-up, operation, inspection and maintenance, lubrication schedules, parts lists, control or power circuitry, emergency procedures, and other pertinent data as applicable. If literature covers more than one (1) model, appropriate provisions shall be neatly identified.

Under a separate cover, two (2) copies of all pertinent shop drawings shall be submitted. Two (2) copies of all “as-builts” shall be stamped and submitted, as well as a reproducible Mylar copy of these “as-builts.” Specialty tools and spare parts as may be considered necessary shall be supplied.

Refer to Figures 2.5.20 and 2.5.21 for required design features for pressure reducing stations.

2.1.5 ABOVE GROUND FACILITIES REQUIRED

Pump stations, pressure regulating stations and similar facilities shall be constructed in appropriate above ground enclosures. Enclosures shall be heated, accessible for maintenance, designed to be resistant to unauthorized entry, constructed of materials not requiring excessive maintenance and designed to minimize negative visual impact on the neighborhood.

2.1.6 AIR VACUUM RELEASE VALVES

High points in the water system shall be equipped with combination air vacuum release valves to purge trapped air bubbles and prevent damaging vacuum conditions.

Refer to Figure 2.5.19 for required design features.

2.1.7 LOCATION

- A. **EASEMENTS:** All water mains shall be installed in dedicated street rights-of-way, or dedicated easements. Location for these water mains shall be six (6') feet from the centerline of the street. Water mains shall be installed in easements; either by plat or separate document when determined by the City Engineer or appointed representative, it is not practical to make such installation in a dedicated street ROW. No structures shall be constructed within these easements or ROW without prior written approval, including terms and conditions, as set by the City. The minimum width requirements for water main easements are 20 feet or

twice the depth of the pipe, whichever is greater. The pipeline shall be offset a minimum of five (5) feet from any property line. In the event two (2) utility lines share the same easement, the minimum width for the easement shall be 30 feet.

- B. Relation to other Utilities: Water mains shall be located a minimum distance of five (5') feet from utilities other than sanitary sewers. When other utilities are installed in the vicinity of an existing water main, they shall be installed a minimum distance of five (5') feet, except at crossings which shall be at angles of 45°.

2.1.8 WATER AND SEWER SEPARATION

Water mains shall be located at least ten (10') feet horizontally from existing or proposed sewer mains. Where water mains cross sewer mains, the sewer main should be located at least 18 inches clear distance vertically below the water main.

- A. SANITARY SEWER LINE CROSSING OVER A WATERLINE. When there is less than 18 inches of vertical clearance between the bottom of the sanitary sewer and the top of the water main, the water main shall be ductile iron pipe, bedded in compacted granular material, a minimum of ten (10') feet on each side of the centerline of the crossing. In all cases, regardless of vertical clearance, the waterline shall be encased in reinforced concrete, a minimum of ten (10') feet on each side of the centerline of the crossing.

Refer to Figure 2.5.11.

- B. WATERLINE CROSSING OVER A SANITARY SEWER LINE. When there is less than 18 inches of vertical clearance between the bottom of the water main and the top of the sanitary sewer, the water main shall be ductile iron pipe a minimum of ten (10') feet on each side of the centerline of the crossing. In addition, the sanitary sewer shall be encased in concrete, a minimum of ten (10') feet on each side of the centerline of the crossing.

Refer to Figure 2.5.12.

2.1.9 AWWA STANDARDS

All design criteria not specifically included in these specifications or detail sheets (for example, water tanks, booster pumps, etc.) shall conform to the latest revision of applicable AWWA standards or AWWA manuals.

2.1.10 BACKFLOW PREVENTION AND DEVICES

Backflow prevention devices shall be provided on all new water services. Backflow prevention devices shall be installed by the customer on existing water services per the

Woodland Park Municipal Code when the service is upgraded or otherwise substantially modified, or when notified by the City as part of the City Program to eliminate backflow hazards. Generally backflow prevention devices shall remain in the ownership of the property owner who shall be responsible for the maintenance, testing, reporting and replacement of backflow prevention devices as required by federal, state and local requirements.

The City will provide a backflow prevention dual check valve integral to the water meter setter for single family residences. Dual check valves are prohibited for commercial application by the Colorado Cross-Connection Control Manual. The City will install such devices in existing residential services, as it deems necessary and shall replace or repair such devices as deemed necessary. All commercial applications shall have backflow prevention devices installed at the property owner's expense that meet the minimum requirements as outlined in the latest version of the Colorado Cross-Connection Control Manual.

2.1.11 CURVILINEAR WATER MAINS

Curvilinear water mains requiring bending of the water pipe or deflection at a bell and spigot joint is not allowed. Water alignments requiring curvilinear designs may be designed using 3° formed couplings with straight pieces of water pipe between couplings. Using one (1) 20-foot length of pipe between each 3° formed coupling allows for a 400 foot radius. Using one (1) 10-foot length of pipe between each 3° formed coupling allows for a 200 foot radius.

2.2 MATERIALS

2.2.1 MAINS

- A. PVC pipe (preferred by the City of Woodland Park) shall conform to AWWA C900 Class 150 DR-18 for normal static pressures less than 150 psi and Class 200 DR-14 for normal static pressures between 150 psi and 200 psi. Pipe shall have gasket bell end joints.
- B. Ductile iron pipe (acceptable upon review by the City Engineer or appointed representative) Class 50 cement lined, conforming to AWWA C-151/A21.51-86 shall be used for mains greater than twelve (12) inches in diameter and/or carrying a normal static pressure over 200 psi but not exceeding 325 psi. A strongly adherent asphaltic coating one (1) mil thick shall be applied to the outside of the pipe. Interior cement lining shall conform to AWWA C-104. Joints shall be "push-on" except where "mechanical joint" is noted on the drawing. Push-on or mechanical joints shall conform to ANSI A21.11. The bolts for mechanical joint pipe shall be of Corten material.

- C. HDPE Class 200, ductile iron pipe size, pipe may be used for water transmission mains where taps are not needed or their numbers are minimized. Only heat fusion welded joints and taps completed in strict conformance with the manufacturer's written recommendations will be accepted.
- D. AWWA C900 Class 100 SDR-21 PVC pipe, asbestos/cement (Transite) pipe, and fiberglass/PVC composite pipe shall not be permitted in new water main construction. Mains composed of other types of materials shall not be installed without written approval of the City Engineer or appointed representative.

2.2.2 FIRE HYDRANTS

Fire hydrants shall be Waterous Model WB 67-250, Mueller Super Centurion 200 Model A-423, Clow Medallion or any equal model as approved by the City Engineer or appointed representative with two (2) 2½ inch nozzles with National Standard Thread Number 743, and one (1) 4½ inch pumper nozzle with National Standard Thread Number 40524. The operating nut shall be a 1½ inch pentagon nut, open left (counter clockwise). All hydrant valves shall be placed on to the tee at the main. Placement of the valve within the limits of the curb or gutter or behind the curb is prohibited. The hydrant shall have a 5¼ inch valve opening. A six (6") inch mechanical joint isolation valve shall be provided. Hydrants shall be painted with high-gloss acrylic enamel in OSHA "Safety Red." Surface preparation and paint application shall be in accordance with the paint manufacturer's published instructions. Hydrant paint shall be Rustoleum 3700 DTM Acrylic Enamel in Rustoleum #3764402 Safety Red or equal as approved by the City Engineer or appointed representative. The stem shall be a minimum of 7½ foot bury. If an extender is required, its maximum length shall be two (2') feet. The height from finished grade to the breakaway flange of the hydrant shall be three (3") inches. Unless otherwise specified herein, hydrants shall be designed, manufactured and tested in compliance with the latest edition of AWWA C-502.

Refer to Figure 2.5.2 for additional detail.

Fire hydrant laterals shall be set at right angles to the street main. The hydrant shall be set at the end of the lateral and shall face the street unless otherwise required. No horizontal or vertical bends or offsets shall be used in installing fire hydrant laterals unless approved by the City Engineer or appointed representative. Under no circumstances shall any size or manner of tap be made on a hydrant lateral between the hydrant and the isolation valve.

Fire hydrant protection posts (bollards) shall be six (6") inch steel pipe, schedule 40 or heavier, or six (6") inch ductile iron pipe class 50 or heavier; six (6') feet long, filled with concrete, buried three (3') feet, and painted with high-gloss acrylic enamel in OSHA "Safety Yellow." Surface preparation and paint application shall be in accordance with the paint manufacturer's published instructions. Bollard paint shall be Rustoleum 3700

DTM Acrylic Enamel in Rustoleum #3744402 Safety Yellow or equal as approved by the City Engineer or appointed representative. Protection posts shall be required in areas where, in the opinion of the Design Engineer or City Engineer or appointed representative, the hydrant is vulnerable to damage from traffic or other hazards. Potentially hazardous areas include, but are not limited to, open parking lots.

Refer to Figure 2.5.3 for additional detail.

2.2.3 VALVES

All valves four (4") to twelve (12") inch in diameter shall be resilient seat, bi-directional, wedge style gate valves, conforming to AWWA C-509 Specifications, with non-rising stem. Valves are to open left (counter clockwise), to have a two (2") inch square operating nut, with "O" ring stem seals and epoxy coated inside and outside. Waterous Series 500 or any equal model as approved by the City Engineer or appointed representative shall be used. Valves shall have Type 18-8 stainless steel body bolts and mechanical joints ends with Corten bolts and "O" ring seals. Valves shall be polyethylene wrapped.

All valves two (2") inches and smaller shall be Ford B22 ball type curb stops or equivalent as manufactured by Mueller, McDonald or Romac.

Valve boxes shall be 5¼ inch diameter slip type valve boxes, Castings Incorporated VBA-16-48 with cast iron lid, or any equal model as approved by the City Engineer or appointed representative. The word "WATER" shall be cast on all valve box covers. Debris caps, as manufactured by S. W. Services or approved equal, shall be installed in all valve boxes.

Refer to Figure 2.5.4 for additional detail.

2.2.4 FITTINGS

All fittings necessary for junctions, changes of direction or size, outlets, connections, etc., to be used in the system shall be ductile iron fittings. All ductile iron fittings shall be a mechanical joint and shall conform to AWWA C-153, ANSI A21.53-88, or the latest revision thereto. Fittings shall be cement lined to conform to ANSI Specification A21.4-85 with a bituminous sealer. Corten bolts shall be used. Fittings shall be polyethylene wrapped. All fittings shall be pressure rated at 350 psi.

2.2.5 SERVICES

- A. Direct taps shall not be permitted. Tapping Saddles shall be used in all cases. When tapping AWWA C-900 PVC class 150 and 200 pipe, wide band style brass or stainless steel strap saddles shall be used (Romac 2025 or any equal model as approved by the City Engineer or appointed representative). Taps in ductile iron Class 50 pipe shall be made using stainless steel repair clamp style tapping saddles with full wrap neoprene

rubber gaskets. Taps in HDPE pipe shall be made using heat fusion welded threaded bosses. When tapping Permastran pipe, stainless steel repair clamp style tapping saddles (Romac or any equal model as approved by the City Engineer or appointed representative) shall be used. Saddles for other types of pipe shall be approved by the City Engineer or appointed representative. Tapping machines shall be hand operated and manually driven; electric drill style tapping machines shall not be permitted. Taps shall be worked wet.

For new subdivisions the Contractor shall install taps one inch (1") and smaller. For existing lots that have not been stubbed out with a water service from the existing City water mains, the City will complete the tap for one inch (1") and smaller services. All taps larger than one inch (1") will be completed by a commercial tapping company designated and paid for by the Contractor or Owner/Developer, but approved and inspected by the City.

For new commercial subdivisions the Owner/Developer shall have the Contractor completing the water main into the subdivision install four (4") inch or six (6") inch service stub-outs to each lot so that potential fire sprinklers and domestic services can be served. These stub-outs shall have an isolation valve at the water main but no valve at the property line. The lot owner shall own these services lines from the valve at the main to the building.

- B. Corporation and curb stops shall conform to AWWA standards. 1½ inch and under shall have CC threads. Corporation and curb stops shall be approved by the City. A.Y. McDonald brass ball valves are the only acceptable corporation or curb stop type valves.
- C. Water service lines between the corporation and the meter set (¾ inch through two (2") inch only) shall be constructed of type K copper or 200 psi polyethylene tubing with stainless steel inserts and shall contain an expansion loop (goose neck). The "goose neck" must have seven (7') feet of cover or be laid horizontally in the trench. Water service lines shall be installed with a minimum of seven (7') feet of cover (from finished grade) at all points, including at the goose neck and ditch flowline. Where water service lines cannot be installed with seven (7') feet of cover due to existing conditions, and as approved by the City Engineer or appointed representative, the service line shall be insulated in accordance with Section 3.1.27 of these specifications. All service lines shall have a 12 GA insulated copper tracer wire made accessible from the service box and extending the entire length of the service line ending at the foundation wall. Water service lines over two (2") inches shall be ductile iron or other City approved material and shall conform to the applicable AWWA standards. The minimum diameter of service lines shall be ¾ inch.

Copper water service lines ($\frac{3}{4}$ inch through two (2") inches only) shall have either straight or flared compression joints. No sweat joints shall be allowed underground; however silver solder joints are acceptable.

- D. All construction shall utilize McDonald Series 5607 steel service boxes. The top shall be set at final grade, adjacent to the property line, with the stem portion plumb.

For two (2") inch and larger curb stops, a regular valve box conforming to Section 2.2.3 shall be used. All lids shall be placed at final grade. In concrete, asphalt, and all areas subject to vehicle loads, a regular valve box top section conforming to Section 2.2.3 shall be used.

Curb boxes shall not be located within five (5') feet of any type of electric, telephone, or cable TV pedestal, or gas meter and ten (10') feet from the sewer line. The contractor shall coordinate placement of the curb stops with the utility companies to insure that a five (5') foot minimum separation is maintained.

- E. For new subdivisions water services for each lot shall be terminated 13 feet beyond the property line with a McDonald 5607 service box or other type as approved by the City Engineer or appointed representative. The location and depth of the end of each stub-out shall be accurately noted on the "as-built" drawings submitted to the City.
- F. All meters placed inside a structure shall be equipped with a remote readout which conforms to AWWA standards. Remote readouts shall be located in an accessible spot in the front half of the house. Meters shall be only a model as approved by the City Engineer or appointed representative and shall be installed horizontally. Meters and remote readouts shall be approved, sold, and installed by the City.

Refer to Figures 2.5.17 and 2.5.18 for additional details.

- G. All service lines shall have seven (7') feet of cover until the service line enters an area of the residence or building having a controlled temperature.

2.2.6 JOINT RESTRAINTS

- A. Joint restraint shall be accomplished using concrete thrust blocks and/or "Megalug" mechanical joint restraint devices.
- B. Thrust Blocks: Concrete for thrust blocks (also referred to as reaction blocks) shall conform to Section 6.2. Concrete thrust blocks shall be provided at all taps larger than two (2") inches, bends, tees, reducers, fire

hydrants, cut and plugs, and all twelve (12”) inch and larger valves. The size, location, and shape of thrust blocks shall be provided by the Design Engineer and shall be located so that the weight and thrust is transferred to the competent, undisturbed soils outside of the trench. Pre-cast concrete thrust blocks are not acceptable. The Contractor shall be responsible for installing temporary thrust blocks to resist the anticipated thrust until the concrete has adequate time to cure. All thrust blocks shall be made of concrete having a 28-day compressive strength of not less than 4,000 psi.

Refer to Figure 2.5.7 for additional detail.

- C. Megalugs: Megalugs (or equivalent restraints), may be used in lieu of thrust blocks or reverse anchors in new construction under the following conditions:
1. Pipe material used is either PVC or ductile iron pipe.
 2. The City Engineer or appointed representative and the Utilities Department shall approve or reject the use of Megalugs for a specific project at or prior to the pre-construction meeting.
 3. Manufacturer’s specifications shall be adhered to in the use and installation of Megalugs.
 4. Megalugs shall be subject to the same warranty requirements as the thrust blocks or reverse anchors they are replacing.
 5. The Design Engineer shall submit design calculations that substantiate the length of pipe that will need to be restrained on each side of a bend, tee, and valve.

2.2.7 TRACER WIRE

A number 12 AWG (insulated) copper tracer wire shall be installed with all new water main installations. Continuity (uninterrupted electrical conductance) of the tracer shall be maintained. Tracer wire shall be accessible at intervals of no more than 250 feet as measured along the pipe. Meeting the 250-foot interval requirement may require installation of an additional valve box for access to tracer wire. The top of the box shall be stamped with “Tracer Wire” for identification. Tracer wire shall be accessible at all fire hydrants and at all valve boxes except as noted below. Tracer wire does not have to be accessible at the fire hydrant isolation valve if it is accessible at the fire hydrant. Tracer wire is not required in more than two (2) valve boxes in any intersection. When blow-offs protrude above ground level, it is preferable to leave the wire exposed beside the pipe. The tracer wire is required for all service lines and shall be accessible at the service box and shall extend from the service box to the foundation wall at final grade.

Refer to Figure 2.5.9 for additional detail and requirements.

2.2.8 POLYETHYLENE WRAP

All ductile iron pipe and ductile iron fittings shall be wrapped with polyethylene. The polyethylene wrap shall be manufactured in accordance with AWWA C105, “Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids”, with the following additional requirements or exceptions:

The raw material used to manufacture polyethylene film shall be Type 1, Class A, Grade E-1, in accordance with ASTM D-1248. The polyethylene film shall meet the following test requirements: Tensile Strength - 1200 psi minimum; Elongation - 300% minimum; Dielectric Strength - 800 V/mil thickness minimum; Thickness – eight (8) mils minimum, nominal with minus tolerance not exceeding ten (10) percent of nominal; Melt Index - .04 maximum.

Refer to Figure 2.5.10 for additional information.

2.2.9 PRESSURE REDUCING STATIONS

Areas with static pressures over 150 psi shall be equipped with pressure reducing stations. Pressure reducing stations shall be constructed above ground and housed in an all weather, secure building. Building materials and style shall be approved by the City Engineer or appointed representative. Pressure reducing stations shall be designed and stamped by a Professional Engineer registered in the State of Colorado.

Refer to Figures 2.5.20 and 2.5.21 for required design features.

2.2.10 ENCASEMENT AND BRIDGING OF PIPE

Pipe encasement is required under certain conditions when water and sewer mains cross. When the sewer main crosses over the water main, the water main shall be installed as a Type I Crossing in accordance with Figure 2.5.11, being encased in reinforced concrete for a distance of ten (10) feet on either side of the point of crossing. When the sewer main is under the water main and less than 18 inches of vertical separation exists, a Type II crossing shall be installed in accordance with figure 2.5.12.

Under certain conditions when the water main is to be installed over or under an existing or proposed utility or structure, the City Engineer or appointed representative may require bridging or encasement of the pipe. If, in the opinion of the City Engineer or appointed representative, there exists the possibility of settlement of the pipe being installed over an existing utility or structure, then bridging of the pipe shall become necessary. This condition shall also apply to other underground utilities or structures being installed over existing water mains. The City Engineer or appointed representative shall determine the site and location of the concrete bridging.

Refer to Figures 2.5.11, 2.5.12, 2.5.13, and 2.5.14 for additional detail.

In cases where ductile iron pipe is cradled in a concrete structure as is shown in Figures 2.5.12 and 2.5.13, a ¼ inch thick neoprene rubber pad shall be installed to separate the pipe from the concrete. A pad is not needed when a ductile iron pipe is completely encased in concrete.

2.2.11 PIPE BEDDING MATERIALS

The bedding of water mains shall conform to Section 7.4 and manufacturer's specifications.

2.2.12 AWWA STANDARDS

All materials not specifically included in these specifications shall conform to the latest revision of applicable AWWA standards.

2.2.13 NEW PRODUCTS OR MATERIALS

New water industry products or materials will be considered, if it is in the opinion of the City Engineer or appointed representative and the Utilities Department that the product or material has some merit. The City Engineer or appointed representative and the Utilities Department will establish the criteria for testing or evaluating the product and reserves the right to accept or reject any product or material regardless of the test results.

2.3 CONSTRUCTION

The following is a recommended guideline for the completion of the water system construction. Any deviation from this guideline must be discussed at the pre-construction conference and approved in writing by the City Engineer or appointed representative. In addition to the requirements specified herein, ductile iron pipe shall be installed in accordance with the requirements of AWWA C600 and PVC pipe shall be installed in accordance with the requirements of AWWA Manual M23–PVC Pipe Design and Installation.

2.3.1 RESPONSIBILITY FOR MATERIAL

- A. **RESPONSIBILITY FOR MATERIAL FURNISHED BY CONTRACTOR.**
The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.

- B. **RESPONSIBILITY FOR MATERIAL FURNISHED BY THE CITY.** In emergency situations, materials that cannot be purchased from private

suppliers may be obtained from the City when in stock. Price shall be at the City's cost plus 15 percent for administration and stocking. Requests for materials should be submitted to the City.

- C. **RESPONSIBILITY FOR SAFE STORAGE.** The contractor shall be responsible for the safe storage of material furnished by or to him and accepted by him and intended for the work, until it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

2.3.2 HANDLING AND STORAGE OF MATERIAL

- A. **HAULING.** All materials furnished by the contractor shall be delivered and distributed at the site of the contractor.

All pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall not be dragged across sharp objects or abrading surfaces.

- B. **UNLOADING AT WORK SITE.** In distributing the material at the work site, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Do not off-load or store material in the improved portion of right of way. Do not leave pipe on uneven surfaces for a prolonged period of time. PVC pipe shall be protected from ultraviolet light when left exposed. Pipe that is shipped to the site having significant discoloration on the pipe surface is generally considered to be evidence of ultraviolet damage and may be reason for rejection and removal from the project. It is the responsibility of the contractor to protect the pipe from ultraviolet damage during storage at the job site.
- C. **CARE OF PIPE COATING AND LINING.** Pipe shall be so handled that the coating and lining will not be damaged. If any part of the coating or lining is damaged, the repair shall be made by the contractor at his expense in a manner satisfactory to the City Engineer or appointed representative.
- D. **COLD TEMPERATURES.** PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care shall be used in handling and installing PVC pipe during cold weather.
- E. **STORAGE.** Care shall be taken to store pipe and fittings to maintain the condition intended by the manufacturer. To prevent damage and

deformation, PVC pipe shall be stored on level ground for even support. Pipe stored outside shall be protected from ultraviolet light in accordance with the manufacturer's recommendations. Pipe that is more than two (2) years old as evident by the manufacturer's pipe labeling will not be permitted. Hydrants shall be stored with the "shoe" down or wrapped sufficiently to prevent materials from getting into hydrant.

2.3.3 ALIGNMENT AND GRADE

GENERAL CONDITIONS: The water main shall be installed according to manufacturer's installation recommendations and installed per the approved engineering plans. The road template, which is comprised of the following cross section symmetrical about the centerline: from the center line 12 foot of asphalt; 30 inch curb and gutter section; minimum six (6') foot flat graded section; slope graded to catch point, shall be rough graded to within +/- 0.5 foot (verified by Surveyor if needed) before water installations can proceed. Deviations for fill areas are acceptable if approved by the City Engineer or appointed representative. A minimum of seven (7') feet of cover must be maintained at all times. Street right-of-way and/or property line and lot corner points must be set and in visible evidence before water installations can proceed. Easements outside the standard right-of-way must be set and in visible evidence before water installations are allowed to proceed. Offset stakes, where necessary for alignment and grade, shall be set by the contractor. Any replacement of stakes shall be at the expense of the contractor.

- A. **DEVIATIONS CAUSED BY OTHER STRUCTURES.** Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration is required, the City Engineer or appointed representative shall have the authority to allow a deviation from the line and grade of the structures and/or the removal, relocation and reconstruction of the obstructions.
- B. **CAUTION IN EXCAVATION.** The contractor shall contact utility locating service at 1-800-922-1987 or 811 at least three (3) working days prior to starting work. The contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair and/or cost of repair of such structures when broken or otherwise damaged. The contractor shall also be held responsible for the prompt notification of the proper authorities should any damage occur or service be interrupted.
- C. **SUBSURFACE EXPLORATIONS.** Whenever, in the opinion of the Contractor, Design Engineer, or City Engineer or appointed representative, it is necessary to explore and excavate to determine the location of existing underground structures, the contractor shall make explorations and excavations for such purposes.

- D. DEPTH OF PIPE. The top of the pipe shall be laid to a minimum depth of seven (7) feet and a maximum depth of nine (9) feet from finished surface unless otherwise approved by the City Engineer or appointed representative. The City Engineer or appointed representative retains the right to have any portion of the water main potholed, at the contractor's expense, to insure adequate cover, if he has reason to believe that depth of cover may be inadequate.

2.3.4 EXCAVATION AND PREPARATION OF TRENCH

Excavation and preparation of trench shall be performed in accordance with Title 7 - Excavation in the Public Right-Of-Way.

2.3.5 LAYING

- A. LOWERING OF WATER MAIN MATERIAL INTO TRENCH. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. Proper implements, tools and facilities satisfactory to the City Engineer or appointed representative shall be provided and used by the contractor for the safe and efficient performance of the work.

If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the attention of the City Engineer or appointed representative. The City Engineer or appointed representative may prescribe corrective repairs or rejection of the damaged items.

- B. INSPECTION BEFORE INSTALLATION. All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends shall be examined with particular care, as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the City Engineer or appointed representative who may prescribe corrective repairs or rejection. Ductile iron pipe and fittings shall be inspected to insure that the asphaltic coating has not been damaged or otherwise removed. Repairs to damaged coatings may be done using a brush-on coal tar or asphaltic coating approved by the City Engineer or appointed representative.
- C. CLEANING OF PIPE AND FITTINGS. All lumps, blisters and excess coating shall be removed from the bell-and-spigot end of each pipe. The outside of the spigot and the inside of the bell shall be wiped clean and dry and be free from oil and grease before the pipe is laid. Dirt and any

other materials must be removed from barrel of pipe before laying. Any foreign material inside the pipe must be removed by swabbing or another method accepted by the City Engineer or appointed representative before the pipe or fitting is installed. Flushing alone shall not necessarily be considered the only method of cleaning pipe before it is placed into service.

- D. **LAYING OF PIPE.** Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot put the pipe into the trench and in place without getting soil into it, the City Engineer or appointed representative may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home with a slow steady pressure without jerky or jolting movements and then brought to correct line and grade. The use of backhoes, excavators or other mechanical equipment to push home pipe is prohibited. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. All necessary precautions shall be taken to prevent dirt from entering the joint space. No wooden blocking shall be left at any point under the pipeline.

Field bending or joint deflection of PVC water pipe will not be permitted. High deflection coupling joints shall be used to obtain the desired horizontal curve for PVC pipe. However, where mechanical joint fittings are used deflection shall not exceed the manufacturer's recommendation for the given pipe diameter. Joint deflection of ductile iron pipe and fittings shall not exceed the manufacturer's recommendations for the given pipe diameter.

At times when pipe laying is not in progress or the pipe is left unattended, the open ends of pipe shall be closed by a watertight plug or other means approved by the City Engineer or appointed representative.

- E. **CUTTING OF PIPE.** The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Cutting method used shall be in accordance with the pipe manufacturers recommendations.
- F. **BELL ENDS TO FACE DIRECTION OF LAYING.** Pipe shall be laid with the bell ends facing in the direction of laying, unless directed otherwise by

the City Engineer or appointed representative. Where pipe is laid on a grade of ten (10) percent or greater, the laying shall start at the top and shall proceed downward with the bell ends of the pipe upgrade.

- G. JOINT RESTRAINTS. Joint restraints shall be used where pipe is laid on a grade of 14 percent or greater.
- H. UNSUITABLE CONDITIONS FOR LAYING PIPE. No pipe shall be laid when, in the opinion of the City Engineer or appointed representative, trench conditions are unsuitable. These may include water in the trench, unstable soil conditions and/or inadequate safety measures.
- I. BRIDGING OF PIPE. Concrete bridging may be required by the City Engineer or appointed representative under certain conditions when the water main is to be installed over or under an existing or proposed utility or structure. If in the opinion of the City Engineer or appointed representative, bridging of pipe is necessary to avoid settlement of pipe being installed, this shall become necessary. This condition shall also apply to other underground utilities being installed over existing water mains. The City Engineer or appointed representative shall approve the design, size and location of concrete bridges.

Refer to Figure 2.5.13 for additional detail.

In certain instances, the City Engineer or appointed representative may require the complete concrete encasement of water mains. The size and location of these encasements shall also be approved by the City Engineer or appointed representative.

Refer to Figure 2.5.14 for additional reinforced concrete encasement detail.

- J. INSULATION BETWEEN DIFFERENT METALLIC PIPE MATERIALS. Whenever it is necessary to join ductile iron pipe with pipe of dissimilar metal, a method of insulating against the passage of electric current (Dielectric connection) shall be provided and shall be approved by the City Engineer or appointed representative.
- K. ENCASEMENT PIPE. Wherever it is necessary to provide an encasement or sleeve pipe for the water main, the water main shall not be inserted into the encasement or sleeve pipe without providing City approved insulating skids for each joint of the water main. In addition, no encasement or sleeve pipe shall be installed without protecting the ends of the pipe with approved manufactured end caps which will deter sand and debris from entering, but at the same time will allow water to escape from the encasement or sleeve pipe. Encasement pipes shall be

protected both inside and out with corrosion resistant materials having a bituminous base. Encasement or sleeve pipe size, length, type and sidewall thickness shall be included in the project design and approved by the City Engineer or appointed representative.

- L. **INTERRUPTION OF SERVICE.** No valve or other control on the existing system shall be operated for any purpose by the contractor. City employees will operate all valves, hydrants, blow-offs and curb stops. A minimum of 24 hours notice shall be given to the City prior to any proposed activity requiring operation of the above mentioned installations.

2.3.6 JOINING OF ANY MECHANICAL JOINT PIPE

- A. **GENERAL REQUIREMENTS.** The general requirements already set forth shall apply except that where the terms “bell” and “spigot” are used they shall be considered to refer to the bell and spigot ends of the lengths of mechanical joint pipe.
- B. **CLEANING AND ASSEMBLY OF JOINT.** The last eight (8) inches outside of the spigot and inside of the bell of the mechanical joint fitting shall be thoroughly cleaned to remove oil, grit, and excess coating or other foreign matter from the joint. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell end. The rubber gasket shall be placed on the spigot end with the thick edge toward the gland. Broken or defective glands shall not be used.
- C. **BOLTING OF JOINT.** The entire section of pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care shall be taken to locate the gasket evenly around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted and the nuts screwed up tightly with the fingers, then tightened with a suitable wrench.

Torques for various sizes of bolts shall be as recommended by the manufacturers for the various type and size of bolts used.

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

- D. **PERMISSIBLE DEFLECTION IN MECHANICAL JOINT PIPE.** Whenever it is necessary to deflect mechanical joint pipe, the amount of deflection shall not exceed the maximum deflection specified by the pipe manufacturer. Long radius curves shall be constructed using preformed 3° couplings and straight lengths of pipe per Section 2.1.11.

2.3.7 JOINING OF ANY PUSH-ON JOINT PIPE

- A. GENERAL REQUIREMENTS. The general requirements already set forth shall apply except that where the terms “bell” and “spigot” are used they shall be considered to refer to the bell and spigot of the lengths of push-on joint pipe.
- B. VARIATIONS IN DIMENSIONS. There is only one nominal dimension of the spigot outside diameter and the socket inside diameter for each size of push-on joint pipe. Similar dimensions of the bell-and-spigot pipe may vary with the class of pipe for each size in existing lines. Therefore, care should be taken that the outside diameter of the push-on joint pipe being installed is the same; otherwise a special adapter to join the two (2) lines may be necessary.
- C. CLEANING AND ASSEMBLY OF JOINT. The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, and excess coating or other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. Since different types of pipe take different types of rubber gaskets, it shall be the responsibility of the contractor to see that the proper type gaskets are installed and installed correctly.

A thin film of gasket lubricant shall be applied to the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant shall be as supplied by the pipe manufacturer and approved by the City Engineer or appointed representative.

The spigot end of the pipe shall be entered into the socket with care to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by the City Engineer or appointed representative. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured. Complete assembly instructions are available from the pipe manufacturer. The use of backhoes, excavators, or other mechanical equipment to push home pipe is prohibited.

- D. PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE. Whenever it is desirable to deflect push-on joint pipe in order to form a long-radius curve, the amount of deflection shall not exceed the maximum deflection specified by the pipe manufacturer.

2.3.8 SETTING OF VALVES AND FITTINGS

- A. **GENERAL REQUIREMENTS.** Valves, fittings, plugs and caps shall be set and joined to pipe in the manner specified above for cleaning, laying and joining pipe. Valves will be blocked using only precast concrete blocks. No wood blocking shall be allowed.
- B. **NUMBER OF VALVES REQUIRED.** Three (3) valves shall be required on all tees. Four (4) valves are required on all crosses. Exceptions may be approved by the City Engineer or appointed representative.
- C. **VALVE BOXES.** A valve box shall be provided for every valve. Debris Caps, as manufactured by S W Services or approved equal, shall be installed in all valve boxes. Refer to Figure 2.5.4 for additional detail. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover $\frac{1}{2}$ inch below the surface of the finished pavement or six (6") inches below grade in gravel drives. In untraveled utility easements, valve box covers shall be flush with the surface.
- D. **DEAD-ENDS.** All dead-ends on new mains shall be closed with ductile iron plugs or caps. All such dead-ends shall be equipped with suitable concrete anchors and blow-off facilities. Reverse concrete anchor and rod tiebacks are acceptable. Megalugs with concrete thrust blocks may also be used (Megalugs alone are not acceptable). All-thread rods used for reverse anchors shall be stainless steel.

The contractor shall furnish, install, and remove temporary blow-offs at locations shown on the drawings or designated by the City Engineer or appointed representative. Where indicated on the drawings, the contractor shall install permanent blow-offs. A permanent blow-off is defined as one that will be left in place at the completion of the work.

2.3.9 SETTING OF FIRE HYDRANTS

- A. **LOCATION AND GRADE.** All fire hydrant locations shall be staked by the developer to include both location and grade. Offset stakes no further than 12 feet from the fire hydrant are acceptable. No obstruction of any kind shall be allowed within five (5) feet of a hydrant location.
- B. **POSITION.** All fire hydrants shall stand plumb and shall have the 4½ inch nozzle facing the street. The hydrant flange shall be placed vertically at three (3") inches above final grade.
- C. **CONNECTION TO MAIN.** Each fire hydrant shall be connected to the main with a six (6") inch branch controlled by an independent six (6") inch

resilient gate valve. A mechanical joint or swivel head tee shall be used and the valve shall be located at the main.

- D. FIRE HYDRANT DRAINAGE. Provisions to allow the hydrant barrel weep hole to drain freely shall be constructed with each fire hydrant. A minimum of 1/3 c.y. of ¾" to 1½" washed rock shall be used to create a drain area around the front and sides of the base of the hydrant and extending 12" above the flange between the base and the barrel. Plastic wrap shall not be placed within 6" of the weep hole. A geotextile filter fabric shall be placed below, above and entirely around the rock to prevent fine materials from filling the voids in the rock. This fabric and rock shall be placed in a manner and in a location which does not undermine or otherwise disturb the hydrant blocks below and behind the hydrant base. The area between the back hydrant block and undisturbed, solid native soil shall be filled with concrete to form a thrust block.

Refer to Figure 2.5.2.

If bends are needed to bring fire hydrant to a desired horizontal or vertical position, special concrete reverse anchors, and/or anchor pipe, or stainless steel all-thread tie back rods, or a combination of all of these along with an extension may be called for. Extensions longer than two (2') feet will not be acceptable.

- E. SERVICE LINES. Service lines are not allowed to be tapped onto the fire hydrant lateral at any locations.
- F. SEPARATION FROM SEWERS. Fire hydrants and laterals shall be at least ten (10') feet away from sewer mains and services.
- G. CLEAN UP. Clean up shall include compacting the ground around the fire hydrant to grade and then raking and seeding same. During the warranty period, the contractor is responsible for filling in any subsidence and bringing the ground surface back up to grade.
- H. PRIVATE FIRE HYDRANTS. Private fire hydrants are not allowed.

2.3.10 ANCHORAGE

- A. ANCHORAGE FOR FIRE HYDRANTS. The bowl (also known as the shoe, foot piece, or bottom) of each fire hydrant shall be well braced against the unexcavated earth at the end of the trench with 18 inches x 18 inches x four (4") inches precast concrete blocks behind and beneath the bowl. Concrete shall be poured between the precast blocks and the end of the trench.

Refer to Figure 2.5.2 for additional detail.

- B. ANCHORAGE FOR PLUGS, CAPS, TEES, TAPS, BENDS, AND REDUCERS. Plugs, caps, tees, taps, bends, and reducers shall be provided with a reaction backing where necessary, by the use of concrete with a compressive strength of not less than 4,000 psi at 28 days. Backing shall be placed between solid ground and the fitting to be anchored, plastic bond breakers are to be in place prior to placement of concrete. The area of bearing on the pipe and on the ground in each instance shall be as shown on Figure 2.5.7 unless previously approved by the City Engineer or appointed representative. No wood shall be used as permanent blocking.

Anchorage blocks will be required for taps four (4) inches and larger. Thrust blocks will in all cases be sized and placed in a manner that will adequately transfer thrust reaction to solid undisturbed ground.

- C. MECHANICAL JOINT RESTRAINT FOR PVC AND DIP PIPE. Mechanical joint restraining devices may be used in lieu of thrust blocks on PVC and DIP piping systems four (4") inches through 12 inches in size and up to 150 PSI operating pressure for PVC and 350 PSI operating pressure for DIP. Restraint devices for nominal pipe sizes four (4") inches through 12 inches shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. The devices shall have a working pressure rating equal to that of the pipe on which it is used and must include a minimum safety factor of 2:1 in all sizes.

Joint restraint devices shall be installed in accordance with the manufacturer's written instructions. All joint restraint devices shall be wrapped with polyethylene in accordance with Section 2.2.8 of these specifications. Mechanical joint restraining devices shall be as manufactured by EBAA Iron, Inc., Uni-Flange, Inc. or approved equal.

- D. FORMING FOR CONCRETE. All forming for concrete thrust blocks and anchors will be done by bulk heading around the shape of the thrust block or anchor with burlap or reinforced paper sacks, which have been filled with sand or earth. Sacks will be of a size easily handled by the workmen when the sacks are full. Filled sacks used to form concrete blocks will be left in place in the trench and backfill will be placed around and over them in the usual manner. Any bolt heads or fittings must be left accessible when pouring concrete about them and must remain free of slopped concrete. If the fitting is to be covered completely upon direction of the Engineer, then the joint must be wrapped with polyethylene plastic sheet, which conforms to Section 2.2.8 of these specifications.

Refer to Figures 2.5.7 and 2.5.8 for sizes and other requirements.

- E. **CURING TIME FOR CONCRETE ANCHORS.** Minimum curing time for concrete anchors regardless of additives shall be 36 hours for anchors containing two (2) cubic yards or less, 48 hours for anchors containing more than two (2) cubic yards but less than six (6) cubic yards, and 72 hours for anchors containing more than six (6) cubic yards but less than twelve (12) cubic yards. Anchors containing more than twelve (12) cubic yards will be cured as directed by the Inspector. Curing time for anchors having flanged rods or other accessories embedded in them for tying pipe and/or fittings directly to the anchor will require approximately 25 percent additional curing time.

2.3.11 BACKFILLING AND COMPACTION

Backfilling and compaction shall be performed in accordance with Section 7.5.

2.3.12 WATER SYSTEM REPAIRS

Repairs to the water system shall be performed by or under the direct supervision of the Utilities Department. Materials and methods used shall conform to these specifications, AWWA standards, and shall be reviewed and approved by the City Engineer or appointed representative and Utilities Department.

2.3.13 SERVICE CONNECTIONS

No water service connections shall be made until the water main has passed the pressure and disinfection tests and until the Engineer or Surveyor has set stakes delineating the final property corners. The location for the water service for each lot shall be identified in the field considering topography, trees to be retained, ten (10') feet separation from sewer service and five (5') foot separation from other utilities. Generally locations shall be determined by a representative of the City and a representative of the Owner. Property shutoff valves shall be installed at or just inside the lot line and the service shall be extended a minimum of 13 feet into the property.

2.3.14 SERVICE LINE DISCONNECTIONS

Water Service lines to be replaced with new taps and service lines or for which use is to be discontinued for any other reasons shall be turned off at the corporation stop valve at the main and the service line pipe shall be physically disconnected from the valve and replaced with a cap.

2.4 TESTING

2.4.1 TESTING

The sterilization and flushing of water mains shall be performed in accordance with AWWA Standard C-651-86 and the following specification. Pressure/leakage testing shall be performed in accordance with AWWA Standard C-600 and the following specifications.

2.4.2 DISINFECTION

The chlorination of the finished main shall be done prior to installation of service taps. Mains shall normally be chlorinated using calcium hypochlorite in tablet form. The calcium hypochlorite shall be placed inside each joint of pipe as the pipe is installed. When installation has been completed, the main shall be charged with water at such a rate that water velocity within the main shall not exceed one (1) foot per second (cfs). Care shall be taken to expel all air through fire hydrants, air release valves, or blowoffs. The contractor shall take all necessary precautions to prevent the flow of the strong chlorine solution into existing water facilities during all phases of the disinfection process. Only City Utilities Department employees shall be allowed to operate valves. All valves in the lines being disinfected, except those isolating the line from sections containing potable water, shall be opened and closed several times during the disinfection process.

The initial chlorine concentration of free residual shall be tested at the time the main is charged to insure at least 50 ppm. A second test shall be taken in 24 hours (or 48 hours if the water temperature is less than 41 degrees Fahrenheit), at which time the residual concentration shall be at least 25 ppm. Regardless of recommended doses to obtain these required chlorine levels, the installing contractor has the responsibility of assuring that adequate free chlorine residuals are achieved. If not achieved, the entire disinfection procedure shall be repeated until required chlorine levels are attained.

- A. **THE TABLET METHOD.** The tablet method of disinfection may be used for main extensions of up to 3,000 feet. Care must be taken to avoid allowing foreign material or trench water to enter the main. If these have entered the main, this method of disinfection may not be used. Tablets shall be attached to the top of each section of pipe. The top of the pipe shall be identified by the manufacturer's printed label which shall always face up. The adhesive used to fasten tablets shall be Permatex No. 1 or any equal product as approved by the City Engineer or appointed representative. Necessary chlorine levels are stated in the previous paragraph. Table 1 summarizes the number of tablets normally required to achieve adequate chlorine levels. Additionally, one 5-gram tablet shall be placed in each fire hydrant, hydrant lateral and other appurtenances.

**TABLE 2.1
NUMBER OF HYPOCHLORITE TABLETS OF 5 GRAMS (3-3/4 grams
available chlorine per tablet) REQUIRED FOR A DOSE OF 50 ppm:**

Length of Section, Feet	Diameter of Pipe in Inches					
	2	4	6	8	10	12
13 or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	7
30	1	2	3	5	7	10
40	1	2	4	6	9	14

- B. CONTINUOUS FEED OR SLUG METHOD. In special cases, the City Engineer or appointed representative may allow the use of the continuous feed or slug method of water main disinfection outlined in AWWA C-651.

2.4.3 FLUSHING THE LINE

When the chlorine test has been successfully completed, the line shall be flushed until the chlorine residual is less than two (2) milligrams per liter (or two (2) parts per million). Care shall be taken when flushing the pipeline to prevent erosion, the killing of desirable vegetation, property damage, and danger to the public. Water lines shall be flushed with a velocity of at least 2½ feet per second through the line. Flushing shall be performed prior to bacteria testing. The chlorinated water may be used later for testing other lines, or if not so used, shall be de-chlorinated, desilted and disposed of by the Contractor per applicable state and/or local regulations. The City will not be responsible for loss or damage resulting from such disposal.

2.4.4 PRESSURE/LEAKAGE TEST

After the pipe has been laid and backfilled, the pipe shall be filled with water and all air expelled from the pipe. If hydrants, blow offs, or air release valves are not available at high points, the contractor shall have the necessary taps made at all high points to expel the air. Plugs shall be inserted after the air is expelled.

Following the successful completion of the chlorine tests and flushing of the lines, a pressure/leakage test shall be performed by the contractor. The contractor shall furnish all equipment and materials necessary for the test and shall advise the City Engineer or appointed representative with a minimum of 24 hours notice of when the test is ready to be witnessed. The test shall run for three (3) hours. The test shall be monitored with a pressure gage located as close as possible to the lowest elevation point in the section of line being tested. The test pressure shall be at least 50 percent higher than the normal static pressure (or 100 psi, whichever is greater) at the low point and shall not vary by more than five (5) psi during the test period. At the end of the test period, the system shall be again pumped up to the pressure of the system at the start of the test.

The amount of make up water necessary to re-establish this pressure shall be carefully measured.

The allowable leakage for PVC pipe during the test period shall not exceed that given by the formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

This equation shall be used for pipe with mechanical joints or push-on joints. In this equation, L is leakage in gallons per hour, N is the number of joints in the section of line being tested, D is the nominal pipe diameter in inches and P is the average pressure in the line during the test in pounds per square inch. Tables 2.2 and 2.3 give typical values for leakage testing.

Makeup water used to pressurize the system shall be clean and properly chlorinated. Regardless of measured leakage or pressure drop, any visible leak shall be repaired before acceptance.

ALLOWABLE LEAKAGE TABLES

TABLE 2.2 ALLOWABLE LEAKAGE FOR PVC PLASTIC PIPE WITH ELASTOMERIC JOINTS (U.S. Gallons per Hour)

Nominal Pipe Size, Inches	Average Test Pressure in Line* - P.S.I.				
	50	100	150	200	250
	Allowable Leakage Per 1,000 Feet or 50 Joints				
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28
14	0.67	0.95	1.16	1.34	1.50

The allowable leakage for gray and ductile iron pipe during the test period shall not exceed that given by the formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

This equation shall be used for pipe with mechanical joints or push-on joints. In this equation, L is the allowable leakage in gallons per hour, S is the length of pipe tested in feet, D is the nominal diameter of the pipe in inches and P is the average pounds per square inch.

**TABLE 2.3 ALLOWABLE LEAKAGE FOR GRAY AND DUCTILE CAST-IRON PIPE
(U.S. Gallons per Hour)**

Nominal Pipe Size Inches	Average Test Pressure in Line* - P.S.I.										
	100	125	150	175	200	225	250	275	300	350	400
	Allowable Leakage Per 1,000 Feet of Pipeline										
4	0.30	0.34	0.37	0.40	0.43	0.45	0.47	0.50	0.52	0.56	0.60
6	0.45	0.50	0.55	0.59	0.64	0.68	0.71	0.75	0.78	0.84	0.90
8	0.60	0.67	0.74	0.80	0.85	0.90	0.95	1.00	1.04	1.12	1.20
10	0.75	0.84	0.92	0.99	1.06	1.13	1.19	1.24	1.30	1.40	1.50
12	0.90	1.01	1.10	1.19	1.28	1.35	1.42	1.49	1.56	1.69	1.80
14	1.05	1.18	1.29	1.39	1.48	1.58	1.66	1.74	1.82	1.97	2.10

*Note: For pipe with 18 foot nominal lengths. To obtain the recommended allowable leakage for pipe with 20 foot nominal lengths, multiply the leakage calculated from the table by 0.9. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

2.4.5 BACTERIOLOGICAL TESTS

After final flushing and before the water main is placed into service, a sample or samples shall be taken from the end of the line by the Contractor while being witnessed by the City Engineer or appointed representative. This sample shall be tested for bacteriologic quality by a City approved qualified laboratory and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfections shall be repeated until satisfactory samples have been obtained.

No water line shall be accepted, service tapped, or placed into service until it has been properly disinfected, flushed, pressure tested, and written evidence of satisfactory bacteriological tests have been received by the City of Woodland Park.

CITY OF WOODLAND PARK, COLORADO

TITLE 3

SANITARY SEWER SPECIFICATIONS

TABLE OF CONTENTS

SECTION	3.1	DESIGN	3-3
	3.1.1	GENERAL	3-3
	3.1.2	PLANNING CONSIDERATIONS	3-6
	3.1.3	MINIMUM SIZE	3-7
	3.1.4	MINIMUM DEPTH	3-7
	3.1.5	SLOPES	3-7
	3.1.6	HIGH VELOCITY PROTECTION	3-8
	3.1.7	ALIGNMENT	3-8
	3.1.8	INTERSECTIONS	3-8
	3.1.9	SERVICE CONNECTIONS	3-8
	3.1.9.1	PRESSURE LATERALS	3-9
	3.1.10	MANHOLES	3-9
	3.1.11	MANHOLE SIZES	3-9
	3.1.12	DROP MANHOLES	3-9
	3.1.13	MANHOLE CHANNELS	3-10
	3.1.14	MANHOLE RINGS AND COVERS	3-10
	3.1.15	MANHOLE WATERTIGHTNESS	3-10
	3.1.16	INVERTED SIPHONS	3-10
	3.1.17	LOCATION	3-10
	3.1.18	STREAM AND DRAINAGE CHANNEL CROSSINGS	3-11
	3.1.19	CROSSINGS UNDER HIGHWAYS	3-12
	3.1.20	STUB OUTS FROM MANHOLES	3-12
	3.1.21	SERVICE STUBS	3-12
	3.1.22	WASTEWATER PUMPING STATIONS	3-12
	3.1.23	GENERAL REQUIREMENTS	3-13
	3.1.24	PUMP STATION DESIGN	3-13
	3.1.25	INSTRUCTION, EQUIPMENT OPERATION AND MAINTENANCE	3-16
	3.1.26	GREASE AND SAND/OIL INTERCEPTORS	3-16
	3.1.27	THERMAL INSULATION FOR SEWER MAINS AND SERVICE LINES	3-17

SECTION	3.2	MATERIALS	3-18
	3.2.1	POLYVINYL CHLORIDE PIPE FOR SEWERS AND FORCE MAINS	3-18
	3.2.2	CAST IRON AND DUCTILE IRON GRAVITY SEWER PIPE	3-20
	3.2.3	HIGH DENSITY POLYETHYLENE GRAVITY SEWER PIPE (HDPE)	3-21
	3.2.4	MANHOLES	3-21
	3.2.5	DROP MANHOLES	3-22
	3.2.6	CONCRETE	3-22
SECTION	3.3	CONSTRUCTION	3-22
	3.3.1	EXCAVATION AND PREPARATION OF TRENCH	3-22
	3.3.2	LAYING OF PIPE	3-22
	3.3.3	TRACER WIRE	3-23
	3.3.4	MANHOLES	3-23
	3.3.5	MANHOLE CASTINGS	3-24
	3.3.6	FITTINGS, COUPLINGS, WYES AND SADDLES	3-24
	3.3.7	SERVICE CONNECTIONS	3-24
	3.3.8	DEEP SERVICE CONNECTIONS	3-25
	3.3.9	BACKFILLING AND COMPACTION	3-25
	3.3.10	SERVICE LINE DISCONNECTIONS	3-25
	3.3.11	SERVICE LINE INSPECTIONS	3-2
	3.3.12	ABANDONMENT OF MAINS AND APPURTENANCES	3-25
	3.3.13	REPAIRS AND REPLACEMENTS	3-25
	3.3.14	TESTING	3-26
	3.3.15	AIR TESTS	3-26
	3.3.16	EXFILTRATION TESTS	3-27
	3.3.17	INFILTRATION TEST	3-28
	3.3.18	TELEVISION INSPECTION	3-28
SECTION	3.4	FIGURES	
	3.4.1	STANDARD MANHOLE CONSTRUCTION	
	3.4.2	STANDARD CONCRETE MANHOLE CONE CAP	
	3.4.3	STANDARD OUTSIDE DROP MANHOLE	
	3.4.4	STANDARD INTERNAL DROP MANHOLE	
	3.4.5	48" PRE-CAST CONCRETE MANHOLE DECK	
	3.4.6	60" PRE-CAST CONCRETE MANHOLE DECK	
	3.4.7	MANHOLE RING AND COVER	
	3.4.8	STREAM CROSSING ENCASMENT WITHOUT CAISSONS	
	3.4.9	STREAM CROSSING ENCASMENT TYPICAL CAISSON	
	3.4.10	DEEP SERVICE CONNECTION	

- 3.4.11 HIGH VELOCITY PROTECTION**
- 3.4.12 SANITARY SEWER SERVICE DETAIL**
- 3.4.13 TYPICAL BORE CONSTRUCTION**

3.1 DESIGN

3.1.1 GENERAL

All sanitary sewer mains and appurtenances shall be in conformance with these Engineering Specifications and shall be designed by or under the direct supervision of a registered PE licensed to practice in the State of Colorado. The following checklist is provided to assist in the development of plans which meet City of Woodland Park requirements:

SANITARY SEWER PLANS CHECKLIST

A. PLAN SHEET FORMAT

		Yes	No	N/A	Comments
1.	Title				
2.	Sheet size 24" X 36"				
3.	North Arrow				
4.	Scale(s) 1"=50' H, 1"=5' V				
5.	Professional Engineer Signature and Seal				
6.	City Approval Block				
7.	Bench Mark (USGS Datum)				
8.	Vicinity Map 1"=2000'				
9.	Key Map 1"=100'				
10.	Legend of Symbols				
11.	Plan Quantity Summary				
12.	Sheet Cross Reference				
13.	Title Block				
14.	Revision Blocks				
15.	Ownership and/or Subdivision Information				
16.	Street Names				
17.	Street Dimensions				
18.	Easements with Dimensions				
19.	Lot Lines				
20.	Lot Numbers (Location and Size)				

		Yes	No	N/A	Comments
21.	Existing Utilities Shown				
	a. Water				
	b. Gas				
	c. Telephone				
	d. Storm				
	e. Irrigation				
	f. Sanitary Sewer				
	g. Cable Television				
	h. Electric				
22.	Join to Existing Improvements				
23.	Construction Details				
24.	Construction Notes				
25.	Flow Arrows on Sewers				
26.	Manhole Sizes				
27.	Manhole Types				
28.	Manhole Numbers				
29.	Manhole Stationing				
30.	Stub-Outs to Future Filings or Future Development				
31.	Location of Cleanouts				
32.	Size and Type of Sewer Main				
33.	Size and Type of Water				
34.	Lengths Between Manholes				
35.	Minimum Clearance Between Water and Sewer				
36.	Location of Fire Hydrants				
37.	Crossing of Utilities Noted				
38.	Crossing Detail(s)				
39.	Location of Crossing(s)				
40.	Staking and Control Information				
41.	Removal of Existing Improvements				
42.	Sewer Lateral Locations				
43.	Proposed Wye and Riser Connections for Services				
44.	Vertical and Horizontal Grids with Scales				

	(Typically 1"=5')				
		Yes	No	N/A	Comments
45.	Datum Elevations				
46.	Datum Locations				
47.	Existing Ground Surface				
48.	Proposed Finish Grade Over Sewer				
49.	Manhole Numbers/Identification				
50.	Manhole Stationing				
51.	Underdrain Note				
52.	Type, Size, and Length of Sewer				
53.	Slope Between Manholes				
54.	Rim Elevation of Manholes				
55.	Invert Elevation(s) of Each Manhole (In and Out)				
56.	Fall Through Manholes				
57.	Utility Crossings Shown				
58.	Encasement Location				
59.	Can It Be Staked and Built?				

C. GENERAL NOTES

1. All materials and workmanship shall conform to the latest edition of the City of Woodland Park Engineering Specifications. Work shall be subject to inspection and approval by authorized City of Woodland Park personnel.
2. All new sewer mains shall be PVC, Standard Dimension Ratio (SDR)-35 Pipe in accordance with ASTM D-3034, bell and spigot with elastomeric seal. PVC pressure pipe C-900, DR-18/DR-24 may also be used. When PVC C-900 pressure pipe is used for sewers or force mains, the contractor shall request from the pipe manufacturer certification that the joint gaskets are compatible for use with raw sewage.
3. The Contractor shall furnish the Design Engineer “as constructed” locations of all facilities installed and this, in turn, shall be submitted to the City of Woodland Park on “As-Built” plans, prepared by the Design Engineer.
4. Rim elevations shown on the plan and profile sheets are approximate only and are not to be taken as final elevations. The pipeline contractor should allow approximately the top one (1’) foot to be adjusted either up or down in order to match final pavement elevation. The maximum adjustment to final grade is 12 inches with concrete rings.
5. Bedding and backfill materials for both water and sewer shall conform to the latest edition of the City of Woodland Park Engineering Specifications.

6. A pre-construction meeting must be held between the Contractor and City Engineer or appointed representative prior to the start of construction activities.
7. All sanitary sewer manhole cones shall be eccentric and the vertical portion shall be turned toward the center of the street in all instances.
8. The Contractor shall be responsible for cleaning nearby public streets of mud or debris due to construction activity on a daily basis or as otherwise directed by authorized City personnel.
9. The Contractor shall control the sewer installation using construction staking provided by a licensed surveyor. Sewer lines shall be staked for line and grade. Cut sheets shall be provided to the City inspector prior to construction of the sewer.

3.1.2 PLANNING CONSIDERATIONS

Except where approved master plans exist, the following criteria for design shall be used unless specific approval for other criteria has been given by the City Engineer or appointed representative:

- A. **DESIGN PERIOD:** The sewer system shall be designed for the estimated ultimate tributary population.
- B. **POPULATION DENSITIES INCLUDING PUBLIC USE LANDS:**
 1. Single-family units at 2.63 persons per unit.
 2. Multi-family and condominiums at 2.63 persons per unit.
 3. Use maximum Single-family units per acre for zoning classification if specific lot plans are not available.
 4. 20 Multi-family cluster housing or condominiums per acre.
- C. **PER CAPITA FLOWS:** Sewer systems shall be designed on the basis of not less than the following:
 1. 92 gallons per person per day, with a peaking factor of 4:1.
 2. Infiltration of 250 gallons per inch of diameter per mile of line, per day.
 3. Commercial land uses at 1400 gallons per acre per day with a peak factor of 3.
 4. Industrial land uses at 1600 gallons per acre per day with a peak factor of 3.
 5. Public use, park and open space at 1000 gallons per day with a peak factor of 3.
- D. **New Subdivisions:** Sewer systems shall generally be designed to provide gravity sewer service to each lot including those with anticipated basements. To avoid household wastewater pumping systems or the excessive construction of additional sewer mains or excessively deep mains, in hilly areas, consideration should be given to the use of private sewer easements and larger service lines to reach down gradient sewer mains to serve lots on the downhill side of streets.

3.1.3 MINIMUM SIZE

No public sewer shall be less than eight (8”) inches in diameter. No residential building sewer shall be less than four (4”) inches in diameter. No commercial or institutional building sewer shall be less than six (6”) inches in diameter unless approved otherwise by the City Engineer or appointed representative. Pumped (ejector) sewer laterals will be considered on a case-by-case basis.

3.1.4 MINIMUM DEPTH

No public mains shall be less than six (6’) feet deep measured from the top of pipe, except by written approval of the City Engineer or appointed representative. Sewer mains and service lines, which have less than four (4’) feet of cover or more than 12 feet of cover, shall be installed using PVC pressure pipe. Under no circumstances shall a sewer have less than three (3’) feet of cover, unless specifically approved by the City Engineer or appointed representative in writing. Sewer lines, which must cross under creeks, streams or through wet lands where the soil is unstable and water infiltration may be high, must be specifically designed by the design engineer and approved by the City Engineer or appointed representative.

Sanitary sewer service lines shall generally be buried a minimum of three (3’) feet below finished grade. Depths less than three (3’) feet may be approved on a case by case basis where drop between the building and the sewer main is inadequate to maintain the three (3’) feet of cover.

Where sewer mains or service lines cannot be installed with six (6’) feet of cover, the line shall be insulated in accordance with Section 3.1.27 of these specifications.

3.1.5 SLOPES

All sewers should be designed to transport average sewage flows at mean velocities of two (2’) feet per second based on a roughness factor of 0.013. In no case shall the slope be less than the following for sewer mains and services:

MINIMUM SLOPE TABLE

Services

4 inch - ¼ inch per foot (2.08%)

6 inch - ⅛ inch per foot (1.04%)

Mains and Services

8 inch - 0.40% 18 inch - 0.15%

10 inch - 0.35% 21 inch - 0.12%

12 inch - 0.26% 24 inch - 0.11%

15 inch - 0.20% 30 inch - 0.08%

Sewers shall be laid with uniform slope between manholes. No vertical curves shall be permitted. Where sewer slopes are less than one (1) percent the sewer pipe shall be bedded in $\frac{3}{4}$ inch rock. Bedding limits shall be in accordance with Figure 2.5.1.

3.1.6 HIGH VELOCITY PROTECTION

In the case of sewer slopes over 15 percent, special provisions shall be made to prevent displacement by erosion and shock. Such high velocity protection shall be shown on detail drawings and approved by the City Engineer or appointed representative.

3.1.7 ALIGNMENT

Manholes shall be located to limit possible storm water entrance. Proposed sewer lines which may conflict with the placement of other underground facilities will require prior approval of the sewer placement location by the controlling agencies whose facilities are affected. Locations other than those specified will require specific approval by the City Engineer or appointed representative. Installation of curvilinear pipelines for mains, sewer in sizes eight (8") inches through 12 inches in diameter are acceptable and necessary to obtain the standard location of sewer mains. PVC sewers with horizontal curves must be designed and constructed using a uniform slope between manholes and shall have a centerline radius no less than that recommended by the pipe manufacturer. The necessary horizontal curvature shall be attained by curving the trench. Horizontal curves shall be constructed using high deflection couplings. No vertical curves will be permitted. Changes in alignment for service lines shall be accomplished with preformed bends not to exceed 45 degrees. When changes of direction exceed 45 degrees, a two (2') foot section of pipe shall separate the fittings necessary to make the needed change of direction. Field bending of pipe will not be permitted.

3.1.8 INTERSECTIONS

All pipes shall have free discharge into the collection system. Where possible, the flow line of the intersecting pipe shall be the spring line (horizontal center of pipeline) of the collection sewer. Where smaller pipes intersect larger pipes, the soffits (internal top of pipe) of the intersecting pipes shall match.

3.1.9 SERVICE CONNECTIONS

All service connections to mains shall be made in the top one-half ($\frac{1}{2}$) of the pipe. Connections made in the lower half of the main will not be permitted. All service connections (laterals) may be constructed of PVC pipe with gasketed joints or HDPE fusion welded joints pipe. If HDPE is used the internal weld bead shall be removed during construction of the service connection.

3.1.9.1 PRESSURE LATERALS

Where structure sewer piping is lower than the sewer main in the street, a pressure sewer lateral may be approved by the City Engineer or appointed representative. Pressure laterals shall be constructed of PVC Sch. 40 pipe with solvent welded joints and fittings.

3.1.10 MANHOLES

Manholes shall be installed at both ends of each line, changes in grade, changes in size, at all pipeline intersections, changes in alignment (except curvilinear sewers) and at distances not greater than 400 feet. For curvilinear sewers, manholes must be placed at all intersections, changes in grade and size, and at distances not greater than 400 feet. Manholes must also be provided at all points of reverse curve or where requested by the City Engineer or appointed representative. Manholes shall be provided with all weather access and must be located to allow unassisted access by City maintenance vehicles. The flow channel through the manhole base shall be made to conform to the shape and slope of the sewer. A minimum three-tenths (0.3') foot fall across manholes shall be maintained. When the sewer main slope is less than one (1) percent, the drop through a manhole, in a straight through or one having an alignment change of less than 30 degrees, shall be reduced to one-tenth (0.1') foot in order to maximize the slope of the sewer main. Lines and manholes located in areas where access, in the opinion of the City Engineer or appointed representative, is not possible, the sewer will not be approved for construction. Where possible, manholes shall not be located in concrete areas, such as sidewalks, cross-pans, aprons, or curbs and gutter.

Refer to Figures 3.4.1 and 3.4.2.

3.1.11 MANHOLE SIZES

The inside diameter of the manhole shall be not less than four (4') feet on lines eight (8") inches through 12 inches in diameter; not less than five (5') feet on lines 15 inches through 36 inches in diameter; and not less than six (6') feet on lines in excess of 36 inches in diameter for standard design manholes. All inside drop manholes and all shallow manholes (six (6') feet in depth or less) shall have an inside diameter of not less than five (5') feet.

3.1.12 DROP MANHOLES

An outside drop pipe shall be provided for a sewer entering a manhole at an invert elevation of 18 inches or more above the manhole invert. Where difference in elevation between the incoming sewer invert and the manhole invert is less than 18 inches, the invert shall be shaped in a filleted fashion to prevent solids deposition. Inside drop manholes, when approved for use, shall be constructed using a five (5') foot minimum inside diameter manhole structure.

Refer to Figures 3.4.3 and 3.4.4.

3.1.13 MANHOLE CHANNELS

The flow channel shall be made to conform to the shape of the sewer pipe and shall be formed in the shape of a “U.” Wherever possible use the lower one-half ($\frac{1}{2}$) of the sewer pipe for the invert of the open flow channel. In such cases the minimum slopes previously discussed shall not apply. At intersections with other lines, channels shall be formed with a curve to minimize turbulence.

3.1.14 MANHOLE RINGS AND COVERS

Manhole rings and covers shall conform to the detail sheets for ring and cover designs. Only concrete grade rings will be accepted for use. All manholes located outside of dedicated street or alley right-of-way will be designed and constructed with a locking type cover with the manhole ring bolted to the concrete cone. Grade adjustment rings between the ring and cover of the concrete cone shall not exceed 12 inches.

Refer to Figures 3.4.5, 3.4.6 and 3.4.7.

3.1.15 MANHOLE WATERTIGHTNESS

Precast manhole joints shall be made watertight with a rubber “O” ring, Ramnek or similar approved material and grouted to a smooth finish.

3.1.16 INVERTED SIPHONS

Inverted siphons may be approved for use when alternate designs are not feasible. Approval must be granted by the City Engineer or appointed representative in writing.

Inverted siphons should have not less than two (2) barrels of cast or ductile iron pipe, with a minimum pipe size of six (6”) inches and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall have adequate clearances for crossing; and in general, sufficient head shall be provided and pipe sizes selected to insure velocities of at least three-point-zero (3’) feet per second (fps) for average flows. The inlet and outlets shall be arranged so that the normal flow is diverted to one barrel, and so that either barrel may be cut out of service for cleaning. The Consulting Engineer shall submit complete calculations, with diagrams, for the design of the siphon for review by the City Engineer or appointed representative.

3.1.17 LOCATION

- A. **EASEMENTS:** All mains shall be installed in dedicated street rights-of-way, or dedicated easements. Location for these sewer mains shall be six (6’) feet from the centerline of the street. Sewer mains shall be installed in easements, either by plat or separate document when as determined by the City Engineer or appointed representative, it is not practical to make such installation in a dedicated street ROW. No structures shall be constructed within these easements or ROW without prior written approval, including terms and

conditions, as set by the City. The minimum width requirements for sanitary sewer main easements are 20 feet or twice the depth of the pipe, whichever is greater. The pipeline shall be offset a minimum of five (5) feet from any property line. In the event two (2) utility lines share the same easement, the minimum width for the easement shall be 30 feet.

B. **RELATION TO WATER MAINS:** Sewers shall be located a minimum of 10 feet horizontally from existing or proposed water mains. Sewers crossing below water main shall be a minimum of 18 inches clear distance vertically below the water main. If this clear distance is not feasible, the crossing must be designed and constructed to protect the water main. Minimum protection shall be as follows:

1. **SANITARY SEWER LINE CROSSING OVER A WATERLINE.** When there is less than 18 inches of vertical clearance between the bottom of the sanitary sewer and the top of the water main, the water main shall be ductile iron pipe, bedded in compacted granular material, a minimum of 10 feet on each side of the centerline of the crossing. In all cases, regardless of vertical clearance, the waterline shall be encased in reinforced concrete, a minimum of 10 feet on each side of the centerline of the crossing.

Refer to Figure 2.5.11.

2. **WATERLINE CROSSING OVER A SANITARY SEWER LINE.** When there is less than 18 inches of vertical clearance between the bottom of the water main and the top of the sanitary sewer, the water main shall be ductile iron pipe a minimum of 10 feet on each side of the centerline of the crossing. In addition, the sanitary sewer shall be encased in concrete, a minimum of 10 feet on each side of the centerline of the crossing.

Refer to Figure 2.5.12.

In all cases, suitable backfill or other structural protection shall be provided to preclude settling or failure of the higher pipe.

C. **RELATION TO OTHER UTILITIES:** Sewers shall be located a minimum distance of five (5') feet from utilities other than water. When other utilities are installed in the vicinity of an existing sewer main, they shall be installed a minimum distance of five (5') feet, except at crossings which shall be at angles of 45° or greater.

3.1.18 STREAM AND DRAINAGE CHANNEL CROSSINGS

All stream and drainage channel crossings shall be ductile iron pipe encased in reinforced concrete (see detail sheets for stream crossing designs). Crossings less than four (4) feet below existing or proposed channel bottoms shall be supported by reinforced concrete

caissons drilled a minimum of five (5') feet into an impervious soil or 20 feet whichever is less. In the absence of impervious soils, caissons shall extend 20 feet below the invert of the sewer main. A 15 foot splash pan consisting of 18 to 24 inch rip rap or gabions shall be placed downstream tapering from six (6') feet deep at the crossing to three (3') feet deep at the end to prevent erosion. The Consulting Engineer shall submit, for review by the City Engineer or appointed representative, a scour study for all proposed live stream crossings of water and sewer pipelines based upon a one (1), five (5), and 100 year storm event.

3.1.19 CROSSINGS UNDER HIGHWAYS

Crossings under highways shall consist of a cast or ductile iron pipe (Carrier) laid inside a steel casing pipe, which has been jacked underneath the roadway. The steel casing pipe shall be jacked horizontally through the ground on substantially the grade of the sewer, with due allowance for the bells of the iron pipe. As the pipe is jacked along, the earth shall be excavated from the face and removed so that it will not be necessary to force the pipe through solid ground. The casing shall be of the sizes shown on the plans. The casing diameter shall be a minimum 1½ times the outside diameter of the carrier pipe. After the casing has been completed, the iron pipe shall be placed inside and blocked in exact position and grade with an isolator/spacer behind each bell and as recommended by isolator/spacer manufacturer. The annular space between the carrier pipe and the casing shall be left empty. Each end of the casing shall then be plugged tight around the iron pipe and inside the casing pipe. The flexible end seal and isolator/spacers shall be as manufactured by Pacific Seal & Insulator or approved equal.

3.1.20 STUB OUTS FROM MANHOLES

Stub outs from manholes shall not exceed 40 feet except for lines that will be extended in the future. Whenever practical, designs to complete the manhole run shall be submitted for review to insure proper grade and alignment for future construction. Future extension of stub outs shall be of like material using the same grade and alignment.

3.1.21 SERVICE STUBS

Service stubs for each property shall be extended to a point 13 feet inside the property line at a point generally 10 feet uphill from lowest front property corner or as approved by the City Engineer or appointed representative. Service lines shall include clean-outs installed at the property line and five (5') feet outside the building foundation, and spaced at a distance not greater than 100 feet.

Refer to Figures 3.4.10 and 3.4.12.

3.1.22 WASTEWATER PUMPING STATIONS

Preliminary Engineering: A basis of design for all wastewater pumping stations shall be prepared and submitted to assist the City Engineer or appointed representative in reviewing the project plans and specifications. The basis of design shall include, but not necessarily be limited to, the following:

- A. Calculations showing average daily flow, peak daily flow and peak hourly flow for present and design flows. Firm pumping capacity shall be provided for 115 percent of peak hourly flow.
- B. Number, type, capacity, motor horsepower and NPSH requirements of proposed pumping units. Motors shall be non-overloading.
- C. System head curve or head computations for design conditions of pumping system. Future pumping capacity requirements shall also be considered in sizing pumping equipment.
- D. System head calculations shall include the size and length of force mains and assumed friction factor.
- E. Design considerations shall include station size, type of construction, pump and motor selection, system design, controls, valves, piping, access and pumping efficiency.
- F. Force mains shall generally be designed for velocities of two (2) to four (4) feet per second (fps) at the design pumping rate.
- G. All wastewater pumping stations shall include emergency storage capacity with a volume appropriate for the specific station. Consideration shall be given to design size, environmental and health risks and emergency response capability.

3.1.23 GENERAL REQUIREMENTS

- A. Wastewater pumping stations shall not be subject to damage by flooding. Suitable superstructures located off the right-of-way of streets and alleys shall be provided, except when approved by the City Engineer or appointed representative. It is important that the station be readily accessible.
- B. Where it may be necessary to pump wastewater prior to grit removal, the wet well and the discharge piping shall be designed to prevent grit accumulation.

3.1.24 PUMP STATION DESIGN

The following items shall be required in the design of wastewater pumping stations:

- A. TYPE: Sewage pumping stations shall be of the dry pit/wet well type when the design pumping capacity is 500 GPM or greater.

Sewage pumping stations shall be of the submersible pump type when the design pumping capacity is less than 500 GPM.

B. STRUCTURES:

1. Separation: Wet and dry wells, including their superstructure, shall be completely separated. Minimum inside diameter of wet and dry wells shall be 60 inches.
2. Equipment Removal: Provisions must be made to facilitate removing pumps, motors and valves.
3. Access: Suitable and safe means of access shall be provided to pump stations dry wells and to wet wells.

C. EQUIPMENT: Equipment shall be consistent with equipment already in use in the City's wastewater system, except when approved otherwise by the City Engineer or appointed representative.

1. Pumps:

- a. Duplicate Units: At least two (2) pumps must be provided. If only two (2) pumps are provided, they shall have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow. Where three (3) or more pumps are provided, they shall be designed to fit actual flow conditions and must be of such capacity that with any one (1) pump out of service, the remaining pumps will have the capacity to handle maximum wastewater flows.
- b. Pump Openings: Pumps shall be capable of passing spheres of at least three (3") inches in diameter. Pump suction and discharge openings shall be at least four (4") inches in diameter.
- c. Priming: The pump shall be so placed that under normal operating conditions, it will operate under a positive suction head.
- d. Electrical Equipment: Electrical equipment in enclosed places where gas may accumulate, shall comply with the National Board of Fire Underwriters' specifications for hazardous locations (NEMA Type 7) or submersible locations (NEMA Type 6). Electrical equipment for pump motors shall contain elapsed time meters.
- e. Intake: Each pump shall have an individual intake. Wet well design shall be such as to avoid turbulence near the intake and cavitation in the pump.
- f. Dry Well Dewatering: A separate sump pump shall be provided in dry wells to remove leakage or drainage with the discharge to the wet well above the overflow level or the wet well. Water ejectors connected to a potable water supply will not be approved. All floor and walkway surfaces shall have an adequate slope to point of drainage.

D. CONTROLS: Liquid level controller activators shall be so located as not to be affected by flows entering the wet well or by the suction of the pumps. Float tubes in dry wells shall extend high enough to prevent overflow. In small stations with duplicate units, provisions shall be made to provide automatic alterations of the pumps in use.

- E. VALVES: Suitable shutoff valves shall be placed on suction and discharge lines of each pump. A check valve or pump control valve shall be placed on each discharge line, between the shutoff valve and the pump.

- F. WET WELLS:
 - 1. Divided Wells: Where continuous pump station operation is required, consideration shall be given to dividing the wet well into two (2) sections, properly interconnected, to facilitate repairs and cleaning.
 - 2. Size: The effective capacity of the wet well shall provide a holding period not to exceed 30 minutes for the design minimum flow. Smaller wet wells may be considered when utilizing variable capacity pumping systems.
 - 3. Floor Slope: The wet well floor shall have a minimum slope of one-to-one to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet.
 - 4. All concrete wet wells shall be lined with PVC to prevent corrosion of internal concrete surfaces.

- G. VENTILATION: Adequate ventilation shall be provided for all pump stations to mechanically ventilate the dry well. Wet well vents shall be provided. There shall be no interconnection between the wet well and dry well ventilating systems. In pits over 15 feet deep, multiple inlets and outlets are required. Dampers shall not be used on exhaust or fresh air ducts, and fine screens or other obstructers in the air ducts shall not be used. Switches for operation of ventilation equipment shall be marked and located conveniently. Consideration shall be given to automatic controls where intermittent operation is practiced. To prevent excessive moisture or low temperatures, installation of heating and/or dehumidification equipment shall be required. Ventilation may be either continuous or intermittent. For continuous operation, at least six (6) complete air changes per hour shall be provided. For intermittent operation, at least 30 air changes per hour shall be provided.

- H. FLOW MEASUREMENT: Pump stations shall be equipped with a magnetic flow meter, on the discharge force main, for measuring, recording and totaling sewage flow.

- I. WATER SUPPLY: There shall be no physical connection between any potable water supply and a sewage pumping station, which under any conditions might cause contamination of the potable water supply.

- J. POWER SUPPLY: Power supply shall be available from at least two (2) independent generating sources, or emergency power equipment shall be provided. Automatic starting of emergency power equipment shall be required.

- K. ALARM SYSTEM: Alarm systems shall be provided for all pumping stations. The alarm shall be activated in cases of power failure, pump failure, or any cause of

pump station malfunction. Additionally, unauthorized entry, flooding, smoke, fire and other alarms may be required.

- L. **OVERFLOW CONTAINMENT:** Provisions for overflow of the wet well shall be included into the pump station design to prevent basement flooding or discharge to the environment. Such provisions may include an additional wet well or a holding pond that can hold the appropriate flow from the tributary system.
- M. **LIFT STATION:** Submersible pump type lift stations shall be used where possible and shall be approved on a case-by-case basis by the City Engineer or appointed representative.
- N. **FORCE MAIN PIPING:** Pump station discharge force mains shall be constructed of PVC pressure pipe, ductile iron pipe or high density polyethylene pipe (HDPE) with heat fusion welded joints as specified herein.

3.1.25 INSTRUCTION, EQUIPMENT OPERATION AND MAINTENANCE

The City Engineer or appointed representative shall be supplied with a complete set of equipment operation and maintenance manuals with instructions, including emergency procedures, maintenance procedures, tools and such spare parts as may be considered necessary. All emergency power generation equipment shall also be provided with operation and maintenance instructions requiring routine starting and running of such units at full load.

3.1.26 GREASE AND SAND/OIL INTERCEPTORS

All commercial operations involved in food preparation, automotive servicing, or any other business or industry discharging any grease, sand, or oil into the City sanitary sewer system shall be required to install a grease or sand/oil interceptor.

A. GREASE INTERCEPTORS:

All interceptors shall be located outside, within 30 feet of the facility served and shall be easily accessible at all times for inspection and maintenance. All interceptors shall be concrete and of a single, precast monolithic pour and shall be installed in accordance with the project's construction documents. Smaller, in-line grease interceptors shall be permitted only where larger interceptors are impractical and upon the specific approval of the City Engineer or appointed representative.

Sizing calculations are to be prepared by the consulting engineer and submitted to the City Engineer or appointed representative using the following method:

1. Based on the seating capacity, compute:
 - a. Number of seats x a full capacity factor of 0.9 x turnover rate of 2.2 per meal period = number of meals served per meal period.

- b. Number of meals per meal period x 2.5 gallons per meal = volumetric capacity of the grease interceptor.
- c. Ten (10) percent rule - if the computed size is within ten (10) percent of a smaller standard approved "shelf" available interceptor, that unit may be acceptable. Custom interceptors may be designed to size specifications so long as it conforms to City of Woodland Park requirements.

B. SAND/OIL INTERCEPTORS:

- 1. Location Design:
 - a. All sand and oil interceptors shall be located outside, within 30 feet and not less than five (5') feet from the facility, unless specifically authorized by the City Engineer or appointed representative. Interceptors shall be accessible for inspection and maintenance.
 - b. All sand and oil interceptors shall have two (2) compartments, the smallest of which shall have at least $\frac{1}{3}$ the capacity of the entire interceptor.
- 2. Sizing:
 - a. Sizing calculations are to be prepared and submitted to the City Engineer or appointed representative using the following standards listed below:
 - (1) Three (3") inch diameter floor drains shall be rated at six (6) fixture units.
 - (2) Four (4") inch diameter floor drains shall be rated at eight (8) fixture units.
 - (3) One (1) fixture unit equals 7.5 gpm.
 - (4) The sizing formula shall be as follows: Number of fixture units connected x 7.5 gpm x five (5) minutes equals interceptor size.
 - b. Where trough drains are used, each bay or compartment area equaling the square foot surface of a standard service station bay, which is served by the trough drain, shall be rated at six (6) fixture units per bay. Vehicle wash drains shall be rated at eight (8) fixture units each, regardless of size.
 - c. No combination sand and oil interceptor smaller than 320 gallons capacity shall be installed at a single bay facility.
 - d. All interceptors shall be installed in accordance with the design engineer's drawings, as approved by the City Engineer or appointed representative.
 - e. Cleanouts are required immediately downstream of the sand and oil interceptor.

3.1.27 THERMAL INSULATION FOR SEWER MAINS AND SERVICE LINES

Sewer mains installed with less than six (6') feet and service lines installed with less than six (6') feet of cover to the top of the pipe shall be insulated from low soil temperatures during

winter months. The insulation material shall be a dry granular material and consist of inorganic non-toxic, non-flammable, Sodium Potassium Aluminum Silicate insulation with Calcium Carbonate filler. The insulation shall be chemically treated to render it hydrophobic. The insulation shall be free of Asbestos.

The material shall be packaged in bags or in bulk and shall be capable of being poured into the trench and around the pipe being protected. The material shall be capable of being consolidated prior to backfill and provide excellent load bearing properties without loss of coverage due to shrinkage or settling during backfill operations. The material shall be GILSULATE 500xr as manufactured by Gilsulate International, Inc. PO Box 802650, Santa Clarita, CA 91380, (800) 833-3881.

Material specified is that which has been evaluated for the specific service. Products of Gilsulate International, Inc. are listed to establish a standard of quality. Standard products of manufacturers other than that specified will be accepted when it is proved to the satisfaction of the City Engineer or appointed representative, they are equal in composition, durability, usefulness and convenience for the purpose intended.

3.2 MATERIALS

All materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on approved drawings or not and all installations shall be completed as fully operational.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Responsible Party of the responsibility for furnishing materials meeting the requirements of the specifications. The City Engineer or appointed representative reserves the right to require or deny use of certain types of materials in specific circumstances.

All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality and fitness for the work.

3.2.1 POLYVINYL CHLORIDE PIPE FOR SEWERS AND FORCE MAINS

- A. All new sewer mains shall be PVC, Standard Dimension Ration (SDR)-35 pipe in accordance with ASTM D-3034, bell and spigot with elastomeric seal. PVC pressure pipe conforming to AWWA C-900, DR-18/DR-24 may also be used for gravity sewers when approved by the City Engineer or appointed representative. Force mains may also be constructed of PVC pressure pipe conforming to AWWA C-900, DR-18/DR-24, or HPDE pipe with heat welded joints.
- B. All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe. However, fittings for force mains shall be manufactured of ductile iron with mechanical joints conforming to ANSI/AWWA C-110/A21.10.

- C. Pipe stiffness for all pipe sizes shall be tested in accordance with ASTM D-2412, while joint tightness shall be tested in accordance with ASTM D-3212. Pipe shall be subjected to drop impact tests in accordance with ASTM D-2444.
- D. Installation of PVC gravity sewer pipe shall be in accordance with Green-Tite PVC Gravity Sewer Pipe Installation Guide TR-614B, published by J-M Pipe, except as modified by these Specifications. Installation of PVC pressure pipe shall be in accordance with Ring-Tite PVC 125-160-200 PSI Installation Guide TR-533A, published by J-M Pipe, except as modified by these Specifications.
- E. All PVC joints shall be of the bell and spigot type with solvent cement or rubber ring gasket for four (4") inch and six (6") inch pipe. Joints for eight (8") inch and larger shall be gasketed joints only. The rubber ring shall be in accordance with ASTM D-3212, except that they shall be compatible for use in a raw sewage environment. Jointing with dissimilar materials shall be accomplished using a compression gasket or other approved commercial connection specifically manufactured for such jointing.
- F. The following markings shall be clearly shown on the exterior of the pipe:
 - 1. Manufacturer's name.
 - 2. Appropriate ASTM designation.
 - 3. Appropriate SDR number for pipe.
 - 4. Spigot mark.
- G. Care shall be taken to store all pipe and fittings to maintain the condition of the pipe as manufactured. To prevent damage and deformation, pipe shall be stored on level ground for even support. Pipe shall not be dropped from trucks, storage piles, or drag across sharp objects or abrading surfaces. Pipe shall be protected from exposure to ultraviolet radiation. Pipe that is shipped to the site having significant discoloration on the pipe surface is generally considered to be evidence of ultraviolet damage and may be reason for rejection and removal from the project. It is the responsibility of the contractor to protect the pipe from ultraviolet damage during storage at the job site.
- H. Bedding and backfill compaction shall meet the requirements of Title 7- Excavation in the Public Right-Of-Way. Pipe depths less than six (6') feet and greater than 12 feet shall require special approval of the City Engineer or appointed representative. PVC pipe installed at depths in excess of 12 feet shall be installed with engineering bedding approved by the City Engineer or appointed representative.
- I. PVC pipe which has any of the following visual defects will not be accepted:
 - 1. Improperly formed pipe such that pipe intended to be straight is curved, measured from the concave side of the pipe exceeding $\frac{1}{16}$ inch per foot of length.
 - 2. Pipe which is out-of-round to prohibit proper jointing.
 - 3. Improperly formed bell and spigot ends.

4. Discoloration of pipe material.
5. Pipe which is fractured, cracked, chipped or damaged in any manner.
6. Pipe that has been damaged during shipment or handling.
7. Pipe or fittings not properly marked as required by this specification.

The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the City Engineer or appointed representative upon request.

3.2.2 CAST IRON AND DUCTILE IRON GRAVITY SEWER PIPE

- A. All cast iron and ductile iron pipe material to be incorporated in the construction of sanitary sewers shall conform to the requirements specified herein or as modified elsewhere in these specifications. The diameter indicated on the drawings shall mean the inside diameter of the pipe.

Except as modified or supplemented herein, all cast iron and ductile iron pipe, fittings and specials shall meet the requirements of the following standard specifications:

American National Standards Institute, ANSI

Numbers in parenthesis are American Water Works Association designations for the standard.

A21.4-03 (C-104)	Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
A21.10-03 (C-110)	Ductile-Iron and Gray-Iron for Water.
A21.11-03 (C-111)	Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
A21.15-03 (C-115)	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

- B. WALL THICKNESS AND CLASS: Pipe shall conform to ANSI 21.51 thickness, Class 51. Fittings shall conform to ANSI 21.10-03 for flanged, mechanical joint and push on joints.
- C. PROTECTIVE LINING AND COATING: Pipe shall be coated with manufacturers' standard bituminous coating approximately one mil thick. Protective lining shall consist of standard thickness cement mortar in conformance with ANSI A21.4 standards.
- D. BEDDING AND BACKFILL COMPACTION: Bedding and backfill Title 7 – Excavation in the Public Right-Of-Way. Pipe depths less than four (4') feet and greater than 20 feet shall require special approval by the City Engineer or

appointed representative. Cast Iron and Ductile Iron pipe shall not be installed at depths in excess of 20 feet with Class C bedding without specific approval of the City Engineer or appointed representative.

3.2.3 HIGH DENSITY POLYETHYLENE GRAVITY SEWER PIPE (HDPE)

High Density Polyethylene Sewer Pipe can be used in the City of Woodland Park for main line sanitary sewers with the approval the City Engineer or appointed representative. The HDPE AWWA C-906 DR-17 with a pressure Class 100 is equivalent to the PVC AWWA C-900 DR-18 with a pressure Class 150. The pipe manufacturer shall provide certification that the stress regression testing has been performed on the specific product. The said certification shall include a stress life curve per ASTM D-2837 and the manufacturer shall provide a product supplying a minimum hydrostatic design basis (HDB) of 1,600 psi as determined by ASTM D-2837.

When HDPE pipe is used for sewer pipe the internal weld bead shall be removed during installation.

3.2.4 MANHOLES

Manholes shall be constructed of precast concrete manufactured in accordance with ASTM Designation C-478.

Manhole steps shall be aluminum, Alcoa No. 12653B, as manufactured by the Aluminum Company of America, or approved equivalent, or plastic coated steel steps manufactured by N.A. Industries, Inc. #PS-2-PF-S, or approved equivalent, spaced 12 inches on center, aligned away from the invert over largest bench. All cones shall be eccentric.

The pre-forming flexible plastic joint sealing compound shall be "RAMNEK" as manufactured by K.T. Snyder Company or approved equal. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer's instructions as to the quantity of material, the grade of the materials and the application temperatures. This plastic joint compound shall be applied to all manhole joints.

The cone section shall not extend closer than 12 inches to the top of the manhole cover. Precast concrete adjustment rings shall be used on top of the cone to support and adjust the manhole frame to the required final grade. Use of bricks to adjust the frame is not permitted.

The manhole barrels shall be watertight at all joints and riser sections. Precast manhole deck (flat top) sections may be used on shallow lines where cone sections are impractical.

Concrete bases shall be poured in place, Class "A" concrete, with a minimum thickness of 18 inches. Manhole inverts shall be formed as indicated in the detail drawings to ensure smooth flow through the manhole. Precast bases may be used in lieu of poured in place bases.

Refer to Figures 3.4.1 and 3.4.2.

3.2.5 DROP MANHOLES

A drop manhole shall be constructed at all manholes where the incoming pipe invert is more than 18 inches above the manhole invert.

Refer to Figures 3.4.3 and 3.4.4.

3.2.6 CONCRETE

Concrete shall conform to Section 6.2 of these specifications.

3.3 CONSTRUCTION

The following is a suggested guideline for sewer system construction. Any deviation from this guideline must be discussed at the pre-construction conference and approved in writing by the City Engineer or appointed representative.

3.3.1 EXCAVATION AND PREPARATION OF TRENCH

Excavation and preparation of trench shall be in accordance with Title 7 - Excavation in the Public Right-Of-Way.

3.3.2 LAYING OF PIPE

Proper implements, tools and facilities satisfactory to the City Engineer or appointed representative shall be provided and used by the contractor for the safe and convenient execution of the work.

Pipe materials shall be unloaded and distributed on the job in a manner approved by the City Engineer or appointed representative. In no case shall materials be thrown or dumped from the truck.

Before lowering and while suspended, the pipe shall be inspected for defects to detect any cracks. Any defective, damaged or unsound pipe shall be rejected, and removed from the job site. The inside of the pipe shall be cleaned before it is lowered into its position in the trench, and it shall be kept clean by approved means, as determined by the City Engineer or appointed representative, during and after laying. All openings along the line of the sewer shall be securely closed as directed, and in the suspension of work, suitable stoppers shall be placed to prevent earth or other foreign substances from entering the sewer.

Pipes shall be laid to true line and at uniform rates of grade between manholes as shown on the plans. Fine grading, to the bottom of the barrel, shall proceed ahead of the pipe laying, and should any over-excavation exceeding two inches be encountered, the material added shall be moistened and compacted or foundation material shall be added at the expense of the contractor to the satisfaction of the City Engineer or appointed representative.

Holes shall be dug for the pipe bells. Bell holes shall be adequate to make the joint, but no larger than necessary so that maximum support will be provided for the pipe. The remainder of the pipe shall be surrounded as required by the appropriate bedding material, shovel placed and hand tamped, to fill completely all spaces under and adjacent to the pipe.

Pipe laying shall proceed upgrade with the spigot ends pointed in the direction of flow. No pipe shall be laid in water or when trench conditions are unsuitable for pipe installation. Generally, pipe shall be laid so that the manufacturer’s labeling is on the top quadrant of the pipe and plainly visible.

When connecting to existing sewers, the contractor shall take every precaution necessary to prevent dirt or debris from entering the existing lines.

3.3.3 TRACER WIRE

Continuity of a tracer signal shall be maintained for all curvilinear sewer installation and all sewer service lines from clean-out to clean-out. Number 12 AWG insulated copper tracer wire shall be taped to the top of the pipe at four (4’) foot intervals with PVC adhesive tape with the installation of all new curvilinear sewer installations. The wire shall be accessible within the manhole ring and cover of all inline manholes. Tracer wire shall be accessible at intervals of no greater than 400 feet as measured along the pipe. For service lines the tracer wire shall be accessible at each clean-out and from the property line to the foundation. All splices shall be made using approved connectors or thermowelding.

3.3.4 MANHOLES

Except as otherwise provided in these specifications, manholes shall be precast and manufactured in accordance with ASTM C-478, and shall conform to the drawings. Manholes shall have steps unless otherwise specified. The internal diameter shall be as follows:

Size of Sewer Main	Inside Diameter of Manhole
<u>Inches</u>	<u>Feet</u>
Up to 12	4
15 through 36 (and all drop manholes and flat top manholes)	5
42 and above	6

All cements used in manhole construction shall be Type V.

The manhole base shall be cast-in-place concrete of the size and depth shown on the plans. Concrete used for bases shall have a 28-day compressive strength of at least 4,000 pounds per square inch.

All manhole covers shall be set to the following grades, irrespective to the exact elevations specified on the drawings:

1. In areas sustaining no normal traffic the covers shall be set six (6) inches above the finished grade, which shall correspond as nearly as possible to the original grade. These covers shall be of the lockable or bolt down type.
2. In paved streets the cover shall be set to ½ inch below proposed finished surface elevation.

3.3.5 MANHOLE CASTINGS

Manhole rings and covers shall be of cast iron or alloyed aluminum corresponding to model number MH 310-24, as supplied by Castings, Inc., of Grand Junction, Colorado, or City Engineer or appointed representative approved equal. Manholes located outside of improved streets shall be rings and covers bolted on the concrete cone with the lid lock assembly.

The manhole lid shall be drilled with a ½ inch hole six (6”) inches off center to the right of the “R” in the word SEWER.

All below grade cast bodies shall be coated for additional protection. Cast iron products conform to physicals of Grade 25, Specific Gravity 7.207 (Reference – Mechanical Engineers Handbook, McGraw Hill Book Co., New York, N.Y.)

The composition of the aluminum alloy shall conform to ASTM B-0179, Alloy SNI22A and Alloy CN42A, and ASTM B-108, Alloy SCIO3A. The tensile strength shall be 30,000 psi. The maximum elongation shall range from ½ to 1½ percent. The Brinell hardness shall range from 75 to 105. The total weight of the ring and cover shall not exceed 150 pounds.

3.3.6 FITTINGS, COUPLINGS, WYES AND SADDLES

Fittings, couplings, wyes and saddles shall be of the same material as the pipeline. Joining of dissimilar materials shall be permitted only through the use of fittings, couplings, wyes, saddles, and adapters or glues specifically manufactured for such transitions.

3.3.7 SERVICE CONNECTIONS

No sewer service connections shall be installed until the engineer or surveyor has set stakes delineating the front property corners. Service connections for each property shall be extended to a point 13 feet inside the property line at a point generally 10 feet uphill from the lowest front property corner or as approved by the City Engineer or appointed representative. Service connections shall include clean-outs spaced at a distance not greater than 100 feet. Tracer wire shall be accessible at all cleanouts and be electrically continuous from the main to the building foundation.

3.3.8 DEEP SERVICE CONNECTIONS

Service connections to mains in excess of 14 feet deep shall conform to Figure 3.4.10 for deep service connections except when approved by the City Engineer or appointed representative.

See Figure 3.4.10 for deep service connections.

3.3.9 BACKFILLING AND COMPACTION

Backfilling and compaction shall be done in accordance with Section 7.5.

3.3.10 SERVICE LINE DISCONNECTIONS

Disconnection of sewer services shall be inspected by the City Engineer or appointed representative to determine the acceptability for future reuse and proper plugging of the pipe.

Services to be disconnected shall be plugged at a point two (2') feet inside the property line with an approved gasket or solvent cemented plug. If the location of the existing pipe at the property line cannot be determined or disconnection at this point would interfere with service to another structure, the service shall be plugged at another point, to be determined by the City Engineer or appointed representative.

3.3.11 SERVICE LINE INSPECTIONS

Service stubs and building sewer lines shall not be backfilled until the City Engineer or appointed representative gives approval. Any deficiencies noted by the City Engineer or appointed representative shall be corrected by the contractor prior to calling for reinspection. The contractor will be notified by the City Engineer or appointed representative of all deficiencies requiring correction. After approval is given for service stubs or building sewers, the contractor shall commence backfilling in accordance with these rules, as soon as practical.

3.3.12 ABANDONMENT OF MAINS AND APPURTENANCES

When new facilities cause or allow the abandonment of existing mains or appurtenances, all materials to be removed by the contractor, or all materials determined to be salvageable by the City Engineer or appointed representative shall be carefully removed and delivered to a site as directed by the City Engineer or appointed representative.

3.3.13 REPAIRS AND REPLACEMENTS

Repairs or replacement of existing sewer mains and appurtenances, service stubs or building sewers shall be done in accordance with the rules and shall be inspected and approved by the City Engineer or appointed representative before backfilling.

3.3.14 TESTING

- A. **CONNECTION PROHIBITED:** Connection of services to mains and service stubs shall be prohibited unless and until such mains and service stubs have been inspected and approved by the City Engineer or appointed representative. All work and required cleaning shall be completed prior to requesting testing and acceptance by the City.
- B. **CLEANING:** Prior to acceptance of each section of sewer main, the contractor shall remove foreign material, which may cause interruption of flow. When excessive debris has entered or exists in the pipeline (sewers up to 24 inches in diameter), the City Engineer or appointed representative may require the contractor to flush a pneumatic cleaning ball through. Larger sewers shall be cleaned by other appropriate methods approved by the City Engineer or appointed representative. All dirt and debris shall be prevented from entering the active sewer system by means of watertight plugs or other methods approved by the City Engineer or appointed representative.
- C. **COMPACTION TESTS:** Shall be in accordance with Title 7 – Excavation in the Public Right-of-Way.
- D. **INFILTRATION AND EXFILTRATION TESTS:** Infiltration and exfiltration tests conducted by and at the expense of the contractor shall be performed on a representative portion of the project. The contractor shall select one (1) of the following tests to perform on one manhole run or approximately 10 percent of the project. Sections to be tested shall be selected by the City Engineer or appointed representative.

3.3.15 AIR TESTS

The contractor shall perform these tests with suitable equipment specifically designed for air testing sewers.

LOW PRESSURE TEST: All pipe outlets shall be plugged with suitable test plugs. If the pipeline to be tested is submerged in groundwater, the Responsible Party shall determine the groundwater elevation at the test location and provide it to the Inspector. The back pressure on the pipe due to groundwater shall be determined and the internal pipeline test pressure shall be established at 4.0 psi (gauge) in excess thereof. Add air slowly to the portions of the pipe being tested. After the pipeline has been filled to the required pressure, allow at least two (2) minutes for the air temperature to stabilize, adding only the amount of air necessary to maintain the test pressure. After the two (2) minute period, disconnect the air supply and allow the initial pressure to drop to 3.5 psi (gauge) in excess of the groundwater back pressure.

The time interval required for the pipeline internal pressure to drop from 3.5 psi (gauge) to 2.5 psi (gauge) above the excess of ground water back pressure shall be measured and recorded.

The basis for acceptance of the air test shall be the minimum time required for the internal pressure to drop 1.0 psi (gauge). The minimum allowable pressure drop time is computed based upon an allowable leakage rate not to exceed 0.003 cfm per square foot of internal pipe surface. Pipelines 15 inches in diameter and smaller shall be tested from manhole to manhole.

Minimum allowable pressure drop (time in seconds) shall be in accordance with the following table:

Pipe Diameter (Inches)	Length of Pipe Being Tested (Feet)			
	100	200	300	400
8	38	76	114	152
10	47	94	141	188
12	56	113	170	226
15	71	141	212	283

3.3.16 EXFILTRATION TEST

The test section shall be bulkheaded and the pipe subjected to a hydrostatic pressure produced by a head of water at a depth of three (3') feet above the invert of the sewer at the upper manhole under test. In areas where ground water exists, this head of water shall be three (3') feet above the existing water table.

This head of water shall be maintained for a duration of one (1) hour during which it is presumed that full absorption of the pipe body has taken place, and thereafter for a further duration of one (1) hour, the measured maximum allowable rate of exfiltration for any section of sewer, including service stubs, shall be as listed below:

Main Sewer Diameter (Inches)	Maximum Allowable Exfiltration Gallons per Hour per 100 Feet
4	0.32
6	0.47
8	0.63
10	0.79
12	0.95
15	1.20

Larger diameter pipes may be tested with a joint tester and method approved by the City Engineer or appointed representative.

If measurements indicate an exfiltration greater than the maximum allowable leakage, additional measurements shall be taken and continued until all leaks are located and the necessary repairs and corrective work have reduced the leakage in the section being tested below the maximum allowed. All repair work and materials used must be approved by the City Engineer or appointed representative. For purposes of the test, the line between adjoining manholes will be considered a section and will be tested as such.

The contractor shall furnish the plugs, standpipe and other material and labor for placing the plugs and standpipe in the sewer and shall assist the City Engineer or appointed representative in making measurements. Any substance introduced into the system with the intent of sealing such leaks will not be permitted. If results of these tests are not satisfactory, the contractor, at his expense, will make the necessary repairs or pipe replacement until the City Engineer or appointed representative is satisfied that the leakage requirements are met.

3.3.17 INFILTRATION TEST

If the ground water level is greater than three (3') feet above the invert of the upper manhole and the City Engineer or appointed representative gives approval, infiltration tests may be allowed in lieu of the above tests. The allowable leakage for this test will be the same as for the exfiltration test.

Any visible leaks detected by observation or closed circuit television shall be repaired even if the section does not exceed the allowable infiltration rate. Failure of the tested sections to pass the allowable rates will result in additional sections of the project being tested.

3.3.18 TELEVISION INSPECTION

- A. INITIAL INSPECTION: The City will televise all new sanitary sewer installations after the initial installation. If on the initial television inspection the cleaning is unsatisfactory and prevents the television inspection from being completed, the Responsible Party shall reclean the sewer line and shall be responsible for all costs incurred by a second television inspection. Pre-flooding of pipe is required prior to television inspection. All inspection reports and videos shall be available for review by the Responsible Party. The Responsible Party shall be responsible for any repairs or replacement of any portions of the pipeline that are determined defective as a result of the television inspections.

- B. FINAL INSPECTION: Prior to the final acceptance, there shall be another television inspection. If there are any discrepancies, a punch list shall be formulated and sent to the Responsible Party. All items must be completed before final acceptance shall be granted. If it is determined that the City's television inspection schedule may delay final acceptance, the contractor may provide VHS or DVD copies of video inspections conducted by an independent contractor at no cost to the City.

CITY OF WOODLAND PARK, COLORADO

TITLE 4

DRAINAGE & EROSION CONTROL SPECIFICATIONS

TABLE OF CONTENTS

SECTION	4.1	DESIGN	4-2
	4.1.1	DRAINAGE DESIGN CRITERIA	4-2
	4.1.2	DRAINAGE REPORT	4-2
	4.1.3	MINIMUM PIPE SIZE	4-3
	4.1.4	MANHOLES	4-3
	4.1.5	CLEARANCE	4-4
	4.1.6	CULVERT INLET AND OUTLET PROTECTION	4-4
SECTION	4.2	MATERIALS	4-4
	4.2.1	REINFORCED CONCRETE PIPE	4-4
	4.2.2	CONCRETE PIPE JOINING MATERIALS	4-6
	4.2.3	STEEL PIPE	4-6
	4.2.4	HIGH DENSITY POLYETHYLENE PIPE (HDPE)	4-8
	4.2.5	MANHOLES	4-9
	4.2.6	CONCRETE	4-9
	4.2.7	RIP-RAP	4-9
SECTION	4.3	DRAINAGE CHANNEL CONSTRUCTION	4-10
	4.3.1	CHANNEL EXCAVATION	4-10
	4.3.2	CONCRETE CHANNEL CONSTRUCTION	4-11
	4.3.3	EARTH CHANNEL CONSTRUCTION	4-12
	4.3.4	GROUTED CHANNEL CONSTRUCTION	4-12
SECTION	4.4	STORM SEWER CONSTRUCTION	4-13
	4.4.1	EXCAVATION	4-13
	4.4.2	PIPE CONSTRUCTION	4-13
	4.4.3	INITIAL ACCEPTANCE	4-13
	4.4.4	MAINTENANCE BETWEEN INITIAL AND FINAL ACCEPTANCE	4-13

SECTION	4.5	EROSION CONTROL	4-13
	4.5.1	NON-STRUCTURAL EROSION CONTROL MEASURES	4-14
	4.5.2	STRUCTURAL EROSION CONTROL MEASURES	4-14
SECTION	4.6	LOW IMPACT DEVELOPMENT	4-15
SECTION	4.7	FIGURES	
	4.7.1	RECOMMENDED TYPICAL DITCH CROSS SECTION	
	4.7.2	TYPICAL ROAD CROSS SECTION	
	4.7.3	CHANNEL PROFILE FOR EROSION CONTROL AT CULVERTS	

4.1 DESIGN

4.1.1 DRAINAGE DESIGN CRITERIA

Design for open channels, culverts, ponds, and storm sewers shall be in accordance with the ~~Colorado Springs/El Paso County Drainage Criteria Manual, Volume 1 and Volume 2 with the exception of Section I, Chapter 3 Drainage Basin Fees, Procedures and Layout~~ Pikes Peak Area Council of Governments Areawide Urban Runoff Control Manual. Said manual is hereby adopted and made as much a part of these specifications as if it were printed herein. Any deviation from this manual's standards shall be allowed only by permission of the City Engineer or appointed representative.

Stormwater detention facilities shall be designed for three flows resulting in three separate volumes to be incorporated into the detention pond design. The volume required for each flow scenario shall be added together with the others to obtain the total detention pond volume. Detention pond volume calculations shall be based upon the proposed or post development conditions. Historic discharge rates shall be based upon the historic or pre-development conditions.

Design Storm	Pond Volume Criteria
Low Flow	75% of the volume from the $Q_{2\text{-yr Proposed}}$; discharge = 0, entire volume to be retained
5-year (Initial/Minor Storm)	100% of the volume from the $Q_{5\text{-yr Proposed}}$ (one hour storm); discharge = $Q_{5\text{-yr Historic}}$
100-year (Major Storm)	100% of the volume from the $Q_{100\text{-yr Proposed}}$ (one hour storm); discharge = $Q_{100\text{-yr Historic}}$
Per City of Woodland Park Resolution No. 299, Series 1994	

4.1.2 DRAINAGE REPORT

The Final Drainage Report shall contain the information and calculations supporting the design of the storm drainage system detailed in the engineering drawings. Such information, assumptions and calculations shall be presented in a neat and orderly fashion to facilitate review. Format of the drainage report should follow the Colorado Springs/El Paso County Drainage Criteria Manual (*since no format is specified in the Pikes Peak Area Council of Governments Areawide Urban Runoff Control Manual*).

The report shall include an analysis of the area under consideration in reference to the zoning, historical and developed conditions, existing topography, contributing runoff from upstream areas, control facilities or features, and continuity with a master plan or with the existing drainage. Natural drainage ways are to be used whenever possible; however, when any open channel is to be used as part of the storm drainage system, the drainage report shall include a thorough hydraulic engineering analysis demonstrating that such use is without unreasonable hazard.

The report shall contain the hydrologic analysis including areas, storm frequencies, rainfall intensities, runoff coefficients, soils information, land use, times of concentration, adjustments for infrequent storms, and all runoff computations.

An optional design method, with approval of the City Engineer, for calculating street drainage may use Chapter 7 in the Colorado Springs/El Paso County Drainage Criteria Manual (amended October 12, 1994).

Engineering analyses of all culverts, open channels, and box culverts shall include the design criteria, and computations for any detention facility design. The Final Drainage Report shall include a soils analysis and water table elevations. All calculations, mass diagrams, and/or hydrographs (methods used will depend on the area of the basin to be analyzed) required to size the detention facility and determine its discharge shall also be included. Calculations for specific detention times shall be provided.

All drainage reports shall include a cover letter indicating the date, the name of the project or subdivision, the engineer or engineers designing the system, and shall be stamped and signed by a Colorado licensed professional engineer.

4.1.3 MINIMUM PIPE SIZE

Minimum circular pipe inside diameter shall be as follows:

Main storm sewer line	18"
Catch basin lateral	18"
Driveway or other culvert	18"

Equivalent sized arch pipe may be used upon written request.

4.1.4 MANHOLES

Maximum allowable manhole spacing shall be as follows:

<u>Horizontal pipe size (inches)</u>	<u>Maximum allowable distance Between Manholes</u>
18 to 30	400'
36 to 60	500'
Larger than 60	750'

Manholes (MH) shall be placed wherever there is a change in size, elevation or slope, where there is a junction of two (2) or more systems or laterals, or where the maximum distance above is reached.

Interior diameter of all storm sewer manholes shall be as follows:

<u>Horizontal pipe diameter (inches)</u>	<u>Minimum MH diameter (feet)</u>
18	4
21-48	5
Larger than 48	6

The City may require a larger MH sizing should conditions warrant.

4.1.5 CLEARANCE

The minimum clearance between storm sewer and water main, either above or below, shall be 18 inches. In all cases, suitable backfill and/or other protection as deemed necessary by the City Engineer or appointed representative shall be provided to prohibit settling or failure of either pipe system.

The minimum clearance between storm sewer and sanitary sewer, either above or below, shall also be 18 inches. However, when a sanitary sewer main lies above a storm sewer, or within 18 inches below, the sanitary sewer shall have an impervious encasement for a minimum of 10 feet on each side of where the storm sewer crosses.

4.1.6 CULVERT INLET AND OUTLET PROTECTION

Riprap and flared end sections shall be required at all transitions between culverts and ditches. Alternate means of protecting culvert ends from vehicle damage and channeling runoff into culverts will be reviewed on a case-by-case basis by the City Engineer or appointed representative.

4.2 MATERIALS

- A. All storm sewer systems within the City shall be constructed using Reinforced Concrete Pipe (RCP), Corrugated Steel Pipe, or High Density Polyethylene Pipe (HDPE, up to 30 inches in diameter) and meet the specifications as listed below.
- B. Residential driveway culverts may be Corrugated Steel Pipe (CSP) or HDPE (up to 30 inches in diameter) in lieu of RCP.

4.2.1 REINFORCED CONCRETE PIPE (RCP)

- A. Reinforced concrete pipe shall be a minimum of Class II and conform to the following American Society of Testing Materials designations listed below. The required pipe strength shall be determined from the actual depth of cover, true load, and proposed field conditions. A typical design strength calculation shall be submitted to the City for approval.
 1. Reinforced Concrete Pipe ASTM C-76/C-506/C-507/C-789/C-850
 2. Low-Head, ASTM C-361

3. Precast Manhole Sections, ASTM C-478
 4. Joints, using rubber gaskets, ASTM C-443
- B. Testing of materials to determine compliance with the specifications shall be the responsibility of the Contractor. Two (2) certified copies of test results indicating compliance shall be furnished for each lot or shipment prior to installation of the material. Reinforced concrete pipe shall be tested for strength by the three-edge bearing test to produce a crack of 0.01 inch. Each manufacturer furnishing pipe under these specifications shall be fully equipped to carry out the tests described in ASTM C-497. Upon the demand of the City Engineer or appointed representative and under his supervision, the manufacturer shall perform such number of tests, as the City Engineer or appointed representative may deem necessary within the requirements of the respective ASTM specifications to establish the quality of the pipe offered for use. Failure of any pipe to meet the test requirements shall be sufficient cause for rejection of all pipe of that size which the test specimen represents.

All pipes shall be subject to inspection at the factory and point of delivery by the City Engineer or appointed representative. The purpose of the inspection shall be to cull and reject pipes which, independent of the physical tests herein specified, fail to meet the requirements of these specifications, and rejection through inspection may be made on account of any of the following, but not limited to:

1. Fractures or cracks passing through the Bell Joint, except for a single crack that does not exceed the depth of the joint.
2. Defects that indicate imperfect proportioning, mixing and molding.
3. Damaged ends where damage would prevent the making of a satisfactory joint.
4. Surface defects indicating honeycomb or open texture.
5. Any continuous crack having a width of 0.01 inch or more and a length of 12 inches or more at any point in the wall of pipe.
6. Failure to give a clear ringing sound when tapped with a light hammer.
7. Exposure of the reinforcement when such exposure indicates that the reinforcement was misplaced.
8. Pipe damaged during shipment or handling may be rejected even if previously approved.

4.2.2 CONCRETE PIPE JOINING MATERIALS

- A. Gasket type joints for reinforced concrete pipe shall be as follows:
1. Bell and Spigot Pipe Type K Gasket for low pressure pipe and Type R3 and R4 for high-pressure pipe.
 2. Tongue and Groove Pipe Type-A gasket.
 3. Gaskets shall be manufactured of Buna N, Neoprene or natural rubber.
 4. The gasket shall comply with ASTM C-443.
- B. Rubber joint sealant: the rubber joint sealant shall be made of top grade vulcanized butyl rubber and meet the requirements of ASTM C-443 for physical properties. The sealant shall be compressible and have a tacky surface for adherence to the joint. The material shall be capable of being installed in the temperature range of zero (0) degrees Fahrenheit to one hundred-ten (110) degrees Fahrenheit.

The contractor shall submit to the City Engineer or appointed representative for approval a sample with specification sheets of the type of sealant proposed prior to ordering the material.

4.2.3 STEEL PIPE

- A. Corrugated steel pipe shall conform to Sections 603 and 707 of the Colorado Department of Transportation Standards. Minimum gage shall be 16-gage.

Cutouts may be provided in the field, providing that edges of plates so shaped shall be smooth, uniform and free of all loose slag and scale accumulations, and provided further that a smooth and uniform bearing surface is provided. Repair of damaged galvanized finishing shall conform to the following:

Galvanized surfaces that are abraded or damaged or cut at any time after the application of the zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with two (2) coats of paint, high zinc dust content, conforming to the requirements of Federal Specifications MIL-P-21035.

- B. PROTECTIVE COATINGS. Where corrosive soil conditions require, additional protection to the galvanized steel pipe shall be applied. The pipe is to be precoated at the place of manufacture and inspected by the City Engineer or appointed representative prior to installation. Patching of damaged pipe may be performed at the job site as directed by the City

Engineer or appointed representative. All cutting and patching shall be made in accordance with the manufacturer's specifications. All fittings and elbows shall be fully coated.

The following coatings are approved:

1. Bituminous protected corrugated steel pipe shall conform to the requirements of AASHTO M-190, Type-A Coating.
2. Smooth lined bituminous protected corrugated steel pipe may be used where specified by the City Engineer or appointed representative. It shall conform to the requirements of AASHTO Designation M-36. In addition, the pipe shall be coated as required in AASHTO Designation M-190, Type-A, and shall be lined on the inside of the pipe so that a smooth surface will be formed by completely filling the corrugations to a minimum thickness of $\frac{1}{8}$ inch above the crest of corrugations. The interior liner shall be applied by a centrifugal or other approved method and shall be free from sags or runs. The pipe is to be precoated and inspected by the City Engineer or appointed representative prior to installation in the field. Riveted steel pipe shall be fabricated in such a manner as to have the rivets located in the inside of the valley of the corrugated pipe.
3. Precoated corrugated steel pipe shall conform to the requirements of AASHTO M-245 and M-246, Type B coating.

- C. TESTING AND INSPECTION OF PIPE. Mill Certifications to determine compliance with the specifications shall be the responsibility of the Contractor. Mill Certifications shall be furnished to the owner prior to final acceptance who in turn provides copies of the certifications to the City Engineer or appointed representative.

Failure of any pipe to meet the test requirements shall be sufficient cause for rejection of all pipe of that size which the test specimen represents.

All pipe shall be subject to inspection at the factory and/or point of delivery by the City Engineer or appointed representative. The purpose of the inspection shall be to cull and reject pipes, which, independent of the physical tests herein specified, fail to meet the requirements of these specifications, and rejection through inspection may be made on account of any of the following, but not limited to:

1. Undue deviation from true shape.
2. Uneven laps.
3. Variations from a reasonably true centerline.
4. Ragged or diagonally sheared edges.
5. Loose, unevenly lined or spaced rivets, bolts, or welds.

6. Poorly formed rivet heads.
7. Illegible brand, type and thickness.
8. Bruised, scaled, or broken zinc coating.
9. Spot welds-crack, tip pickup, pits, and metal expulsion.
10. Dents or bends, other than corrugations.
11. Manually deposited arc welds-cracks, and closely spaced in-line surface porosity.
12. Spiral machine welds-cracks, skips, or deficient welds.
13. Corroded or improperly cleaned and painted welds.
14. Poorly formed lock seams and damaged lock seam metal.
15. Inadequate, improperly applied, cracked, or loose asphalt coating.

D. Steel band joints for corrugated steel pipe shall be as follows:

Coupling bands shall conform to the requirements of AASHTO M-36 with the following exceptions:

1. The use of channel bands as described in 9.1 of AASHTO M-36 will not be allowed.
2. Connecting bands shall be at least 10½ inches wide.

4.2.4 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

A. PIPE

HDPE storm water pipe shall meet ASTM F2648 and be manufactured from an engineered compound of virgin and recycled high density polyethylene conforming with the requirements of cell classification 424420C (ESCR Test Condition B) for 4-inch through 10-inch diameters, and 435420C (ESCR Test Condition B) for 12-inch through 30-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The recycled compounds used shall be those generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

B. JOINTS

Pipe shall be joined using a bell and spigot joint meeting ASTM F2648. The joint shall be soil-tight and gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to insure the gasket is free from debris. A Joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

C. FITTINGS

Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F2306.

D. PIPE PACKAGING, HANDLING AND STORAGE

The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact and without physical damage. The transportation carriers shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked and restrained during transportation such that the pipe is not nicked, gouged, or physically damaged.

Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

Sections of pipe having been discovered with cuts or gouges in excess of ten (10) percent of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method.

4.2.5 MANHOLES

Manholes shall conform to Section 3.3.4 with exception of the size of manhole required which is covered in Section 4.1.4.

4.2.6 CONCRETE

All concrete shall conform to Section 6.2.

4.2.7 RIP-RAP

Rip-rap shall consist of hard, dense, durable stone, angular in shape and resistant to weathering. Rounded stone or boulders shall not be used as rip rap material. The stone shall have a specific gravity of at least 2.5. Each piece shall have its greatest dimension not greater than three (3) times its least dimension.

Material used for rip-rap may be approved by the Engineer if, by visual inspection, the rock is determined to be sound and durable. The Engineer may require the Contractor to furnish laboratory results if, in the Engineer's opinion, the material is marginal or unacceptable. Rip-rap shall conform to the gradation requirements given in Table 4-1.

TABLE 4-1

Pay Item		% of Material Smaller Than Typical Stone ²	Typical Stone Dimensions ³ (Inches)	Typical Stone Weight ⁴
Type	Stone Size d50 ¹ (Inches)			
Rip Rap	6	70-100	12	85
		50-70	9	35
		35-50	6	10
		2-10	2	0.4
Rip Rap	9	70-100	15	160
		50-70	12	85
		35-50	9	35
		2-10	3	1.3
Rip Rap	12	70-100	21	440
		50-70	18	275
		35-50	12	85
		2-10	4	3
Rip Rap	18	100	30	1280
		50-70	24	650
		35-50	18	275
		2-10	6	10
Rip Rap	24	100	42	3500
		50-70	33	1700
		35-50	24	650
		2-10	9	35

¹d50 = nominal stone size
²based on typical rock mass
³equivalent spherical diameter
⁴based on a specific gravity = 2.5

Nominal stone size and total thickness of the Rip-Rap shall be as shown on the plans. The use of broken concrete shall not be allowed as a substitute for Rip-Rap. Control of gradation will be by visual inspection. The Contractor shall provide two samples of rock at least five (5) tons each, meeting the gradation specified. One (1) sample shall be provided at the construction site and may be a part of the finished Rip-Rap covering. The other sample shall be provided at the quarry.

4.3 DRAINAGE CHANNEL CONSTRUCTION

4.3.1 CHANNEL EXCAVATION

- A. PERMIT RECEIVED. All excavation in the public right-of-way requires a permit and shall conform to Title 7 of these specifications.
- B. TOLERANCES. The profile of the invert of ditches and channels shall be +/- 0.3 feet of the lines and grades shown on the drawings. The extremes of such tolerances shall not be continuous over a distance of 100 feet measured at any place in any direction parallel to the excavated surface.

- C. EXCAVATION BEYOND ESTABLISHED LINES. Precautions shall be taken to preserve, in an undisturbed condition, material beyond the designated lines of the excavations except unsuitable material ordered removed by the City Engineer or appointed representative. Material loosened beyond the excavation limits as a result of excavation operations shall be considered defective work and be compacted or removed and replaced with compacted embankment as directed by the City Engineer or appointed representative.
- D. BOTTOM AND SIDE SLOPES. The bottom and side slopes of excavation in soil against which surfacing is to be placed shall be finished carefully to the elevations and dimensions shown on the drawings. If foundation material is loosened or disturbed it shall be compacted to not less than 95 percent of the maximum Proctor Density when tested to ASTM D-1557 for a depth of one (1') foot, or if directed, it shall be removed and replaced with compacted backfill, flowcrete, or concrete. Material, which will not provide a suitable foundation, shall be removed and replaced with compacted backfill, flowcrete, or concrete as directed.

4.3.2 CONCRETE CHANNEL CONSTRUCTION

All concrete work shall conform to Title 6 of these specifications except as follows:

- A. SLUMP. Limitations for concrete lining shall be as follows:
On side slopes, slumps of over 2½ inches will be grounds for rejection of the load. On channel bottom, the slump shall be held to a maximum working limit of four (4") inches.
- B. WEEP HOLES. Weep holes shall be constructed of minimum two (2") inch diameter plastic or galvanized steel pipe inserted to the thickness of the concrete lining.
- C. JOINTS. Expansion joints shall be a minimum of 100 foot spacing unless specified otherwise by the City Engineer or appointed representative.
- D. PLACEMENT AND FINISH. The concrete shall be placed in the form and thoroughly spaced or tamped so that there will be no air spaces in the mass. The surface shall be floated with a wood float to draw the mortar to the surface. Just before the concrete takes its initial set, the surface shall be brushed with a soft bristle brush so as to remove all trowel marks and leave a uniform appearance. Brushing shall be perpendicular to the ditch line on side slopes and parallel to the ditch line on the bottom.
- E. TESTING. The contractor shall bear all costs of compaction, concrete and other tests ordered by the City Engineer or appointed representative. Test results shall be furnished verbally to the City Engineer or appointed

representative as soon as available, with a written, certified confirmation as soon as possible.

4.3.3 EARTH CHANNEL CONSTRUCTION

- A. **RIP RAP.** Rip rap shall be placed at all points where drainage is required to change directions more than 30 degrees horizontally or as directed by the City Engineer or appointed representative. Rip rap shall be placed a minimum of ten (10') feet on each side of said changes of direction.

Rip rap shall be placed in such a manner as to produce a well-graded mass of rock with a minimum of voids. The larger stones shall be well distributed and the finished protection shall be free from pockets of small stones and clusters of larger stones. Rearranging of individual stones by equipment or by hand shall be required if necessary to maintain a well-graded distribution of rock conforming to the contour specified.

- B. **ROLLED EROSION CONTROL MATERIAL.** Erosion control materials shall be used when the slope of ditch or the velocity of water is determined to be great enough to cause erosion based on the soil conditions of the channel.

Fastening pins shall be non-metallic, such as wood or plastic, when erosion control material is placed over existing underground utility alignments.

4.3.4 GROUTED CHANNEL CONSTRUCTION

When grouted rip rap is required, the riprap shall be grouted with concrete grout conforming to the requirements of these specifications except that a minimum of five (5) sacks of cement per cubic yard shall be used. The maximum size of coarse aggregate shall be $\frac{3}{4}$ inches, and may be mixed by a method that will produce properly mixed concrete grout. The grout shall be used within one (1) hour after mixing.

Concrete mortar shall be placed in conformance with Section 601.12 of the Colorado Department of Transportation Standards with the following exceptions:

The grout slump shall be between six (6") inches and eight (8") inches. The surfaces of the rock or stone to be grouted shall be cleaned of adhering dirt or other deleterious material. All concrete mortar shall be delivered by means of a low pressure (less than 10 psi) grout pump using a two (2") inch diameter nozzle. Full depth penetration of the concrete mortar into the rip rap is required. To achieve this, a pencil vibrator shall be used. After placement of grout the boulders shall be thoroughly washed to remove all residual grout. All grout between boulders shall be finished with a broom finish. The edge of grouted boulders shall be formed to present a neat line to spread topsoil. All concrete mortar shall be sprayed with a clear liquid membrane curing compound as approved by the City Engineer or appointed representative.

4.4 STORM SEWER CONSTRUCTION

4.4.1 EXCAVATION

All excavation in the public right-of-way requires a permit and shall conform to Title 7 of these specifications.

4.4.2 PIPE CONSTRUCTION

All main lateral and manhole installation shall conform to Section 3.3 of these specifications.

4.4.3 INITIAL ACCEPTANCE

Refer to Title 1, Section 1.3.7.2 for Initial Acceptance Requirements.

4.4.4 MAINTENANCE BETWEEN INITIAL AND FINAL ACCEPTANCE

The City may consider assuming the maintenance of surface and subsurface drainage systems and erosion control structures after a minimum one (1) year maintenance period (detention ponds after a minimum of two (2) years maintenance period) or upon the establishment of substantial vegetative ground cover by the developer if the following are met:

- A. All of the requirements of the City of Woodland Park Engineering Specifications.
- B. The City has completed an inspection of the facilities.
- C. All necessary easements and/or R.O.W., entitling the City to properly maintain the facility, have been conveyed to the City.

4.5 EROSION CONTROL

There are two (2) types of water erosion control measures; those that prevent initial movement (cover factor) and those that reduce sediment content in moving water (practice factor). Erosion control measures must be properly designed, installed and maintained if they are to accomplish their intended purpose and effectiveness. Timing of implementing measures is one of the most critical factors involved in the control of erosion from developing and redeveloping sites. Erosion Control requirements shall be in accordance with the conditions of the City Code, Sections 18.40.020 and 18.40.140 and City Guidelines for developing Erosion and Sediment Control Plan (ESCP).

4.5.1 NON-STRUCTURAL EROSION CONTROL MEASURES

Non-structural erosion control measures provide the best means of managing sediment from disturbed lands by preventing soil movement. The more effective practices are the use of vegetation.

Vegetative measures can provide temporary cover to help control erosion during construction and permanent cover to stabilize a site after construction is completed. The measures include the use of sod, planting of temporary cover crops and establishing permanent cover crops.

When establishing a permanent dry land grass cover, seeded areas shall be protected with mulch or other acceptable measures (e.g. crimped straw, excelsior fabric, hydraulic mulch, mulched tactifier, etc.) and the mulch shall be adequately secured. It is important to establish vegetative cover as soon as possible in order to reduce erosion.

Reestablishing vegetation within City R.O.W. shall be accomplished using a seed mix suitable for the mountain environment and approved by the City Engineer or appointed representative. Arkansas Valley seeds “Low Grow Mix” is preferred.

Hydro mulching or the use of rolled erosion control materials, is essential in establishing good stands of grass on moderate to steep slopes, and on other areas where it is difficult to establish vegetation.

4.5.2 STRUCTURAL EROSION CONTROL MEASURES

Once erosion commences due to water, structural measures have to be utilized to reduce sediment from disturbed lands. Below are some of the more practical and cost effective measures used in implementing an erosion control plan. These are some of the common structural Best Management Practices for controlling erosion.

- Sediment trap basins
- Diversions
- Terraces
- Berms
- Surface roughening
- Filter berms
- Sediment barriers
- Erosion logs or waddles
- Filtered inlets
- Contour wind row

4.6 LOW IMPACT DEVELOPMENT

The Low Impact Development (LID) approach combines a hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality.

The use of Low Impact Development (LID) techniques are encouraged so the site meets the following criteria:

- Post-development hydrograph essentially mimics or matches the pre-development hydrograph in peak flow and volume.
- Source (on-site) control of both water quantity and water quality.

The goal of LID is to design the site in a way that mimics hydrologic functions. The first step is to minimize the generation of runoff (reduce the change in the runoff curve number (CN)). In many respects, this step is very similar to traditional techniques of maximizing natural resource conservation, limiting disturbance and reducing impervious areas. The major difference with LID is the need to consider how best to make use of the hydrologic soil groups and site topography to help reduce and control runoff. These considerations would include:

1. Maintain natural drainage patterns, topography and depressions,
2. Preserve as much existing vegetation as possible in pervious soils; hydrologic soil groups A and B,
3. Locate BMP's in pervious soils; hydrologic soil groups A and B,
4. Where feasible construct impervious areas on less pervious soil groups C and D,
5. Disconnect impervious surfaces, maintain pre-development times of concentration,
6. Direct and disburse runoff to soil groups A and B,
7. Flatten slopes within cleared areas to facilitate on lot storage and infiltration and
8. Re-vegetate cleared and graded areas.

Where ground water recharge is particularly important (to protect well, spring, stream and wetland flows) it is important to understand the source and mechanisms for ground water recharge. When using the LID design concepts to mimic the hydrologic regime the designer must determine how and where ground water on the site is recharged and where necessary protect and utilize the recharge areas in the site design.

Source: Low –Impact Development Design: A New Paradigm for Stormwater Management Mimicking and Restoring the Natural Hydrologic Regime *An Alternative Stormwater Management Technology*

CITY OF WOODLAND PARK, COLORADO

**TITLE 5
STREET SYSTEM SPECIFICATIONS**

TABLE OF CONTENTS

SECTION	5.1	DESIGN	5-1
	5.1.1	LAYOUT	5-1
	5.1.2	DRIVEWAY CONSTRUCTION REGULATIONS	5-2
	5.1.3	CURB CUTS FOR RECESSED DIAGONAL PARKING	5-4
	5.1.4	SUBGRADE INVESTIGATION AND PAVEMENT DESIGN (REPORT)	5-4
	5.1.5	MINIMUM ASPHALT REQUIREMENTS	5-5
	5.1.6	STREET SIGNAGE	5-6
SECTION	5.2	ASPHALT PAVEMENT MATERIALS AND CONSTRUCTION	5-6
	5.2.1	REQUIRED INSPECTIONS FOR ROADWAYS	5-6
	5.2.2	SUBGRADE	5-7
	5.2.3	BASE COURSE	5-8
	5.2.4	ASPHALT PRIME COAT AND TACK COAT	5-11
	5.2.5	ASPHALT CONCRETE PAVEMENT	5-13
	5.2.6	ASPHALTIC OVERLAY (PLANT-MIX SEAL)	5-15
	5.2.7	SEAL COAT	5-15
	5.2.8	CONTROL OF MATERIALS	5-15
	5.2.9	INITIAL ACCEPTANCE	5-16
SECTION	5.3	FIGURES	
	5.3.1	UTILITIES IN R.O.W. (PLAN VIEW)	
	5.3.2	UTILITIES IN R.O.W. (CROSS SECTION)	

5.1 DESIGN

5.1.1 LAYOUT

Layout of all street systems (public or private) shall conform to City subdivision requirements as defined in the subdivision ordinance and the City of Woodland Park Engineering Specifications.

A. GEOMETRIC CROSS SECTION.

Local residential roadway elements, symmetrical about the centerline, shall conform to the following cross section: from the center line twelve foot of asphalt; 30 inch curb and gutter section; minimum six (6') foot bench section; slope graded to catch point at three (3) horizontal to one (1) vertical maximum without slope stabilization. Bench section (bench) width may be increased to accommodate utility installation. Generally, local residential cross sections shall be used in areas where average daily traffic (ADT) is not likely to exceed 1,000 vehicles per day. Collector and arterial streets shall be constructed whenever engineered traffic analysis of the future traffic volumes indicates the need of a cross section greater than that of a local service street.

Refer to Figure 5.3.2.

Additional R.O.W. and/or easements may be required to satisfy other criteria contained in these Engineering Specifications. Areas outside the R.O.W shall be contour graded, compacted, and sloped, as required for proper drainage, soil stability, and maintenance accessibility. Cuts and fills proposed on slopes greater than three horizontal to one vertical shall require supporting calculations prepared by a licensed Geotechnical Engineer based on a soils analysis and approved by the City Engineer or appointed representative.

B. DESIGN ELEMENT COORDINATION.

Horizontal and vertical alignment continuity shall be provided between new and existing streets to achieve safe transitions. Sufficient data on existing infrastructure shall be depicted on plans, and limits of construction shall be designated to assure that the desired continuity is achieved. Drainage and utility facilities are to comply with all applicable sections of these Engineering Specifications and are to be fully coordinated with the street design and proposed construction.

C. TRAFFIC IMPACT STUDY.

All subdivision, zoning and other site developments shall provide a Traffic Impact Study using the Institute of Transportation Engineers (ITE) -

Manual and report, giving information and details as required by the City Engineer or appointed representative, in a form specified by the City Engineer or appointed representative. In certain instances with the permission of the City Engineer, a Traffic Letter may be substituted for the full Traffic Impact Study.

5.1.2 DRIVEWAY CONSTRUCTION REGULATIONS

Every driveway hereafter constructed, reconstructed or altered, in the City right-of-way, shall conform to the following regulations:

- A. No driveway shall be so located as to create a hazard to pedestrians or motorists, or to invite or compel illegal or unsafe traffic movements.
- B. Unless otherwise approved by the City Engineer or appointed representative, all driveways shall be constructed within lines at right angles from the curb or street line to property line.
- C. No driveway shall be constructed in such a manner as to create a hazard to any existing street lighting standard, utility pole, traffic regulating device or fire hydrant. The cost of relocating any such street structure when necessary to do so shall be borne by the abutting property owner. Relocation of any street structure shall be performed only by or through the person holding authority for the particular structure involved.
- D. No property shall be allowed more than two (2) driveways on any particular street without permission from the City Engineer or appointed representative.
- E. All driveways shall be so constructed that they shall not interfere with the drainage system of the street.
- F. Where curbs exist, or are required, driveways shall be paved for their full width from the back of curb to the property line.
- G. Where a driveway crosses a sidewalk, the sidewalk shall be increased to a minimum thickness of six (6") inches of concrete.
- H. A driveway or curb cut on a corner lot shall be set back a minimum of 10 feet from the property line at the corner or shall be a minimum of 20 feet from the cross street curb line whichever is greater.
- I. There shall be a minimum of 30 feet between any two (2) driveways whether on one (1) or more properties, except common driveways may be used on adjoining properties. Distance between driveways will be such as to maximize the amount of on-street parking.

- J. Driveways greater than 150 feet in length from the public street will require review by the Northeast Teller County Fire Protection District.
- K. Runoff from the driveway must enter improved drainage-ways such as curb and gutter, not on to the street. Erosion from the lot and driveway must not enter the street. Provide the City with the proposed erosion control measures that will accomplish this in accordance with Section 18.40 of the City Code.
- L. The proposed grade(s) of the driveway shall be indicated on the driveway plan or site plan. The driveway grade may not exceed six (6) percent within the public right-of-way, and 17 percent between the right-of-way line and garage or structure.
- M. The materials and thickness of the proposed driveway shall be indicated on the plan. The minimum gravel thickness is four (4”) inches. The gravel material shall be crushed stone or an aggregate that does not track on to the City street. The minimum asphalt thickness for single resident driveways is two (2”) inches and concrete driveway thickness is four (4”) inches. Driveways servicing more than a single residence shall conform with Table 5.1.
- N. The following widths are permitted for driveways:

ZONING DISTRICT	WIDTH OF DRIVEWAYS
Single Family	12’ – 24’
Multiple Family	16’ – 25’
Commercial & Industrial	25’ – 35’

- O. No curb cuts shall be allowed on State Highway except with written permission of Colorado Department of Transportation.
- P. Where curbs do not exist and a driveway crosses a drainage ditch, a culvert shall be installed by the property owner at a diameter sized according to the ditch capacity, but in no case less than 18 inches without written approval from the City Engineer or appointed representative. The minimum length of any culvert shall be five (5’) feet greater than the driveway width or 20 feet whichever is greater. Culvert installation shall include flared end sections with geomembrane beneath riprap to prevent erosion.
- Q. Where a sewer clean-out or water valve is located in a culvert or paved driveway, a six (6”) inch valve box top section shall be installed over the clean-out or valve.

- R. Any deviation from those standards shall be allowed only by special written permission of the City Engineer or appointed representative.

5.1.3 CURB CUTS FOR RECESSED DIAGONAL PARKING

- A. No portion of a parked car shall extend on to a sidewalk unless the sidewalk is widened by the same width that the car extends into the sidewalk or two (2') feet, whichever is greater.
- B. Flow line of gutter will be maintained.
- C. Rear portion of parked car will not extend more than six (6') feet from original curb line where parallel parking was in effect.
- D. Not allowed on State Highway or City arterial street.
- E. Must comply with Model Traffic Code which includes the following:
 - 1. No parking within five (5') feet of public or private driveway
 - 2. No parking within 15 feet of a fire hydrant
 - 3. No parking within 20 feet of a crosswalk at an intersection
 - 4. No parking within 30 feet of flashing beacon, stop sign, yield sign or traffic control signal
- F. Design, location, and construction subject to the approval of the City Engineer or appointed representative.
- G. No construction or design expense to be borne by the City.
- H. It will be understood that completed parking area is for use of the general public and not solely for the private use of the person requesting it.

5.1.4 SUBGRADE INVESTIGATION AND PAVEMENT DESIGN (REPORT)

The report shall be prepared by or under the supervision of and signed by a Professional Engineer registered in the State of Colorado and shall include the following information:

- Vicinity map to locate the investigated area.
- Scaled drawings showing the location of borings.
- Scaled drawings showing the estimated extent of subgrade soil types for each street.
- Pavement design alternatives for each street on a scaled drawing.

- Tabular listing of sample designation, sample depth, Group Number, Liquid Limit, Plasticity Index, percent passing the No.200 sieve, Group Index, Unified and AASHTO Classification, and soil description.
- Proctor Compaction Curves.
- R-value test results of each soil type used in the design.
- Pavement design nomographs properly drawn to show Soil Support - EDLA -SN.
- Design calculations.
- A discussion regarding potential subgrade soil problems including, but not limited to: heave or settlement prone soils, frost susceptible soils, ground water, drainage considerations (surface and subsurface), cold weather construction (if appropriate), and other factors, properties, or fill areas which could affect the design or performance of the pavement system.
- Recommendations to alleviate or mitigate the impact of problems discussed above.

5.1.5 MINIMUM ASPHALT REQUIREMENTS

A. MIMINUM REQUIREMENTS

The following table provides the minimum acceptable pavement sections for each roadway classification. These pavement thicknesses may be used for preliminary planning purposes. Final pavement designs should be in accordance with the current version of the CDOT Pavement Design Manual, and actual subgrade support test results. In addition, strength coefficient calculations resulting in lower pavement section depths than shown in Table 5-1 may be acceptable with the following conditions being addressed:

Additional field investigations consisting of borings or other suitable methods of sampling subgrade soils to a depth of at least five (5') feet below proposed subgrade elevation, at intervals not to exceed 250 feet. Samples are to be taken after grading is completed and the subgrade is rough graded. Pavement design shall address special site specific problems which may be encountered such as value of material when subjected to frost action, frost susceptibility of in-situ material, frost heave, and groundwater potential.

TABLE 5-1

MINIMUM ACCEPTABLE PAVEMENT SECTIONS

Classification	Composite Section		Full Depth
	Asphalt Inches	Roadbase Inches	Asphalt Inches
Commercial (Parking Lots)	3.0	4.0	5.0
Local Street	3.0	6.0	5.0
Collector Street	4.0	6.0	6.0
Arterial Street	5.0	6.0	7.0

- Common driveways serving three (3) or fewer homes will have a pavement section the same as for Commercial Parking Lots.
- Common driveways serving more than three (3) dwellings are required to meet the Local Street designs.

5.1.6 STREET SIGNAGE

All street signage shall be in accordance with the Manual on Uniform Traffic Control Devices (M.U.T.C.D.), Latest Edition.

5.2 ASPHALT PAVEMENT MATERIALS AND CONSTRUCTION

5.2.1 REQUIRED INSPECTIONS FOR ROADWAYS

Adequate inspections assure compliance to City requirements and are the basis for the City's recommendation that said streets be given initial acceptance. It is the responsibility of the Responsible Party to contact the City Engineer or appointed representative two (2) business days in advance of the required inspections. Required inspections shall include:

- A. **CULVERTS** - trenching, grade, bedding, installation, backfill and compaction. Inspection is to be requested when backfill is completed to ½ the depth of the culvert.
- B. **CONCRETE** - finished excavation, grade, forming, reinforcing steel, and compaction.
- C. **STRUCTURES** - concrete pour, surface finish, and test cylinders. Three (3) inspections are required: (1) prior to placing steel; (2) prior to concrete pour; and (3) after final pour.
- D. **STREET** - Five (5) inspections are required: (1) subgrade, (2) subbase, (3) base course, (4) prime, and (5) paving; all of which are required prior

to proceeding with the next phase. The City Engineer or appointed representative shall designate locations of required samples for testing.

5.2.2 SUBGRADE

A. PAVEMENT SUBGRADE

The bottom of the excavation for the pavement, or top of fill, shall be known as the pavement subgrade and shall conform to the lines, grades, and cross sections shown on the approved plans. All subgrade material shall be free of organic matter or other deleterious material.

B. EXCAVATION

Excavation shall consist of removal of all material necessary for the construction of the subgrade to the elevation, line, and grade shown on the plans. All tree stumps and roots shall be removed to a depth of two (2') feet below subgrade and disposed of in accordance with applicable City, State, and Federal requirements. The Contractor shall dispose of all excavated material unless otherwise directed by the City Engineer or appointed representative. All excavation shall conform to Title 7 – Excavation in the Public Right-Of-Way.

C. EMBANKMENT

Where fill is required, it shall consist of earth, sand, or gravel that is free of organic matter or other deleterious material. A Geotechnical Engineer shall approve all fill material. The original surface shall be stripped of all vegetation prior to beginning the embankment operation, also scarify and compact the top six (6") inches. The fill shall be placed in a maximum of six (6") inch lifts, uncompacted thickness, and shall be compacted in accordance with the requirements of CDOT Standard Specifications for Road and Bridge Construction, Section 203.

The subgrade for the pavement structure shall be graded to conform to the cross section and profile required by the approved set of plans. The top six (6") inches of the subgrade shall be scarified and recompacted to a density not less than 95 percent of Modified Proctor. After the subgrade has been prepared, it shall be maintained to drain and be kept free of erosion until the City Engineer or appointed representative has checked and approved it for the placement of base course material.

D. SLOPES

Side slopes of all excavations and embankments within the street section shall generally not exceed the ratio of three-to-one (3:1) (3' horizontal to 1' vertical) unless otherwise approved by the City Engineer or appointed

representative. Special consideration will be given to allow steeper slopes where said slopes are shown to be stable by engineering analyses.

E. UTILITY TRENCHES

Prior to approval to place base course, all utility services and main lines shall be backfilled in accordance with Title 7 – Excavation in the Public Right-Of-Way.

F. COMPACTION

See Section 7.5.

G. FINAL PROOF-ROLLING

After the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof-rolled with a heavily loaded vehicle. The vehicle must have a certified loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 90 psi. Subgrade which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The City Engineer or appointed representative shall be notified at least 48 hours before final proof-rolling of the subgrade.

5.2.3 BASE COURSE

A. MATERIAL

The aggregates for the base course material shall be composed of crushed stone, crushed slag, crushed gravel, or natural gravel which conforms to the quality requirements of AASHTO M-147. The material shall conform to the following gradation requirements:

**Table 5-2
Percent by Weight Passing
(Current CDOT standards)**

Sieve Size	Class 2	Class 5	Class 6
4"	100		
3"	95-100		
1-1/2"		100	
1"		95-100	
3/4"			100
No. 4		30-70	30-65
No. 8			25-55
No. 200	3-15	3-15	3-12

The liquid limit shall not exceed 35 for Class 2 or 30 for Class 5 and Class 6 when tested in accordance with AASHTO T-89 and AASHTO T-90. The plastic index shall not exceed six (6) for Classes 2, 5 and 6. The aggregate shall have a Los Angeles Abrasion Test (AASHTO T-96) percentage of wear not exceeding 45 percent. Gradation shall be Class 5 (1½ inch maximum) or Class 6 (¾ inch maximum).

B. CONSTRUCTION METHODS

1. Materials shall be placed on an approved subgrade, which has been proof-rolled within the past 24 hours and found to be stable and non-yielding. Should weather conditions change, such as freezing, precipitation, etc., aggregate base materials shall not be placed until the subgrade is reapproved.

The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the plans and as directed by the City Engineer or appointed representative. Placing and spreading shall be done by means of a spreader machine, moving vehicle, motor grader, or by other approved equipment methods. The material shall be placed without segregation. Any segregated areas shall be removed and replaced with uniformly graded material at the Responsible Party's expense.

The base material may be placed in lifts of up to six (6") inches, providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds six (6") inches, it shall be placed in two (2) or more lifts of approximate equal thickness. If uniform density cannot be obtained by six (6") inch lifts, the maximum lift shall not exceed four (4") inches in final thickness.

Base material shall not be placed on a foundation that is soft or spongy or one that is covered by ice or snow. Base material shall not be placed on a dry or dusty foundation where the existing condition would cause rapid dissipation of moisture from the base material and hinder or preclude its proper compaction. Such dry foundations shall have water applied to them and shall be reworked or recompacted.

Rolling shall be continuous until the base material has been compacted thoroughly in accordance with Section 304 of the CDOT Standard Specifications. Water shall be uniformly applied as needed during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that

a uniform texture is produced and the aggregates are firmly placed.

The finished base course surface shall be smooth and free of ruts and irregularities, and shall be true to grade and crown as shown on the plans. The base course shall be maintained in this condition by watering, drying, rolling, or blading or as the City Engineer or appointed representative may direct until the surfacing is placed.

2. Hauling and Placing - Care shall be exercised in the hauling and placing of base course so as to avoid segregation of the course and fine materials. The base course material shall be placed on the previously prepared and approved subgrade in sufficient quantity to conform to the thickness specified on the approved plan and profile. The material shall be mixed and watered to obtain a uniform mixture at optimum moisture.

If the required compacted thickness exceeds six (6") inches, the base course shall be constructed in two (2) or more layers of equal thickness. The maximum thickness of any layer to be compacted shall not exceed six (6") inches. The minimum depth of base course on streets and alleys shall be six (6") inches.

The required thickness of the base course may be reduced only when specified in an approved Pavement Report prepared by a State of Colorado licensed Professional Engineer.

Class 5 and 6 material shall be classified as base course. Class 2 materials shall be classified as subbase course and used only when the base requirement is greater than six (6") inches.

Class 2 materials shall have a minimum "R" value of 68. Class 5 and Class 6 material shall have a minimum "R" value of 80.

All material shall be placed and compacted at optimum moisture (\pm 2 percent). The compaction shall be continued until the base course has a density of not less than 95 percent of its Modified Proctor at optimum moisture. At least 20 percent of the test shall be taken within one (1') foot of a manhole or valve. Nuclear testing equipment and methods are acceptable when performed by an approved certified testing laboratory and when performed in accordance with the requirements of ASTM D-222 and ASTM D-3017.

3. Surface and Thickness Tolerances. The surface of the prepared base course material shall be free from depressions exceeding $\frac{1}{4}$ inch in 10 feet when measured with a straight edge. The surface shall be smooth and true to the established crown and grade. Any

areas not complying with these tolerances shall be reworked to conform. Blue top staking and string lining shall be required for all roadway construction.

4. Final Proof-Rolling. After the subbase has been compacted, tested and found to meet specifications, the entire subbase shall be proof-rolled with a heavily loaded vehicle. The vehicle must have a certified loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 70 psi. Subbase which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The City Engineer or appointed representative shall be notified at least 48 hours before final proof-rolling.
5. The results of field density tests and proof-rolling shall be submitted and reviewed by the City Engineer or appointed representative. Provided all tests are acceptable, compaction shall be approved for the placement of the next paving course. Should testing indicate unsatisfactory work, the necessary reworking, compaction or replacement shall be required prior to continuation of the paving process. The approval is valid for 24 hours. Changes in weather, such as freezing or precipitation, shall require reapproval of the subgrade.

5.2.4 ASPHALT PRIME COAT AND TACK COAT

A. PRIME COAT

1. Surface Preparation. Before applying the prime coat all loose material shall be removed from the surface. That portion of the surface prepared for treatment shall be dry and in satisfactory condition.
2. Emulsified Asphalt. Emulsified asphalt of any of the following grades may be used: SS-1, SS-1h, CSS-1, CSS-1h. All of these should be diluted 1:1 with water. A certificate of compliance must be provided by the supplier.
3. Application. Prior to prime coat application, the surface should be allowed to dry to approximately 80 percent of optimum moisture. The asphalt material shall be applied in the range of 0.05 to 0.15 gallons/square yard. The prime coat shall be carefully applied. If excessive amounts of curb, sidewalks, or other structures are sprayed with liquid asphalt, they shall be cleaned at the Contractor's expense. The prime coat shall not be applied when

the surface is wet or when the atmospheric temperature is less than 40 degrees Fahrenheit, or when precipitation is imminent.

4. Curing. Curing shall be required for all prime and tack coats. The prime or tack coat shall be sticky, or tacky, when cured. The length of time required for curing shall depend on the air temperature, humidity and wind conditions and shall be black when cured. The prime coat shall be allowed to cure for a minimum of 24 hours prior to the paving operation. If after the curing period the prime coat has not penetrated the base material, and the surface must be used by traffic, a suitable blotter material shall be applied in amounts needed to absorb excess liquid asphalt. The blotter material shall be dry, gritty sand. Dust or contamination of prime or tack coats shall require brooming and reapplication.

B. TACK COAT

1. When a tack coat is specified on the approved plans or required by the City Engineer or appointed representative, all materials and construction shall be in accordance with the requirements of the CDOT Standard Specifications, Section 407. Tack coat shall be applied where additional HBP is to be placed over existing asphaltic or Portland cement surfaces. Tack coats shall not be required where HBP is less than 24 hours old and remains free of dust, dirt or debris. A 1:1 dilution should be applied at the rate of 0.05 to 0.15 gallons per square yard. A wand or hand spray nozzle attached to the spray bar can be used for applying tack to gutter faces, valve boxes, manholes and rings.
2. Surface Preparation.

Refer to 5.2.4.A.1.
3. Liquid Asphalt. The liquid asphalt used for tack coat shall be an emulsified asphalt grade CSS-1h or SS-1h and shall satisfy the requirements of ASTM 977. Other emulsified asphalts may be used upon written permission of the City Engineer or appointed representative.
4. Application. The surface shall be allowed to cure to permit drying and setting of the tack coat prior to the paving operation.

Refer to 5.2.4.A.3

5.2.5 ASPHALT CONCRETE PAVEMENT

A. HOT BITUMINOUS PAVEMENT

All pavement shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the City Engineer or appointed representative. Materials and construction shall be in accordance with the Pikes Peak Region “Asphalt Paving Specifications,” and the following requirements:

B. CONSTRUCTION METHODS

1. Hauling Equipment. Trucks used for hauling the asphaltic concrete mixture shall be equipped with tight, clean, smooth metal beds. When directed by the City Engineer or appointed representative the beds shall be coated with an oil or other approved material to prevent the mixture from adhering to the beds. Each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions.
2. Paving Machines. Paving machines shall meet the minimum requirements of Pikes Peak Region “Asphalt Paving Specifications.”
3. Rollers. Rollers shall be steel wheeled and pneumatic tire type and be in good condition, capable of reversing without backlash. They shall weigh not less than eight (8) tons. All rollers shall have a water system capable of keeping the wheels properly moistened to prevent adhesion of the mixture to the wheels.
4. Paving Surface. After the pavement base has been prepared, it shall be made ready for paving by clearing any loose material off as directed by the Engineer and applying a prime coat as specified in Section 5.2.4.A. of these specifications. Each lift of compacted asphalt pavement shall be of uniform thickness. The minimum uncompacted lift thickness shall be three times the nominal aggregate size of the mixture. The maximum lift thickness shall be three (3”) inches unless the Contractor can demonstrate the ability to achieve required compaction of thicker lifts.
5. Spreading, finishing and compaction. The mixture shall be laid upon the approved base surface, spread, and struck off to the grade and elevation required. Pavers shall be used to distribute the mixture over the entire surface except where hand placing is necessary.

Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected. Placing the mixture shall be as continuous as possible. All surface irregularities shall be adjusted by the addition or removal of mixture prior to rolling. After the mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. Heavy equipment or rollers shall not be allowed to stand on freshly placed pavement.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the street centerline, each pass overlapping $\frac{1}{2}$ the roller width, gradually progressing to the crown of the street. When paving adjacent to a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure.

Rolling shall be continued until all roller marks are eliminated and no further compression is possible.

Along forms, curbs, manholes, and other places not accessible to rollers, the mixture shall be thoroughly compacted with hand tampers or with mechanical tampers. The joints between these structures shall be effectively sealed.

Any asphalt that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform to the surrounding area.

6. Joints. Transverse joints shall be formed by cutting through the previously laid course to expose the full depth of the course. A coat of tack coat material shall be used on contact surfaces of all joints just before additional mixture is placed.
7. Weather Conditions. Weather conditions shall meet the minimum requirements of Pikes Peak Region "Asphalt Paving Specifications."
8. Surface and Thickness Tolerances. The surface of the finished pavement shall be free from depressions exceeding $\frac{3}{16}$ inch in ten (10) feet, when tested with a straight edge. All depressions exceeding the specified tolerances shall be corrected by removing

defective work and replacing it with new material as directed. The surface shall be smooth and true to the established crown and grade.

5.2.6 ASPHALTIC OVERLAY (Plant-Mix Seal)

- A. The work to be performed under this section shall be in accordance with CDOT Standard Specifications for Road and Bridge Construction, Section 410.
- B. GEOTEXTILE FABRIC. All Geotextile fabric shall meet pavement design criteria and that set forth by the Colorado Department of Transportation and subject to the approval of the City Engineer or appointed representative.

5.2.7 SEAL COAT

When seal coat is required, all materials and construction shall be in accordance with the requirements of the CDOT Standard Specifications for Road and Bridge Construction, Section 409. The type of bituminous material, cover aggregate, and rates of application shall be as shown on the approved construction plans.

5.2.8 CONTROL OF MATERIALS

A. APPROVAL OF SOURCES OF SUPPLY OF MATERIALS

The source of supply of each of the materials required shall be approved by the City Engineer or appointed representative before delivery is started. Representatives of preliminary samples shall be submitted by the subdivider, producer, or owners of the supply for inspection or tests. The results obtained from testing such samples may be used for preliminary approval but will not be used as a final acceptance of the materials.

B. APPROVAL AND ACCEPTANCE OF MATERIALS

Samples of all materials for testing upon which acceptance or rejection is to be based, shall be taken by the City Engineer or appointed representative, at the discretion of the City Engineer or appointed representative. Materials may be sampled either prior to shipment or after being received at the place of construction. All sampling, inspections, and testing shall be done in accordance with the methods herein prescribed at the Contractor's expense.

The contractor shall provide such facilities as required by AASHTO and/or ASTM for performing the specified field tests and forwarding samples to an approved testing laboratory. Only materials conforming to the requirements of these specifications and which have been approved by

the City Engineer or appointed representative shall be used in the work. Any material, which, after approval, has for any reason become unfit for use, shall be removed from the site and shall not be incorporated into the work.

C. METHODS OF SAMPLING AND TESTING

Except as otherwise provided, sampling and testing of all materials, and the laboratory methods and testing equipment required under these specifications shall be in accordance with the “Standard Specifications for Highway Materials and Methods of Sampling and Testing” of AASHTO or with the Standards and Testing Methods of the ASTM using the latest editions.

All sampling and testing shall be performed by a laboratory and personnel approved by the City Engineer or appointed representative. All testing laboratories must comply with ASTM E-329 standard practices for inspection and testing.

5.2.9 INITIAL ACCEPTANCE

Refer to Title 1, Section 1.3.7.2 for Initial Acceptance Requirements.

CITY OF WOODLAND PARK, COLORADO

TITLE 6

CONCRETE CONSTRUCTION

TABLE OF CONTENTS

SECTION	6.1	DESIGN	6-1
	6.1.1	GENERAL PROVISIONS	6-1
SECTION	6.2	CONCRETE	6-1
	6.2.1	CEMENT	6-1
	6.2.2	WATER	6-2
	6.2.3	ADMIXTURES	6-2
	6.2.4	FINE AGGREGATE	6-2
	6.2.5	COARSE AGGREGATE	6-2
	6.2.6	FIBEROUS REINFORCING	6-3
SECTION	6.3	CONSTRUCTION	6-4
	6.3.1	MIX DESIGN	6-4
	6.3.2	SPACING OF JOINTS	6-5
	6.3.3	REINFORCING STEEL AND FORMS	6-6
	6.3.4	PLACING CONCRETE	6-8
	6.3.5	FINISHING AND CURING	6-9
	6.3.6	MISCELLANEOUS	6-12
	6.3.7	TESTING	6-14
	6.3.8	FLOWCRETE/FLOWFILL CONCRETE	6-16
SECTION	6.4	FIGURES	
	6.4.1	CURB & GUTTER - TYPE I	
	6.4.2	CURB & GUTTER - TYPE II	
	6.4.3	CROSS-PAN	
	6.4.4	INTERSECTION DETAIL	
	6.4.5	CURB RAMP	
	6.4.6	PEDESTRIAN RAMP DETAIL	
	6.4.7	DRIVEWAY DETAILS (VERTICAL CURB & GUTTER)	
	6.4.8	DRIVEWAY DETAILS (DRIVE-OVER CURB, GUTTER AND SIDEWALK)	

6.1 DESIGN

6.1.1 GENERAL PROVISIONS

All concrete work within any street, parking lot, trail, alley R.O.W. or in any part of the water system, sewage system, parks, and storm drainage system of the City shall meet the requirements of these Engineering Specifications. Engineering, plans, licenses, permits, inspection, warranties and acceptance shall be as detailed in these applicable Engineering Specifications for the type of construction involved.

Permits shall be obtained before work begins. Responsible Party shall give the City Engineer or appointed representative 48 hours notice, and inspection shall be made before placement of concrete can occur. Written notice of Inspector's approval to place materials shall be obtained by Responsible Party after inspection has been made and before concrete is placed. Written notice of rejection shall be given to Responsible Party in the event any aforementioned conditions given by the City Engineer or appointed representative are not met, and work shall be halted until corrective action is taken. Copies of the approved drawings and the permit shall be on the job site and available to the Inspector.

Concrete shall be composed of Portland cement, aggregate, and water, and shall be reinforced with steel bars, steel wire fabric or fibrous reinforcing where required. No admixture other than air-entraining agents shall be used without written permission of the City Engineer or appointed representative. All concrete shall have a minimum compressive strength of 4,000 psi in 28 days.

6.2 CONCRETE

6.2.1 CEMENT

All cement used in concrete work shall be Portland cement conforming to the requirements of ASTM C-150, Type I, IA, Type I/II modified, II, Type V. In general, Type II shall be used in concrete that shall be in contact with the soil, unless otherwise allowed or directed by the City Engineer or appointed representative. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.

The Responsible Party shall be responsible for the proper storage of all cement until it is used. No damaged cement shall be used in the work, and all such cement shall be immediately removed from the site when so ordered by the City Engineer or appointed representative. When requested by the City Engineer or appointed representative the Responsible Party shall, at his own cost and expense, furnish the City Engineer or appointed representative with a certificate from an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work, stating that the cement meets the requirements of these Engineering Specifications for Portland cement.

6.2.2 WATER

Water for concrete shall be clean and free from sand, oil, acid, alkali, organic matter, or other deleterious substances. Water from public supplies of water, which has been proven suitable for drinking, is satisfactory.

6.2.3 ADMIXTURES

The Responsible Party shall use air-entraining admixtures for all surfaces of exposed concrete. The Responsible Party may elect to use another admixture provided the admixture is specifically approved by the City Engineer or appointed representative. Admixtures to be used for plasticizing, densifying, or acceleration of hardening of concrete shall, when added to the mixture, produce a concrete of specified strength in seven (7) day and 28 day tests. Documented evidence of acceptability shall be required when new or unknown admixtures are proposed for use. Air-entraining admixtures shall conform to the requirements of ASTM C-260.

6.2.4 FINE AGGREGATE

Fine aggregate shall be composed of clean, hard, durable, uncoated particles of sand, free from of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate shall be well graded from coarse to fine and when tested by means of laboratory sieves shall meet the CDOT Concrete Aggregate Gradation Table and shall conform to AASHTO M6:

Sieve Size	Percent Passing
3/8"	100
#4	95 - 100
#8	80 - 100
#16	45 - 80
#30	25 - 60
#50	10 - 30
#100	2 - 10

6.2.5 COARSE AGGREGATE

The coarse aggregate shall consist of broken stone or gravel composed of clean, hard, tough and durable stone and shall be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, organic, or other deleterious matter.

Coarse aggregate shall conform to Number 357 or Number 467 course aggregate from the CDOT Concrete Aggregate Gradation Table 703-1, which shall also conform to AASHTO M43.

6.2.6 FIBROUS REINFORCING

- A. When specified by the City Engineer or appointed representative fibrous reinforcing shall be used in all Portland cement concrete used for all curb, gutter, sidewalks, curb turn fillets, cross pans, and valley gutters.
- B. The following shall be submitted to the City Engineer or appointed representative:
 - 1. One (1) copy of manufacturer's printed product data clearly marked indicating proposed fibrous concrete reinforcement materials. Printed data should state 1.5 lbs of fiber to be added to each cubic yard of each type of concrete.
 - 2. One (1) copy of manufacturer's printed batching and mixing instructions.
 - 3. One (1) copy of a certificate prepared by the concrete supplier stating that the approved fibrous concrete reinforcement materials at the rate of 1.5 lbs per cubic yard were added to each batch of concrete delivered to the project site. Each certificate shall be accompanied by one (1) copy of each batch delivery ticket-indicating amount of fibrous concrete reinforcement material added to each batch of concrete.
- C. Fibrous concrete reinforcement shall consist of:
 - 1. 100 percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. Fibrous concrete reinforcement shall be as manufactured by Fibermesh Company, 4019 Industry Drive, Chattanooga, Tennessee 37416, or approved equivalent. Substitutions may be considered at the discretion of the City.
 - 2. Physical characteristics:
 - a. Specific gravity = 0.905 grams per cubic centimeter.
 - b. Fiber lengths: ½ inch, ¾ inch, 1½ inch, two (2") inches per manufacturer.
 - c. Fibrous concrete reinforcement materials provided by this subsection shall produce concrete conforming to the requirements for each type and class of concrete required as indicated.
 - d. Construction methods:
 - (1) Add fibrous concrete reinforcement to concrete materials at the time concrete is batched in amounts in accordance with approved submittals for each type of concrete required.
 - (2) Mix batched concrete in strict accordance with fibrous concrete reinforcement manufacturer's instructions and recommendations for uniform and complete dispersion.

- D. **CONCRETE PLACING AND FINISHING.** Place and finish concrete materials as specified in Subsection 6.3.

All other right-of-way construction shall conform to the diagrams in Section 6.4. Where diagrams are not applicable or special conditions exist, all construction shall be approved in writing by the City Engineer or appointed representative.

6.3 CONSTRUCTION

All concrete shall be thoroughly mixed in a batch mixer of an approved type and capacity for a period of not less than two (2) minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum shall be operated at the speed specified by the manufacturer of the equipment. The entire contents of the mixer shall be discharged before recharge, and the mixer shall be cleaned frequently. The concrete shall be mixed only in such quantities that are required for immediate use. No re-tempering of concrete shall be permitted. Hand-mixed concrete shall not be permitted except by written approval of the City Engineer or appointed representative; and then in only very small quantities or in case of an emergency.

6.3.1 MIX DESIGN

- A. **PROPORTIONING**

Proportioning the "dry" constituents of all concrete mixtures shall be accomplished by weighing. The Responsible Party shall provide adequate and accurate scales for this work. Scales shall be accurate within the allowable tolerances as prescribed by state law. The scales shall be sealed by the measurement standards section of the Colorado Department of Agriculture at least once each year, each time the scales are relocated, and as often as the City Engineer or appointed representative may deem necessary. Scales shall be operated by operators certified by the measurement standards section of the Colorado Department of Agriculture. The certified weigher shall perform the duties according to the Colorado Department of Agriculture's regulations. There shall be no variance permitted in the minimum cement factor (sacks per cubic yard) as specified for the calls of concrete. The total quantity of mixing-water per sack of cement, including free water in the aggregates, shall not exceed the maximum specified herein.

The Responsible Party shall be responsible for developing the proper proportions of aggregates, cement and water that shall conform to the various requirements of these Engineering Specifications. Mix design shall be submitted to the City Engineer or appointed representative, along with at least two (2) sets of certified 28 day test results, for review and approval. No concrete shall be incorporated into the work until the proportions are approved by the City Engineer or appointed representative.

B. CLASSIFICATION

Shall conform to CDOT Standard Specifications Table 601-1 for concrete classes and mix requirements for class Ax, except that Number 357 or Number 467 shall be used.

C. READY-MIXED CONCRETE

The use of ready-mixed concrete in no way relieves the Responsible Party of the responsibility for proportion, mix, delivery, or placement of concrete; all concrete must conform to all requirements of these Engineering Specifications and ASTM C-94.

Concrete shall be continuously mixed or agitated from the time the water is added until the time of use and shall be completely discharged from the truck mixer or truck agitator within 1½ hours after it comes in contact with the mixing water or with the aggregates. Retempered concrete shall not be allowed.

The City shall have free access to the mixing plant at all times of operation. The organization supplying the concrete shall have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. The Responsible Party shall collect delivery, or batch, tickets from the driver for all concrete used on the project and deliver them to the City Engineer or appointed representative. Batch tickets shall provide the following information:

1. Weight and type of cement.
2. Weights of fine and coarse aggregates.
3. Volume (in gallons) of water including surface water on aggregates.
4. Quantity (cubic yards) per batch.
5. Times of batching and discharging of concrete.
6. Name of batch plant.
7. Name of Responsible Party.
8. Type of mix.
9. Type and amount of admixture.
10. Date and truck number.

6.3.2 SPACING OF JOINTS

A. EXPANSION JOINT

Expansion joint material shall be provided at the following locations and shall be in place prior to the placement of concrete:

1. At each end of curb return.
2. At both edges of driveway.
3. Between back of sidewalk and driveway slab or service walk.
4. Between new concrete and existing masonry buildings.

5. As shown on the drawings.
6. As directed by the City Engineer or appointed representative.
7. Between new and existing concrete.
8. Every 100 feet in sidewalk curb and gutter when handformed.
9. Every 200 feet in sidewalk, curb and gutter when place slip formed.
10. At or around inlets.

B. CONTRACTION JOINTS

Transverse joints shall be placed at maximum intervals of 10 feet to control random cracking; joints shall be formed, sawed, or tooled to a minimum depth of ¼ of the total thickness. If divider plates are used, the maximum depth of plates shall not be greater than ½ depth at the finished surface and shall be no less than one (1”) inch.

C. TOOL JOINTS

Tool joints shall be spaced as follows:

1. Not more than ten 10 feet nor less than five (5’) feet apart in curb and gutter and combination curb-sidewalk.
2. Not more than the width of the sidewalk (up to eight (8’) feet), nor less than five (5’) feet apart in sidewalk.
3. At least two (2) joints, equally spaced at not greater than 10 foot intervals applicable in driveways.
4. As directed by the City Engineer or appointed representative.

D. JOINT MATERIALS

Joint materials shall conform to AASHTO, ASTM Specifications according to the types as follows:

Joint Material	AASHTO	ASTM
Concrete joint sealer, hot poured elastic or Corning 888 or approved equivalent	M-173	D-1/90-74
Preformed expansion joint filler (Bituminous Type)	M-33	D-99-71
Preformed sponge rubber and cork expansion joint fillers	M-153	D-1752-67
Preformed expansion joint fillers-nonextruding and resilient bitumen	M-213	D-1751-73

6.3.3 REINFORCING STEEL AND FORMS

Before being positioned, all reinforcing steel shall be thoroughly cleaned of mill and rust scale and of coatings that destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, cleaned.

Reinforcement shall be carefully formed to the dimensions indicated on the plans by the cold bending method. Cold bends shall be made around a pin having a diameter of six (6) or more times the diameter of the reinforcing bars. Reinforcement shall not be bent and then straightened. Bars with kinks or bends not shown on the plans shall not be used. Precast mortar blocks, or other non-metal supports not approved by ACI shall not be allowed to remain in the concrete placement.

Reinforcing steel shall be accurately placed and secured against displacement by using annealed iron wire of not less than No.18 gauge, or by suitable clips at intersections. Where necessary, reinforcing steel shall be supported by ACI approved metal or plastic chairs, spacers, or metal hangers. Splicing of bars, except where shown on the plans, shall not be permitted without approval of the City Engineer or appointed representative.

Welded wire fabric for concrete reinforcement shall be of the gauge, spacing, dimensions, and form specified on the plans or detailed drawings and shall comply with "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-741) or "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement" (ASTM A-497).

Responsible Party shall submit to the City Engineer or appointed representative shop drawings of the reinforcement for his approval. The City Engineer or appointed representative's approval of shop drawings and bar schedules shall not relieve the Responsible Party of fulfilling his responsibilities as outlined in the plans and specifications.

Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel shall be the following, which is specified in ACI -301, Section 5.5:

- Bottom bars on soil bearing foundations and slabs, three (3") inches
- Bars adjacent to exposed surfaces or earth backfill:
 - > For bars more than $\frac{3}{4}$ inches in diameter, two (2") inches
 - > For bars $\frac{3}{4}$ inch or less in diameter, $1\frac{1}{2}$ inches
- Interior Surfaces: slabs, walls, and joints with $1\frac{3}{8}$ inch diameter or smaller, $\frac{3}{4}$ inch

Whenever necessary, forms shall be used to confine the concrete and shape it to the required lines. Forms shall have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms shall be constructed so that the finished concrete shall conform to the shapes, lines, grades and dimensions indicated on the approved plans. Any form which is not clean and has not had the surface prepared with a commercial form oil that shall effectively prevent bonding and that shall not stain or soften concrete surfaces shall not be used.

Plywood forms, plastic coated plywood forms, or steel forms shall be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having sub-standard surfaces.

Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage. Minimum time before removal of forms and placing concrete shall be one (1) day for footings and Class “B” concrete and two (2) days for all other concrete except in curbs, gutters, sidewalks and pavements. The use of slip forms and concrete paving machines shall be allowed, with approval of the City Engineer or appointed representative.

6.3.4 PLACING CONCRETE

A. SUBGRADE PREPARATION

The subgrade shall be excavated or filled to the required grades and lines. All soft, yielding, or otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and compaction shall extend a minimum of two (2') feet outside the form lines.

The subgrade shall be compacted to the density shown on the plans or Title 7, Section 7.5.2, whichever is greater, and trimmed to provide a uniform surface at the correct elevation. A compaction test is required for every 100 lineal feet of sidewalk to be placed.

Before depositing concrete, debris shall be removed from the space to be occupied by the concrete and the forms, including any existing concrete surfaces and shall be thoroughly wetted. Concrete shall not be placed until all forms and reinforcing steel have been inspected and approved by the City Engineer or appointed representative. Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods, which prevent separation or loss of ingredients. The concrete shall be deposited in the forms as neatly as practicable in its final position to avoid rehandling. It shall be deposited in continuous layers, the thickness of which generally shall not exceed 12 inches. Concrete shall be placed in a manner that shall avoid segregation and shall not be dropped freely more than five (5') feet. If segregation occurs, the City Engineer or appointed representative may require the concrete to be removed and replaced at the Responsible Party's expense. Concrete shall be placed in one (1) continuous operation, except where keyed construction joints are shown on the plans or as approved by the City Engineer or appointed representative. Delays in excess of 30 minutes may require removal and replacement of that pour, as determined by the City Engineer or appointed representative.

B. VIBRATING

Concrete shall be thoroughly compacted and/or vibrated. All concrete shall be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, shall be either tamped or vibrated. Care shall be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to

the surface. Vibration shall stop before any segregation of the concrete occurs. Mechanical vibrators shall be an approved type as specified in ACI Publication 309, Chapter 5. Vibrators shall not be used to move or spread the concrete.

Any evidence of the lack of consolidation or over consolidation shall be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Responsible Party's expense. The Responsible Party shall be responsible for any defects in the quality and appearance of the completed work.

C. WORKABILITY

The consistency of concrete shall be kept uniform for each class of work and shall be checked by means of slump tests or Kelly ball tests. The workability of the concrete shall be varied as directed by the City Engineer or appointed representative. At all times concrete shall have a consistency such that it can be worked into corners and angles of the forms and sound joints, dowels and tiebars by the construction methods which are being used without excessive spading, segregation or undue accumulation of water or latent material on the surface. If, through accident, intention, or error in mixing, any concrete fails to conform to the proportions of the approved mix design, such concrete shall not be incorporated in the work but shall be properly disposed of off the project site as waste material at the Responsible Party's expense. No water may be added at the job site without permission of the City Engineer or appointed representative. If approval is obtained and water is added at the job site, slump tests shall be run and test cylinders cast following the addition of the water. Any expense incurred in testing shall be borne by the Responsible Party.

6.3.5 FINISHING AND CURING

A. FINISHING CONCRETE

Where applicable, finishing shall be done with a metal screed designed to give proper shape to the section as detailed. Particular care shall be used to finish the gutter flowline to a true, uniform grade. When using face forms, they shall be left in place until the concrete has hardened sufficiently so that they can be removed without injury to the curb. The Responsible Party shall use at all times, a 10 foot straightedge for finishing curb and gutter sections. When irregularities are discovered, they shall be corrected by adding or removing concrete. All disturbed places shall be floated with a wooden or metal float which is not less than three (3') feet long and not less than six (6") inches wide, and again straightened. No water or cement shall be added to the surface of the concrete to aid in finishing, excessive working of the finished surface will not be permitted. Products such as "CONFILM" Evaporation Reducer, manufactured by BASF, or equal may be used. Before final finishing is complete and the concrete has taken its initial set, edges of the concrete and joints shall be carefully finished with an edger having a 1/8 inch radius. Concrete shall be finally finished with a wood float and lightly broomed to a slightly roughened surface. On

grades less than one (1) percent, the Responsible Party shall check for depressions before final finish so that no water holes exist. Any water puddles or "bird baths" larger than one (1) square foot and deeper than $\frac{3}{8}$ inch shall be cause for removal and replacement of the defective sections of concrete.

Exposed faces of curbs and sidewalks shall be finished to true-line and grade as shown on the plans. Sidewalk and curb shall be broomed or combed and edged, unless otherwise directed by the City Engineer or appointed representative. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms shall be tooled with an edger having a $\frac{3}{8}$ inch radius. No dusting or topping of the surface or sprinkling with water to facilitate finishing shall be permitted.

Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface shall be left sound, of acceptable finish, even, and uniform in color. Mortar used in pointing shall not be more than 30 minutes old. All construction and expansion joints in the completed work shall be left carefully tooled, free of all mortar, and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

B. CURING

Fresh concrete shall be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the City Engineer or appointed representative. The selected curing process shall be started as soon as it can be done without injury to the concrete surface. The use of a membrane curing compound is required.

The following curing procedures may be used subject to the approval of the City Engineer or appointed representative

1. Ponding (for slabs or footings).
2. Membrane curing compound.
3. Wet burlap, earth, or cotton mats.
4. Waterproof paper or polyethylene plastic cover.

Liquid membrane curing compound shall be Type 2, white pigmented Class B in accordance with AASHTO M148. Curing compound shall be applied immediately after the water sheen has left the finished concrete. At the time of application, pigmented curing compounds shall be thoroughly mixed, with the pigment uniformly dispersed throughout the mixture. The compound shall be applied at a rate to completely cover the surface uniformly and at a rate that will achieve the performance requirement specified in ASTM Specification C-309.

Liquid membrane curing compound shall not be used when the concrete surface is to be painted. The type of membrane curing compound chosen shall not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process shall be carefully adhered to as follows:

1. Surfaces being wetted by ponding, spraying, or wetted material shall be kept completely wetted, with an excess of free water on the surface, at all times for the first 72 hours. After this period, but for the remaining four (4) days, a wetting schedule shall be followed whereby the concrete is wetted on a schedule approved by the City Engineer or appointed representative.
2. Surfaces being protected by waterproof paper or polyethylene plastic cover shall receive special attention during the first 72 hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The engineer may require the removal of the cover and a wetting of the surface when, in his judgement, there is insufficient moisture for curing.

After the first 72 hours the cover shall be kept tightly in place for the remainder of the curing period.

C. CURING TIME

Walks shall not be opened to pedestrian traffic for at least 24 hours after placement; driveways, crosspans, and curb and gutter shall not be opened to vehicular traffic for at least seven (7) days after placement. The contractor shall maintain suitable barricades to comply with these requirements.

D. PROTECTION

1. Cold Weather Concreting

During extreme weather conditions, placing of concrete shall be permitted only when the temperature of the concrete placed in the forms is not less than 60 degrees Fahrenheit nor more than 90 degrees Fahrenheit. To maintain this temperature range, the Responsible Party shall provide acceptable heating apparatus for heating the aggregates and the water. Concrete may be placed when the air temperature in the shade is 40 degrees Fahrenheit, and rising. No concrete shall be placed, regardless of the present temperature, when the weather forecast promises freezing weather before final set of the concrete unless special means of heating and protection are used. Protection against freezing is the Responsible Party's responsibility regardless of the weather forecast or climatic conditions at the time of placing.

Small structures and slabs may be protected by completely covering fresh concrete with plastic sheeting or insulating blankets to a thickness

that insures protection. Material shall be secured to prevent displacement by the elements. Large structures or vertical walls shall be protected against freezing by enclosing the structure and heating with salamanders, heaters, or other devices capable of providing uniform and even heat throughout the structure.

Concrete placed in cold weather shall be protected from extreme temperatures as follows:

- a. A temperature of at least 50 degrees Fahrenheit for the first 72 hours shall be maintained.
- b. After the first 72 hours and until the concrete is seven (7) days old, it shall be protected from freezing temperatures.
- c. Concrete adjacent to heaters or salamanders shall be insulated from direct heat of the unit, which may dry it out prior to being properly cured.
- d. Temperatures shall be measured by maximum and minimum thermometers furnished by the Responsible Party and installed adjacent to the concrete.

Concrete slabs shall not be placed regardless of temperature conditions if the supporting ground is frozen or contains pockets of frost. Use of salt or other additives to prevent concrete from freezing shall not be allowed. Concrete which has been frozen shall be completely removed and replaced as directed by, and to the satisfaction of, the City Engineer or appointed representative.

2. Hot Weather Concreting

Except by written authorization, concrete shall not be placed if the temperature of the plastic concrete cannot be maintained at 90 degrees Fahrenheit or lower. The placement of concrete in hot weather shall comply with ACI 305.

6.3.6 MISCELLANEOUS

A. REPAIRS

After stripping of the forms, if any concrete is found to be not formed as shown on the drawings or is out of alignment or level, or shows a defective surface, it shall be considered as not conforming with the intent of these Engineering Specifications and shall be removed and replaced by the Responsible Party at his expense unless the City Engineer or appointed representative gives written permission to patch the defective area. In this case, patching shall be done as described in the following paragraphs. Defects that require replacement or repair are those that contain honeycomb, damage due to stripping of forms, loose pieces of concrete, bolt-holes, tie-rod holes, uneven or excessive ridges at form joints, and bulges due to movement of the forms. Ridges and bulges

shall be removed by grinding. Honeycombed and other defective concrete that does not affect the integrity of the structure shall be chipped out, and the vacated areas shall be filled in a manner acceptable to the City Engineer or appointed representative. The repaired area shall be patched with a non-shrink, non-metallic grout with a minimum compressive strength of 5,000 psi in 28 days. All repair areas treated with an epoxy-bonding agent shall have the approval of the City Engineer or appointed representative before the repair filling is placed.

Bolt-holes, tie-rod holes, and minor imperfections as approved by the City Engineer or appointed representative shall be filled with dry-patching mortar composed of one (1) part Portland cement to two (2) parts of regular concrete sand (volume measurement) and only enough water so that after the ingredients are mixed thoroughly, the mortar shall stick together on being molded. Mortar repairs shall be placed in layers and thoroughly compacted by suitable tools. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar. The mortar mix proportions described above are approximate.

It shall be the contractor's responsibility to protect fresh concrete from damage as a result of vandalism or other cause; damaged concrete shall be removed and replaced by and at the expense of the contractor.

Those areas with excessive deficiencies as determined by the City Engineer or appointed representative shall be removed and replaced at the Responsible Party's expense. Where repairs are made in existing sidewalks, all edges of the old sidewalk allowed to remain shall be sawcut to a minimum depth of two (2") inches. No rough edges shall be permitted where new construction joins the old section. Unless directed by the City Engineer or appointed representative no section less than five (5') feet in length shall be placed or left in place. Where new sidewalk construction abuts existing sidewalks, the work shall be accomplished so that there is no abrupt change in grade between the old section and the new work.

No addition to existing sidewalks or other flat work concrete shall be made less than four (4') feet in width. The City Engineer or appointed representative may require doweling into the existing concrete.

B. CLEANUP

The exposed surfaces of the concrete shall be thoroughly cleaned upon completion of the work, and the site shall be left in a neat and orderly condition.

C. BACKFILLING

When side forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete shall be promptly backfilled with suitable

material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete and then sloped as shown on the drawings or as directed by the City Engineer or appointed representative.

When the area behind the walk is to be paved, the pavement thickness shall be per Table 5-1 and or per Section 5.1.2. Existing pavement, which is damaged during construction, shall be repaired by the Responsible Party at his expense.

6.3.7 TESTING

A. GENERAL

The requirements of this section shall apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.

Concrete materials and operations shall be tested as directed by the City Engineer or appointed representative and as herein stipulated. The required testing services shall be performed by a testing agency approved by the City Engineer or appointed representative and all testing agencies shall meet the requirements of ASTM E-329.

A representative of the testing agency shall inspect, sample, and test material and production of concrete as required by the City Engineer or appointed representative at the Responsible Party's expense. When it appears that any material furnished or work performed by the Responsible Party fails to fulfill specification requirements, the testing agency shall report such deficiency to the City Engineer or appointed representative and the Responsible Party.

The testing agency shall report all test and inspection results to the City Engineer or appointed representative and Responsible Party immediately after they are performed. Test reports shall include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test shall include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.). All test reports shall bear the seal and signature of a Professional Engineer registered in the State of Colorado and competent in the field of concrete testing. Reports not properly certified shall not be accepted.

The testing agency or its representative is not authorized to revoke, alter, relax, enlarge or release any requirements of these Engineering Specifications nor approve or accept any portion of the work.

B. TESTS PROVIDED BY THE RESPONSIBLE PARTY

The following services shall be performed by the designated testing agency at the expense of the Responsible Party:

1. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T-141; mold and cure specimens from each sample in accordance with AASHTO T-23. The maximum time between sampling and casting the cylinders or beams shall be 45 minutes. One (1) test series shall be taken per 50 cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the City Engineer or appointed representative.
 - a. Field cured test series: four (4) cylinders, two (2) to be broken at seven (7) days and two (2) to be broken at 28 days or as directed by the City Engineer or appointed representative.
 - b. Lab cured test series: four (4) cylinders, two (2) to be broken at seven (7) days, two (2) to be broken at 28 days.
2. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the City Engineer or appointed representative, in accordance with AASHTO T-119.
3. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T-152 (pressure method), T-196 (volumetric method), or T-121 (gravimetric method).
4. Sample additional concrete at point of placement, and perform other testing or inspection service as required.
5. When required by the City Engineer or appointed representative, the Responsible Party shall provide concrete mix designs, the results of which shall be immediately reported to the City Engineer or appointed representative. When pumped concrete is to be used, a separate mix design shall be required. Mix designs shall be in accordance with ACI 211 and ACI 304, as applicable.
6. Additional testing and inspection required because of changes in materials or proportions.
7. When the work fails to pass inspection or previous tests fail to meet specifications, additional tests shall be taken as directed by the City Engineer or appointed representative.
8. Core samples shall be obtained and tested when samples of fresh concrete were not obtained and tested in accordance with the provisions of these Engineering Specifications. Obtaining and testing cores shall be

in accordance with ASTM C-42. Concrete in the area represented by a core test shall be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength, and if no single core is less than 75 percent of the specified strength. Core holes shall be filled with low slump concrete or mortar.

9. Failure of the Responsible Party to furnish testing as herein described shall be sufficient cause for rejection of the work in question.

C. RESPONSIBILITY AND DUTIES OF THE RESPONSIBLE PARTY

The Responsible Party shall provide the testing agency with the following:

1. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.
2. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T-23.

The use of testing services in no way relieves the Responsible Party of the responsibility to furnish material and construct in full compliance with these Engineering Specifications.

6.3.8 FLOWCRETE/FLOWFILL CONCRETE

A. SPECIFICATIONS

The following is the specification of the flowcrete/flowfill concrete as directed by the City Engineer or appointed representative:

Mix proportions: (per cubic yard of concrete)

Material	ASTM Specification	Weight
Cement	ASTM C-150	42 to 50 lbs.
Sand	ASTM C-33	1845 to 1850 lbs.
Aggregate	ASTM C-33	1700 to 1750 lbs.
Air Entrainment	ASTM C-260	5.0 ounces
Water	ASTM C-94	39 gallons

Design Physical Properties: Slump shall be six (6”) to eight (8”) inches.

CITY OF WOODLAND PARK, COLORADO

TITLE 7

EXCAVATION IN THE PUBLIC RIGHT-OF-WAY

TABLE OF CONTENTS

SECTION	7.1	PERMIT AND LICENSES REQUIRED	7-2
SECTION	7.2	TRAFFIC CONTROL AND PEDESTRIAN SAFETY	7-2
	7.2.1	BARRICADES REQUIRED	7-3
SECTION	7.3	EXCAVATION	7-3
	7.3.1	GENERAL	7-3
	7.3.2	CLEARING AND GRUBBING	7-3
	7.3.3	REMOVAL OF MISCELLANEOUS MATERIALS/STRUCTURES	7-4
	7.3.4	PROTECTION OF UTILITY LINES AND STRUCTURES	7-5
	7.3.5	PROTECTION OF PUBLIC AND PRIVATE INSTALLATIONS	7-5
	7.3.6	WIDTH OF TRENCH	7-6
	7.3.7	EXCAVATION IN POOR SOIL AND REFILLING TO GRADE	7-6
	7.3.8	EXCAVATION AND EMBANKMENT	7-6
	7.3.9	BORROW	7-7
	7.3.10	BLASTING	7-7
	7.3.11	PIPE CLEARANCE IN ROCKS	7-8
	7.3.12	SUBGRADE	7-8
	7.3.13	SUBBASE CONSTRUCTION	7-8
	7.3.14	GRADING	7-10
	7.3.15	FINAL PROOF-ROLLING	7-10
SECTION	7.4	BEDDING	7-11
	7.4.1	PREPARATION OF FOUNDATION FOR PIPE LAYING	7-11
	7.4.2	BEDDING TYPES	7-11

SECTION	7.5	BACKFILLING AND COMPACTION	7-13
	7.5.1	CAREFULLY PLACED	7-13
	7.5.2	COMPACTION REQUIREMENTS	7-13
SECTION	7.6	TRENCH SAFETY	7-15
	7.6.1	GENERAL	7-15
SECTION	7.7	REMOVAL, RESTORATION AND MAINTENANCE OF PAVEMENT SURFACE	7-16
	7.7.1	REMOVAL OF PAVEMENT	7-16
	7.7.2	TEMPORARY ASPHALT REPLACEMENT	7-16
	7.7.3	PERMANENT ASPHALT REPLACEMENT	7-16
	7.7.4	CLEAN UP	7-17
	7.7.5	BACKFILL WARRANTY AND MAINTENANCE	7-17
SECTION	7.8	FIGURES	
	7.8.1	TYPICAL BEDDING AND MATERIAL DETAIL	

7.1 PERMITS AND LICENSES REQUIRED

All contractors and sub-contractors must be licensed by the appropriate agencies. All excavation greater than one foot (1') in depth within existing or proposed rights-of-way and infrastructure easements shall be done by a contractor holding a "Full Excavator" License issued by the Teller County Building Department. All contractors and sub-contractors must have a City of Woodland Park Business License and Street Cut Permit prior to the start of work.

The Contractor shall also provide the City with a Performance Bond in the amount of \$5,000.00 per City Code 12.04.020.

7.2 TRAFFIC CONTROL AND PEDESTRIAN SAFETY

The Contractor shall obtain all applicable permits and an approved Traffic Control Plan prior to commencement of construction. The Contractor shall not interrupt the flow of traffic (vehicular, pedestrian or other) along, across, through or to any properties, private or public, without express written permission as provided by the required Traffic Control Plan. Traffic will be permitted to use the street at all times, unless a detour is specifically permitted by the City Engineer or appointed representative. It is the responsibility of the Contractor to provide prior notification to the City and to make satisfactory arrangements with any affected property owners.

Prior to the commencement of work, the Contractor shall provide the City Engineer or appointed representative a Traffic Control Plan for any work that will affect any public thoroughfare. The plan shall meet the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), latest revision. The Traffic Control Plan shall be prepared by a person that is qualified to do so. All traffic control plans must be approved by the City prior to the commencement of any work.

The Traffic Control Plan shall include a map showing the location and type of advanced warning signs and barricades to be used. The Traffic Control Plan shall include installing, maintaining, and removing all advance signing at each end and along the construction zone to alert the public. The contractor shall notify adjacent property owners at least 24 hours in advance of beginning work. This notification may be verbal, written or by hanging door tags. The Plan shall also include all other signs, barricades, flagging personnel, lights, and other devices necessary for the protection of the work and safety of the public. All traffic control signing and devices shall be in accordance with the MUTCD.

The safety of all pedestrians in the vicinity of construction shall be provided for by the Contractor. If, in the opinion of the City Engineer or appointed representative, provisions for pedestrian safety are not adequate, work will cease until adequate safety precautions are in place.

7.2.1 BARRICADES REQUIRED

During the daytime, the barricades and temporary fencing shall be maintained and be kept in place, but warning lights shall not be required. During the nighttime, sufficient warning lights are to be placed with suitable barricades and temporary fencing around such excavation. Type IV barricades are required for construction areas within 10 feet of the roadway or as outlined in the latest OSHA guidelines. No excavation within a City right-of-way and easements shall be left open overnight except by written permission of the City Engineer or appointed representative.

7.3 EXCAVATION

7.3.1 GENERAL

The intent of this section is to specify materials, methods, and standards to be used in the construction of embankments or excavations in City rights-of-way and easements, or for other purposes, as indicated on the drawings or contract documents. The work shall include: excavation, embankment, grading, compacting, clearing and grubbing, and the removal of topsoil, trees, stumps, or other vegetation; removal and/or resetting of minor obstructions, subgrade preparations; and any other work incidental for the construction of excavations and embankments. All workmanship and materials shall be in accordance with the requirements of these Engineering Specifications and in conformity with the lines, grades, quantities, and the typical cross section shown on the plans, or as directed by the City Engineer or appointed representative.

7.3.2 CLEARING AND GRUBBING

Work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the project as indicated on the plans. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

All surface objects and trees, stumps, roots and other protruding obstructions not designated to remain shall be cleared and/or grubbed as required, to ensure complete removal.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted in accordance with these Engineering Specifications. Materials and debris shall be disposed of in a manner acceptable to the City Engineer or appointed representative. Burning of any materials shall not be permitted without prior written approval of the City Engineer or appointed representative, Teller County Health Department, and Northeast Teller County Fire Protection District.

The Contractor shall make all necessary arrangements for obtaining suitable disposal locations. If disposal is to be at other than established disposal sites, the City Engineer or appointed representative may require the Contractor to furnish written permission from the owner of the property on whose property the materials and debris shall be placed.

Branches on trees or shrubs shall be removed as approved by the City Engineer or appointed representative. Branches of trees extending over the work zone shall be trimmed to give safe height above the work zone surface. All trimming shall be done in accordance with good tree pruning practices.

7.3.3 REMOVAL OF MISCELLANEOUS MATERIALS/STRUCTURES

A. GENERAL

The Contractor shall raze, remove, and dispose of all foundations, signs, structures, fences, pavements, utilities, traffic signal materials and other obstructions, which are designated for demolition within the project limits. Special care shall be given to protect materials, utilities and vegetation which are to be preserved.

Pedestals and bases from sign posts and similar structures shall be removed to a minimum of two (2') feet below the proposed subgrade.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. All remaining structures are to be delineated on the "as-built" drawings.

B. BRIDGES, CULVERTS AND OTHER DRAINAGE STRUCTURES

Bridges, culverts, and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic and storm drainage.

Unless otherwise directed, the substructures of existing structures shall be removed entirely. Where such portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

C. MANHOLES

When removing manholes, catch basins and inlets, any live sewer connected with these items shall be properly reconnected, and satisfactory bypass service shall be maintained during such operation.

D. PAVEMENTS, SIDEWALKS, CURBS, AND OTHER CONCRETE STRUCTURES

Portland Cement Concrete or asphaltic concrete that is to remain shall be cut in a straight, true line with a vertical face. The sawing shall be done carefully, and all damages, which are caused by the Contractor's operations, shall be repaired by the Contractor at his expense. The minimum depth of saw cuts in concrete shall be $\frac{2}{3}$ of the thickness of the concrete section.

E. BACKFILL

Except in areas to be excavated, all cavities left by structure removal shall be backfilled with suitable material and compacted in accordance with these Engineering Specifications.

7.3.4 PROTECTION OF UTILITY LINES AND STRUCTURES

The Contractor shall be responsible for contacting the **Utility Notification Center of Colorado, 1-800-922-1987 or 811**, for underground utility location. A three (3) day notification shall be given before you dig, grade, or excavate for the marking of underground member utilities. The Contractor is also responsible for contacting any other utilities not covered by the Utility Notification Center of Colorado.

The Contractor shall take proper precautions at all times to protect utility lines, manholes, valve boxes, survey monuments, and other structures which are present or can be determined to be present by examination of the appropriate maps of the utility companies. Any damage to the facilities will be repaired immediately at the Contractor's expense and any claim for disruption of service will be settled by the Contractor.

The Contractor shall be held responsible for the repair or replacement of structures damaged. Hand excavation shall be used where necessary. All existing manholes and valve boxes shall be adjusted to final grade by the Contractor. Where riser rings are installed, they shall have a wide, slotted flange for support and be equal to Clay Bailey #3100, or as approved by the City Engineer or appointed representative. If any existing manhole rings and covers or valve boxes are found to be defective, they shall be reported to the City and replaced at the direction of the City Engineer or appointed representative. The City will pay the cost of replacement materials if it is determined that the damage is not due to the Contractor's neglect.

7.3.5 PROTECTION OF PUBLIC AND PRIVATE INSTALLATIONS

The Contractor shall take proper precautions at all times for the protection of and replacement or restoration of driveway culverts, street intersection culverts or aprons, storm drains or inlets, fences, irrigation ditches, crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches, and all other public

and private installations that may be encountered during construction. The Contractor shall have the responsibility of providing each property with access to and from the property during the time of construction or have other arrangements in place prior to starting work. Existing driveways shall be cut, filled, and graded as required and as directed by the City Engineer or appointed representative to provide permanent access. Existing driveways shall be resurfaced with the presently existing type of surfacing whenever the existing surface is destroyed.

7.3.6 WIDTH OF TRENCH

The trench width at the top of the excavation may vary depending upon the depth of the trench and the nature of material encountered. However, the maximum allowable width of a trench at the level of one (1') foot above the top of pipe shall not be greater than either the outside diameter of the pipe plus 24 inches or 36 inches, whichever is greater. A wider trench is permitted if trench box shoring is larger than 36 inches or after approval by the City Engineer or appointed representative.

The trench bottom shall be brought to grade to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes.

7.3.7 EXCAVATION IN POOR SOIL AND REFILLING TO GRADE

If, when dry, the bottom at sub-grade is soft and in the opinion of the City Engineer or appointed representative cannot support the pipe or structure, a further depth shall be excavated as directed by the City Engineer or appointed representative and refilled to foundation grade as required under the above paragraphs, or other approved methods shall be adopted to assure a firm foundation for the pipe or structure. The type of material, which is to be used for refilling up to the grade of the pipe or structure, shall be granular bedding material as defined in Section 7.4.2.

7.3.8 EXCAVATION AND EMBANKMENT

Excavation of whatever materials are encountered within the limits of the project shall be performed to the lines and grades indicated on approved plans. All excavated areas shall be graded in a manner that will permit adequate drainage. Whenever practicable, all suitable material removed from the excavations shall be used in the formation of embankments, for backfilling, and for other purposes. Where material encountered within the limits of the work is considered unsuitable, such material shall be excavated below the grade shown on the drawings or as directed by the City Engineer or appointed representative, and replaced with suitable material. All unsuitable excavated materials, and any surplus of excavated material, which is not required for embankments, shall be disposed of by the Contractor.

The construction of embankments by deposition, placing, and compacting materials of acceptable quality above the natural ground or other surface shall be in accordance with the lines, grades, and cross sections shown on the approved plans and/or as required by the City Engineer or appointed representative. The cleared surface upon which fill material is to be placed shall be completely broken-up by plowing, scarifying or stepping to a minimum depth of six (6”) inches. This scarified layer shall be compacted per Section 7.5. Each lift of the embankment material shall not exceed eight (8”) inches in loose depth. The Contractor shall thoroughly mix the backfill material to secure uniform moisture content and to insure uniform density and proper compaction. Each layer shall be thoroughly compacted by roller or vibratory equipment which is suitable for the type of embankment material, to the densities specified in these Engineering Specifications.

7.3.9 BORROW

In the event sufficient suitable fill material is not obtainable within the limits of the project to provide the entire embankment required, the Contractor shall furnish such additional fill material (borrow) to complete the designated embankment. Borrow material shall be an acceptable type of embankment material, verified by a soils report and approved by the City Engineer or appointed representative prior to placement.

7.3.10 BLASTING

The Contractor shall submit to the City Engineer or appointed representative a blasting plan for review and approval, addressing standard operating procedures and safety.

The Contractor shall comply with all laws, ordinances and applicable safety code requirements and regulations of the City of Woodland Park, the County of Teller and the State of Colorado relative to the handling, storage and use of explosives and the protection of life and property; and shall be responsible for all damage thereto caused by blasting operations.

Suitable weighted plank coverings or mattresses shall be provided by the Contractor to confine all materials lifted by blasting within the limits of the excavation or trench.

The Contractor shall notify all persons verbally, by written letter, or by use of door hangers within a minimum distance of 500 feet from any blasting area a minimum of 48 hours prior to any blasting operations. The City Engineer or appointed representative shall be notified a minimum of 48 hours in advance of any blasting within the City.

7.3.11 PIPE CLEARANCE IN ROCKS

Large rock, boulders and stones larger than six (6”) inches shall be removed to provide a clearance of at least 36 inches above, below and on each side of all pipe, fire hydrants, valves and fittings.

7.3.12 SUBGRADE

The bottom of the excavation for the pavement, or top of the fill, shall be known as the pavement subgrade and shall conform to the lines, grades, and cross sections shown on the approved plans.

After excavation and embankment is completed and the subgrade brought to final grade, it shall be rolled with a rubber tired or sheepsfoot roller to bring the subgrade to the required density and stability. All soils shall be compacted per Section 7.5. The minimum moisture content shall comply with the approved geotechnical report. Additional wetting may be required when the minimum water requirement is not sufficient to produce a stable condition in the subgrade soil.

No paving, subbase, or base shall be placed on soft, spongy, frozen, or unstable subgrade which is considered unsuitable by the City Engineer or appointed representative.

7.3.13 SUBBASE CONSTRUCTION

A. MATERIALS

Subbase material shall be composed of granular material consisting, essentially, of sand, gravel, rock, slag, or a combination of such materials. Supplied material shall be a well-graded mixture containing sufficient soil mortar, or other proper quality binding material which, when placed and compacted in the roadway structure, shall result in a firm, stable foundation. Material composed of uniform size particles, or which contains pockets of excessively fine or excessively coarse material, shall not be acceptable for use.

This material need not be crushed but shall be graded within the following limits:

Standard Size of Sieve	Percent By Weight Passing Sieve
2½ inch	100
2 inch	95 - 100
No.4	30 - 60
No.200	5 - 15
Liquid Limit	35 Maximum
Plasticity Index	6 Maximum

B. GENERAL

The specifications presented in this subsection are performance oriented. The objective in setting forth these specifications is to achieve an acceptable quality of roadway structures. All sources, mined or manufactured, must be annually approved by the City Engineer or appointed representative as having met the appropriate material performance specifications. This approval is a condition of using those material sources for public and private improvement construction.

C. VIOLATIONS OF APPROVAL CONDITIONS

The City Engineer or appointed representative may order random tests of materials used in the City to verify compliance with material specifications. All material used to construct public and private improvements that is not from a certified source, or that is from a certified source and fails one or more random material tests, shall be subject to complete removal. The extent of the material to be removed shall be at the discretion of the City Engineer or appointed representative.

D. USE OF MATERIALS NOT LISTED

Any additional public and private improvement materials such as manufactured paints and coatings, bonding agents, scalers, gaskets, insulating materials, etc., should be in compliance with CDOT material specifications for the appropriate materials employed. Alternative materials for construction may be proposed for use, except where expressly prohibited. Decisions on acceptability of alternative materials shall be made by the City Engineer or appointed representative.

E. CONSTRUCTION

The construction of subbase shall consist of furnishing and placing approved subbase material to form a stable foundation on which to construct base course, in conformity with the lines, grades and typical cross sections shown on the plans, and as staked by a Surveyor registered in the State of Colorado. In addition, subbase material shall be used to replace unsuitable foundation materials at locations shown on the plans, or as directed by the City Engineer or appointed representative.

Each layer of material shall be placed and spread so that after compaction it shall conform to the width and crown of the typical cross sections. The wetting of subbase layers shall be done with sprinkling equipment of a type, which insures uniform and controlled distribution of the water. All wetting shall be done by uniformly sprinkling each layer of

material being placed with only that amount of water needed to obtain maximum density of the material. Premixing of water and soil is acceptable for extremely dry materials rather than sprinkling.

Travel may be allowed over subbase to assist in compaction of the material. Mixing and blading of the subbase material on the street shall be required if the material is spotty and nonuniform. However, grading shall be held to a minimum in order to avoid the floating of the heavier rock particles to the surface.

Concurrently with the wetting operations, the material shall be uniformly compacted by rolling. Rolling equipment shall be consistent for the type of material being compacted and will usually be one (1) or more of the following: rubber tire roller, sheepfoot roller and flat wheel steel roller.

7.3.14 GRADING

Excavation shall be performed to the lines, grades and cross sections indicated on the drawings and/or staked out on the ground. Suitable material removed from the excavations shall be used as far as practicable for embankments and backfilling. Unsuitable material shall be excavated below the grade shown on the drawings or indicated by grade stakes as directed by the City Engineer or appointed representative and replaced with selected material. Excavated materials which are considered unsuitable and any surplus of excavated material not required for embankments or backfill shall be disposed of by the Contractor.

Embankments shall be constructed by depositing, placing and compacting materials of acceptable quality above the natural ground in accordance with lines, grades and cross sections shown on the plans and/or staked out on the ground. Clearing shall include removal and disposal of obstructions and rubbish to a depth that ensures complete removal. Each lift of embankment material, not to exceed eight (8") inches of loose depth, shall be thoroughly mixed and moistened to full depth and compacted to uniform minimum density of 95 percent of Modified Proctor density (ASTM D1557), and optimum moisture content \pm two (2) percent.

The subgrade under forms shall be compacted and shaped so that the forms, when set, will be uniformly supported for its entire length at the specified elevation. The finished grade shall be maintained in a smooth and compacted condition until concrete has been placed.

Before placing concrete, the subgrade shall be tested for conformity with the cross-section shown on the plans, using an approved template. If necessary, material shall be removed or added to bring all portions of the subgrade to the correct elevation. It shall then be thoroughly compacted and again tested with the template.

7.3.15 FINAL PROOF-ROLLING

Prior to asphalt placement, and after the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof-rolled with a heavily loaded vehicle. The vehicle must have a certified loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 70 psi. Subgrade which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. Subgrade shall not be approved for base course construction until it is uniformly stable and unyielding. The City Engineer or appointed representative shall be notified at least 24 hours before final proof-rolling.

7.4 BEDDING

7.4.1 PREPARATION OF FOUNDATION FOR PIPE LAYING

When the excavation is in firm earth, care shall be taken to avoid excavations below the established grade. If this should occur, the area so excavated shall be backfilled in six (6") inch lifts and thoroughly compacted to the required density.

7.4.2 BEDDING TYPES

The type of bedding shall be determined by standard engineering methods or as directed by the City Engineer or appointed representative.

See Figure 7.8.1 for pipe bedding details.

- A. CLASS A – CONCRETE CRADLE OR CONCRETE ARCH BEDDING.
This class of bedding may take either of two forms:

See Figure 7.8.1

1. Concrete Cradle. The pipe shall be bedded in a monolithic cradle of plain or reinforced concrete having a minimum thickness of $\frac{1}{4}$ the inside pipe diameter or a minimum of four (4") inches under the barrel and extending up the sides for a height equal to $\frac{1}{4}$ the outside diameter. The cradle shall have a width at least equal to the outside diameter of the pipe barrel plus eight (8") inches. Backfill above the cradle and extending to 12 inches above the crown of the pipe shall be compacted carefully.
2. Concrete Arch. The pipe shall be embedded in carefully compacted granular material having a minimum thickness of $\frac{1}{4}$ the outside diameter between barrel and bottom of trench excavation and extending halfway up the sides of the pipe. The top half of the pipe shall be covered with a reinforced concrete arch having a minimum thickness of $\frac{1}{4}$ the inside diameter at the crown and

having a minimum width equal to the outside pipe diameter plus eight (8") inches.

- B. CLASS B – FIRST CLASS BEDDING. Class B bedding may be achieved by either of two (2) construction methods:

See Figure 7.8.1

1. Shaped Bottom with Tamped Backfill. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least two (2") inches greater than the radius of the outside of the pipe and with a width sufficient to allow 6/10 of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation and to extend to the top of pipe. Carefully compacted backfill shall then be placed to a thickness of at least 12 inches above the top of the pipe.
2. Compact Granular Bedding with Tamped Backfill. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of $\frac{1}{4}$ the outside pipe diameter or a minimum of four (4") inches and shall extend to the top of the pipe barrel at the sides. The remainder of the fill to a minimum depth of 12 inches over the top of the pipe shall be filled with carefully compacted material.

- C. CLASS C – This is the City's standard bedding type and is shown in Figure 7.8.1.

See Section 7.3.13

- D. MATERIAL – The material may be squeegee non-fractured rounded and shall conform to the following limits when tested by means of laboratory sieves:

Sieve Size	Total Percent Passing by Weight
3/8-inch	100
No. 200	0.5

7.5 BACKFILLING AND COMPACTION

7.5.1 CAREFULLY PLACED

Granular material shall be carefully deposited in the trench simultaneously on both sides of the pipe for the full width of the trench to a height of six (6") inches for Class-C bedding type and 12 inches for Class-B bedding type above the crown of the pipe or shovel placed and hand tamped to fill completely all spaces under and adjacent to the pipe.

7.5.2 COMPACTION REQUIREMENTS

All backfill shall be compacted by tamping; vibrating or other means approved by the City Engineer or appointed representative. The density tests shall be performed during backfilling at specified depths in the trench to ensure that the required density and moisture is obtained throughout. For trenches less than 30 inches in depth, density tests shall be taken within 18 inches above the top of pipe or conduit and at the surface as a minimum. For trenches greater than 30 inches in depth, density tests shall be taken within 18 inches of the top of the pipe or conduit, and at two (2') foot vertical intervals to the top of the trench with the final test at the surface.

Horizontal & Vertical Frequency of Density Tests (*The number of density tests required may be increased if directed by either the design engineer or the City Engineer (or appointed representative)*):

1. **Utility Mains** – One set of tests per 250 feet of linear trench at specified depths
2. **Service Lines** – One test per every service per utility type at specified depths
3. **Open pit** – Minimum of one set of tests at two (2') foot vertical intervals from the bottom to the top of the pit (Open pit shall include, but not limited to, excavations associated with bore pits, manholes, water valves, storm inlets, vaults, etc.)

All tests shall be performed by an approved independent testing laboratory at random locations.

Backfill shall be suitable earth free from rocks, roots or other deleterious material. Backfilling and compacting shall be done as thoroughly as possible so as to prevent after-settlement. Depositing of the backfill shall be done so the impact of falling material will not injure the pipe or structures.

Backfilling shall be done in uniform lifts not to exceed eight (8") inches which shall be completely compacted over the full width of the excavated area. A minimum of one (1') foot of compacted material over the top of the pipe shall be required before a vibratory or sheepsfoot roller is operated over the pipe. Any pipe damaged during backfill operations shall be repaired or replaced by the Contractor.

All backfill shall be compacted to the following percentage of the Modified Proctor Density at optimum moisture (ASTM D-1557):

	<u>Beneath Improvements</u>	<u>Outside Improvements</u>
City Roadways, Easements & Rights-of-way	95% (a)	85% (b)

Notes:

- (a) Examples of “improvements” include, but are not limited to; pavement, sidewalks, parking lots, retaining walls, etc. Roadway improvements specifically include the area from the centerline of the road and extend six (6’) feet beyond the furthest improvement (e.g. sidewalk).
- (b) Testing is not required(outside improvements) if lifts do not exceed one (1’) foot maximum thickness and appropriate compaction equipment and procedures are used.

Succeeding layers of backfill may contain coarse materials, but shall be free from large pieces of rock, frozen material, concrete, roots, stumps, rubbish and other similar articles whose presence in the backfill, in the opinion of the City Engineer or appointed representative, would cause settlement of the trench or damage to the pipe. No stone larger than six (6”) inches in diameter shall be placed within three (3’) feet of the pipe.

Special compaction shall be done around all manholes, catch basins, valve boxes, curb boxes, services, other structures, and utilities by the use of pneumatic tampers, plate tampers, or plate vibrators with lifts not to exceed eight (8”) inches.

Service trenches must be compacted in the same manner as the main line trenches. All excavation in trenches shall be backfilled to the original ground surface or to such grades as specified or shown in the plans. The backfill shall begin as soon as practical after the pipe has been placed and shall thereafter be carried on as rapidly as the protection of the balance of the work shall permit.

As an option, utility trench backfill meeting the following requirements (flowable-fill) may be used in lieu of native backfill in any excavation regardless of width or depth. Conventional concrete will not be allowed within the public right-of-way as backfill. Compaction and testing of utility backfill will not be required if material meeting the flowable-fill specification is used.

FLOWABLE FILL	
INGREDIENTS	LBS/CY
Cement	42 (0.47 sack)
Water	325 (39 gallons or as needed)
Coarse Aggregate (Size No. 57)	1700
Sand (ASTM C-33)	1845
<i>The maximum desired 28 day strength is 60 psi</i>	

For street maintenance purposes, “flowable-fill” shall be prohibited as a permanent street surface within the top four (4”) inches of any utility trench. The permanent top four (4”) inches (minimum) of all utility trenches shall be properly compacted asphalt, or six (6”) inches (minimum) concrete pavement or gravel (for existing concrete or gravel streets).

Beneath pavements flowable-fill will be required as utility trench backfill for all trenches less than one (1’) foot in width.

When the trench excavation is within the rights-of-way of State, or County highways, the backfilling of the trench, compaction of materials, subgrade preparation and surfacing shall be done in strict accordance with the requirements and specifications of the State or County Highway Department. In all cases, the Contractor shall grade and compact the roadway after the trench has been backfilled, so that it shall be passable to traffic at all times. The Contractor shall maintain the roadway in a condition acceptable to the controlling agency at all times until final acceptance of the entire work by the controlling agency. The Contractor shall also grade and maintain all detours and by passes.

In addition to grading and maintenance requirements specified, the Contractor shall provide at least one (1) tank truck with pressurized spray bars for spraying water on the streets to control dust. Dust control shall be required, as necessary, on all streets after compaction and grading, and on all detours and bypasses.

The methods of compaction are the responsibility of the contractor/utility and shall be sufficient to attain the required density in accordance with these specifications. The method of testing the compacted material shall be the responsibility of the professional engineer certifying the results. Said engineer shall be responsible for the validity of all test results. The Contractor shall remedy at his own expense any defects that appear in the backfill following completion, and during the warranty period.

7.6 TRENCH SAFETY

7.6.1 GENERAL

- A. Safety standards relating to the shoring and stabilization of trench sidewalls shall be maintained as prescribed by appropriate safety regulatory agencies (OSHA, State of Colorado). No open excavations are to be left overnight or unattended within the right-of-way. Any trench outside the right-of-way left open overnight must be completely protected per OSHA standards.
- B. The trench for such construction shall not be opened for a distance of more than 300 feet at any one time, or a distance that can be safely backfilled and compacted during normal business hours, unless authorized by the City Engineer or appointed representative.

- C. All shoring, bracing, or sheet piling shall be consistent with OSHA regulations.

7.7 REMOVAL, RESTORATION AND MAINTENANCE OF PAVEMENT SURFACE

7.7.1 REMOVAL OF PAVEMENT

- A. All road surface cuts shall be a minimum of four (4') feet in width.
- B. Existing pavement shall be cut so the joint line between existing and replacement pavement is straight, neat, and free from horizontal irregularities. All vertical cuts shall be made by saw. The cut depth shall be full depth to permit pavement removal without damage to the existing pavement.
- C. Where trenching excavation occurs within the roadway surface, the minimum allowable remaining pavement section shall not be less than four (4') feet.

7.7.2 TEMPORARY ASPHALT REPLACEMENT

A temporary patch of cold-mix shall be placed on all pavement surface cuts immediately after backfilling has been completed and shall be removed at the time a permanent patch is made. Minimum requirements for temporary patch shall be well compacted surfacing material conforming to "Road Mixed Asphalt Surfacing Material" of the CDOT Standard Specifications and shall match the existing asphalt thickness, but shall not be less than four (4) inches in depth. All temporary patches shall be properly maintained until permanent patches are installed.

7.7.3 PERMANENT ASPHALT REPLACEMENT

- A. Asphalt replacement shall meet the criteria set forth in Section 5.2 of the City of Woodland Park Engineering Specifications.
- B. Where the original surface was asphalt cement; asphalt shall be compacted in layers not to exceed three (3") inches to a total compacted thickness of four (4") inches or the thickness of the existing asphalt plus one (1") inch, whichever is greater.
- C. In areas where several cuts are made or substandard asphalt surfaces exist, an overlay asphalt pavement of two (2") inches thick shall be placed across the entire lane disturbed.
- D. Where the original surface was Portland cement concrete, Portland cement concrete shall be placed to a thickness of six (6") inches or the thickness of the removed pavement, whichever is greater. (See Section 6.2 and 6.3 of the City of Woodland Park Engineering Specifications)

7.7.4 CLEAN UP

All surplus materials furnished by the contractor, tools and temporary structures shall be removed from the site by the contractor. All dirt, rubbish and excess earth from excavation shall be hauled to a dump provided by the contractor and the construction site left clean to the satisfaction of the City Engineer or appointed representative.

7.7.5 BACKFILL WARRANTY AND MAINTENANCE

For a period of one (1) year after initiation of the warranty period, the Responsible Party shall maintain and repair any trench settlement which may occur and shall make suitable repairs to any pipe, fitting, valve, valve box, pavement, sidewalks or other structures which may be damaged as a result of backfill settlement as determined by the City Engineer or appointed representative.

CITY OF WOODLAND PARK, COLORADO

TITLE 8

PARKING STANDARDS

TABLE OF CONTENTS

SECTION	8.1	ON STREET PARKING	8-1
SECTION	8.2	OFF STREET PARKING	8-1
SECTION	8.3	FIGURES	
	8.3.1	ON STREET PARKING PAVED STREETS	
	8.3.2	OFF STREET PARKING TABLE	
	8.3.3	OFF STREET PARKING LAYOUT	

8.1 ON STREET PARKING

All on street parking should conform to the requirements of the Model Traffic Code for Colorado.

8.2 OFF STREET PARKING

All off street parking layout shall be reviewed by the City at the time of plan check. Off street parking shall conform to the standards of Figure 8.3.2 and to City code Section 18.39. If a conflict exists between the above standards, Code Section 18.39 shall govern.

CITY OF WOODLAND PARK, COLORADO

TITLE 9

BIKEWAYS & TRAILS STANDARDS

TABLE OF CONTENTS

SECTION	9.1	DESIGN	9-1
SECTION	9.2	STANDARDS AND CRITERIA	9-1
SECTION	9.3	MATERIALS AND CONSTRUCTION	9-4

9.1 DESIGN

Bikeway design shall conform to “A Bikeway Criteria Digest” prepared for the U. S. Department of Transportation, and the Manual on Uniform Traffic Control Devices. Generally, for trails an eight (8') feet minimum trail width is allowed. Bikeway widths shall have a minimum finished surface width of eight (8') feet.

All projects shall optimize pedestrian and bicycle travel within the City by providing bikeways, trails and pathways in all new developments in accordance with the City's Trails Plan.

Off-site improvements may also be required to provide residents with access to schools, and local commercial and community facilities. The bikeway and pathway system shall make use of, but not be limited to, the drainage and open space system.

Bicycle paths, lanes or routes, where required by applicable City ordinances, approved site plans or development agreements, shall be shown on the approved construction plans and shall meet, at a minimum, these Regulations.

All trails shall have a minimum of 12 feet clear vertical distance above the path.

Where possible, bikeways and trails shall be located to minimize the loss of trees and disruption of natural environmental conditions. A minimum of three (3') feet is required between the trail/bikeway edge and any vertical obstructions such as trees, utility poles, signs or other obstacles.

The materials used in the construction of bike paths and bikeways shall be in conformance with the appropriate chapter of the Engineering Specifications. Exceptions are listed below.

When Bikeways/Trails are to be constructed, maintenance and operation responsibility will be determined during the site/subdivision plan approval process. Public access/trail easements shall be conveyed to the City. The easement width shall be clearly indicated on the site plan or construction plans.

9.2 STANDARDS AND CRITERIA

A. BIKEWAY/TRAIL LOCATION

Bikeway/Trail location shall be based on safety, circulation, and access considerations. Trails designated on the City plan generally parallel to existing or proposed roadways shall be constructed wholly within the road right-of-way. These bikeways/trails shall be constructed in the general location designated as a sidewalk on a typical road section.

Where the typical road section does not include sufficient width to meet the minimum required bikeway/trail easements specified in the following table, the deduction of additional land adjacent to the street right-of-way will be necessary.

Trail Type	Minimum Required Easement Width (Feet)
Bikeway (8')	20 foot minimum
Walkways (8')	20 foot minimum
Equestrian/Hiking Trails (8')	20 foot minimum

B. GRADE

A plan and profile of the proposed trail construction shall be included in the construction plans or site plan. Typical cross-sections shall be provided for all critical points along the length of the trail.

Minimum Allowable – A minimum grade of 1.5 percent is recommended except in sags where proper drainage is provided by cross slope.

Maximum Allowable – A maximum grade of six (6) percent is recommended. However, staff will consider on a case-by-case basis grades up to ten (10) percent. Short dips or excessively long grades are discouraged.

C. CROSS SLOPE

Minimum allowable – ¼ inch per foot of width (2.08% slope)

Maximum allowable – ½ inch per foot of width (4.16% slope)

Where required, design shall conform to applicable ADA requirements.

D. TURNING RADIUS

Minimum Allowable – A twenty 20 foot radius is recommended; however, the actual minimum allowable should be computed by the Consulting Engineer based on expected use and site conditions.

E. DRAINAGE

All trail designs shall be in accordance with the storm drainage requirements as listed in Title 4 of these Engineering Specifications.

Appropriate drainage improvements shall be provided along slopes exceeding six (6) percent.

Trails located within the State right-of-way shall meet CDOT standards.

As a general guide, where a trail is cut into a hillside, a ditch shall be placed along the high side of the path to prevent sheet flow across the trail.

F. SAFETY CONSIDERATIONS

Trail and Bikeway location shall be based on safety, circulation, and access considerations.

The safety of potential pedestrians, and others, who may use or travel on a trail, shall be a prime consideration in the trail design.

Trails which are to be located adjacent to roads with speed limits exceeding 25 mph, and which have slopes greater than six (6) percent, may require special safety measures such as the installation of barriers or other safety devices, or an increase in the distance between the trail and highway.

Standard signing and markings from the MUTCD shall be included in the design and construction of the trail to alert trail users of potential hazards and to convey regulatory messages.

The Consulting Engineer shall address stopping and intersection sight distance at all trail intersections, curves, and particularly where steep grades are proposed at trail/roadway intersections. Obstructions to the visibility of motorists or trail users shall be removed or the trail aligned around the obstruction to maximize visibility.

Standard handicapped ramps will be provided at all trail curb crossings to allow continuity of trail use by bicyclists and the handicapped. For trails equal to or greater than eight (8) feet in width, curb depressions equaling the trail width shall be used, with the trail surface sloping to the pavement at one (1') foot for every inch of curb height.

G. PEDESTRIAN BRIDGES

Pedestrian bridges shall be prefabricated using a standardized steel truss design with pressure treated timber decking or other designs as approved by the City Engineer or appointed representative.

Bridge Width – A minimum of ten (10') feet wide. Bridge widths are to be two (2') feet greater than the trail width for trails greater than eight (8') feet wide.

9.3 MATERIALS AND CONSTRUCTION

The standards and criteria in this chapter and other chapters as relating to materials used and methods of construction shall be used in the design and review of proposed Bikeways and Trails.

Pavements shall be designed to support wheel loads from vehicles, which will require access to them. These may include emergency, patrol, snow removal, maintenance and other motor vehicles.

Aggregate quality shall meet the requirements of the CDOT “Standard Specifications for Road and Bridge Construction” Section 703.04.

A. SUBGRADE

Prior to construction, all vegetation shall be cleared, including stumps and roots along the trail for a minimum of three feet outside the edge of the proposed pavement. All subgrade preparation shall conform to the requirements of Title 7 and exceptions listed in Title 9. Soil sterilants and or inhibitors are to be placed prior to placement of asphalt.

B. ASPHALT

Where a trail/bikeway is constructed as part of the roadway section the criteria as listed in Title 5 here in shall apply. Asphalt depth for the trail/bikeway shall be the same as for the roadway section and will be dependent upon the Geotechnical Engineer’s report or have a minimum thickness of three (3”) inches of asphalt with a six (6”) inch base course. The asphalt and base course shall be placed per the “Pikes Peak Regional Asphalt Paving Specifications”.

C. CONCRETE

All concrete bikeway construction shall conform to Section 6.2 and 6.3 of these specifications with respect to sidewalks.

Where a trail/bikeway is constructed as part of the sidewalk system the criteria as listed in Title 6 shall apply. Minimum concrete thickness shall be four (4”) inches and six (6”) inches at driveway cuts.

D. GRAVEL

Gravel bikeway construction is to be discouraged. When special permission is given by Council for gravel bikeways, the surface shall be reviewed and approved by the City Engineer.

CITY OF WOODLAND PARK, COLORADO

TITLE 10

SAMPLE SUBDIVISION DEVELOPMENT AGREEMENT

TABLE OF CONTENTS

SECTION 10.1	SAMPLE SUBDIVISION DEVELOPMENT AGREEMENT	10-1
SECTION 10.2	SAMPLE PERFORMANCE GUARANTEE	10-6

10.1 SAMPLE SUBDIVISION DEVELOPMENT AGREEMENT

THIS AGREEMENT made and entered into this _____ day of _____, 20____, by and between the CITY OF WOODLAND PARK, (the “City”), and _____, (the “Developer”):

WHEREAS, the property which is subject to this agreement is the _____ Subdivision, within the City of Woodland Park, County of Teller, Colorado, and the Developer has submitted this plat for the subject property to the City for approval as required by City Ordinance; and

WHEREAS, the Developer and City desire to provide for the orderly development of the subject area now submitted to platting and provide for all matters required by the Subdivision Regulations, Engineering Specifications, Zoning Ordinance and all other applicable ordinances of the City; and

WHEREAS, City Code Section 13.12.040, City Code Section 13.36.030 and City Code Section 17.44.030 provide for an agreement with those desiring to extend water or sewer facilities, requiring all third parties to pay for their pro-rata share of the cost of extension prior to tapping on to said facilities; and

WHEREAS, the parties hereto wish to make an equitable agreement defining various terms concerning the construction/installation of such facilities and future reimbursement,

NOW THEREFORE, IT IS AGREED AS FOLLOWS:

A. GENERAL CONDITIONS

1. The Developer agrees as follows:
 - a. To develop the platted area in accordance with the Subdivision Regulations, Engineering Specifications, Zoning Ordinance and all other applicable ordinances of the City.
 - b. To install and construct the following subdivision improvements: street base and surface, water lines, sanitary sewer line, drainage, street signs, traffic control signs; and all other improvements necessary to develop the area in accordance with the Subdivision Regulations, Engineering Specifications, Zoning Ordinance, and all other applicable ordinances of the City. All public improvements shall be installed/constructed in accordance with the engineering plans filed with and approved by the City Engineer or appointed representative on _____, and according to revised engineering plans as may be received and approved by the City Engineer or appointed representative.
 - c. To obtain, place, and keep current with the City, a surety bond, letter of credit, or other acceptable assurance for the purpose of guaranteeing to

the City, the installation, interim maintenance and initial and final acceptance by the City of all public improvements in accordance with the Subdivision Regulations, Engineering Specifications, Zoning Ordinance, and all other applicable ordinances of the City. The amount of the collateral shall be equal to one hundred and fifty percent (150 percent) of the construction cost as estimated by the Developer and approved by the City Engineer or appointed representative. The amount of this collateral is hereby set at \$_____. The Developer shall remain liable for all costs of completion of the required public improvements in excess of this amount.

- d. The Developer agrees that after initial acceptance by the City Engineer or appointed representative of all public improvements, said improvements shall become the sole and exclusive property of the City free and clear from any liens, claims, restrictions or encumbrances. The Developer shall furnish the City lien waivers and/or satisfactory proof that all claims and payments to be made in connection with installation/construction of said public improvements have been satisfied.
 - e. The Developer SHALL FURTHER: Maintain all public improvements in the subdivision until these improvements have received initial acceptance by the City for maintenance. The Developer agrees to warrant workmanship and material for one (1) year from date of initial acceptance by the City.
2. All improvements shall be completed by _____, unless an extension is granted as outlined in Section 17.28.030 of the Municipal Code. Street paving shall not be completed until all water, sanitary sewer, drainage, and other utilities are installed and accepted by the City unless otherwise approved by the City Engineer or appointed representative.
3. The City and the Developer agree and understand as follows:
- a. All construction/installation shall be done and accomplished in accordance with City Ordinances, Engineering Specifications, rules, regulations and standards in effect at the time of the execution of this Agreement and under the observation of the City.
 - b. The construction cost for all public improvements shall be borne by Developer.
 - c. Any costs for engineering, construction staking, and right-of-way acquisition shall be borne by Developer.
 - d. If desired by the City, portions of the improvements may be placed in service when completed, but such use and occupation shall not constitute an acceptance of said portions. However and notwithstanding

the preceding sentence, any portion of the improvements placed into service by the City for a period of _____ months shall constitute an initial acceptance by the City of such portions of the improvements, as applicable, unless the Developer is notified in writing by the City during said period of service of specified deficiencies for correction by the Developer.

- f. The City will issue building permits for construction on lots only when the final grade within the right-of-way, at least the first lift of paving, curb and gutter, cable, phone, electrical, gas, water, wastewater, stormwater, fire hydrants, street name, and traffic control signs installed and erosion control are in place and functionally complete as determined by the City Engineer or appointed representative.
- g. Public improvements installed/constructed pursuant to this Agreement are eligible for initial acceptance in accordance with the Subdivision Regulations, Engineering Specifications, Zoning Ordinance, and all other applicable ordinances of the City, which initial acceptance upon written request of the Developer shall not be unreasonably withheld, conditioned or delayed by the City Engineer or appointed representative. Request for final acceptance, in writing, may be received by the City no sooner than twelve (12) months following initial acceptance. After inspection the City will identify and provide a written list of deficiencies based on physical inspection of the public improvements. The Developer shall correct all said deficiencies to the City Engineer or appointed representative's satisfaction within six (6) months from the date said deficiency list was issued. When all said deficiencies have been corrected, the City will grant a final acceptance to the Developer.
- h. From time to time, as work to be performed and public improvements to be installed/constructed progresses, the Developer may request in writing that the City inspect such work and improvements as are completed and that corresponding reductions of the collateral be granted. These requests will be processed in a manner similar to a request for initial acceptance. When the City is satisfied that such work and improvements as are specified by the Developer have been completed in accordance with the terms hereof, the City Engineer or appointed representative will submit his statement that he has no objection to the partial reduction of so much of the above specified collateral as is necessary to pay the cost of the work performed and improvements installed/constructed pursuant to this Agreement. In no event shall the amount of any collateral which remains subsequent to any request and approval of a partial release be less than one hundred fifty percent (150 percent) of the established construction cost of the required public improvements for which no release has been made. Also in the event partial releases have been requested and approved, the City and the Developer agree that upon satisfactory completion of all

required public improvements, all remaining collateral shall be released by the City to the Developer.

- i. In order to obtain any releases of the collateral, the Developer shall be required to submit to the City satisfactory documentation confirming proof of payment for contractor services, materials, professional services and other expenditures related to the installation/construction of the applicable public improvements.

B. UTILITY REIMBURSEMENT: As Applicable

C. SPECIAL REQUIREMENTS: As Required

D. IT IS FURTHER AGREED between the parties that this Agreement shall be recorded in the records of Teller County at Developer expense; and further, that this Agreement shall be binding upon the heirs, successors, and assigns of the parties hereto. The parties also agree that upon the satisfactory completion of the obligations and terms of this Agreement, the parties shall cause to be recorded in the records of Teller County a document releasing the subdivided property and the parties, as well as their respective heirs, successors and assigns, from the obligations and covenants imposed herein.

E. IT IS FURTHER AGREED that the rights and remedies of the City provided in this Agreement shall not be exclusive and are in addition to any other rights or remedies provided by law. In the event the City is required to pursue legal action to enforce the terms of this Agreement and prevails, the Developer shall be liable for reimbursement of the City's court costs and attorneys' fees resulting therefrom.

10.2 SAMPLE PERFORMANCE GUARANTEE

DATE _____ STREET NAME:_____

PROJECT _____ From _____

To _____

The undersigned Contractor hereby guarantees that:

The materials and workmanship furnished under this contract will be according to City engineering specification and will be free from defects for a period of one (1) year from the date of final acceptance by the City.

Within the guarantee period and upon notification to the Contractor by the City, the Contractor shall promptly make all needed adjustments, repairs or replacements arising out of defects, which in the judgment of the City, become necessary during such period.

The costs of all materials, parts, labor, transportation, supervision, special tools and supplies required for replacement of parts, repair of parts, or correction of abnormalities shall be paid by the Contractor.

The Contractor also extends the terms of this guarantee to cover repaired parts and all replacement parts furnished under the guarantee provisions for a period of one (1) year from the date of their installation.

If within 24 hours after the City gives the Contractor notice of a defect, failure, or abnormality of the work, the Contractor neglects to make, or undertake with due diligence to make, the necessary repairs or adjustments, the City is hereby authorized to make the repairs or adjustments himself or order the work to be done by the third party, the cost of the work to be paid by the Contractor plus 15 percent.

In the event of an emergency where, in the judgment of the City, delay would cause serious loss or damage, repairs or adjustment may be made by the City, or a third party chosen by the City, without giving notice to the Contractor, and the cost of the work shall be paid by the Contractor.

NOTARY PUBLIC

CONTRACTOR

Doing Business As

**CITY OF WOODLAND PARK, COLORADO
ENGINEERING SPECIFICATIONS**

TABLE OF CONTENTS

TITLE 1:	POLICIES AND PROCEDURES FOR INFRASTRUCTURE IMPROVEMENT PROJECTS		
SECTION	1.1	PURPOSE	1-1
	1.1.1	ADOPTED STANDARDS	1-1
SECTION	1.2	DESIGN POLICY	1-2
	1.2.1	GENERAL	1-2
	1.2.1.1	SUBDIVISION FLOW CHART	1-3
	1.2.1.2	SITE PLAN REVIEW FLOW CHART	1-4
	1.2.2	PREAPPLICATION CONFERENCE	
		CONCEPT/SKETCH PLAN	1-5
	1.2.3	PRELIMINARY PLANS AND REPORTS	1-5
	1.2.4	CONSTRUCTION PLANS	1-8
	1.2.5	CONSTRUCTION DRAWINGS	1-9
	1.2.6	EASEMENTS	1-11
SECTION	1.3	CONSTRUCTION POLICY	1-11
	1.3.1	ENGINEERED AND APPROVED PLANS	1-11
	1.3.2	CONTRACTOR LICENSES REQUIRED	1-11
	1.3.3	PERMITS	1-11
	1.3.4	PRE-CONSTRUCTION CONFERENCE	1-11
	1.3.5	INSPECTION, TESTING, STOP WORK ORDERS	1-12
	1.3.5.1	RE-INSPECTIONS	1-13
	1.3.5.2	INSPECTIONS OUTSIDE NORMAL INSPECTION HOURS	1-13
	1.3.5.3	STOP WORK ORDERS	1-13
	1.3.6	“AS-BUILT” DRAWINGS	1-14
	1.3.6.1	RESPONSIBILITIES	1-15
	1.3.6.2	SPECIFIC “AS-BUILT” REQUIREMENTS	1-15
	1.3.6.3	SUBMITTAL OF CERTIFIED “AS-BUILT” PLANS AND DOCUMENTS	1-17
	1.3.7	ACCEPTANCE AND WARRANTY	1-17
	1.3.7.1	PRE-ACCEPTANCE INSPECTION AND PUNCH LIST	1-17
	1.3.7.2	INITIAL ACCEPTANCE	1-18
	1.3.7.3	FINAL ACCEPTANCE	1-19

TITLE 2: WATER SYSTEM SPECIFICATIONS

SECTION	2.1	DESIGN	2-3
	2.1.1	GENERAL	2-3
	2.1.2	MAIN SIZE, WATER PRESSURE	2-6
	2.1.3	FIRE HYDRANTS	2-7
	2.1.4	PUMP STATIONS, STORAGE TANKS, PRESSURE REDUCING STATIONS, HIGH PRESSURE MAINS	2-8
	2.1.5	ABOVE GROUND FACILITIES REQUIRED	2-9
	2.1.6	AIR VACUUM RELEASE VALVES	2-9
	2.1.7	LOCATION	2-9
	2.1.8	WATER AND SEWER SEPARATION	2-10
	2.1.9	AWWA STANDARDS	2-10
	2.1.10	BACKFLOW PREVENTION DEVICES	2-10
	2.1.11	CURVILINEAR WATER MAINS	2-11
SECTION	2.2	MATERIALS	2-11
	2.2.1	MAINS	2-11
	2.2.2	FIRE HYDRANTS	2-12
	2.2.3	VALVES	2-13
	2.2.4	FITTINGS	2-13
	2.2.5	SERVICES	2-13
	2.2.6	JOINT RESTRAINTS	2-15
	2.2.7	TRACER WIRE	2-16
	2.2.8	POLYETHYLENE WRAP	2-17
	2.2.9	PRESSURE REDUCING STATIONS	2-17
	2.2.10	ENCASEMENT AND BRIDGING OF PIPE	2-17
	2.2.11	PIPE BEDDING MATERIALS	2-18
	2.2.12	AWWA STANDARDS	2-18
	2.2.13	NEW PRODUCTS OR MATERIALS	2-18
SECTION	2.3	CONSTRUCTION	2-18
	2.3.1	RESPONSIBILITY FOR MATERIAL	2-18
	2.3.2	HANDLING AND STORAGE OF MATERIAL	2-19
	2.3.3	ALIGNMENT AND GRADE	2-20
	2.3.4	EXCAVATION AND PREPARATION OF TRENCH	2-21
	2.3.5	LAYING	2-21
	2.3.6	JOINING OF ANY MECHANICAL JOINT PIPE	2-24
	2.3.7	JOINING OF ANY PUSH-ON JOINT PIPE	2-25
	2.3.8	SETTING OF VALVES AND FITTINGS	2-26
	2.3.9	SETTING OF HYDRANTS	2-26
	2.3.10	ANCHORAGE	2-27
	2.3.11	BACKFILLING AND COMPACTION	2-29
	2.3.12	WATER SYSTEM REPAIRS	2-29

	2.3.13	SERVICE CONNECTIONS	2-29
	2.3.14	SERVICE LINE DISCONNECTIONS	2-29
SECTION	2.4	TESTING	2-30
	2.4.1	TESTING	2-30
	2.4.2	DISINFECTION	2-30
	2.4.3	FLUSHING THE LINE	2-31
	2.4.4	PRESSURE/LEAKAGE TEST	2-31
	2.4.5	BACTERIOLOGICAL TESTS	2-33
SECTION	2.5	FIGURES	
	2.5.1	TYPICAL TRENCH SECTION AND PIPE PROTECTION	
	2.5.2	FIRE HYDRANT INSTALLATION DETAIL	
	2.5.3	HYDRANT PROTECTION POST (BOLLARD) DETAIL	
	2.5.4	TYPICAL VALVE BOX SETTING	
	2.5.5	STANDARD BLOW-OFF INSTALLATION (TYPE 1)	
	2.5.6	STANDARD BLOW-OFF INSTALLATION (TYPE 2)	
	2.5.7	POURED CONCRETE THRUST REACTION BLOCK	
	2.5.8	REVERSE ANCHOR DETAILS	
	2.5.9	COPPER TRACER WIRE DETAILS	
	2.5.10	POLYETHYLENE WRAP	
	2.5.11	WATER AND SEWER CROSSING (TYPE I)	
	2.5.12	WATER AND SEWER CROSSING (TYPE II)	
	2.5.13	BRIDGING DETAIL	
	2.5.14	REINFORCED CONCRETE ENCASEMENT DETAIL	
	2.5.15	WATERLINE LOWERING DETAIL	
	2.5.16	WATERLINE STANDARD DETAIL PIPE CLAMP	
	2.5.17	REMOTE READING WATER METER, TYPICAL INSIDE SETTING	
	2.5.18	$\frac{3}{4}$ " AND 1" SERVICE LINE DETAIL, INSIDE METER SETTING	
	2.5.19	AIR VACUUM RELEASE AND VALVE INSTALLATION	
	2.5.20	8-INCH PRESSURE REDUCING STATION (PAGE 1)	
	2.5.21	PRESSURE REDUCING STATIONS (PAGE 2)	
	2.5.22	FIRE HYDRANT SPACING MEASUREMENTS	
TITLE 3:		SANITARY SEWER SPECIFICATIONS	
SECTION	3.1	DESIGN	3-3
	3.1.1	GENERAL	3-3
	3.1.2	PLANNING CONSIDERATIONS	3-6
	3.1.3	MINIMUM SIZE	3-7
	3.1.4	MINIMUM DEPTH	3-7
	3.1.5	SLOPES	3-7
	3.1.6	HIGH VELOCITY PROTECTION	3-8

	3.1.7	ALIGNMENT	3-8
	3.1.8	INTERSECTIONS	3-8
	3.1.9	SERVICE CONNECTIONS	3-8
	3.1.9.1	PRESSURE LATERALS	3-9
	3.1.10	MANHOLES	3-9
	3.1.11	MANHOLE SIZES	3-9
	3.1.12	DROP MANHOLES	3-9
	3.1.13	MANHOLE CHANNELS	3-10
	3.1.14	MANHOLE RINGS AND COVERS	3-10
	3.1.15	MANHOLE WATERTIGHTNESS	3-10
	3.1.16	INVERTED SIPHONS	3-10
	3.1.17	LOCATION	3-10
	3.1.18	STREAM AND DRAINAGE CHANNEL CROSSINGS	3-11
	3.1.19	CROSSINGS UNDER HIGHWAYS	3-12
	3.1.20	STUB OUTS FROM MANHOLES	3-12
	3.1.21	SERVICE STUBS	3-12
	3.1.22	WASTEWATER PUMPING STATIONS	3-12
	3.1.23	GENERAL REQUIREMENTS	3-13
	3.1.24	PUMP STATION DESIGN	3-13
	3.1.25	INSTRUCTION, EQUIPMENT OPERATION AND MAINTENANCE	3-16
	3.1.26	GREASE AND SAND/OIL INTERCEPTORS	3-16
	3.1.27	THERMAL INSULATION FOR SEWER MAINS AND SERVICE LATERALS	3-17
SECTION	3.2	MATERIALS	3-18
	3.2.1	POLYVINYL CHLORIDE PIPE FOR SEWERS AND FORCE MAINS	3-18
	3.2.2	CAST IRON AND DUCTILE IRON GRAVITY SEWER PIPE	3-20
	3.2.3	HIGH DENSITY POLYETHYLENE GRAVITY SEWER PIPE (HDPE)	3-21
	3.2.4	MANHOLES	3-21
	3.2.5	DROP MANHOLES	3-22
	3.2.6	CONCRETE	3-22
SECTION	3.3	CONSTRUCTION	3-22
	3.3.1	EXCAVATION AND PREPARATION OF TRENCH	3-22
	3.3.2	LAYING OF PIPE	3-22
	3.3.3	TRACER WIRE	3-23
	3.3.4	MANHOLES	3-23
	3.3.5	MANHOLE CASTINGS	3-24
	3.3.6	FITTINGS, COUPLINGS, WYES AND SADDLES	3-24
	3.3.7	SERVICE CONNECTIONS	3-24
	3.3.8	DEEP SERVICE CONNECTION	3-25

	3.3.9	BACKFILLING AND COMPACTION	3-25
	3.3.10	SERVICE LINE DISCONNECTIONS	3-25
	3.3.11	SERVICE LINE INSPECTIONS	3-25
	3.3.12	ABANDONMENT OF MAINS AND APPURTENANCES	3-25
	3.3.13	REPAIRS AND REPLACEMENTS	3-25
	3.3.14	TESTING	3-26
	3.3.15	AIR TESTS	3-26
	3.3.16	EXFILTRATION TESTS	3-27
	3.3.17	INFILTRATION TEST	3-28
	3.3.18	TELEVISION INSPECTION	3-28
SECTION	3.4	FIGURES	
	3.4.1	STANDARD MANHOLE CONSTRUCTION	
	3.4.2	STANDARD CONCRETE MANHOLE CONE CAP	
	3.4.3	STANDARD OUTSIDE DROP MANHOLE	
	3.4.4	STANDARD INTERNAL DROP MANHOLE	
	3.4.5	48" PRE-CAST CONCRETE MANHOLE DECK	
	3.4.6	60" PRE-CAST CONCRETE MANHOLE DECK	
	3.4.7	MANHOLE RING AND COVER	
	3.4.8	STREAM CROSSING ENCASEMENT WITHOUT CAISSONS	
	3.4.9	STREAM CROSSING ENCASEMENT AND TYPICAL CAISSON	
	3.4.10	DEEP SERVICE CONNECTIONS	
	3.4.11	HIGH VELOCITY PROTECTION	
	3.4.12	SANITARY SEWER SERVICE DETAIL	
	3.4.13	TYPICAL BORE CONSTRUCTION	
TITLE 4:		DRAINAGE AND EROSION CONTROL SPECIFICATIONS	
SECTION	4.1	DESIGN	4-2
	4.1.1	DRAINAGE DESIGN CRITERIA	4-2
	4.1.2	DRAINAGE REPORT	4-2
	4.1.3	MINIMUM PIPE SIZE	4-3
	4.1.4	MANHOLES	4-3
	4.1.5	CLEARANCE	4-4
	4.1.6	CULVERT INLET AND OUTLET PROTECTION	4-4
SECTION	4.2	MATERIALS	4-4
	4.2.1	REINFORCED CONCRETE PIPE	4-4
	4.2.2	CONCRETE PIPE JOINING MATERIALS	4-6
	4.2.3	STEEL PIPE	4-6
	4.2.4	HIGH DENSITY POLYETHYLENE PIPE	4-8
	4.2.5	MANHOLES	4-9

	4.2.6	CONCRETE	4-9
	4.2.7	Rip- RAP	4-9
SECTION	4.3	DRAINAGE CHANNEL CONSTRUCTION	4-10
	4.3.1	CHANNEL EXCAVATION	4-10
	4.3.2	CONCRETE CHANNEL CONSTRUCTION	4-11
	4.3.3	EARTH CHANNEL CONSTRUCTION	4-12
	4.3.4	GROUTED CHANNEL CONSTRUCTION	4-12
SECTION	4.4	STORM SEWER CONSTRUCTION	4-13
	4.4.1	EXCAVATION	4-13
	4.4.2	PIPE CONSTRUCTION	4-13
	4.4.3	INITIAL ACCEPTANCE	4-13
	4.4.4	MAINTENANCE BETWEEN INITIAL AND FINAL ACCEPTANCE	4-13
SECTION	4.5	EROSION CONTROL	4-13
	4.5.1	NON-STRUCTURAL EROSION CONTROL MEASURES	4-14
	4.5.2	STRUCTURAL EROSION CONTROL MEASURES	4-14
SECTION	4.6	LOW IMPACT DEVELOPMENT	4-15
SECTION	4.7	FIGURES	
	4.7.1	RECOMMENDED TYPICAL DITCH CROSS SECTION	
	4.7.2	TYPICAL ROAD CROSS SECTION	
	4.7.3	CHANNEL PROFILE FOR EROSION CONTROL AT CULVERTS	
TITLE 5: STREET SYSTEM SPECIFICATIONS			
SECTION	5.1	DESIGN	5-1
	5.1.1	LAYOUT	5-1
	5.1.2	DRIVEWAY CONSTRUCTION REGULATIONS	5-2
	5.1.3	CURB CUTS FOR RECESSED DIAGONAL PARKING	5-4
	5.1.4	SUBGRADE INVESTIGATION AND PAVEMENT DESIGN (REPORT)	5-4
	5.1.5	MINIMUM ASPHALT REQUIREMENTS	5-5
	5.1.6	STREET SIGNAGE	5-6
SECTION	5.2	ASPHALT PAVEMENT MATERIALS AND CONSTRUCTION	5-6
	5.2.1	REQUIRED INSPECTIONS FOR ROADWAYS	5-6

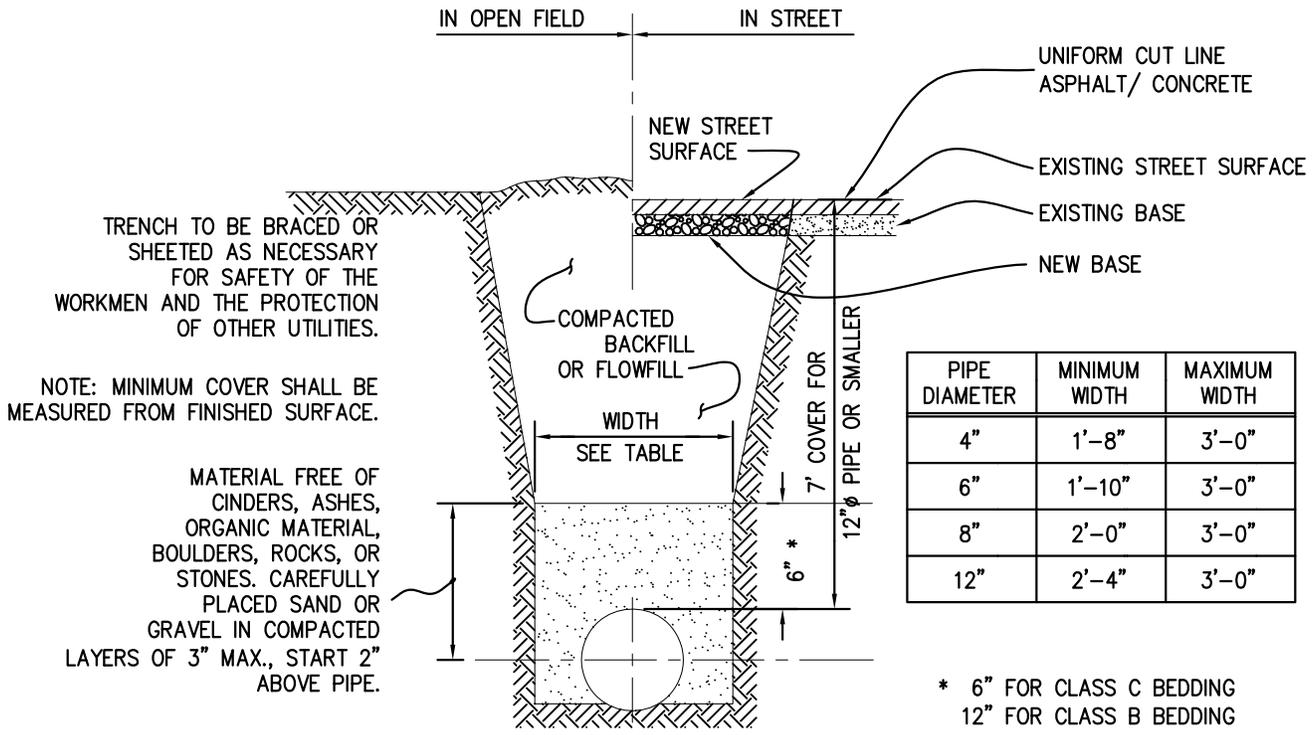
	5.2.2	SUBGRADE	5-7
	5.2.3	BASE COURSE	5-8
	5.2.4	ASPHALT PRIME COAT AND TACK COAT	5-11
	5.2.5	ASPHALT CONCRETE PAVEMENT	5-13
	5.2.6	ASPHALTIC OVERLAY (PLANT-MIX SEAL)	5-15
	5.2.7	SEAL COAT	5-15
	5.2.8	CONTROL OF MATERIALS	5-15
	5.2.9	FINAL ACCEPTANCE	5-16
SECTION	5.3	FIGURES	
	5.3.1	UTILITIES IN R.O.W. (PLAN VIEW)	
	5.3.2	UTILITIES IN R.O.W. (CROSS SECTIONS)	
TITLE 6:	6.0	CONCRETE CONSTRUCTION	
SECTION	6.1	DESIGN	6-1
	6.1.1	GENERAL PROVISIONS	6-1
SECTION	6.2	CONCRETE	6-1
	6.2.1	CEMENT	6-1
	6.2.2	WATER	6-2
	6.2.3	ADMIXTURES	6-2
	6.2.4	FINE AGGREGATE	6-2
	6.2.5	COARSE AGGREGATE	6-2
	6.2.6	FIBEROUS REINFORCING	6-3
SECTION	6.3	CONSTRUCTION	6-4
	6.3.1	MIX DESIGN	6-4
	6.3.2	SPACING OF JOINTS	6-5
	6.3.3	REINFORCING STEEL AND FORMS	6-6
	6.3.4	PLACING CONCRETE	6-8
	6.3.5	FINISHING AND CURING	6-9
	6.3.6	MISCELLANEOUS	6-12
	6.3.7	TESTING	6-14
	6.3.8	FLOWCRETE/FLOWFILL CONCRETE	6-16
SECTION	6.4	FIGURES	
	6.4.1	CURB & GUTTER - TYPE I	
	6.4.2	CURB, GUTTER & SIDEWALK GUTTER - TYPE II	
	6.4.3	CROSS-PAN	
	6.4.4	INTERSECTION DETAIL	
	6.4.5	CURB RAMP	
	6.4.6	PEDESTRIAN RAMP DETAIL	

- 6.4.7 DRIVEWAY DETAILS (VERTICAL CURB & GUTTER)
- 6.4.8 DRIVEWAY DETAILS (DRIVE-OVER CURB, GUTTER AND SIDEWALK)

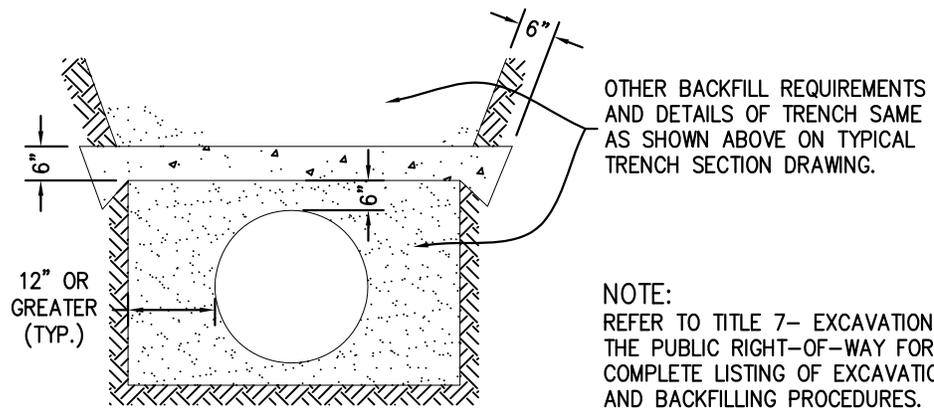
TITLE 7: EXCAVATION IN THE PUBLIC RIGHT-OF-WAY

SECTION	7.1	PERMIT AND LICENSES REQUIRED	7-2
SECTION	7.2	TRAFFIC CONTROL AND PEDESTRIAN SAFETY	7-2
	7.2.1	BARRICADES REQUIRED	7-3
SECTION	7.3	EXCAVATION	7-3
	7.3.1	GENERAL	7-3
	7.3.2	CLEARING AND GRUBBING	7-3
	7.3.3	REMOVAL OF MISCELLANEOUS MATERIALS/STRUCTURES	7-4
	7.3.4	PROTECTION OF UTILITY LINES AND STRUCTURES	7-5
	7.3.5	PROTECTION OF PUBLIC AND PRIVATE INSTALLATIONS	7-5
	7.3.6	WIDTH OF TRENCH	7-6
	7.3.7	EXCAVATION IN POOR SOIL AND REFILLING TO GRADE	7-6
	7.3.8	EXCAVATION AND EMBANKMENT	7-6
	7.3.9	BORROW	7-7
	7.3.10	BLASTING	7-7
	7.3.11	PIPE CLEARANCE IN ROCKS	7-8
	7.3.12	SUBGRADE	7-8
	7.3.13	SUBBASE CONSTRUCTION	7-8
	7.3.14	GRADING	7-10
	7.3.15	FINAL PROOF-ROLLING	7-10
SECTION	7.4	BEDDING	7-11
	7.4.1	PREPARATION OF FOUNDATION FOR PIPE LAYING	7-11
	7.4.2	BEDDING TYPES	7-11
SECTION	7.5	BACKFILLING AND COMPACTION	7-13
	7.5.1	CAREFULLY PLACED	7-13
	7.5.2	COMPACTION REQUIREMENTS	7-13
SECTION	7.6	TRENCH SAFETY	7-15
	7.6.1	GENERAL	7-15

SECTION	7.7	REMOVAL, RESTORATION AND MAINTENANCE OF PAVEMENT SURFACE	7-16
	7.7.1	REMOVAL OF PAVEMENT	7-16
	7.7.2	TEMPORARY ASPHALT REPLACEMENT	7-16
	7.7.3	PERMANENT ASPHALT REPLACEMENT	7-16
	7.7.4	CLEAN UP	7-17
	7.7.5	BACKFILL WARRANTY AND MAINENANCE	7-17
SECTION	7.8	FIGURES	
	7.8.1	TYPICAL BEDDING AND MATERIAL DETAIL	
TITLE 8: PARKING STANDARDS			
SECTION	8.1	ON STREET PARKING	8-1
SECTION	8.2	OFF STREET PARKING	8-1
SECTION	8.3	FIGURES	
	8.3.1	ON STREET PARKING PAVED STREETS	
	8.3.2	OFF STREET PARKING TABLE	
	8.3.3	OFF STREET PARKING LAYOUT	
TITLE 9: BIKEWAYS & TRAILS STANDARDS			
SECTION	9.1	DESIGN	9-1
SECTION	9.2	STANDARDS AND CRITERIA	9-1
SECTION	9.3	MATERIALS AND CONSTRUCTION	9-4
TITLE 10: SAMPLE SUBDIVISION DEVELOPMENT AGREEMENT			
SECTION	10.1	SAMPLE SUBDIVISION DEVELOPMENT AGREEMENT	10-1
SECTION	10.2	SAMPLE PERFORMANCE GUARANTEE	10-6



TYPICAL TRENCH SECTION



PIPE PROTECTION

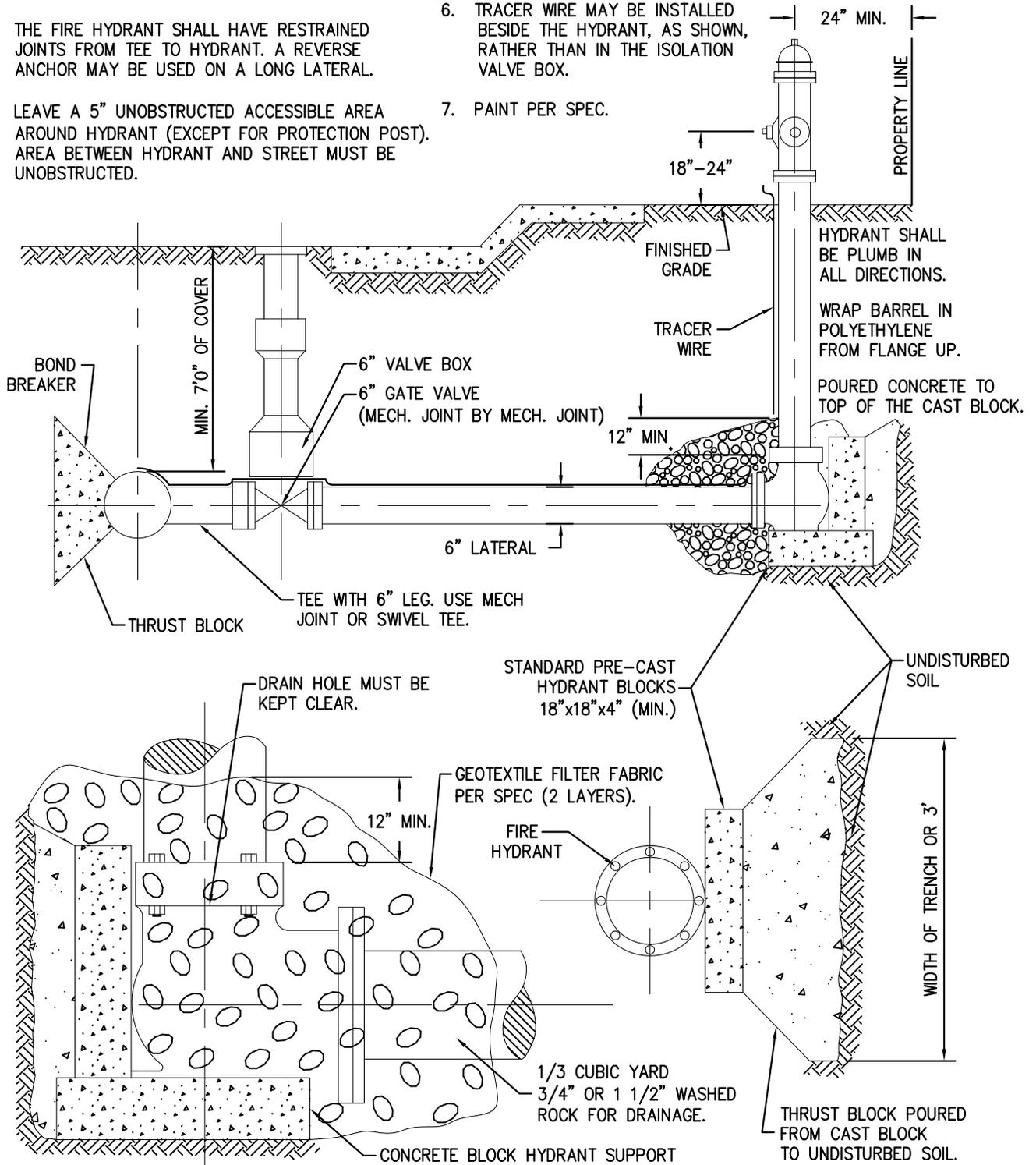
WHEN TRENCH WIDTH IN EXCESS OF O.D. +24"



TYPICAL TRENCH SECTION
PIPE PROTECTION

GENERAL NOTES:

1. DRAWING NOT TO SCALE.
2. ALL D.I. PIPE AND FITTINGS TO BE WRAPPED IN POLYETHYLENE.
3. THE FIRE HYDRANT SHALL HAVE RESTRAINED JOINTS FROM TEE TO HYDRANT. A REVERSE ANCHOR MAY BE USED ON A LONG LATERAL.
4. LEAVE A 5" UNOBSTRUCTED ACCESSIBLE AREA AROUND HYDRANT (EXCEPT FOR PROTECTION POST). AREA BETWEEN HYDRANT AND STREET MUST BE UNOBSTRUCTED.
5. ALL REQUIRED COMPONENTS ARE NOT NECESSARILY SHOWN ON EACH VIEW.
6. TRACER WIRE MAY BE INSTALLED BESIDE THE HYDRANT, AS SHOWN, RATHER THAN IN THE ISOLATION VALVE BOX.
7. PAINT PER SPEC.

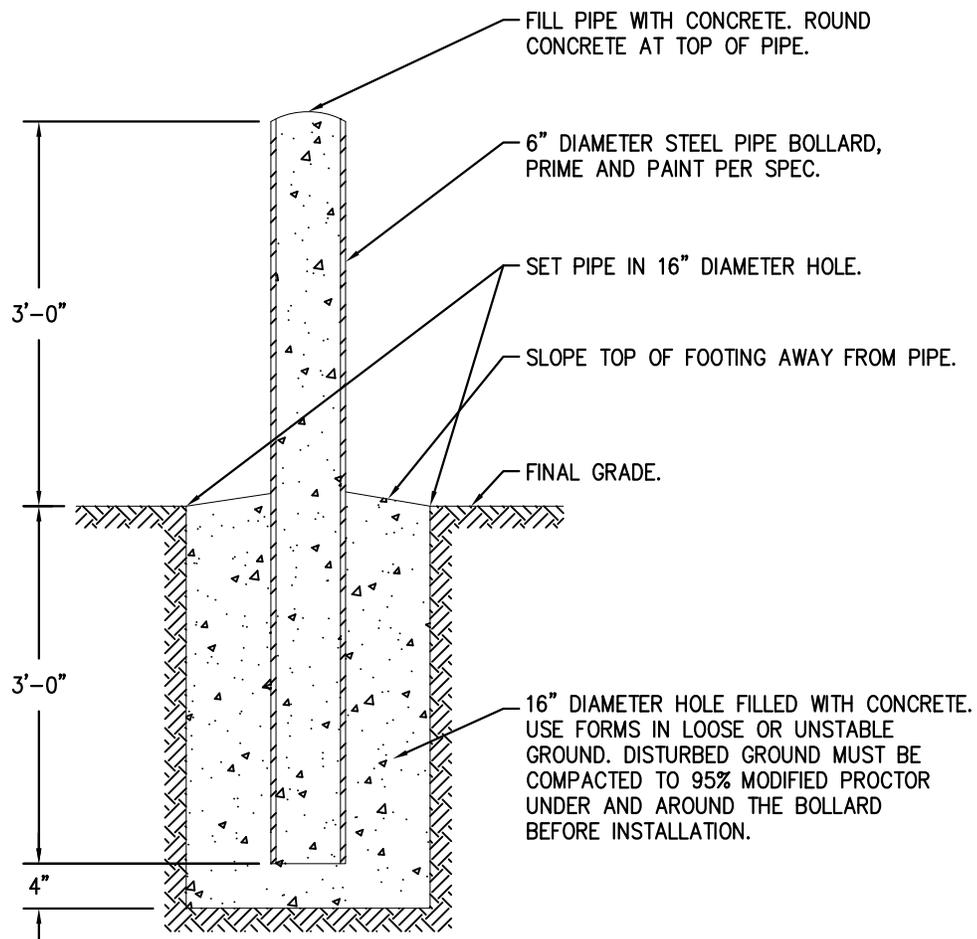


FIRE HYDRANT INSTALLATION DETAIL

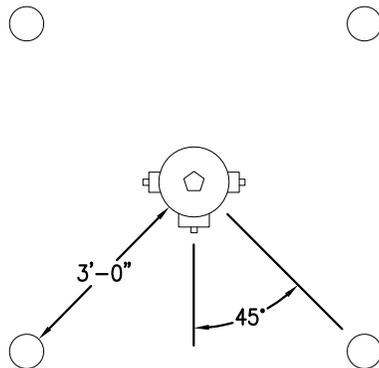
DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.2



PLAN VIEW:
TYPICAL SPACING

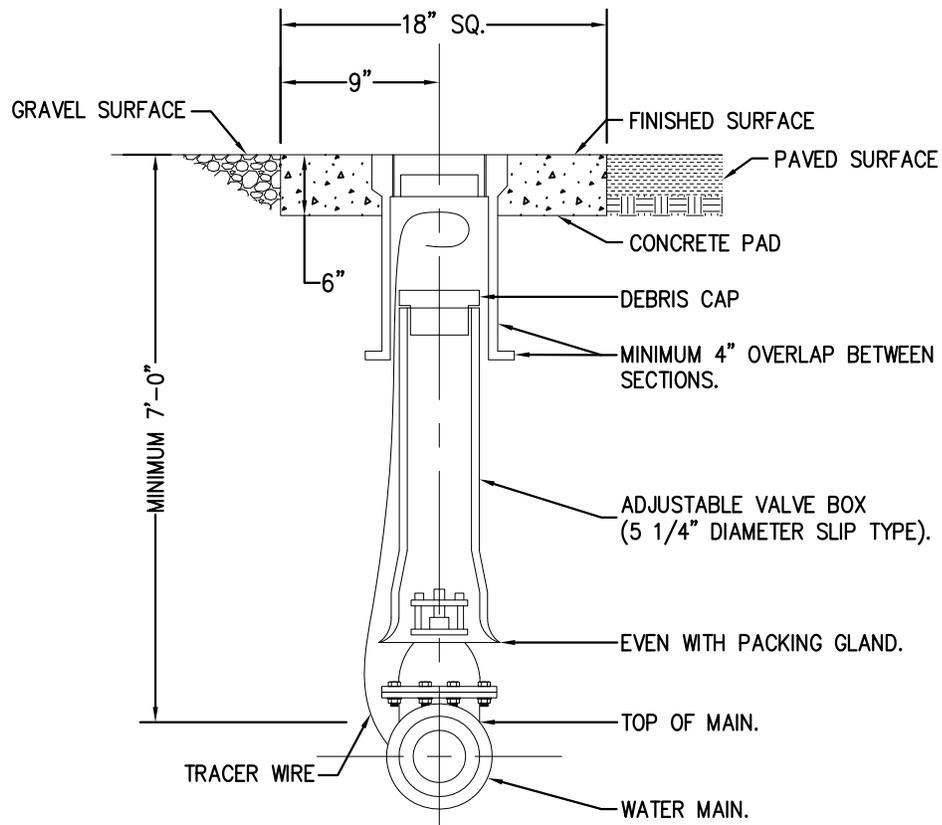


HYDRANT PROTECTION POST (BOLLARD) DETAIL

DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.3



TYPICAL VALVE BOX SETTING

- NOTE:
1. FOR GRAVEL SURFACE, VALVE BOX COVER AND CONCRETE PAD COLLAR SHALL BE LOCATED FLUSH WITH FINISHED GRADE.
 2. FOR PAVED SURFACE, VALVE BOX COVER AND CONCRETE PAD COLLAR SHALL BE LOCATED FLUSH WITH FINISHED PAVED SURFACE.
 3. FOR EASEMENTS NOT TRAVELED NOR MAINTAINED FOR VEHICULAR TRAFFIC, VALVE BOX COVER SHALL BE LOCATED EVEN WITH FINISHED GRADE.
 4. REFER TO FIGURE 2.5.9 FOR TRACER WIRE DETAIL.
 5. CONCRETE SHALL BE PER SPEC.

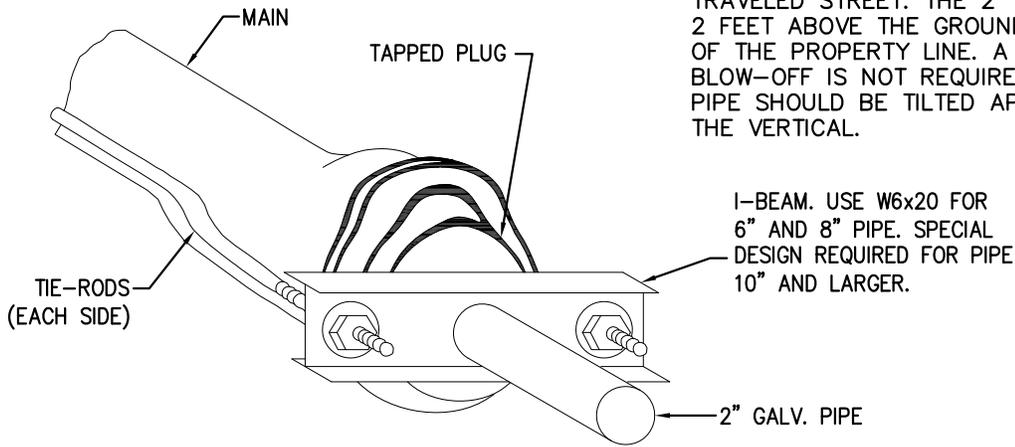


TYPICAL VALVE BOX SETTING

DATE: FEB, 2011

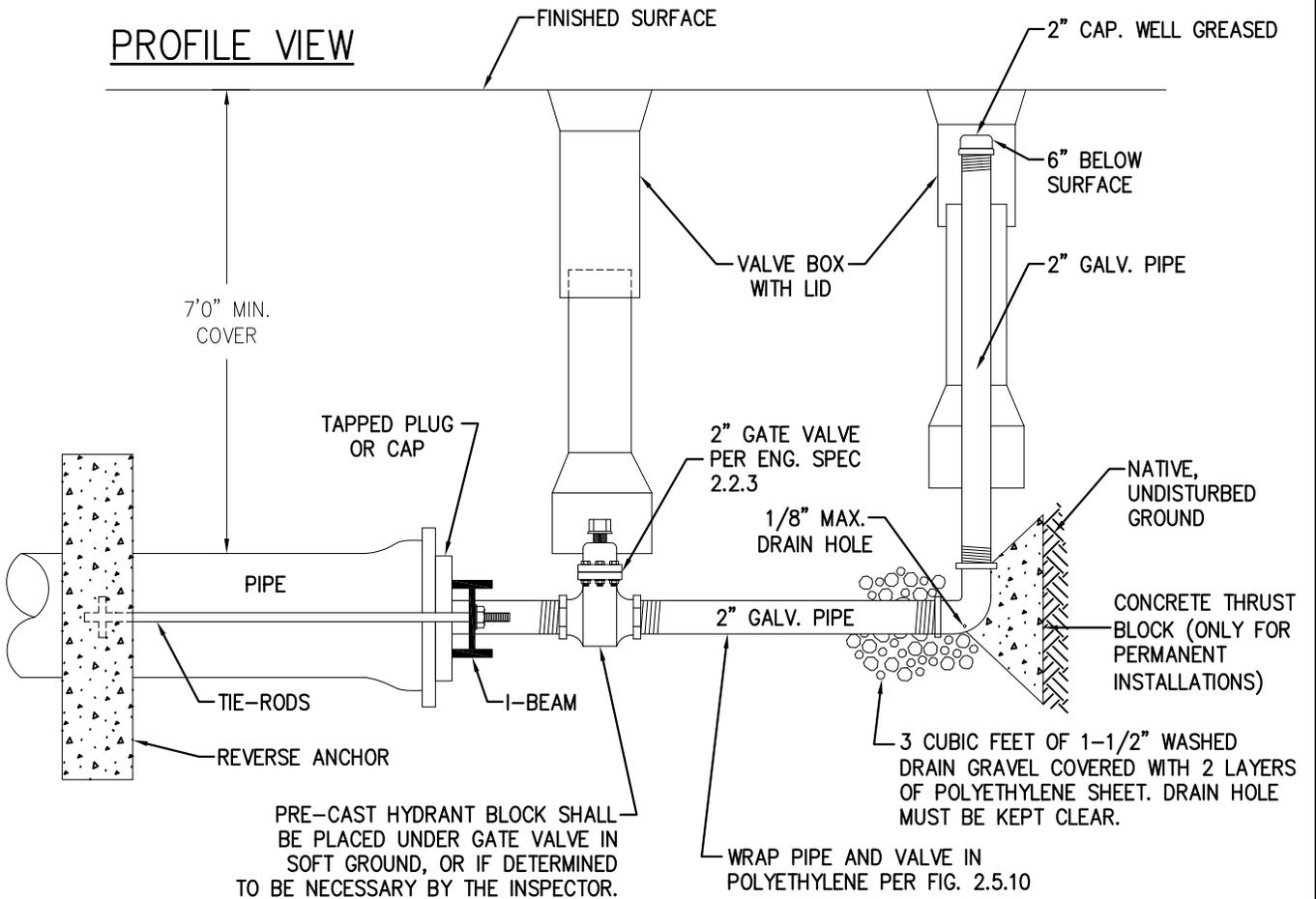
REV. -/-/-

FIG. 2.5.4



IN CASE OF A BLOW-OFF WHICH IS NOT IN A TRAVELED STREET. THE 2" GALV. PIPE MAY PROTRUDE 2 FEET ABOVE THE GROUND SURFACE WITHIN 2 FEET OF THE PROPERTY LINE. A VALVE BOX OVER THE BLOW-OFF IS NOT REQUIRED IN THIS CASE AND THE PIPE SHOULD BE TILTED APPROXIMATELY 10° FROM THE VERTICAL.

ISOMETRIC VIEW, SHOWING PARTIAL DETAIL



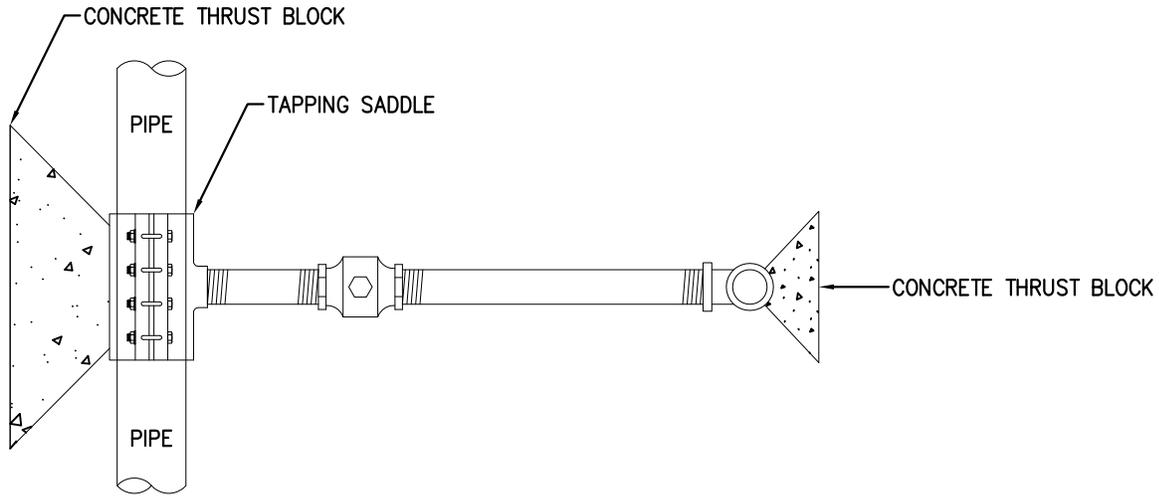
STANDARD BLOW-OFF INSTALLATION (TYPE 1)

DATE: FEB, 2011

REV. -/-/-

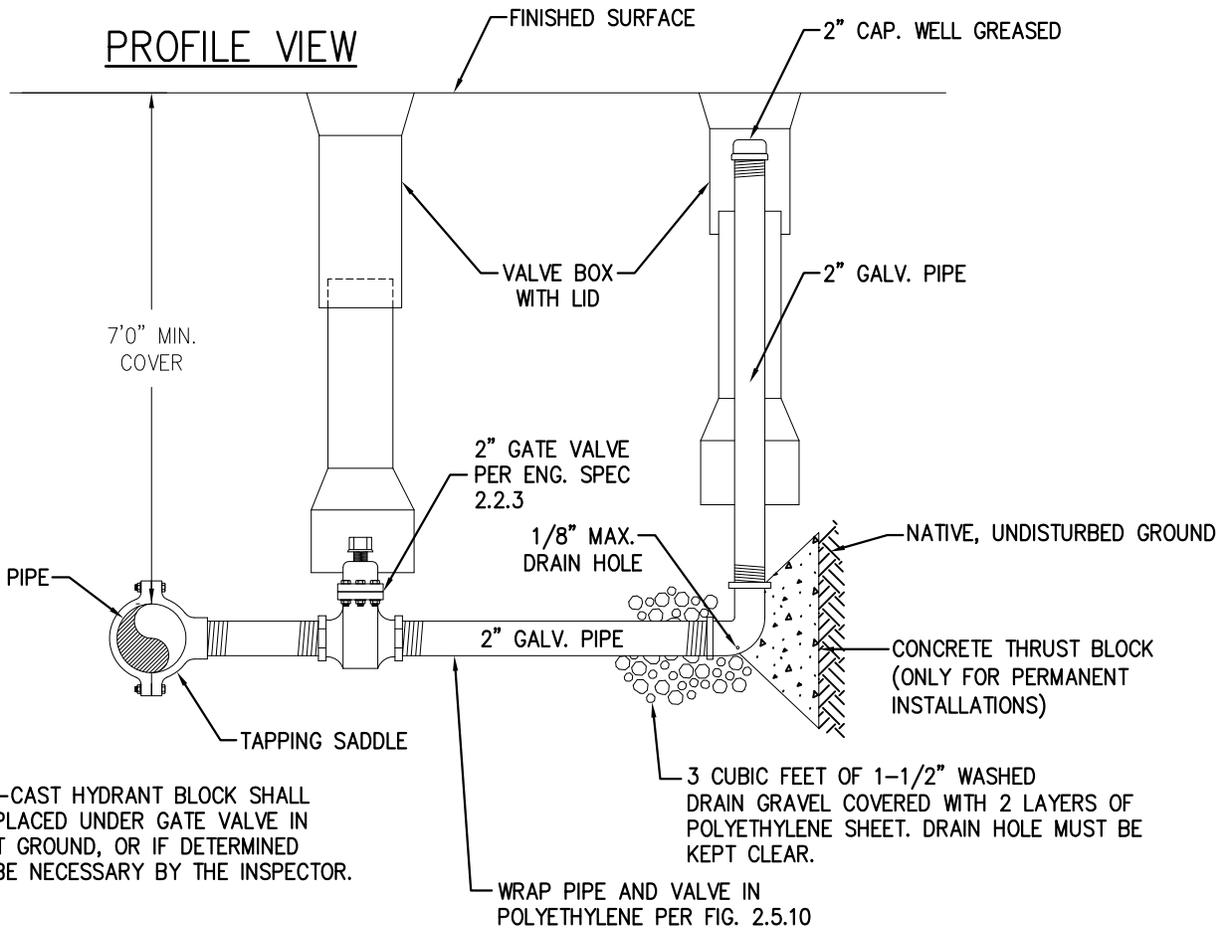
FIG. 2.5.5

PLAN VIEW



IN CASE OF A BLOW-OFF WHICH IS NOT IN A TRAVELED STREET, THE 2" GALV. PIPE MAY PROTRUDE 2 FEET ABOVE THE GROUND SURFACE WITHIN 2 FEET OF THE PROPERTY LINE. A VALVE BOX OVER THE BLOW-OFF IS NOT REQUIRED IN THIS CASE, AND THE PIPE SHOULD BE TILTED APPROXIMATELY 10° FROM THE VERTICAL.

PROFILE VIEW

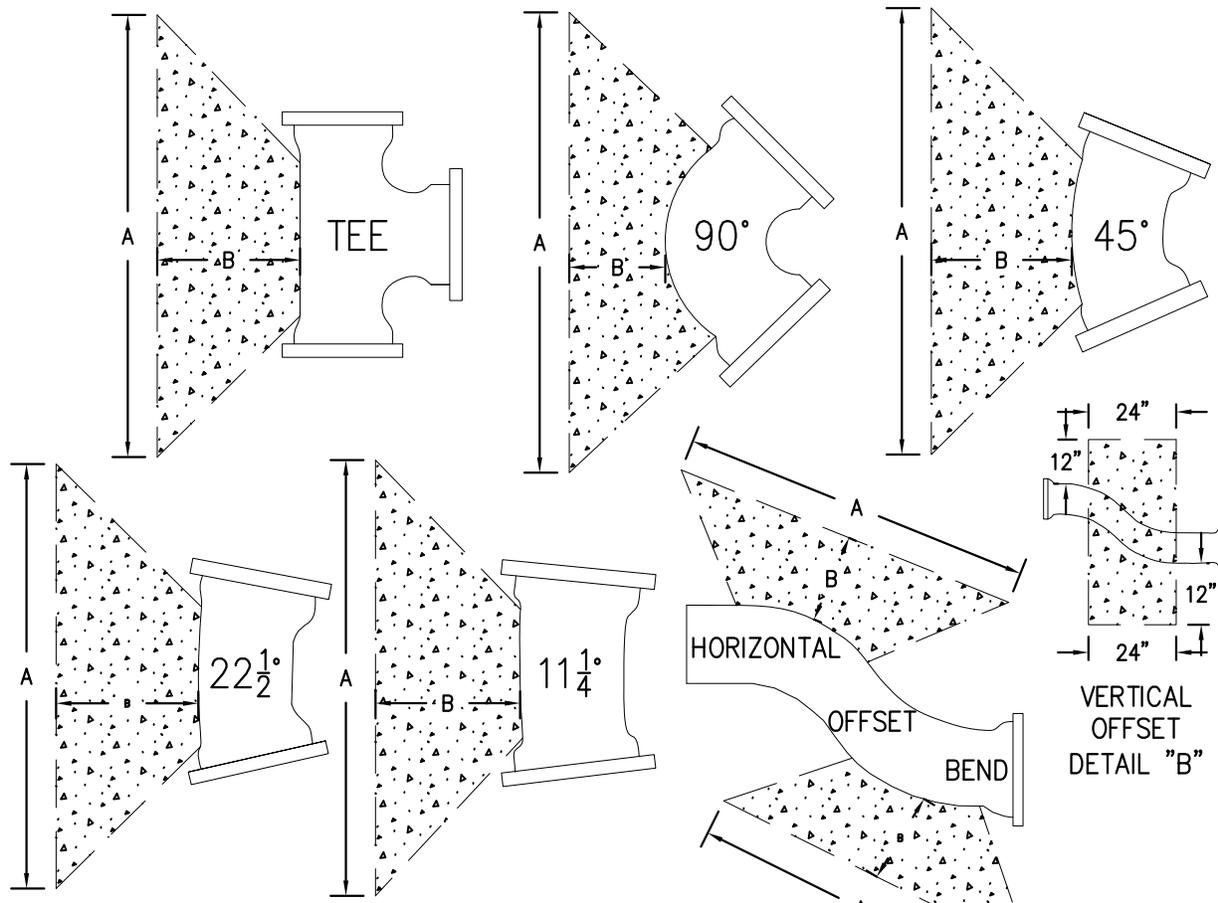


STANDARD BLOW-OFF INSTALLATION (TYPE 2)

DATE: FEB, 2011

REV. -/-/-

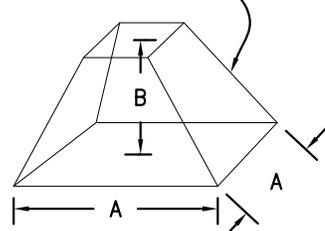
FIG. 2.5.6



DIMENSIONS AND VOLUMES (SEE ISOMETRIC VIEW)

SIZE	TEE			90°			45°			22 1/2°			11 1/4°		
	IN. A	IN. B	CU. YD. VOL	IN. A	IN. B	CU. YD. VOL	IN. A	IN. B	CU. YD. VOL	IN. A	IN. B	CU. YD. VOL	IN. A	IN. B	CU. YD. VOL
4"	1'6"	1'6"	1/8	1'6"	1'6"	1/8	1'6"	1'6"	1/8	1'6"	1'6"	1/8	1'6"	1'6"	1/8
6"	2'0"	2'0"	1/4	2'3"	2'3"	1/4	1'8"	1'8"	1/8	1'6"	1'6"	1/8	1'6"	1'6"	1/8
8"	2'6"	2'6"	1/3	2'10"	2'10"	1/2	2'2"	2'2"	1/4	1'6"	1'6"	1/8	1'6"	1'6"	1/8
10"	3'0"	3'0"	1/2	3'6"	3'0"	3/4	2'8"	2'8"	1/3	1'10"	1'10"	1/8	1'6"	1'6"	1/8
12"	3'6"	3'0"	3/4	4'3"	3'6"	1	3'2"	3'0"	1/2	2'3"	2'3"	1/4	1'8"	1'8"	1/8
14"	4'2"	3'8"	1 1/4	5'0"	4'6"	2 1/4	3'8"	3'6"	1	2'8"	2'8"	1/2	1'10"	1'10"	1/8

ISOMETRIC VIEW, SHOWING A AND B DIMENSIONS.



NOTES:

1. THE REACTION BLOCKS ON THIS PAGE ARE DESIGNED BASED ON INTERNAL PRESSURE OF 300 PSI AND A SOIL BEARING CAPACITY OF 3000 POUNDS PER SQUARE FOOT.
2. WHEN INTERNAL PRESSURES ARE LESS THAN 300 PSI AND/OR SOIL BEARING CAPACITIES ARE GREATER THAN 3000 PSF. THRUST BLOCK DIMENSIONS AND VOLUMES MAY BE ADJUSTED ACCORDINGLY. THE DESIGN ENGINEER SHALL PROVIDE THE APPROPRIATE CALCULATIONS, ALONG WITH DIMENSIONS AND VOLUMES, FOR APPROVAL BY THE CITY ENGINEER PRIOR TO ACCEPTANCE OF PLANS.
3. THRUST BLOCK SIZING SHALL BE BASED ON AN INTERNAL PRESSURE EQUAL TO THE REQUIRED TEST PRESSURE FOR THE LINE.
4. IN POOR SOIL CONDITIONS OR FOR INTERNAL PRESSURES OVER 300 PSI DIMENSIONS AND VOLUMES SHALL BE INCREASED ACCORDINGLY.
5. THE MINIMUM A AND B DIMENSIONS FOR ALL BLOCK ARE 1'6"
6. FOR HORIZONTAL OFFSETS, USE TABLE FOR 45° ELBOWS.
7. FOR VERTICAL OFFSETS, USE DETAIL "B" FOR ANCHOR.
8. THRUST BLOCK DIMENSIONS AND VOLUMES FOR DEAD ENDS SHALL BE THE SAME AS FOR TEE'S.
9. THE ABOVE VOLUMES ARE ROUNDED TO THE NEAREST PORTION OF A CUBIC YARD.
10. NUTS AND BOLTS SHALL REMAIN ACCESSIBLE AND FREE OF SPLASHED CONCRETE. A BOND BREAKER IS REQUIRED BETWEEN FITTINGS AND CONCRETE.
11. REFER TO SECTION 2.2.6 AND 2.3.10 OF THESE SPECIFICATIONS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.
12. WRAP ALL DIP FITTINGS WITH POLYETHYLENE PER FIG. 2.5.10 PRIOR TO POURING THRUST BLOCK.

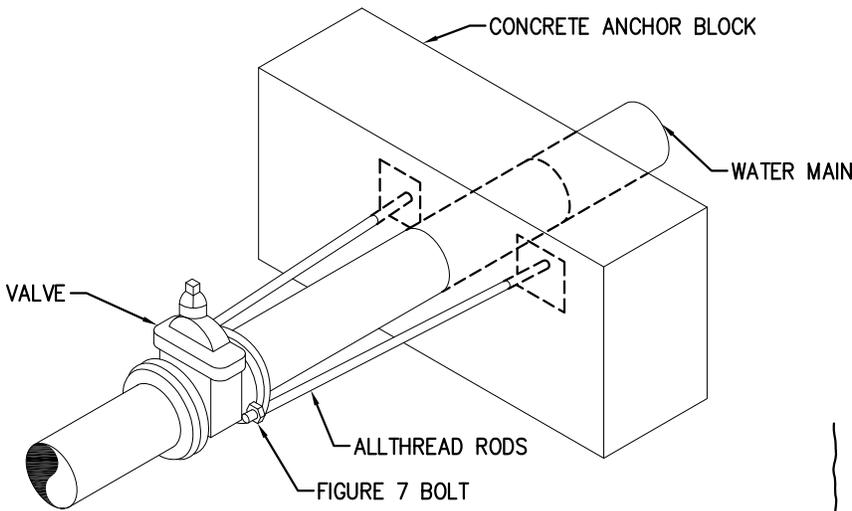


POURED CONCRETE THRUST REACTION BLOCK

DATE: FEB, 2011

REV. -/-/-

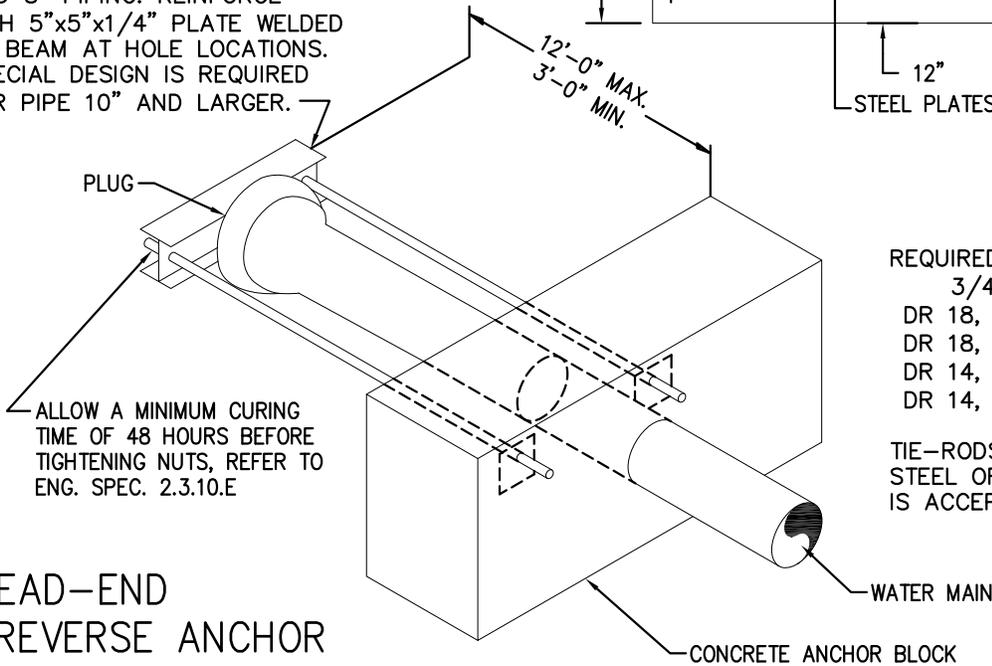
FIG. 2.5.7



VALVE OR TEE ANCHOR

DIMENSIONS:
 T=24" FOR PIPE 12" AND UNDER
 T=36" FOR PIPE OVER 12"
 H=PIPE OD. +24"

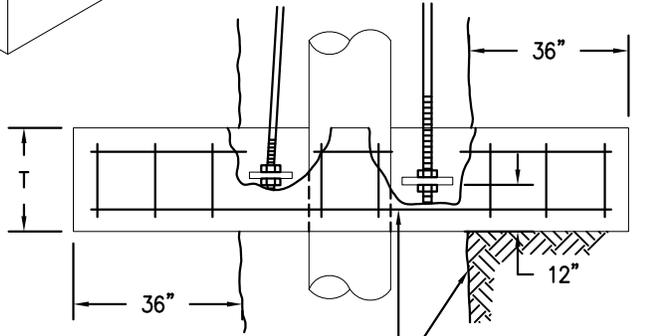
USE W6x20. BEAM FOR 6" AND 8" PIPING. REINFORCE WITH 5"x5"x1/4" PLATE WELDED TO BEAM AT HOLE LOCATIONS. SPECIAL DESIGN IS REQUIRED FOR PIPE 10" AND LARGER.



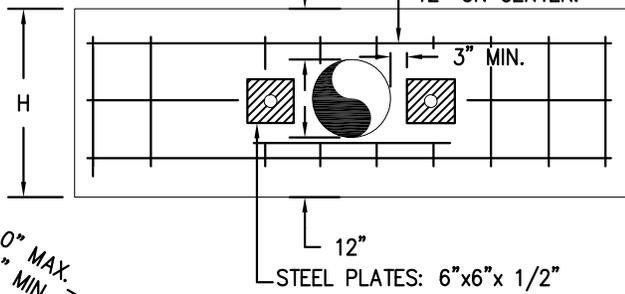
DEAD-END REVERSE ANCHOR

ALLOW A MINIMUM CURING TIME OF 48 HOURS BEFORE TIGHTENING NUTS, REFER TO ENG. SPEC. 2.3.10.E

PLAN
 POUR A MINIMUM OF 36" BACK INTO NATIVE GROUND.



END PROFILE



- REQUIRED NUMBER OF 3/4" TIE-RODS:
- DR 18, 10" AND UNDER: 2
 - DR 18, 12" AND OVER: 4
 - DR 14, 8" AND UNDER: 2
 - DR 14, 10" AND OVER: 4

TIE-RODS SHALL BE STAINLESS STEEL OR PLATED. ALLTHREAD IS ACCEPTABLE.

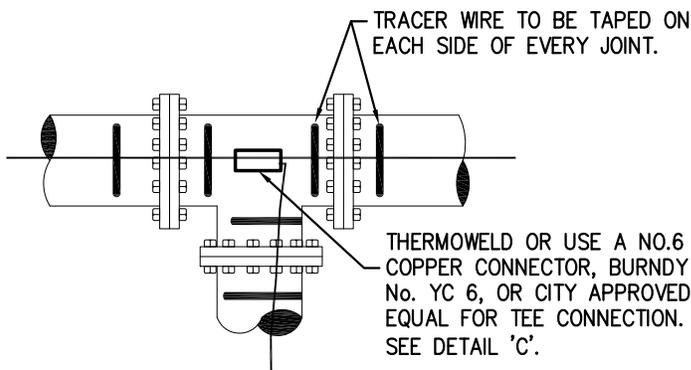
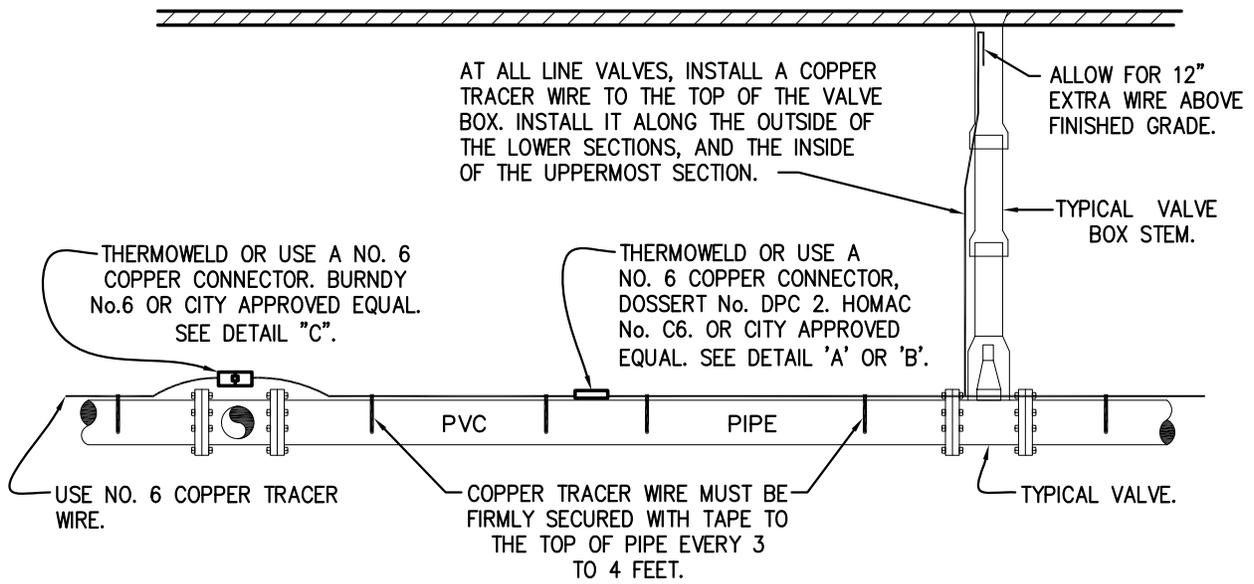


**REVERSE ANCHOR
 DETAIL**

DATE: FEB, 2011

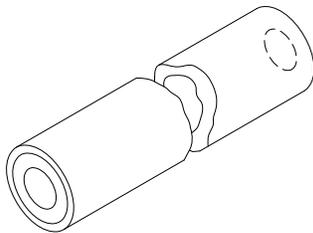
REV. -/-/-

FIG. 2.5.8

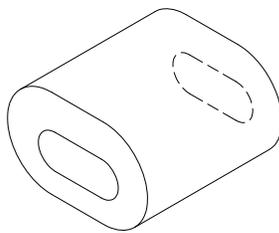


NOTE:
 1. ALL CONNECTIONS SHALL BE SECURELY WRAPPED WITH ELECTRICAL TAPE FOR AT LEAST 3 INCHES ON ALL SIDES OF THE CONNECTOR.

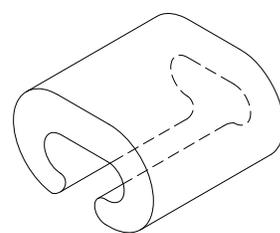
COPPER CONNECTORS



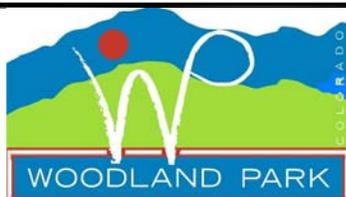
DETAIL "A"



DETAIL "B"



DETAIL "C"

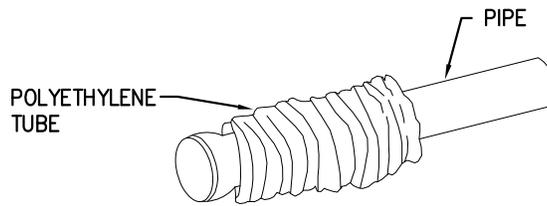


COPPER TRACER WIRE DETAILS

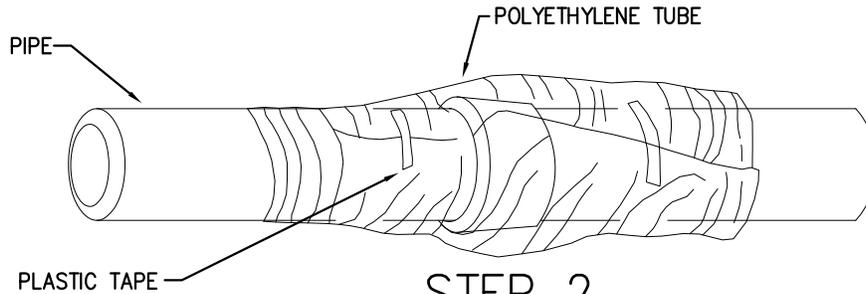
DATE: FEB, 2011

REV. -/-/-

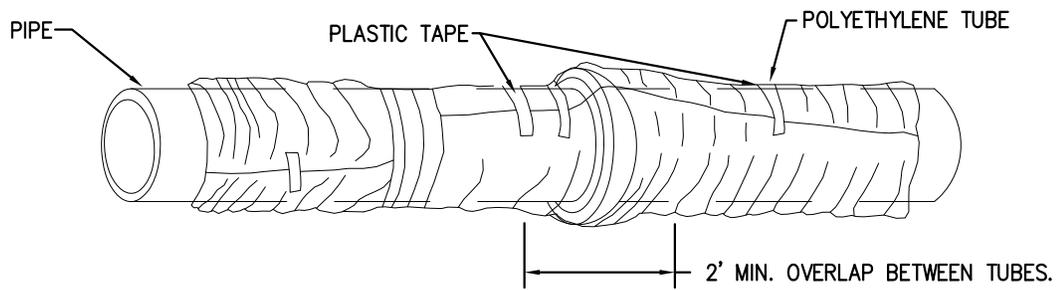
FIG. 2.5.9



STEP 1



STEP 2



STEP 3

STEP 1—PLACE TUBE OF POLYETHYLENE MATERIAL ON PIPE PRIOR TO LOWERING IT INTO TRENCH.

STEP 2—PULL THE TUBE OVER THE LENGTH OF THE PIPE. TAPE TUBE TO PIPE AT JOINT. FOLD MATERIAL AROUND THE ADJACENT SPIGOT END AND WRAP WITH TAPE TO HOLD THE PLASTIC TUBE IN PLACE.

STEP 3—OVERLAP FIRST TUBE WITH ADJACENT TUBE AND SECURE WITH PLASTIC ADHESIVE TAPE. THE POLYETHYLENE TUBE MATERIAL COVERING THE PIPE SHALL BE LOOSE. EXCESS MATERIAL SHALL BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED ON TOP OF PIPE AND TAPED IN PLACE.

POLYETHYLENE WRAP SHALL BE IN CONFORMANCE WITH ANSI/AWWA C105/A21.5

ALL OPENINGS SUCH AS OVERLAP, RIPS AND PUNCTURES SHALL BE SEALED WITH POLYETHYLENE COMPATIBLE ADHESIVE TAPE.

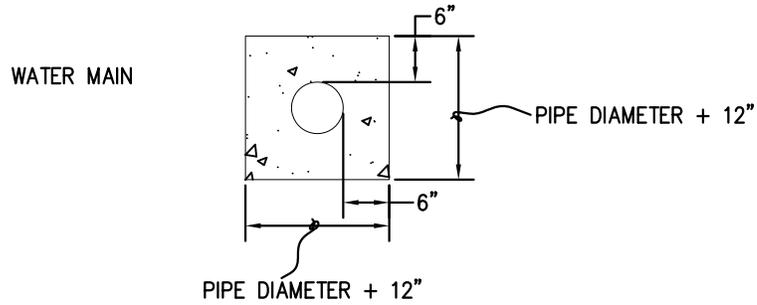
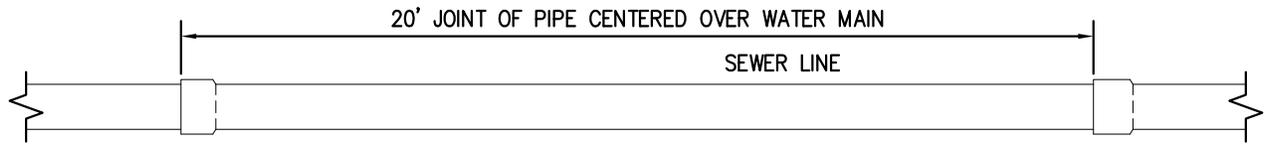


POLYETHYLENE WRAP

DATE: FEB, 2011

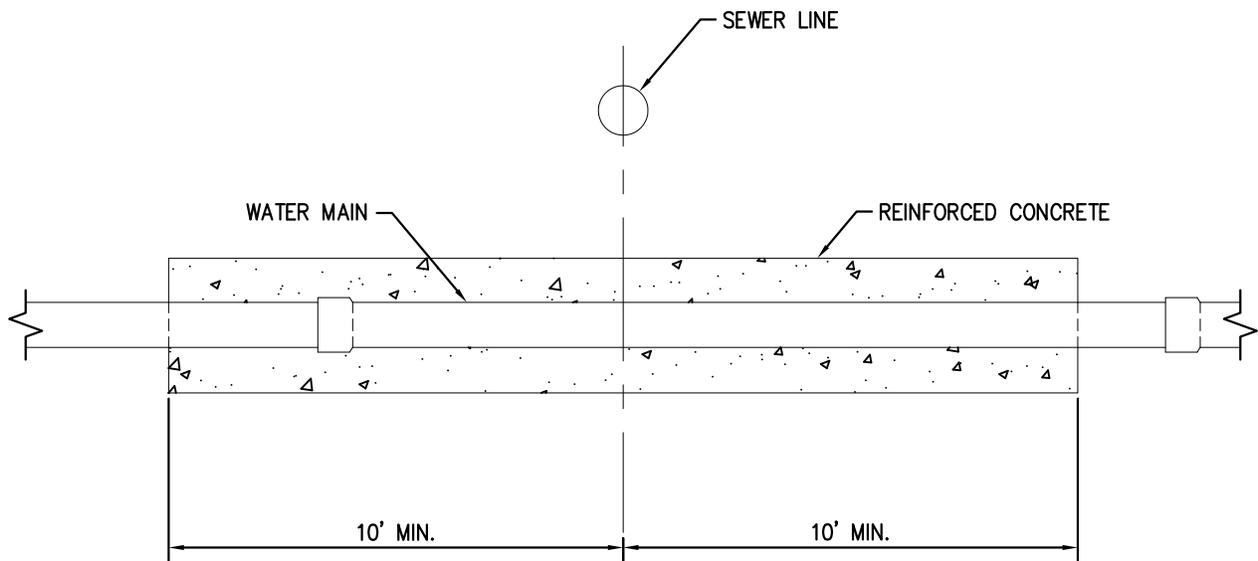
REV. -/-/-

FIG. 2.5.10



END VIEW

NOTE: A 6" THICK REINFORCED CONCRETE ENCASEMENT MAY BE USED IN PLACE OF THE CENTERED 20' JOINT. SAID ENCASEMENT SHALL EXTEND AT LEAST 10' (FT) ON EACH SIDE OF WATER MAIN.



SIDE VIEW

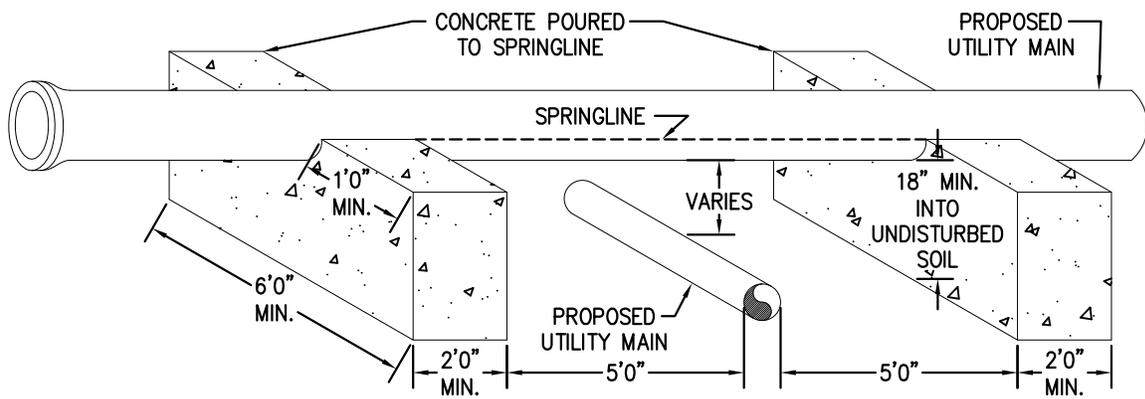


WATER & SEWER CROSSING (TYPE I)

DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.11



- NOTE: 1. BLOCKS SHALL BE REINFORCED WITH NO. 6 REBAR, SET ON 12" CENTERS.
2. NO JOINTS OF UTILITY MAIN ARE ALLOWED BETWEEN THE CONCRETE BRIDGING BLOCKS.

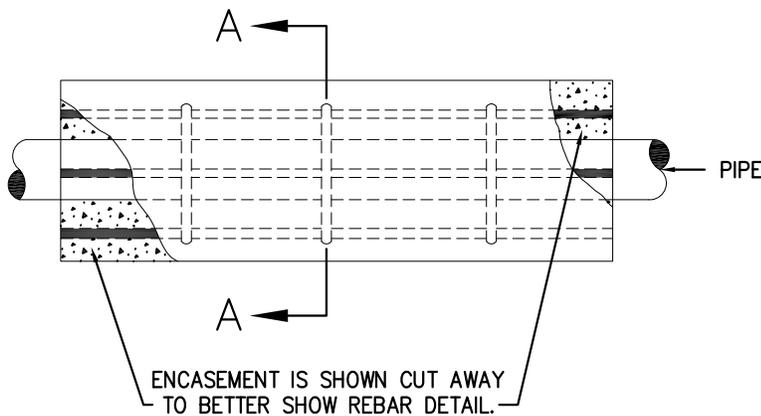
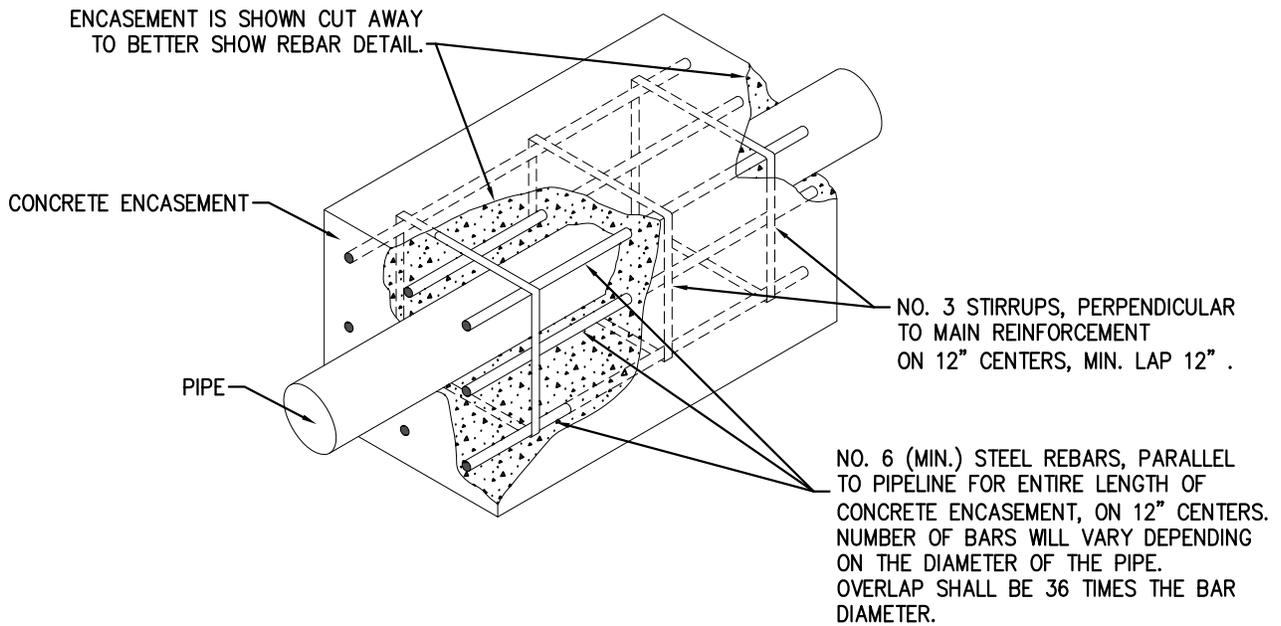


BRIDGING DETAIL

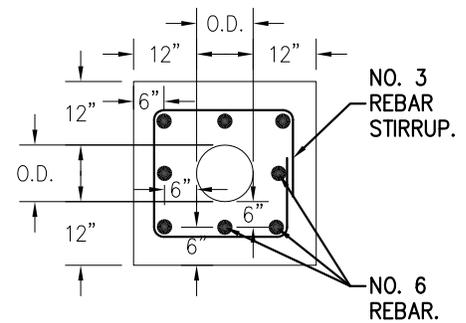
DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.13



PROFILE VIEW



CROSS SECTION A-A

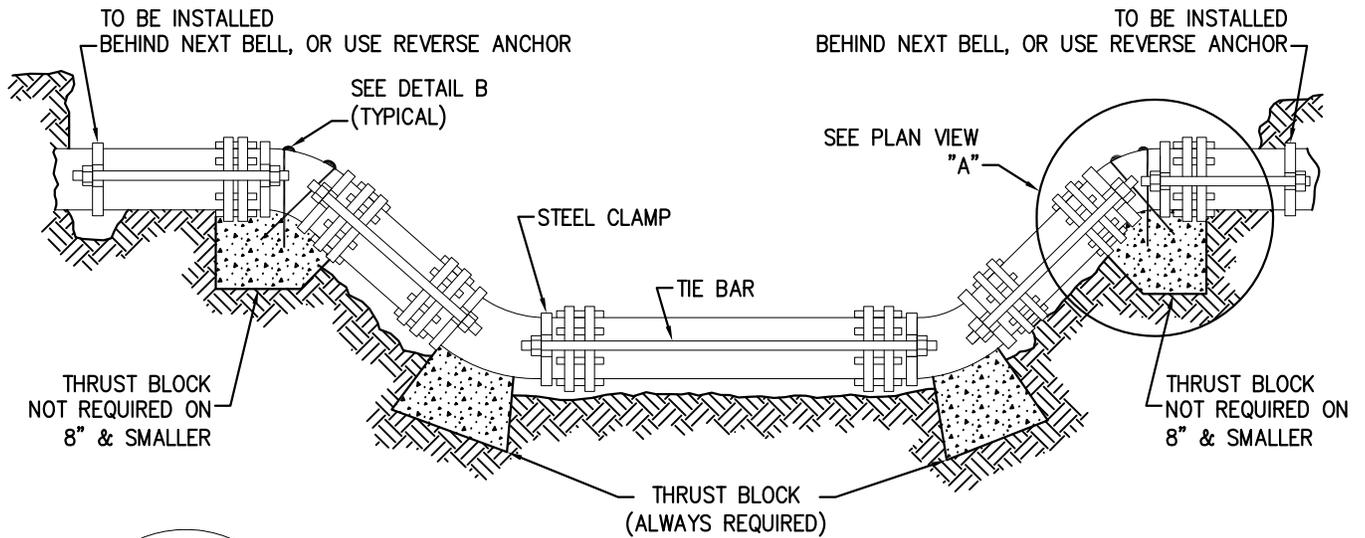


REINFORCED CONCRETE ENCASEMENT DETAIL

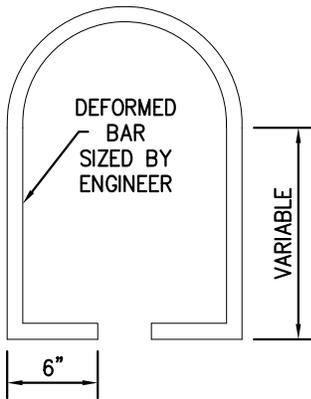
DATE: FEB, 2011

REV. -/-/-

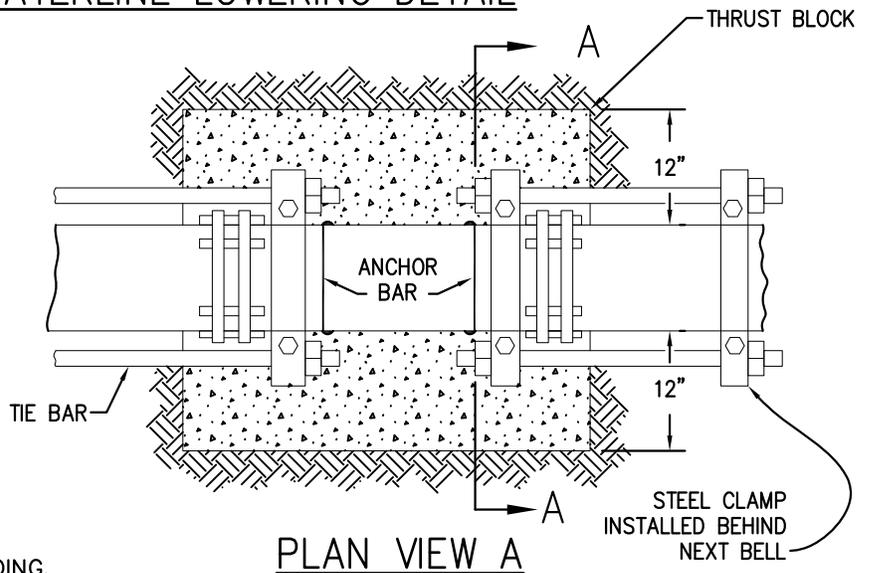
FIG. 2.5.14



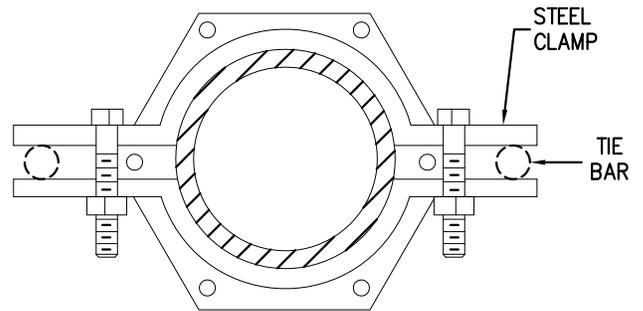
WATERLINE LOWERING DETAIL



DETAIL B
ANCHOR BAR



PLAN VIEW A



SECTION A-A
STEEL CLAMP

NOTES

1. CLAMPS SHALL BE USED FOR RODDING.
2. ALL PIPES & RODS SHALL BE WRAPPED SEPARATELY IN POLYETHYLENE.
3. 45° FITTINGS SHALL BE USED.
4. ALL MATERIALS & CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF WOODLAND PARK ENGINEERING SPECIFICATIONS FOR WATERLINE CONSTRUCTION.
5. THERE SHALL BE A MINIMUM CLEARANCE OF 18" BETWEEN WATERLINE & ANY NEW CONSTRUCTION.
6. FITTINGS SHALL BE RODDED TO THE NEXT BELL.
7. NO JOINTS SHALL BE ALLOWED BETWEEN THE FITTINGS.
8. NUMBER & SIZE OF RODS TO BE DETERMINED BY THE ENGINEER.
9. REFER TO FIG. 2.5.16 FOR PIPE CLAMP AND LUG WASHER DETAIL.

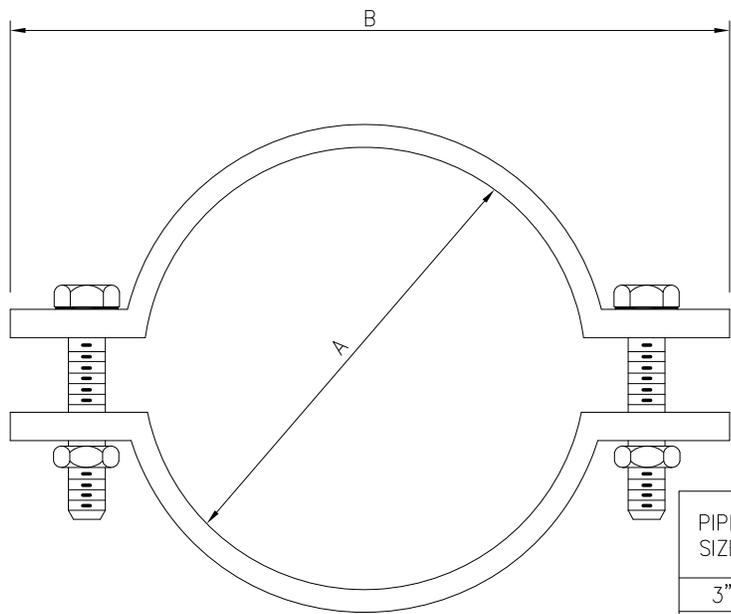


WATERLINE LOWERING DETAIL

DATE: FEB, 2011

REV. -/-/-

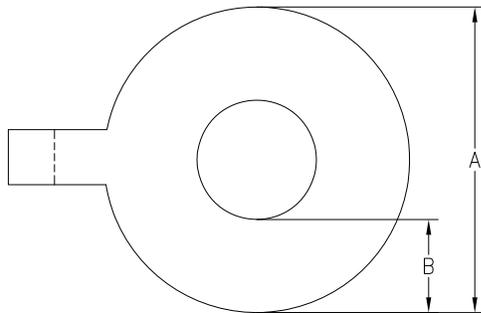
FIG. 2.5.15



MATERIAL : STEEL
 FUNCTION : CLAMP IS USED FOR UNDERGROUND
 A.W.W.A. CAST IRON WATER PIPE TO
 PREVENT JOINTS FROM SEPARATING.
 COMPONENTS: TWO HALF CLAMPS & TWO
 BOLTS WITH NUTS-ASSEMBLED.
 FINISH: GALVANIZED OR PLAIN (MUST BE
 WRAPPED IN POLYETHYLENE)

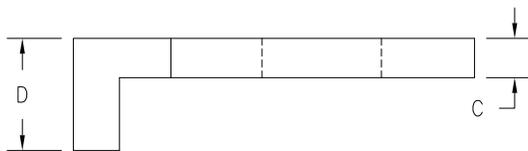
UNDERGROUND CLAMP

PIPE SIZE	A	B	BOLT SIZE	STOCK SIZE	RECOM. TIE-ROD SIZE
3"	3.94	10 7/8	5/8	3/8 x 2	3/4
4"	4.80	12	5/8	1/2 x 2	3/4
6"	6.90	14 5/16	5/8	1/2 x 2	3/4
8"	9.05	15 7/16	5/8	1/2 x 2	3/4
10"	11.10	19 3/16	5/8	1/2 x 2	3/4
12"	13.20	21 7/16	5/8	1/2 x 2	3/4
14"	15.30	26 7/16	7/8	3/4 x 3	1
16"	17.40	28 7/8	1	3/4 x 4	1 1/8
18"	19.50	31 1/4	1 1/4	3/4 x 4	1 1/4
20"	21.60	35 1/4	1 1/4	3/4 x 4 1/2	1 3/8
24"	25.80	39 1/4	1 1/2	3/4 x 5	1 1/2



MATERIAL : STEEL
 FUNCTION : USE WITH UNDERGROUND CLAMP WHEN THE
 RODS ARE REQUIRED. THE PROJECTING LUG
 BEARS AGAINST THE CLAMP BOLT TO
 PREVENT WASHER AND TIE ROD FROM
 SLIPPING OFF CLAMP.

FINISH: PLAIN (MUST BE WRAPPED) OR GALVANIZED



LUG WASHER

ROD SIZE	A	B	C	D
3/4	2 3/4	7/8	9/16	1 5/8
1	3 3/4	1 1/4	11/16	3 1/4
1 1/4	3 3/4	1 3/8	11/16	3 1/4
1 3/8	3 3/4	1 1/2	11/16	3 1/4
1 1/2	3 3/4	1 5/8	11/16	3 1/4

NOTES:

1. CLAMPS SHALL BE USED FOR ALL HARNESS RODDING.
2. STAINLESS STEEL OR GALVANIZED NUTS, BOLTS AND RODS ARE REQUIRED.
3. "ELCAR" OR APPROVED EQUAL SHALL BE USED.
4. TIE ROD SIZE SHALL BE IN ACCORDANCE WITH THE TABLE UNLESS OTHERWISE SPECIFIED.



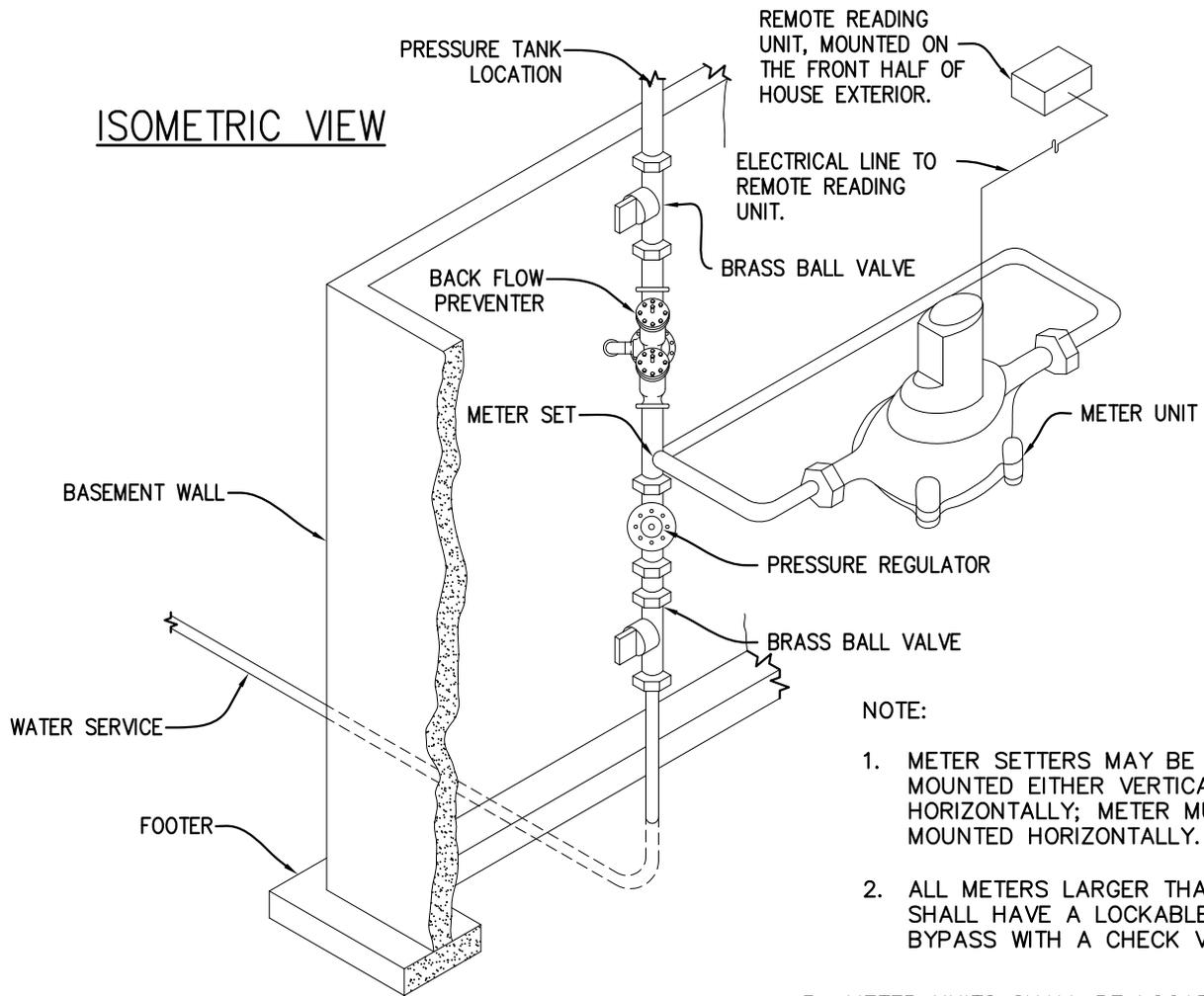
**WATERLINE STANDARD
 DETAIL
 PIPE CLAMP**

DATE: FEB, 2011

REV. -/-/-

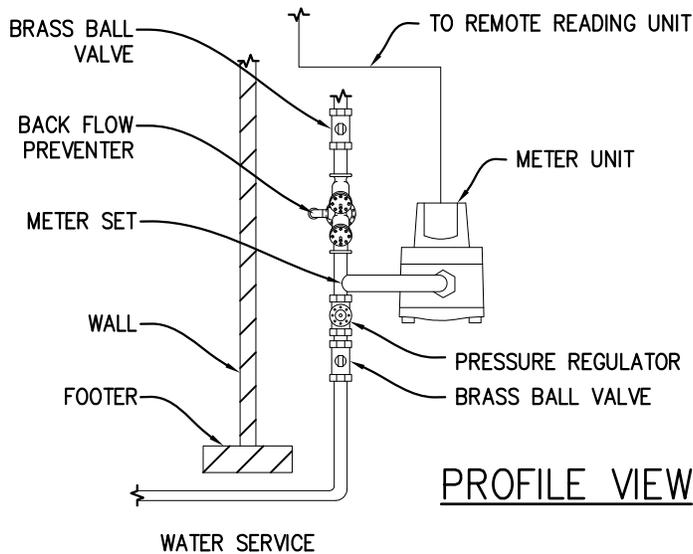
FIG. 2.5.16

ISOMETRIC VIEW



NOTE:

1. METER SETTERS MAY BE MOUNTED EITHER VERTICALLY OR HORIZONTALLY; METER MUST BE MOUNTED HORIZONTALLY.
2. ALL METERS LARGER THAN 1" SHALL HAVE A LOCKABLE BYPASS WITH A CHECK VALVE.
3. METER UNITS SHALL BE LOCATED AS FAR AWAY FROM CRAWL SPACE VENTS AS POSSIBLE TO PREVENT FREEZING.
4. WATER SERVICE LINES MAY COME THRU THE BASEMENT WALL OR UNDER THE FOOTER, AS LONG AS 7 FEET OF COVER IS MAINTAINED OUTSIDE.
5. ALL SERVICE INSTALLATIONS SHALL BE PROVIDED WITH BACKFLOW DEVICE PER STATE DEPARTMENT OF HEALTH CROSS CONNECTION MANUAL. RESIDENTIAL BACKFLOW PROTECTION SHALL BE PROVIDED IN THE METER SETTER.
6. ALL IN-BUILDING WATER PLUMBING SYSTEMS SHALL BE EQUIPPED WITH A PROPERLY SIZED EXPANSION TANK TO PREVENT OVER-PRESSURING DUE TO THERMAL EXPANSION.



PROFILE VIEW



REMOTE READING WATER METER TYPICAL INSIDE SETTING

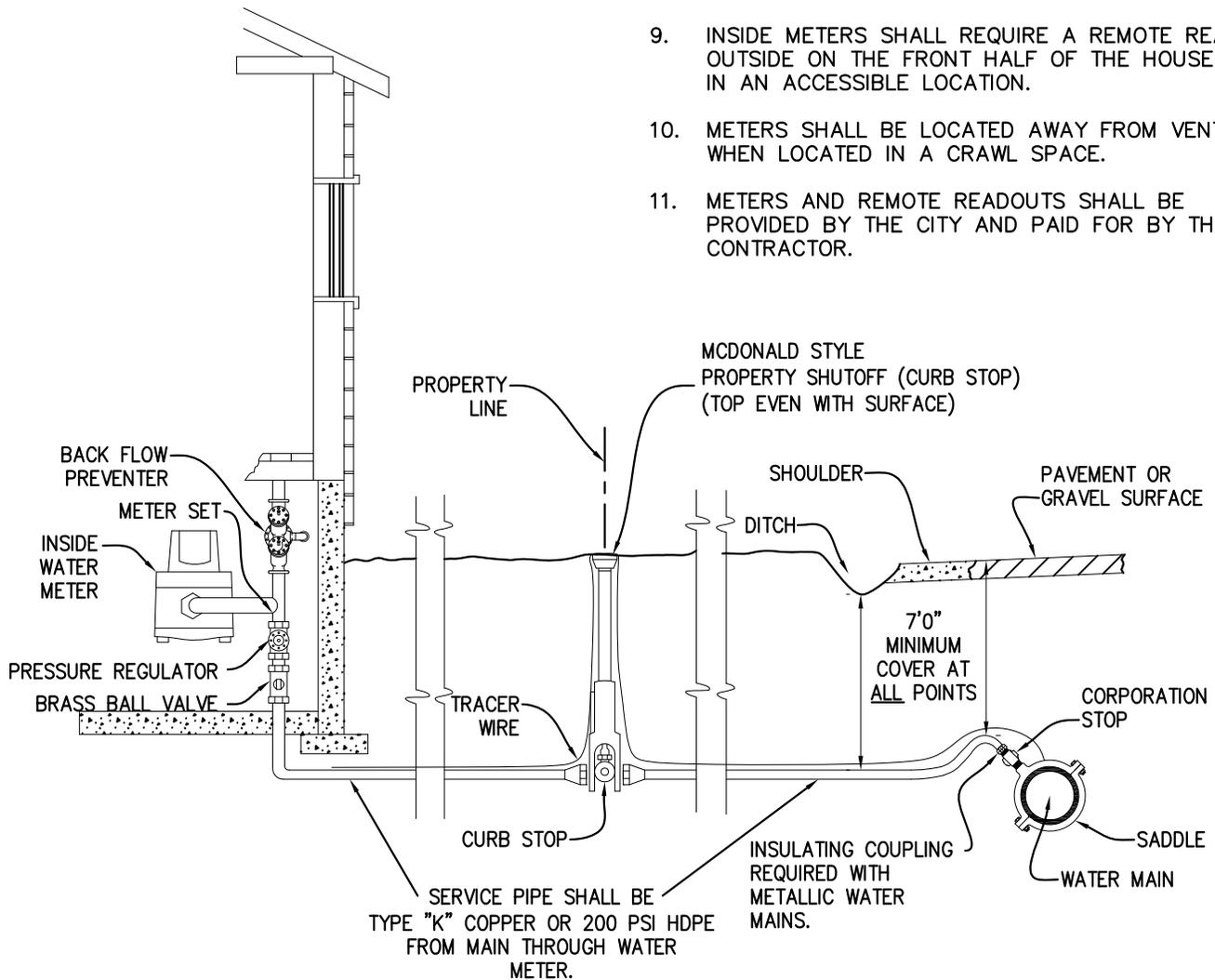
DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.17

NOTE:

1. TAP LOCATION MUST BE RECORDED ON AS-BUILT PLANS, AND SUBMITTED TO THE CITY.
2. SERVICE LINE MUST RUN AT RIGHT ANGLES TO THE PROPERTY LINE FROM THE MAIN TO THE PROPERTY SHUT OFF.
3. ALL TAPS TO WATER MAIN SHALL BE MADE ACCORDING TO THE PIPE MANUFACTURER'S SPECIFICATIONS AND CITY ENGINEERING SPECIFICATIONS. A SADDLE SHALL BE USED. ALL TAPPING PROCEDURES SHALL BE APPROVED BY THE CITY ENGINEER.
4. TAPE END OF CURB STOP TO KEEP DIRT OUT. CONTRACTOR SHALL INSTALL SERVICE LINES UP TO PROPERTY LINE INCLUDING CURB STOP AND RISER. THE CITY SHALL INSPECT AND APPROVE THIS CONSTRUCTION.
5. BACKFILL AND COMPACTION OVER SERVICE LINE SHALL CONFORM TO CITY ENGINEERING SPECIFICATIONS FOR WATER MAIN INSTALLATION.
6. FOR MULTIPLE TAPS ON ONE PIPE, THE TAPS SHALL BE STAGGERED AND NO CLOSER THAN 18 INCHES APART MEASURED LONGITUDINALLY.
7. TAP SHALL BE LOCATED AT 18 INCHES FROM THE SPIGOT END OF THE PIPE; ALSO COMPLETELY WRAP THE TAP AND THREAD OF THE CORPORATION STOP WITH TWO LAYERS OF TEFLON PIPE THREAD TAPE. DO NOT USE PIPE DOPE. TIGHTEN CORPORATION STOP USING A TORQUE WRENCH TO 27 FOOT-POUNDS.
8. ANY METER INSTALLATION LARGER THAN ONE INCH SHALL REQUIRE A BYPASS WITH A LOCKING DEVICE AND A BACKFLOW PREVENTION DEVICE PER STATE DEPARTMENT OF HEALTH CROSS CONNECTION MANUAL.
9. INSIDE METERS SHALL REQUIRE A REMOTE READ OUTSIDE ON THE FRONT HALF OF THE HOUSE IN AN ACCESSIBLE LOCATION.
10. METERS SHALL BE LOCATED AWAY FROM VENTS WHEN LOCATED IN A CRAWL SPACE.
11. METERS AND REMOTE READOUTS SHALL BE PROVIDED BY THE CITY AND PAID FOR BY THE CONTRACTOR.

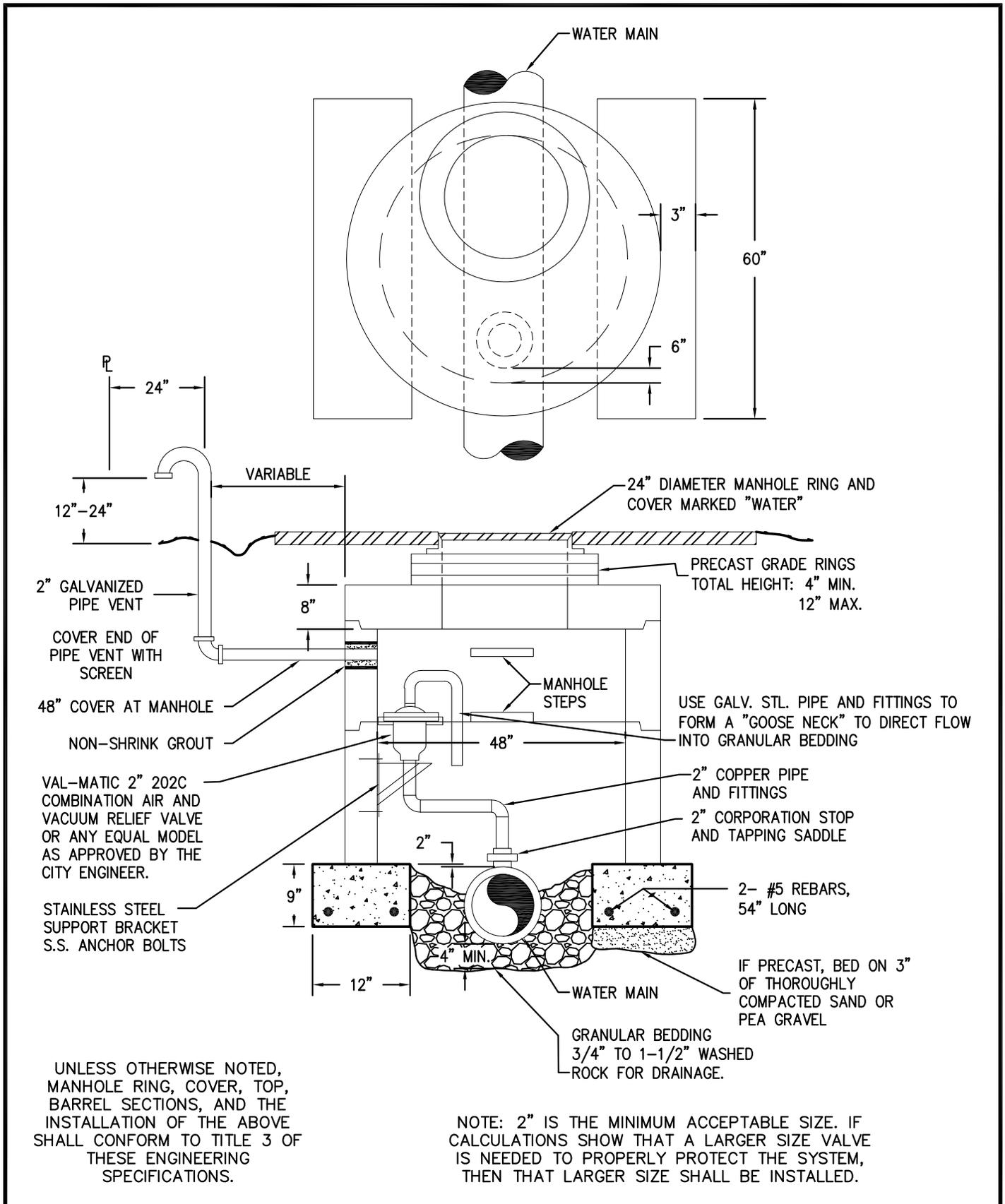


3/4" & 1" SERVICE INLINE DETAIL INSIDE METER SETTING

DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.18

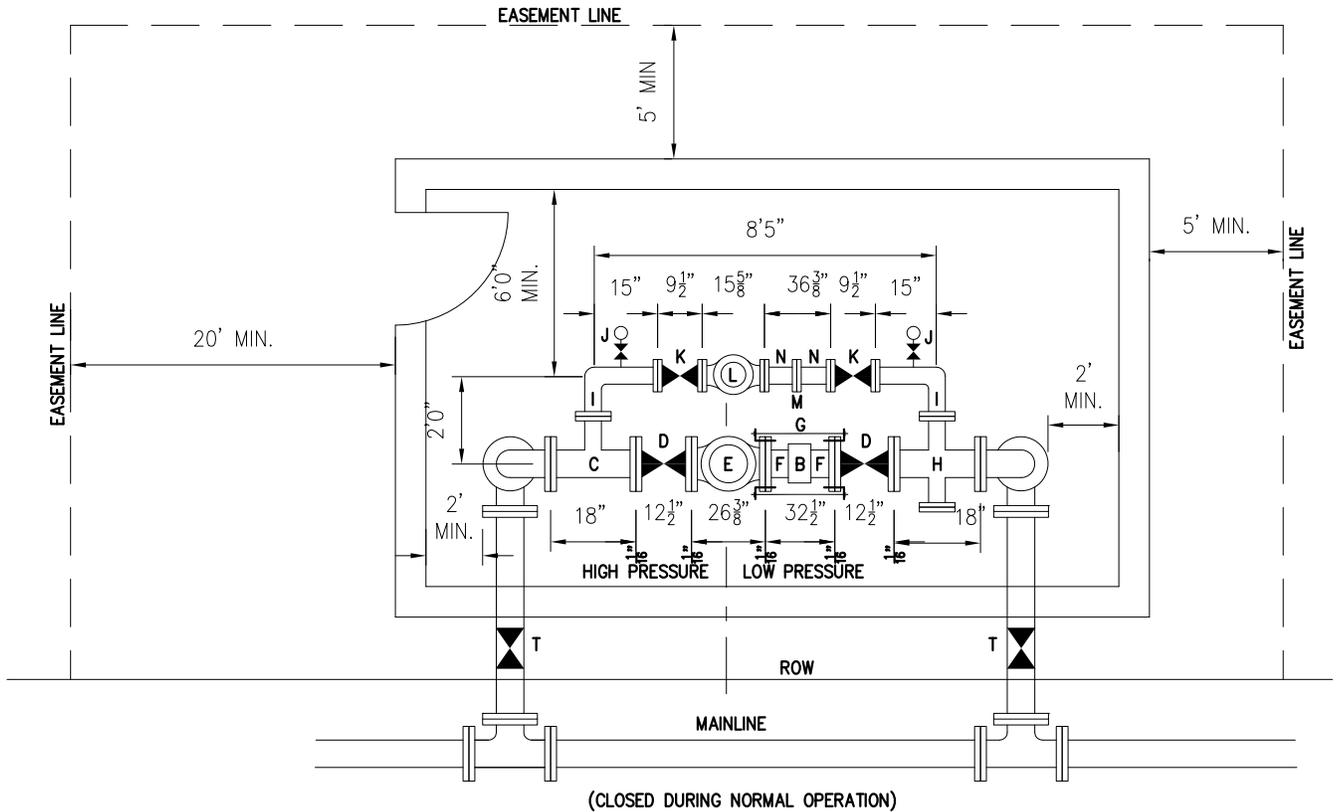


AIR VACUUM RELEASE VALVE INSTALLATION

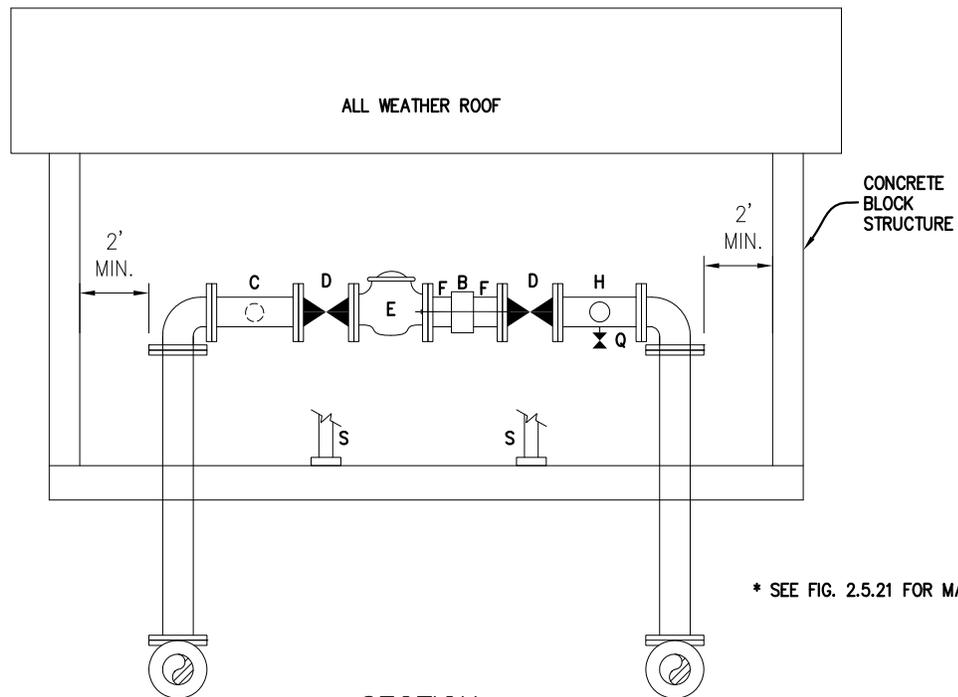
DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.19



PLAN VIEW



SECTION



8-INCH PRESSURE REDUCING STATION (PAGE 1)

DATE: FEB, 2011

REV. -/-/-

FIG. 2.5.20

LISTING OF PARTS AND SPECIFICATIONS FOR DESIGN AND EQUIPMENT
FOR TYPICAL 6" AND 8" PRESSURE REDUCING STATIONS

MAJOR PARTS LIST, WITH REFERENCE TO APPROPRIATE
CITY OF WOODLAND PARK ENGINEERING SPECIFICATIONS:

- B. 8" COUPLING (2.2.9)
- C. 8"x8"x4" FLANGED TEE (2.2.4)
- D. 8" FLANGED GATE VALVE (2.2.3)
- E. 8" CLA-VALVE PRESSURE REDUCING VALVE, CLAYTON 90G-01AB
- F. 8" FLANGE X PLAIN-END (APPROX 16-1/4", CUT TO FIT)
- G. 3/4" TIE ROD (2.3.10.A)
- H. 8"x4" FLANGE REDUCING CROSS (2.2.4)
- I. 4" FLANGED ELBOW (2.2.4)
- J. PRESSURE INDICATOR GAUGE
- K. 4" FLANGED GATE VALVE (2.2.3)
- L. 4" CLA-VALVE PRESSURE REDUCING VALVE, CLAYTON 90G-01AB
- M. 4" COUPLING, WITH TIE RODS (2.2.9, 2.3.10.A) (UNION
MAY BE USED FOR INSTALLATIONS SMALLER THAN 4")
- N. 4" FLANGE X PLAIN-END (APPROX. 18". CUT TO FIT)
- P. 3" PRESSURE SURGE RELIEF VALVE
- Q. STOPCOCK (DRAIN VALVE)
- R. 4" DUCTILE IRON PIPE (2.2.1.A.1)
- S. ADJUSTABLE PIPE SUPPORT
- T. 8" GATE VALVE. MJ X MJ (2.2.3)

NOTES ON DESIGN AND PARTS SPECIFICATIONS:

1. PRESSURE REDUCING STATION TO BE LOCATED
IN ABOVE GROUND STRUCTURE IN PUBLIC
RIGHT-OF-WAY OR DEDICATED CITY EASEMENT.

2. PROVIDE WATER DEMAND CALCULATIONS
AND APPLICABLE MANUFACTURERS DATA TO
JUSTIFY SIZING OF PRESSURE REDUCING VALVES.

3. OPERATING CONDITIONS SHALL BE
STATED FOR EACH PIECE OF EQUIPMENT.
THE FOLLOWING IS A SAMPLE OF
APPROPRIATE CALCULATIONS:

- A. INLET CONDITION: 185 PSI
MAXIMUM STATIC PRESSURE.
- B. OUTLET CONDITIONS: 2" PRV: 0
TO 200 GPM AT 93 PSI. 8"
PRV: 200 TO 3000 GPM AT 90
PSI.
- C. PRESSURE SURGE RELIEF VALVE,
3": OPEN AT 100 PSI.
- D. PRESSURE INDICATOR GAUGES:
0 TO 300 PSI.

4. BYPASS SHALL BE OF THE SAME SIZE
PIPE AS THE ADJACENT HIGH AND LOW
PRESSURE MAIN. PARTS AND THRUST RESTRAINTS
SHALL CONFORM TO APPLICABLE
ENGINEERING SPECIFICATIONS, TITLE 2.

5. FIGURE 2.5.20 APPLIES TO 8" AND
6" (HIGH DEMAND SIDE) INSTALLATIONS.
ALL REGULATOR INSTALLATIONS LARGER
THAN 8" SHALL BE SPECIALLY DESIGNED
AND APPROVED BY THE CITY ENGINEER.

6. PIPING DIMENSIONS SHOWN ON FIG.
2.5.20 ARE FOR AN 8" HIGH DEMAND AND
4" LOW DEMAND PRESSURE REDUCING
STATION. IT IS THE RESPONSIBILITY OF
THE DESIGN ENGINEER TO CONFIRM THESE

DIMENSIONS AND MAKE APPROPRIATE
ADJUSTMENT FOR DIFFERENT SIZES OF
REGULATORS.

7. FLANGED FITTINGS (300 POUND) SHALL
BE USED ON THE HIGH PRESSURE SIDE OF
THE PRESSURE REDUCING SYSTEM. FLANGED
OR THREADED CONNECTIONS MAY BE USED
ON THE LOW PRESSURE SIDE FOR PIPING AND
REGULATOR DEVICES 4" OR SMALLER.

8. THREE ADJUSTABLE PIPE SUPPORTS
SHALL BE PROVIDED (PART S). ONE SHALL
BE INSTALLED UNDER EACH 6" OR 8" GATE
VALVE, AND ONE UNDER A VALVE ON THE
LOW VOLUME SIDE.

9. STRUCTURE SHALL INCLUDE, AT A MINIMUM,
LIGHTS, HEAT, ELECTRICAL OUTLETS, SECURITY
DOOR WITH UNAUTHORIZED ENTRY ALARM, AND A
WATER SUPPLY HOSE BIBB.

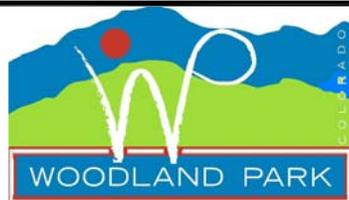
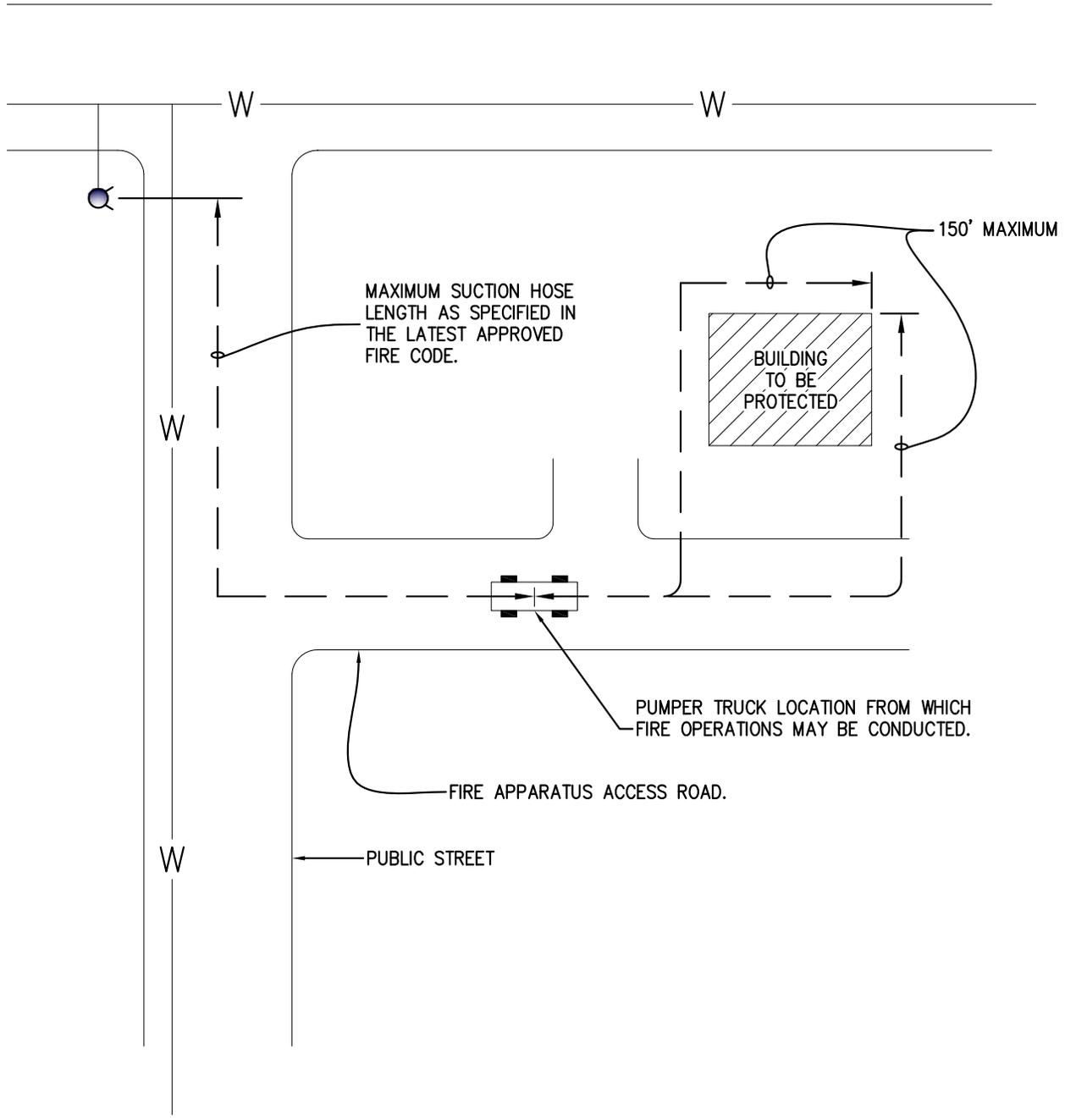


PRESSURE REDUCING
STATIONS (PAGE 2)

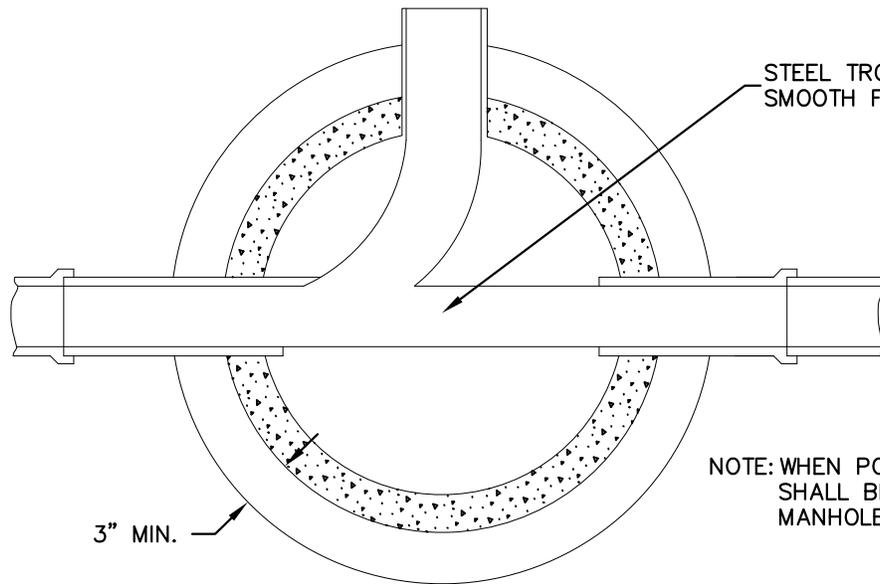
DATE: FEB, 2011

REV. -/-/-

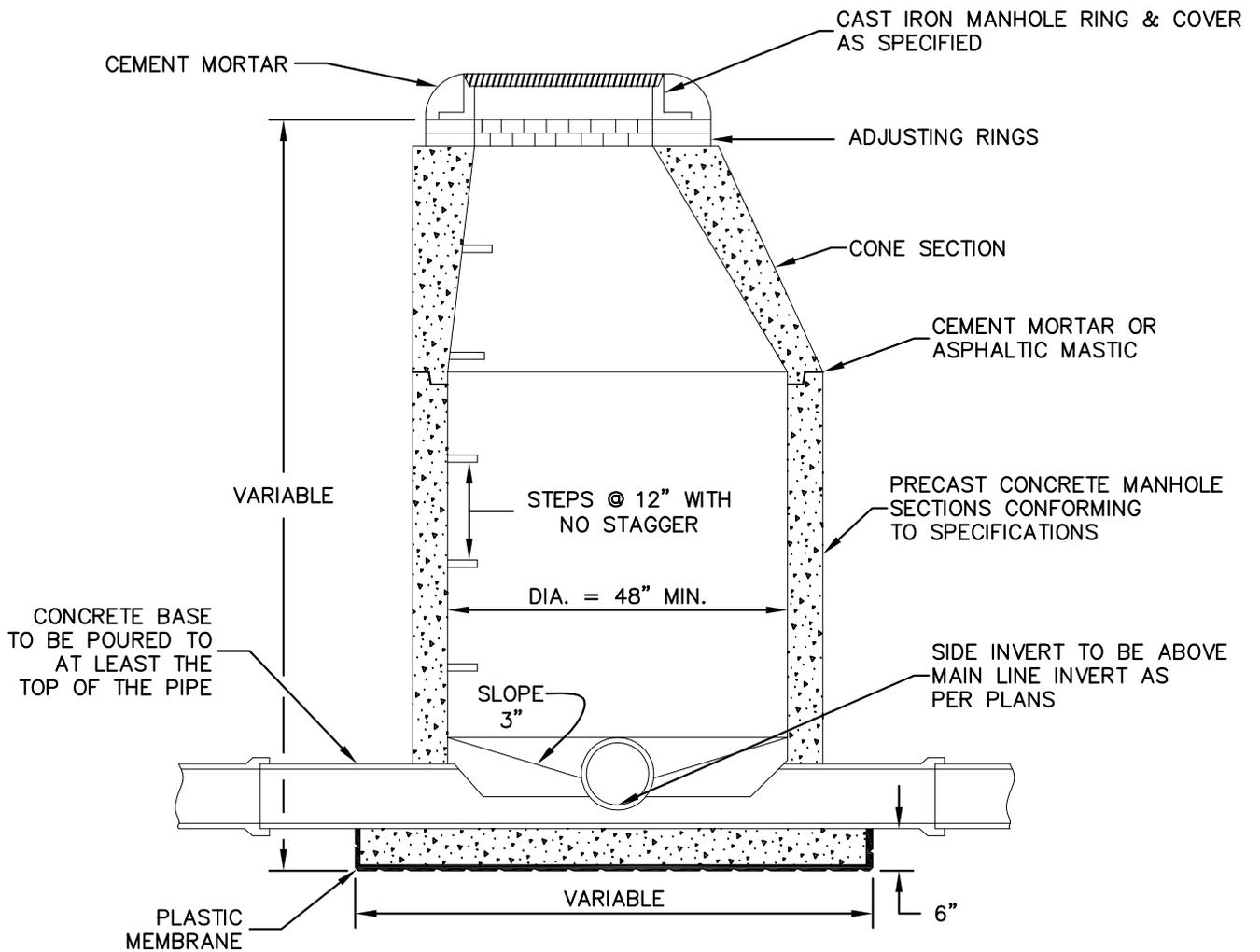
FIG. 2.5.21



FIRE HYDRANT SPACING MEASUREMENTS



NOTE: WHEN POSSIBLE, PIPE SHALL BE LAID THROUGH MANHOLE TO FORM INVERT.



STANDARD MANHOLE CONSTRUCTION

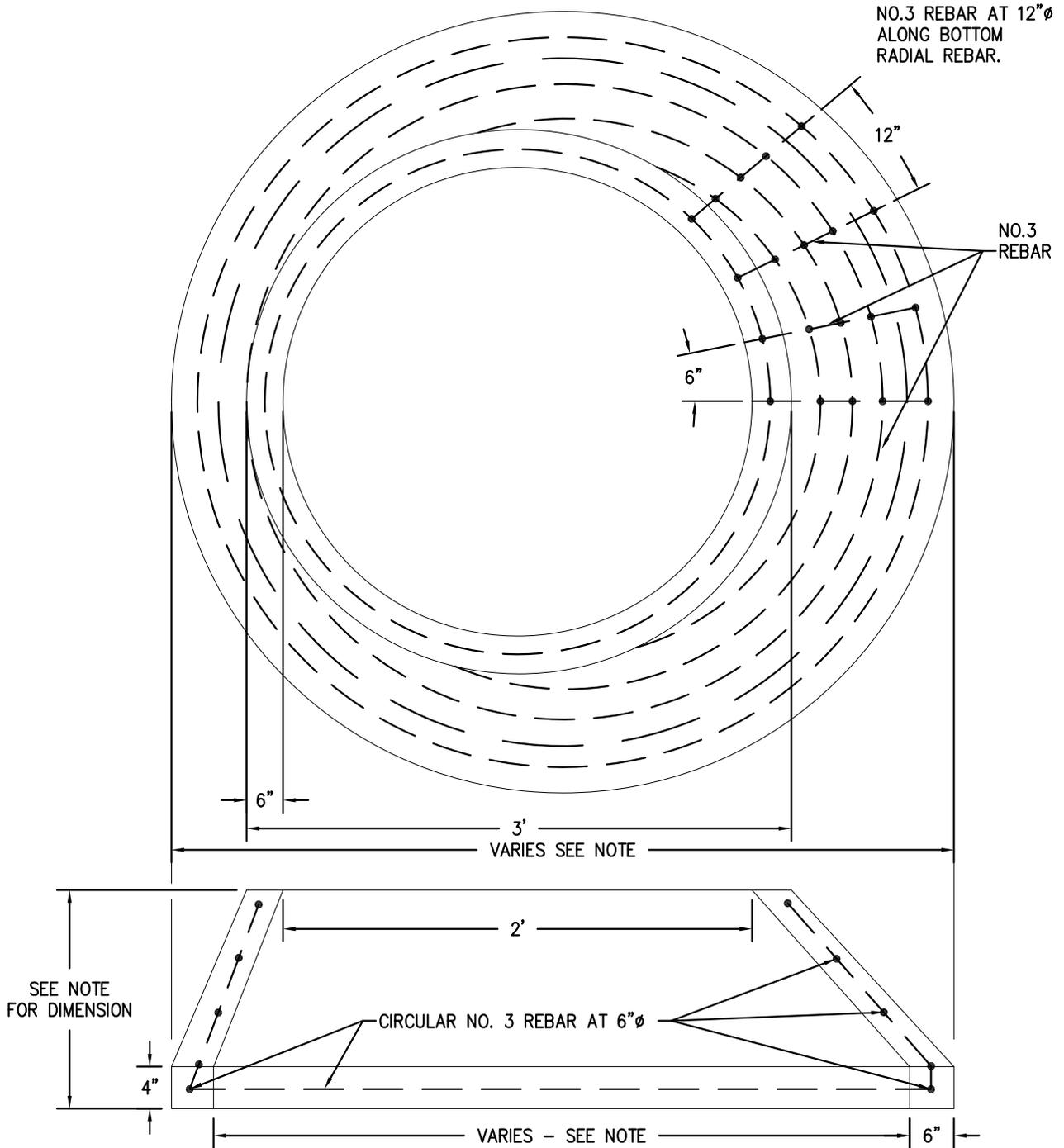
DATE: FEB, 2011

REV. -/-/-

FIG. 3.4.1

NOTE:

- 4' I.D. MH-18" CONE CAP 5' O.D.
- OR 4' I.D. MH-24" CONE CAP 5' O.D.
- 5' I.D. MH-30" CONE CAP 6' O.D.
- 6' I.D. MH-30" CONE CAP 7' O.D.

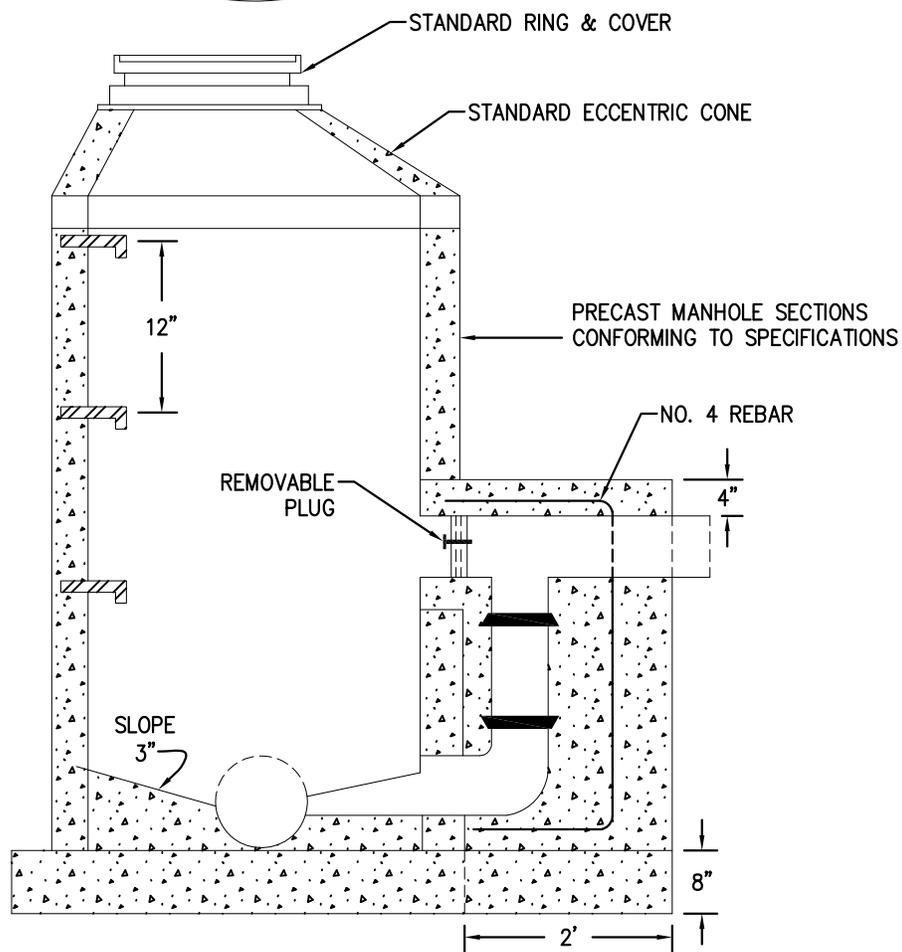
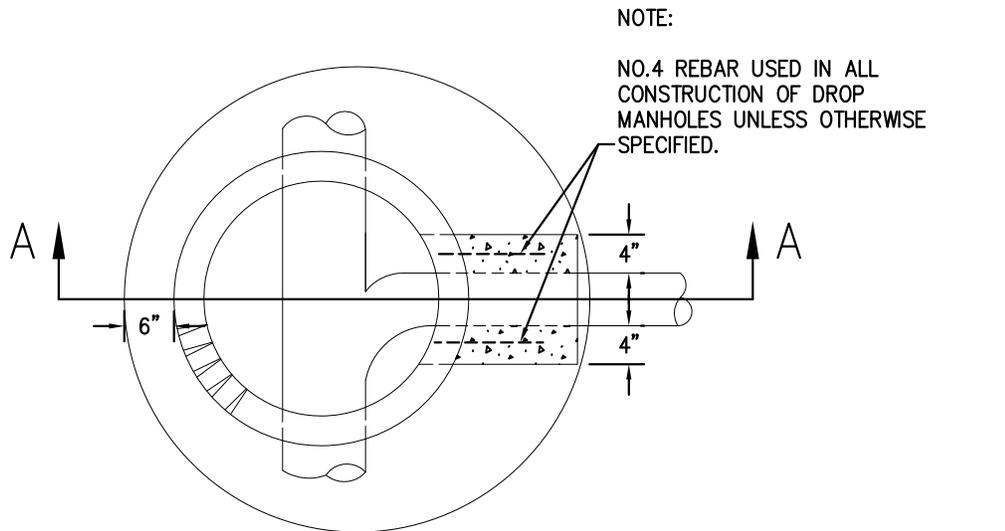


STANDARD CONCRETE MANHOLE CONE CAP

DATE: FEB, 2011

REV. -/-/-

FIG. 3.4.2



SECTION A-A

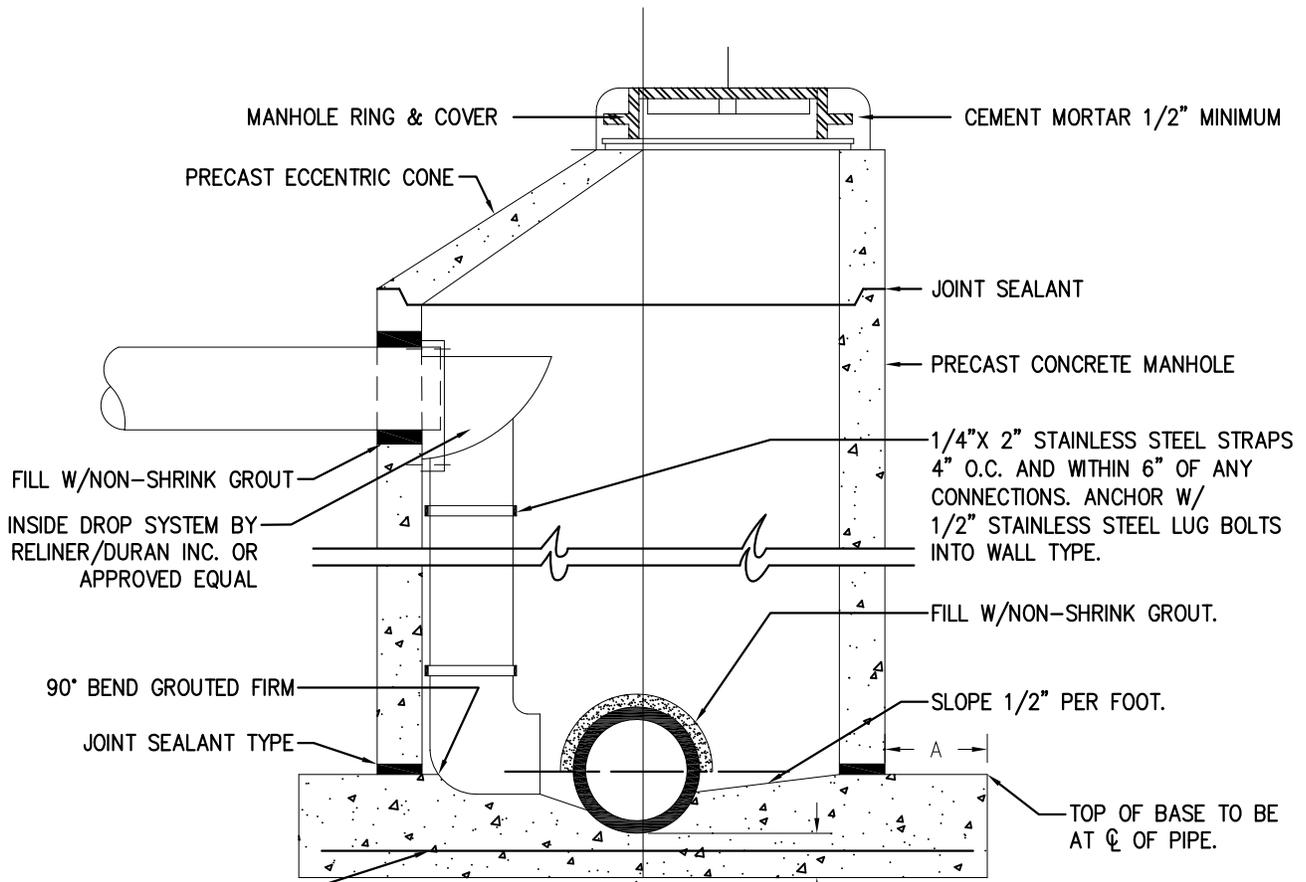


STANDARD OUTSIDE DROP MANHOLE

DATE: FEB, 2011

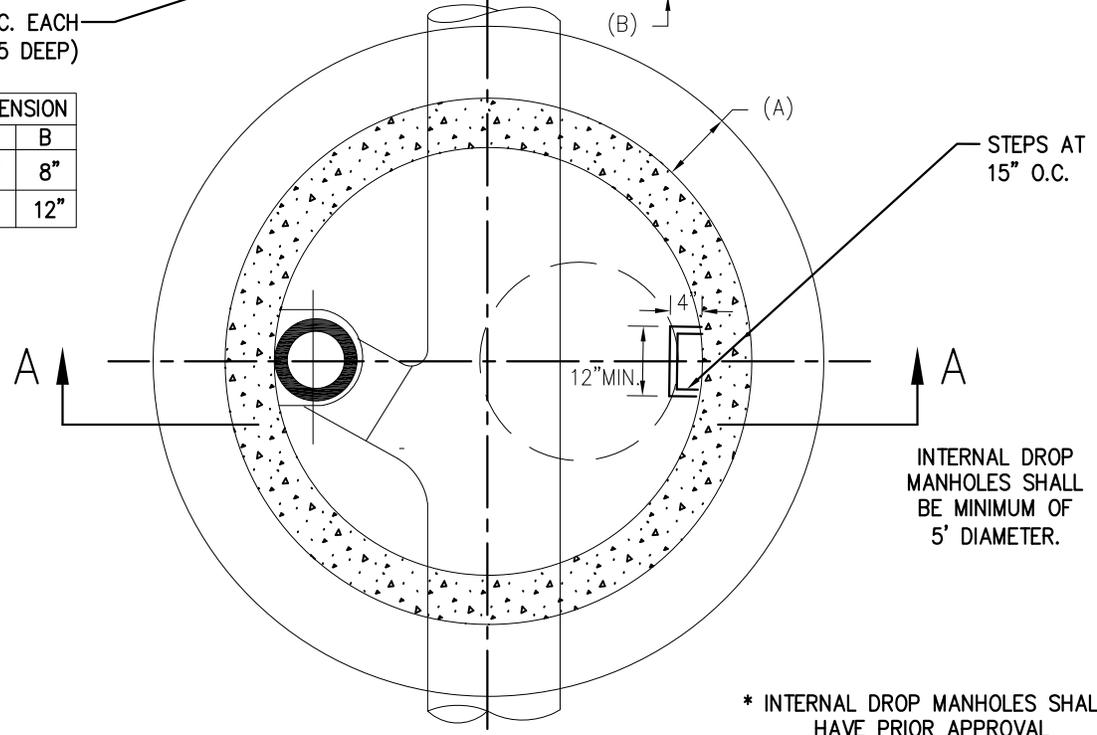
REV. -/-/-

FIG. 3.4.3



#4 BARS 1' O.C. EACH WAY (IF OVER 15 DEEP)

MANHOLE DEPTH	DIMENSION	
	A	B
0' TO 15'	6"	8"
OVER 15'	6"	12"



* INTERNAL DROP MANHOLES SHALL HAVE PRIOR APPROVAL



STANDARD INTERNAL DROP MANHOLE *

DATE: FEB, 2011

REV. -/-/-

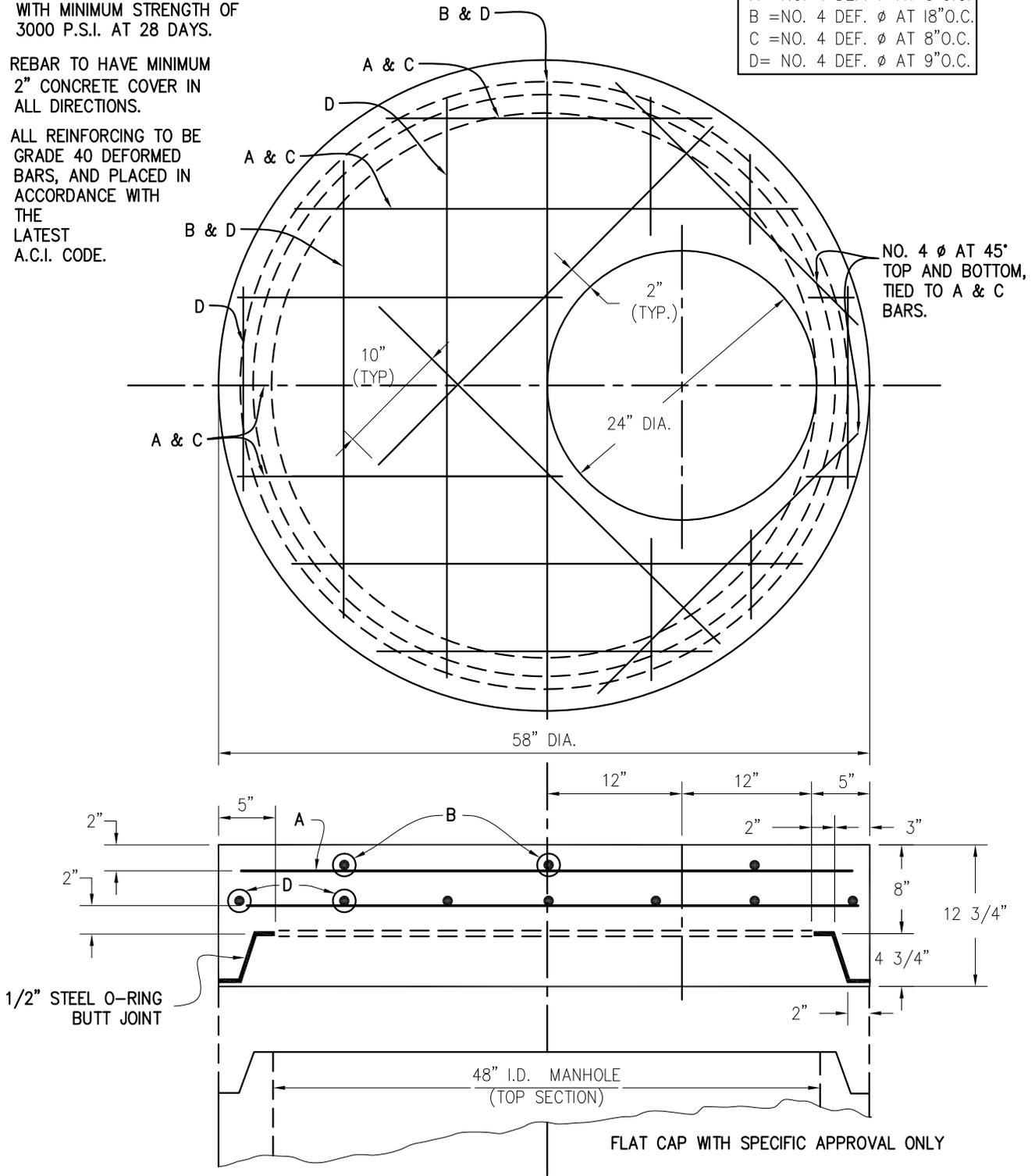
FIG. 3.4.4

H-20 LOADING

NOTE:

1. CONCRETE SHALL BE TYPE II WITH MINIMUM STRENGTH OF 3000 P.S.I. AT 28 DAYS.
2. REBAR TO HAVE MINIMUM 2" CONCRETE COVER IN ALL DIRECTIONS.
3. ALL REINFORCING TO BE GRADE 40 DEFORMED BARS, AND PLACED IN ACCORDANCE WITH THE LATEST A.C.I. CODE.

A	=NO. 4 DEF. ϕ AT 8"O.C.
B	=NO. 4 DEF. ϕ AT 18"O.C.
C	=NO. 4 DEF. ϕ AT 8"O.C.
D	=NO. 4 DEF. ϕ AT 9"O.C.



48" PRE-CAST CONCRETE MANHOLE DECK

DATE: FEB, 2011

REV. -/-/-

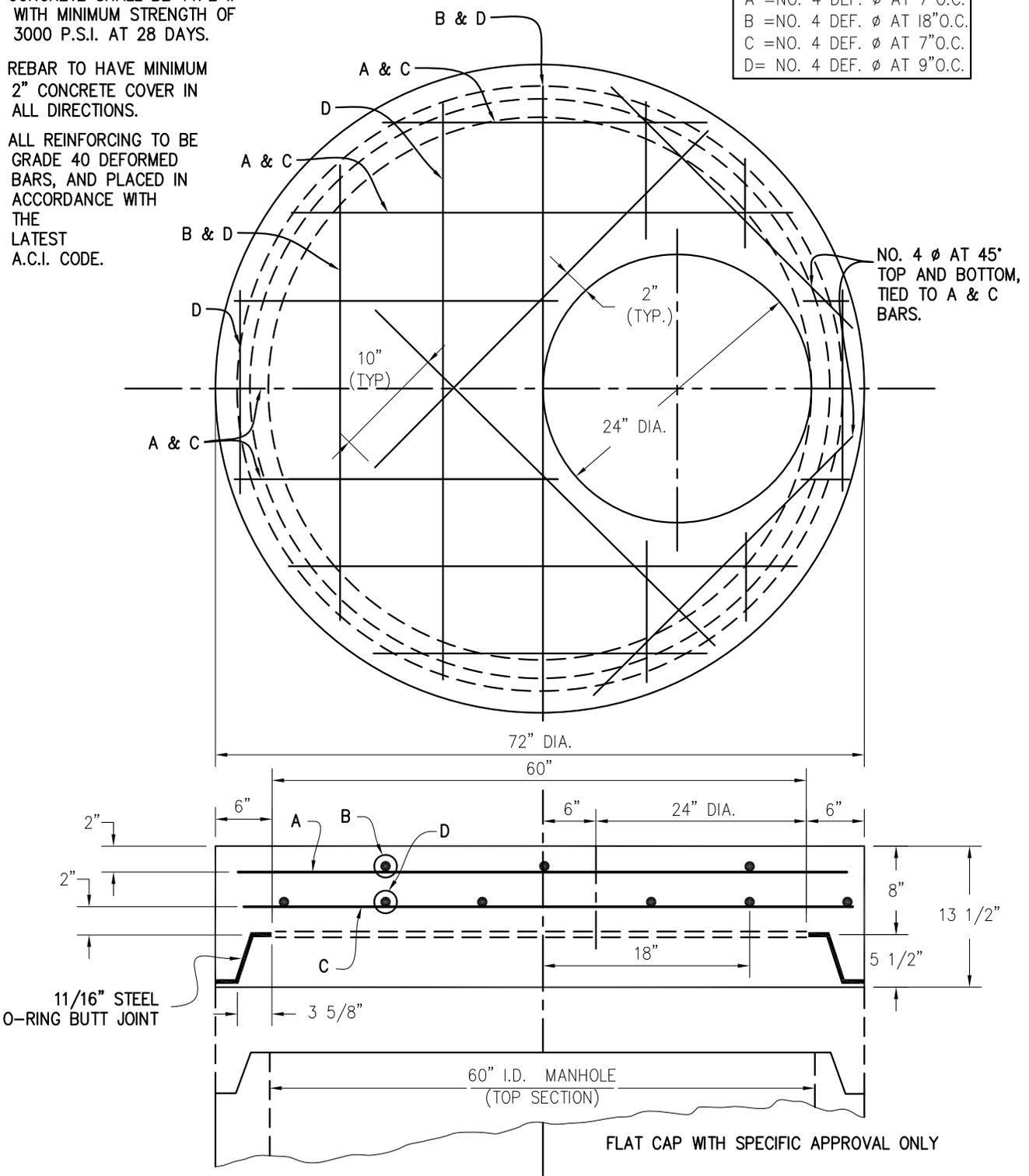
FIG. 3.4.5

H-20 LOADING

NOTE:

1. CONCRETE SHALL BE TYPE II WITH MINIMUM STRENGTH OF 3000 P.S.I. AT 28 DAYS.
2. REBAR TO HAVE MINIMUM 2" CONCRETE COVER IN ALL DIRECTIONS.
3. ALL REINFORCING TO BE GRADE 40 DEFORMED BARS, AND PLACED IN ACCORDANCE WITH THE LATEST A.C.I. CODE.

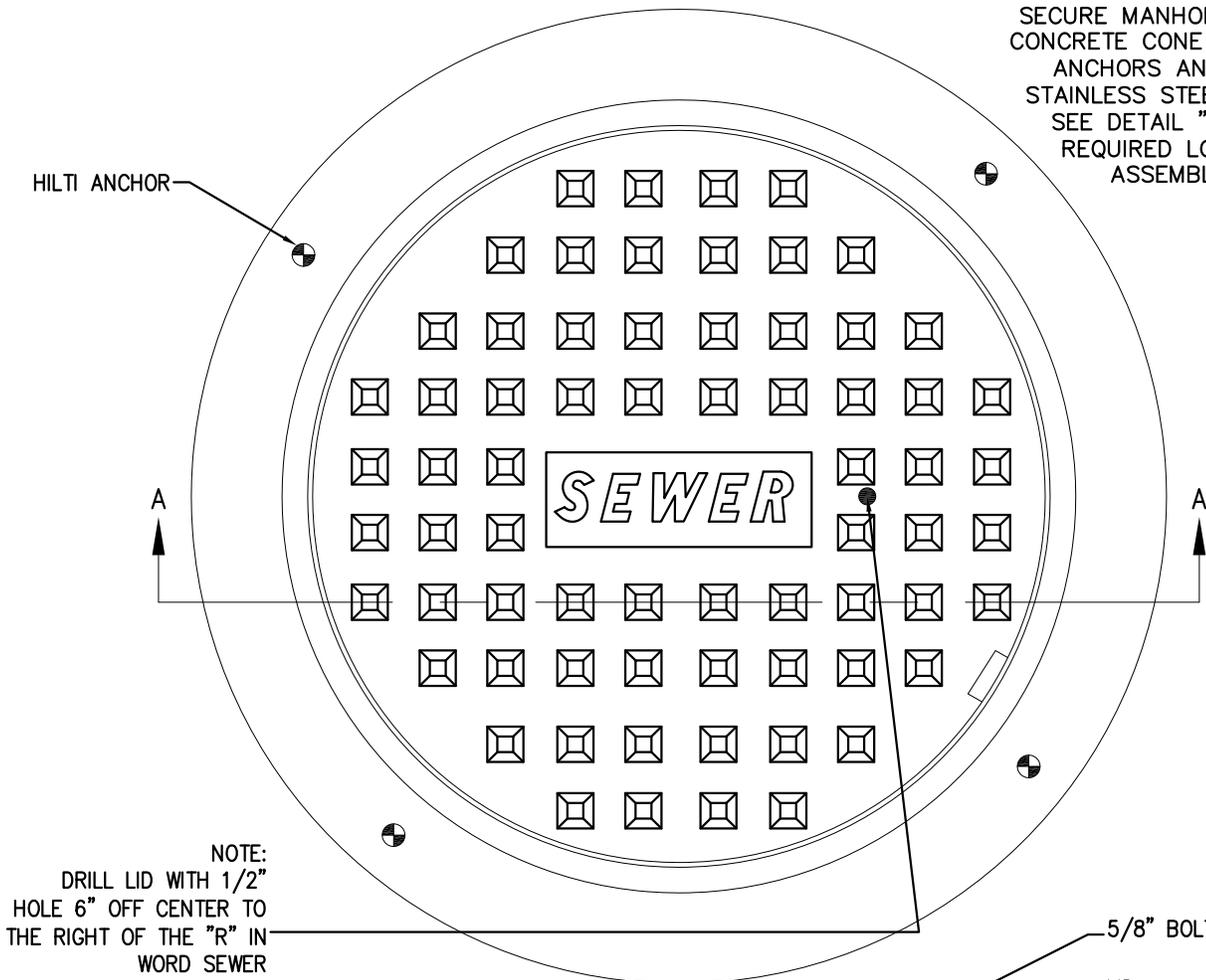
A	=NO. 4 DEF. ϕ AT 7"O.C.
B	=NO. 4 DEF. ϕ AT 18"O.C.
C	=NO. 4 DEF. ϕ AT 7"O.C.
D	=NO. 4 DEF. ϕ AT 9"O.C.



60" PRE-CAST CONCRETE MANHOLE DECK

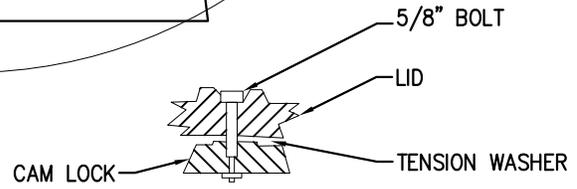
**MANHOLE OUTSIDE
PUBLIC STREETS**

SECURE MANHOLE RING TO CONCRETE CONE WITH HILTI ANCHORS AND 5/8" STAINLESS STEEL BOLTS. SEE DETAIL "A" FOR REQUIRED LOCKING ASSEMBLY.

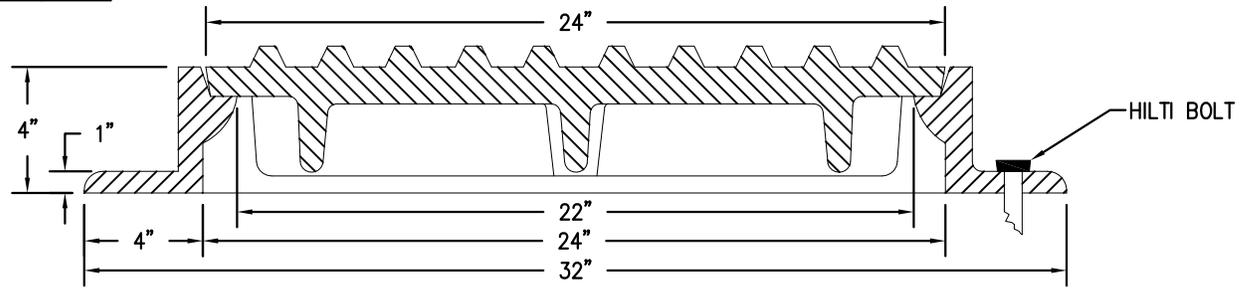


NOTE:
DRILL LID WITH 1/2" HOLE 6" OFF CENTER TO THE RIGHT OF THE "R" IN WORD SEWER

WEIGHT	C.I.
COVER A	166
COVER B	126
RING	150



DETAIL A (LID LOCK ASSEMBLY)



SECTION A-A

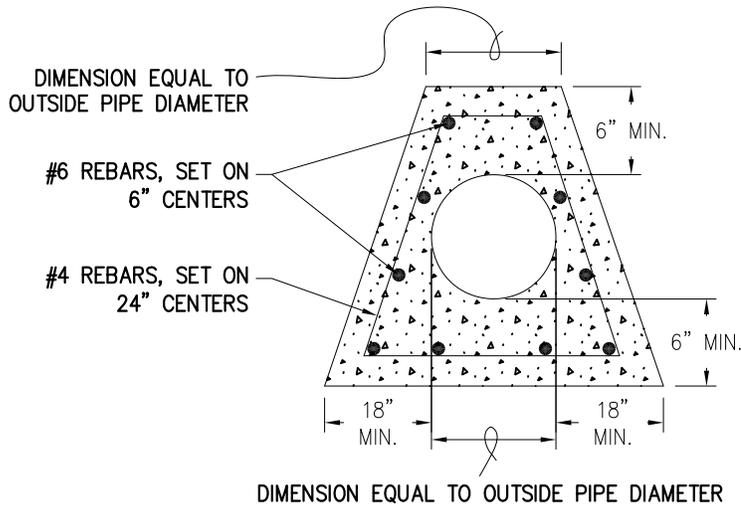
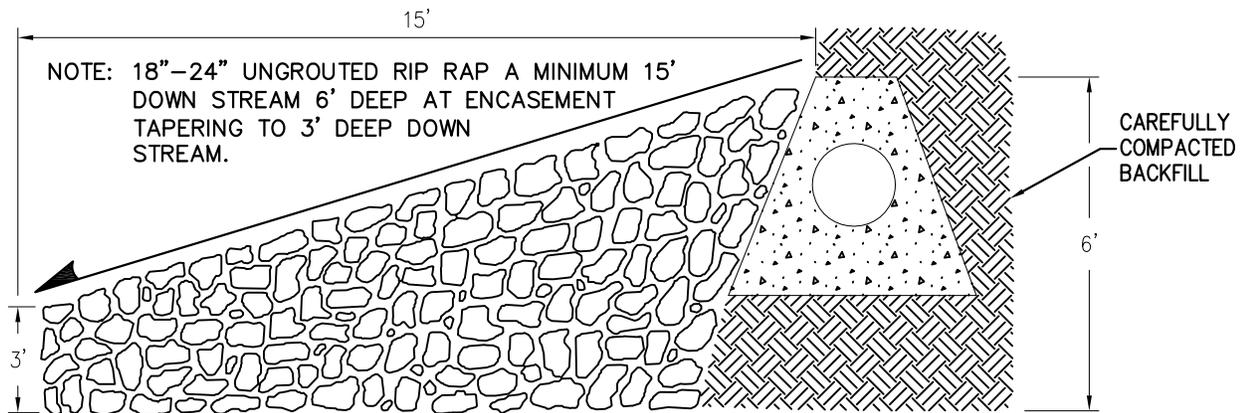
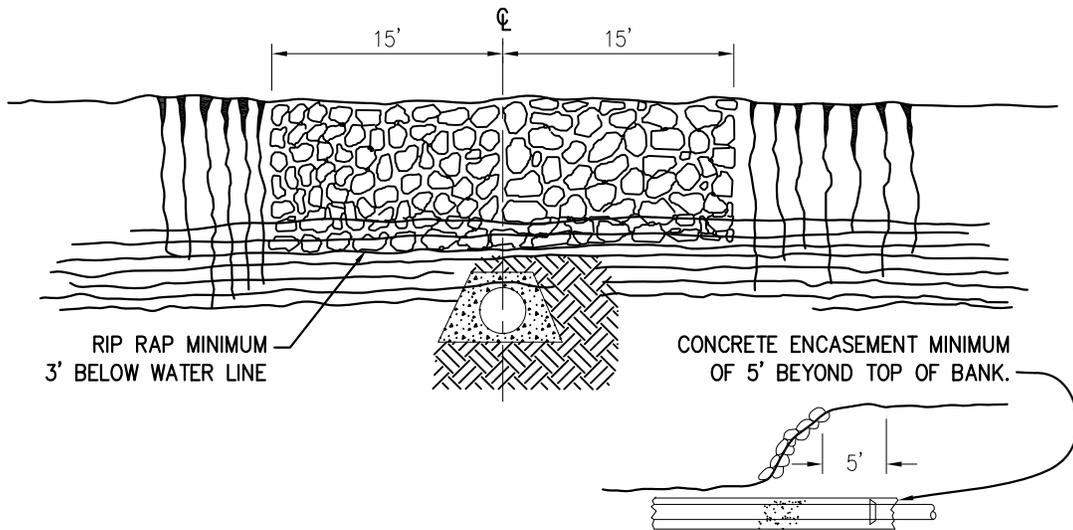


**MANHOLE RING
AND COVER**

DATE: FEB, 2011

REV. -/-/-

FIG. 3.4.7



NOTE: PIPE ENCASEMENT DETAILS ARE FOR DEPTHS BELOW 4' WHERE CAISSON'S ARE NOT REQUIRED.

DUCTILE IRON PIPE OR STEEL PIPE WITH CONCRETE ENCASEMENT.

SECTION A-A



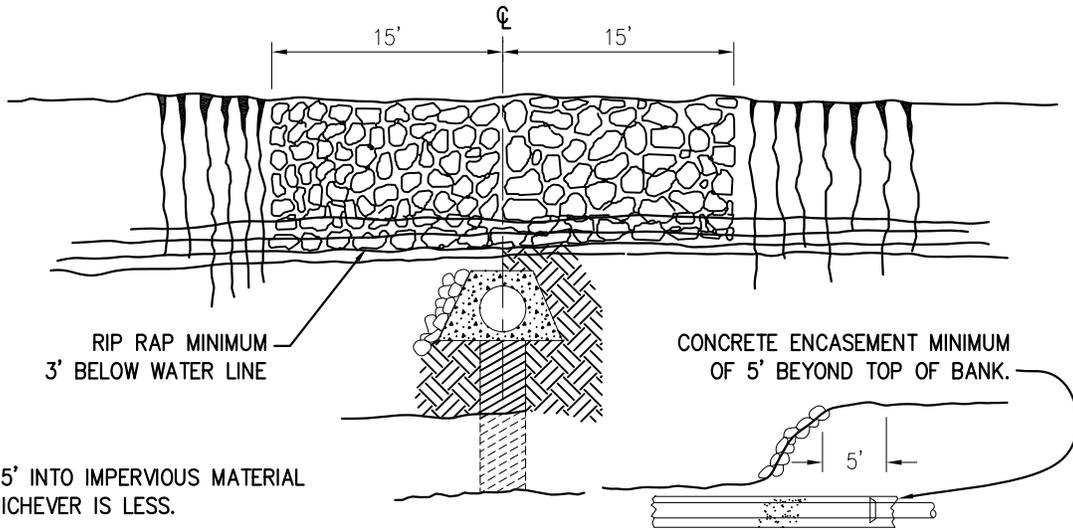
**STREAM CROSSING
ENCASEMENT
WITHOUT CAISSONS**

DATE: FEB, 2011

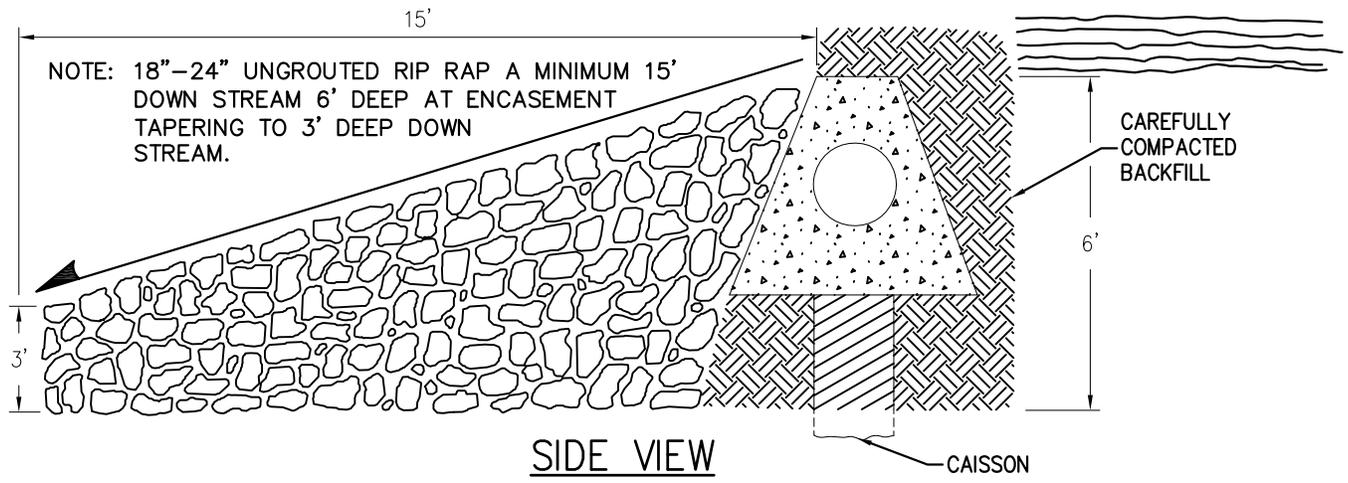
REV. -/-/-

FIG. 3.4.8

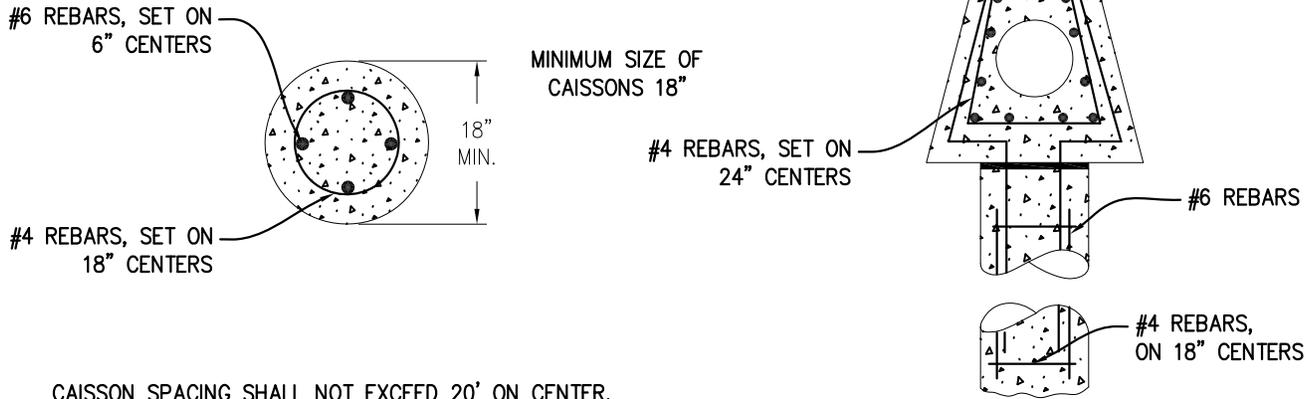
FRONT VIEW



NOTE: 18"-24" UNGROUTED RIP RAP A MINIMUM 15' DOWN STREAM 6' DEEP AT ENCASEMENT TAPERING TO 3' DEEP DOWN STREAM.

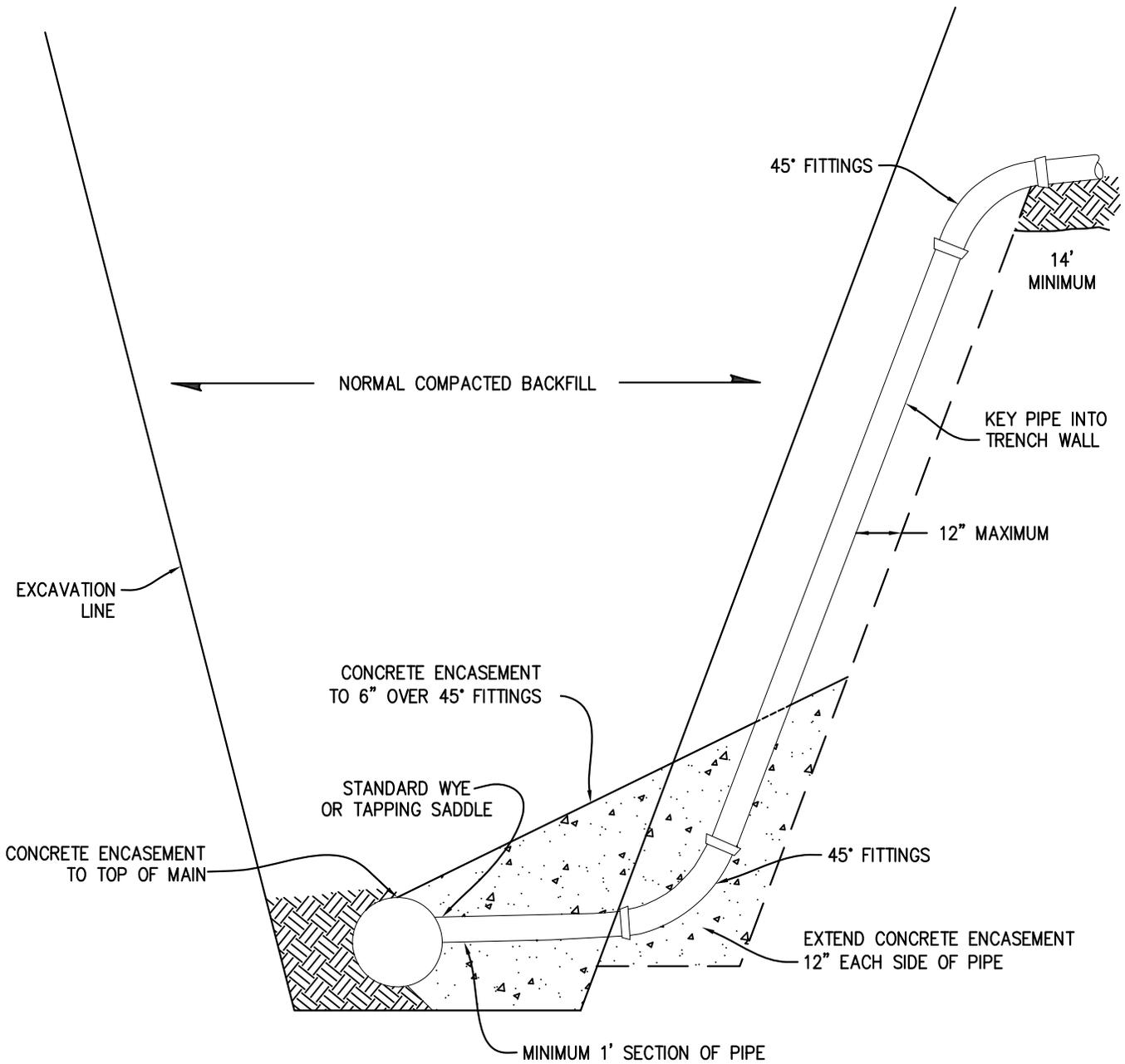


CAISSON DETAIL



STREAM CROSSING ENCASEMENT TYPICAL CAISSON

DEEP SERVICE CONNECTIONS
SERVICE CONNECTION IN EXCESS OF 14 FT
(ON HIGH SIDE OF STREET)

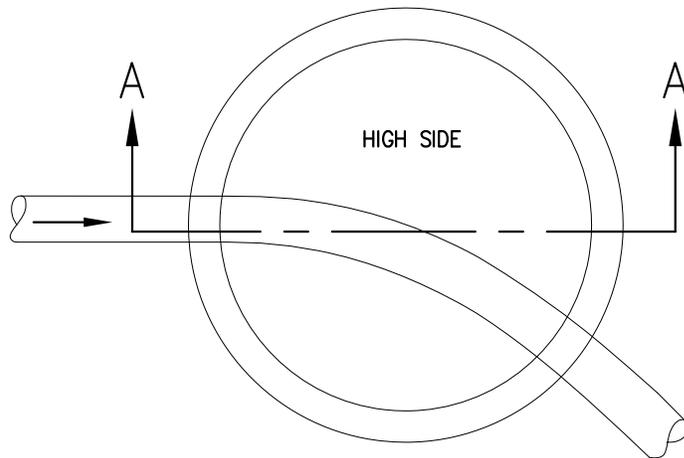


**DEEP SERVICE
CONNECTION**

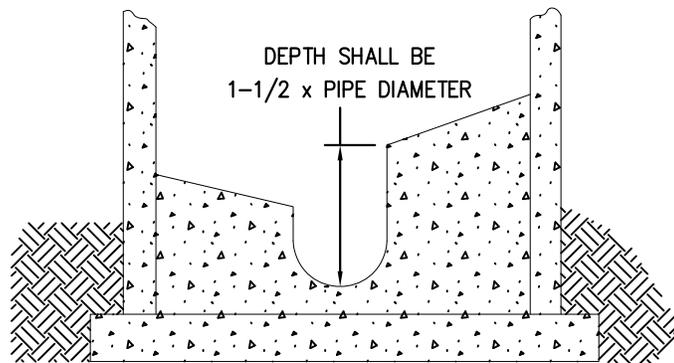
DATE: FEB, 2011

REV. -/-/-

FIG. 3.4.10



SECTION A-A



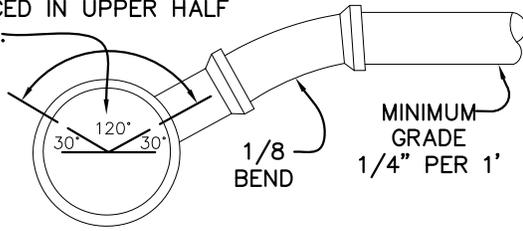
HIGH VELOCITY PROTECTION

DATE: FEB, 2011

REV. -/-/-

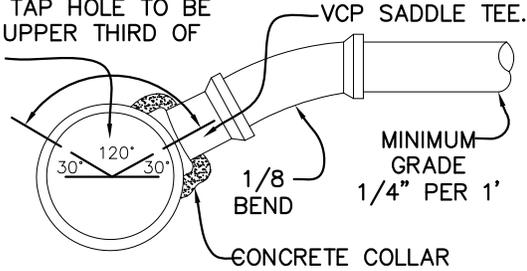
FIG. 3.4.11

CENTER OF TEE BRANCH TO BE PLACED IN UPPER HALF OF MAIN.



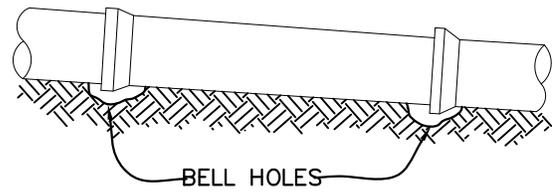
1/8 BEND CONNECTION TO TEE

CENTER OF TAP HOLE TO BE PLACED IN UPPER THIRD OF MAIN.

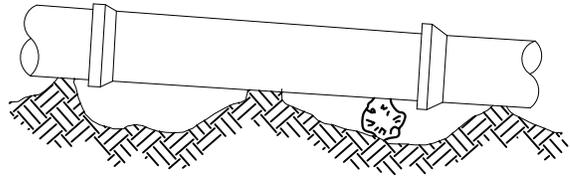


TAP TO BE MACHINE DRILLED ONLY

1/8 BEND & SADDLE CONNECTION



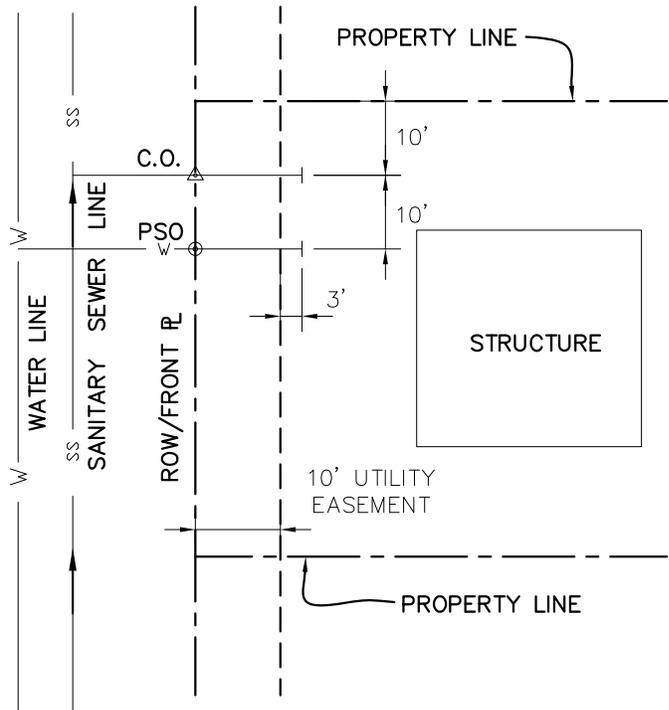
ACCEPTABLE BEDDING



UNACCEPTABLE BEDDING

NOTES:

1. BELLS SHALL NOT TOUCH THE SIDES OR BOTTOM OF THE BELL HOLE.
2. THE BARREL SECTION SHALL BE SUPPORTED THROUGHOUT ITS LENGTH.
3. SERVICE TAPS SHALL BE IN LINE TEE OR MACHINE TAPPED, HAND TAPS SHALL NOT BE ALLOWED.
4. SERVICE LINES SHALL BE LOCATED TEN FEET UP HILL FROM THE LOWEST FRONT PROPERTY CORNER.
5. THE CURB SHALL BE MARKED WITH "S" WHERE THE SEWER SERVICE LINE CROSSES THE CURB.
6. THE MINIMUM SERVICE LINE GRADE SHALL BE 1/4" PER FOOT.
7. JOINTS SHALL BE WATER TIGHT.
8. SERVICE LINES SHALL RUN PERPENDICULAR TO THE FRONT LOT LINE AND SHALL EXTEND AT LEAST THIRTEEN FEET INSIDE THE PROPERTY LINE. AN AIR & WATER TIGHT PLUG OR CAP SHALL BE PLACED ON THE END OF THE SERVICE LINE AND 4x4 POST PLACED IN GROUND FOR FUTURE LOCATION.
9. A CLEAN OUT SHALL BE PROVIDED AT THE PROPERTY LINE.



RESIDENTIAL SEWER SERVICE

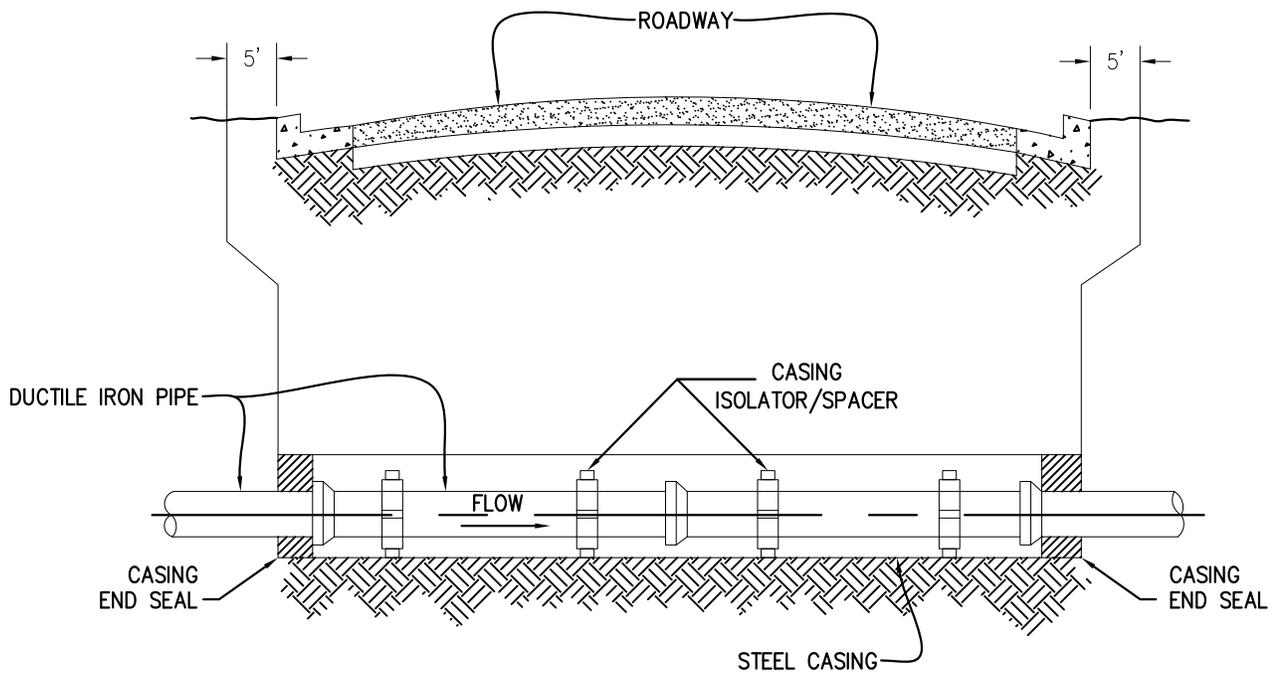


SANITARY SEWER SERVICE DETAIL

DATE: FEB, 2011

REV. -/-/-

FIG. 3.4.12



NOTES:

1. DUCTILE IRON PIPE ONLY SHALL BE USED THROUGH ALL BORES.
2. IF THE BORE IS NOT CONSTRUCTED TO THE PROPER GRADE AN ADDITIONAL MANHOLE SHALL BE INSTALLED AT THE GRADE CHANGE.
3. THE CASING SHALL BE SEALED WITH A FLEXIBLE CASING END SEAL SUCH AS PSI MODEL "S".
4. THE PIPE AND CASING SHALL BE INSULATED USING A PSI MODEL "PE" CASING ISOLATOR/SPACER ATTACHED TO THE PIPE.

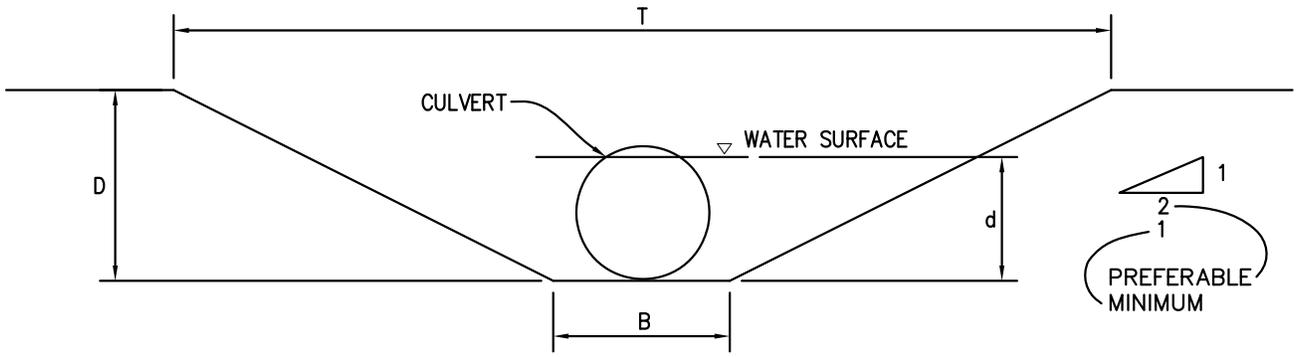


TYPICAL BORE CONSTRUCTION

DATE: FEB, 2011

REV. -/-/-

FIG. 3.4.13



- B = BOTTOM WIDTH OF CHANNEL
CULVERT DIAMETER +6" OR 2'0" MINIMUM
- D = DEPTH OF CHANNEL AT CULVERT DETERMINED BY
CULVERT DIAMETER, 18" MINIMUM
- d = DEPTH OF WATER
- T = TOP WIDTH OF CHANNEL

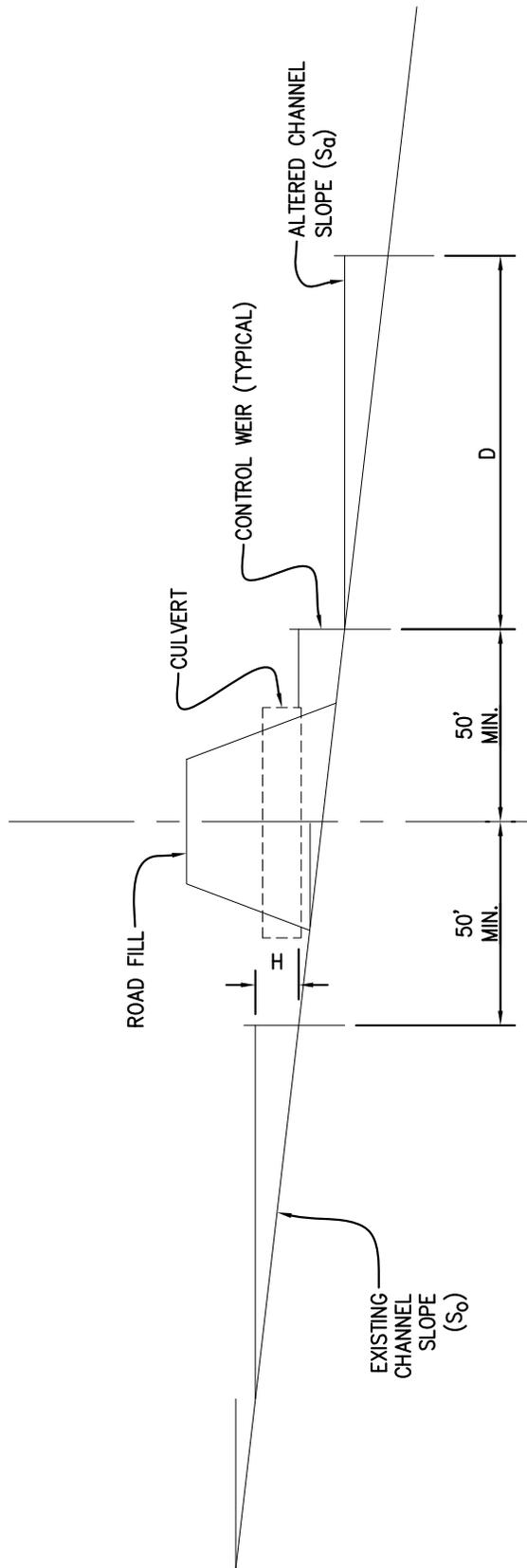


RECOMMENDED TYPICAL DITCH CROSS SECTION

DATE: FEB, 2011

REV. -/-/-

FIG. 4.7.1



$$H = D(S_0 - S_d)$$

S_0 = SLOPE HAS SUPERCritical OR EROSIve VELOCITY

S_d = SLOPE HAS SUBCRITICAL AND NONEROSIVE VELOCITY

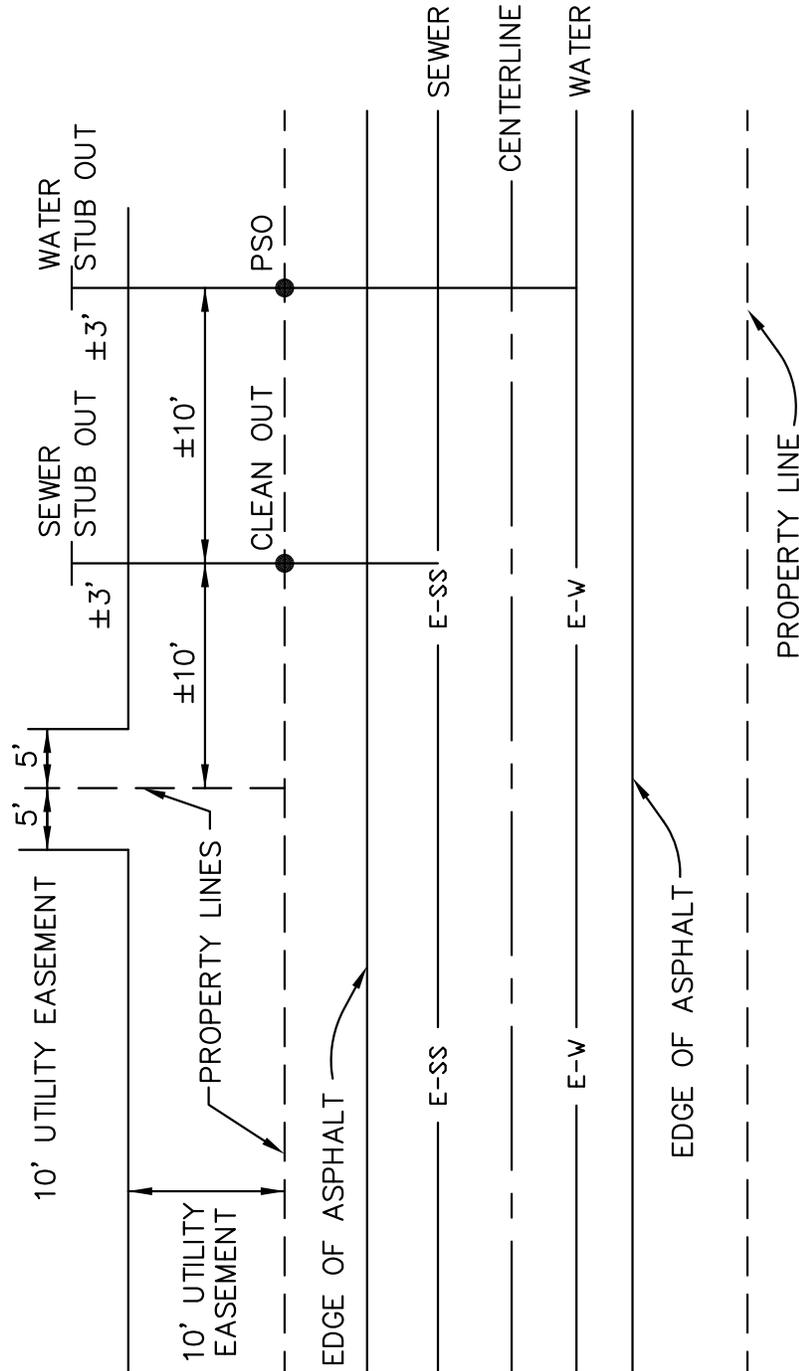


CHANNEL PROFILE FOR EROSION CONTROL AT CULVERTS

DATE: FEB, 2011

REV. -/-/-

FIG. 4.7.3



STANDARD PLAN VIEW
 SCHEMATIC
 FOR UTILITIES IN A STREET
 RIGHT-OF-WAY

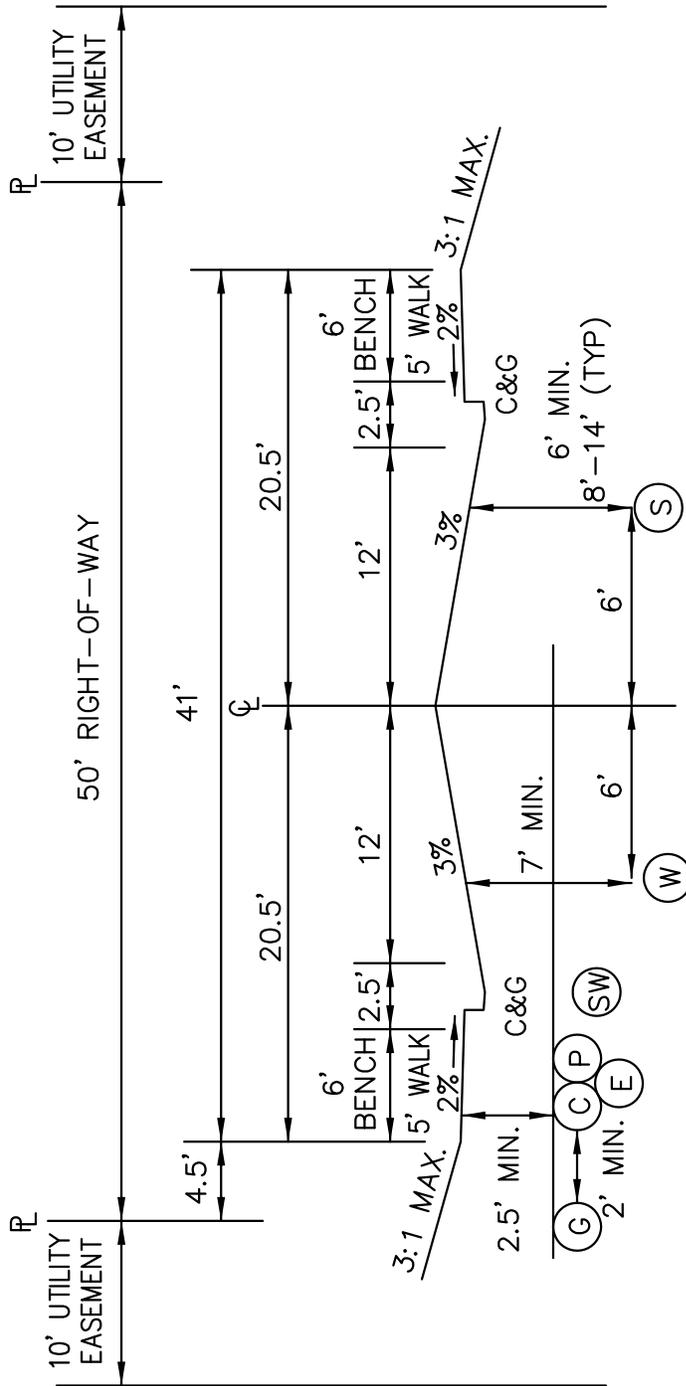


UTILITIES IN R.O.W.
 (PLAN VIEW)

DATE: FEB, 2011

REV. -/-/-

FIG. 5.3.1



- (C) CABLE TV
- (P) TELEPHONE
- (E) ELECTRIC
- (SW) STORMWATER
- (W) WATER
- (G) GAS
- (S) SEWER

STANDARD CROSS SECTION
SCHEMATIC
FOR UTILITIES IN A STREET
RIGHT-OF-WAY

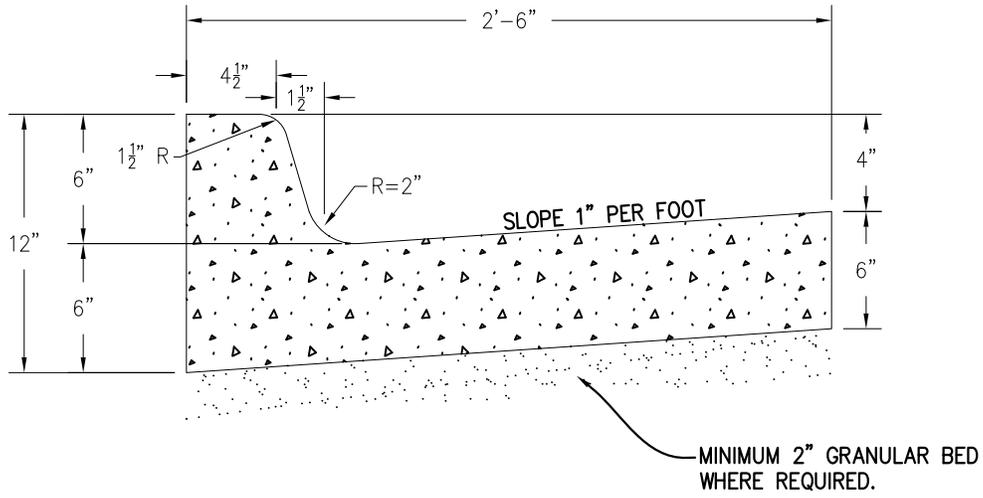


UTILITIES IN R.O.W. (CROSS SECTION)

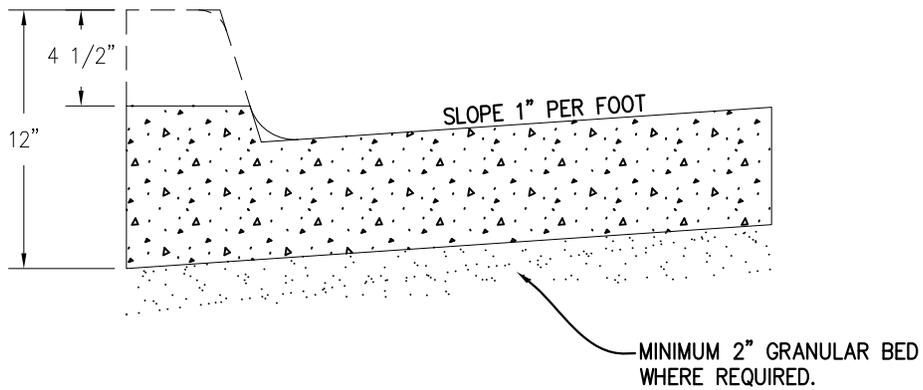
DATE: FEB, 2011

REV. -/-/-

FIG. 5.3.2



FULL CROSS SECTION



CROSS SECTION AT
DRIVEWAYS AND ALLEYS

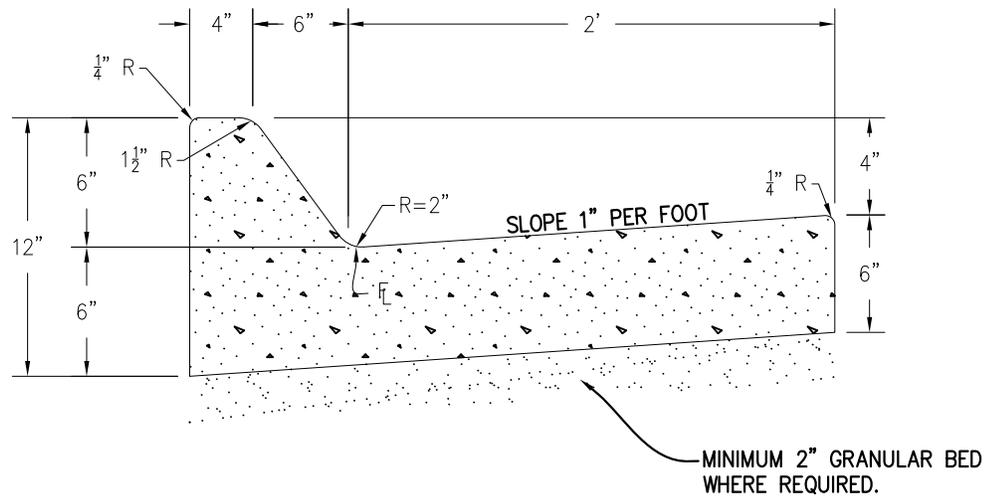


**CURB & GUTTER
TYPE I**

DATE: FEB, 2011

REV. -/-/-

FIG. 6.4.1

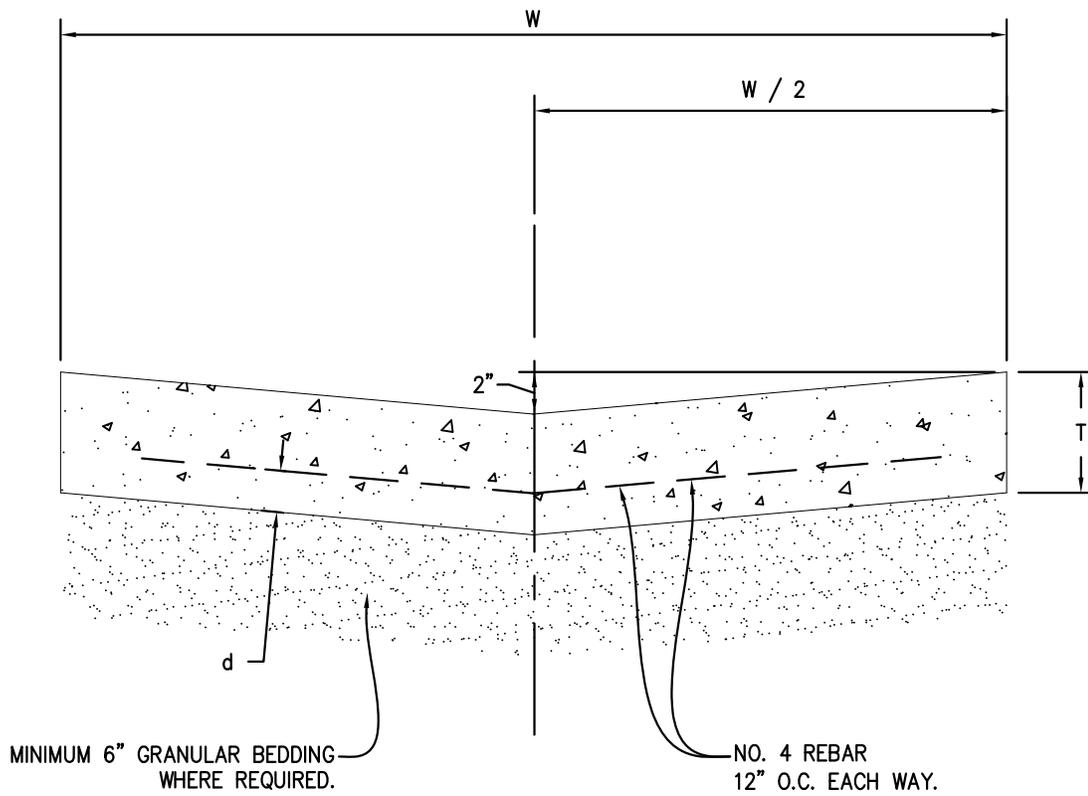


CURB & GUTTER TYPE II

DATE: FEB, 2011

REV. -/-/-

FIG. 6.4.2



TYPE OF STREET	W	T	d
HIGHWAY	10'-0"	8"	3"
COMMERCIAL, LOCAL & COLLECTOR	8'-0"	8"	3"
RESIDENTIAL, ARTERIAL	6'-0"	8"	3"

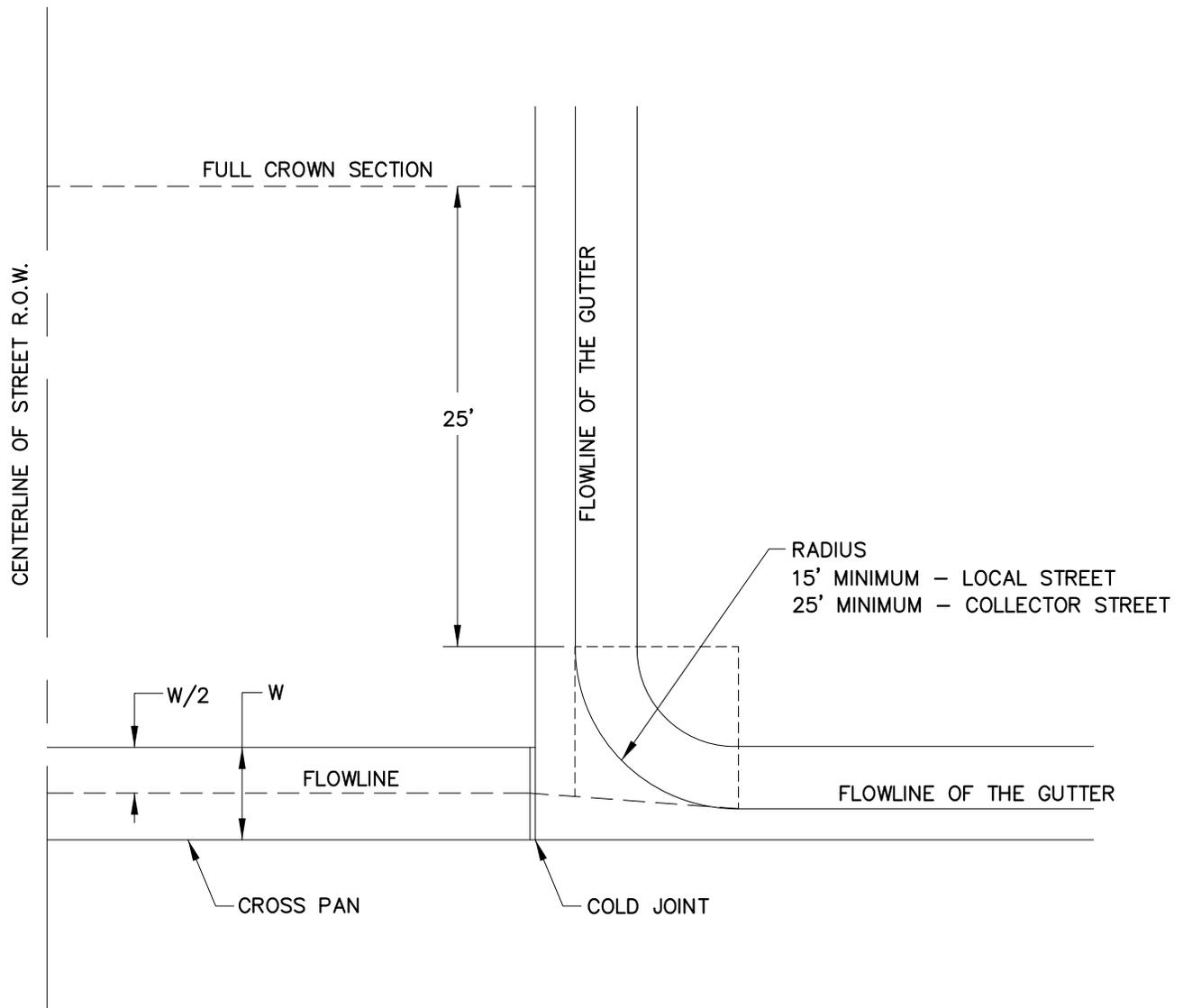


CROSS - PAN

DATE: FEB, 2011

REV. -/-/-

FIG. 6.4.3



MINIMUM CURB RADIUS FOR
COMMERCIAL AND INDUSTRIAL
AREA SHALL BE 30 FEET

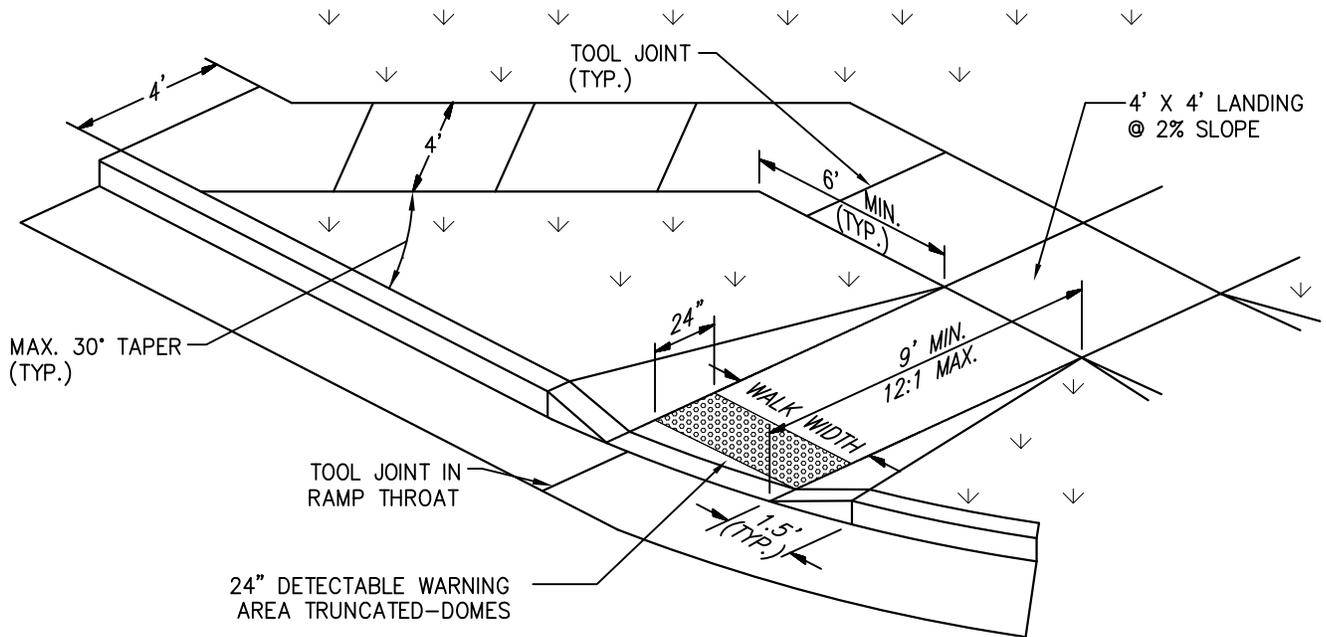


INTERSECTION DETAIL

DATE: FEB, 2011

REV. -/-/-

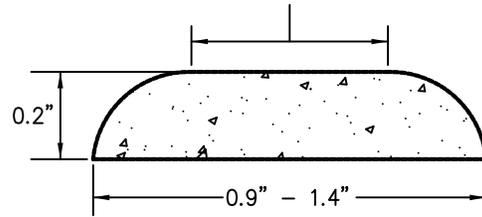
FIG. 6.4.4



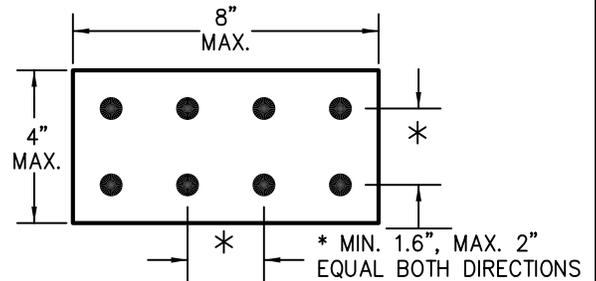
GENERAL NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH CURRENT CITY OF WOODLAND PARK ENGINEERING STANDARD SPECIFICATIONS.
2. CONTRACTOR TO OBTAIN REQUIRED CONCRETE PERMITS PRIOR TO CONSTRUCTION.
3. CONTRACTOR TO NOTIFY PUBLIC WORKS AT LEAST 24 HOURS PRIOR TO PLACEMENT OF ANY CONCRETE.
4. PEDESTRIAN RAMPS SHALL BE 4000 PSI, GRAY CONCRETE, FINISHED WITH A COARSE BROOM FINISH, PERPENDICULAR TO DIRECTION OF TRAVEL WITH 2' DETECTABLE WARNING AREA.
5. RAMP LOCATION AND LENGTH MAY REQUIRE MODIFICATION TO MAINTAIN THE 12:1 MAXIMUM RUNNING SLOPE DUE TO INTERSECTION STREET GRADES AND/OR ALIGNMENT.
6. WHERE THE 1'-6" FLARED SIDE(S) OF A PERPENDICULAR CURB RAMP IS (ARE) CONTIGUOUS WITH A PUBLIC WALK, THEIR LENGTH SHALL BE INCREASED TO 8' MINIMUM AND THE MAXIMUM FLARE SLOPE SHALL NOT EXCEED 10:1.
7. PEDESTRIAN WALKWAY AND/OR LOCATION OF EXISTING OR FUTURE PEDESTRIAN RAMPS ON OPPOSITE CORNERS SHALL BE REVIEWED BEFORE CONSTRUCTING NEW RAMPS. NEW RAMPS SHALL ALIGN WITH EXISTING RAMPS AND PEDESTRIAN WALKWAYS.
8. AT MARKED PEDESTRIAN CROSSINGS, THE BOTTOM OF THE RAMPS, EXCLUSIVE OF THE FLARE SIDES, SHALL BE TOTALLY CONTAINED WITHIN THE MARKINGS.
9. DETECTABLE WARNING AREA SHALL BE PREFABRICATED REDDISH-BROWN INTEGRALLY COLORED TRUNCATED- DOME SURFACED CONCRETE OR MASONRY PAVERS.
10. CONTACT PUBLIC WORKS DEPARTMENT FOR MOST CURRENT REQUIREMENTS REGARDING ADA RAMPS.

THE TOP DIAMETER OF THE TRUNCATED DOMES SHALL BE 50% TO 65% OF THE BASE DIAMETER



ELEVATION VIEW



DOME SPACING

TRUNCATED DOME DETAIL

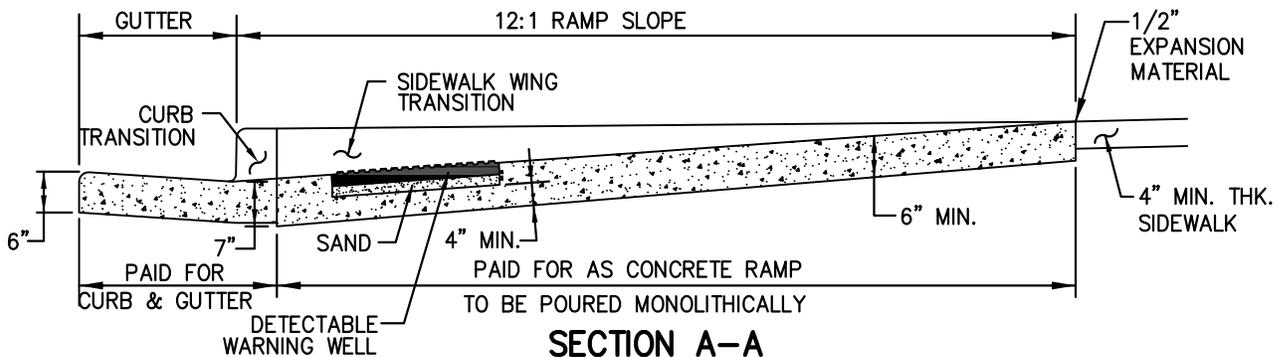
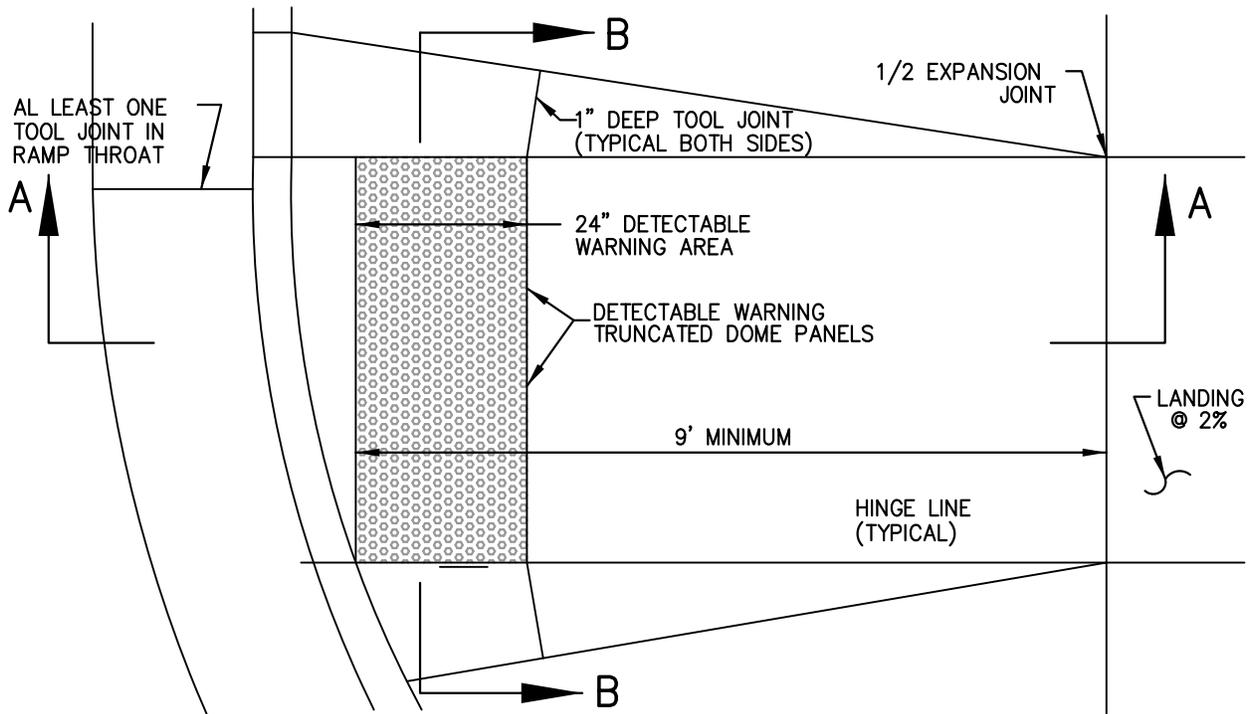


CURB RAMP

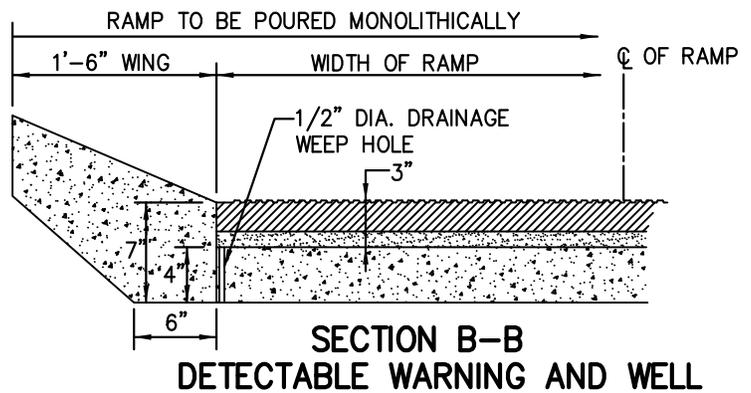
DATE: FEB, 2011

REV. -/-/-

FIG. 6.4.5



NOTE:
1. CONTACT PUBLIC WORKS DEPARTMENT FOR MOST CURRENT REQUIREMENTS REGARDING ADA RAMPS

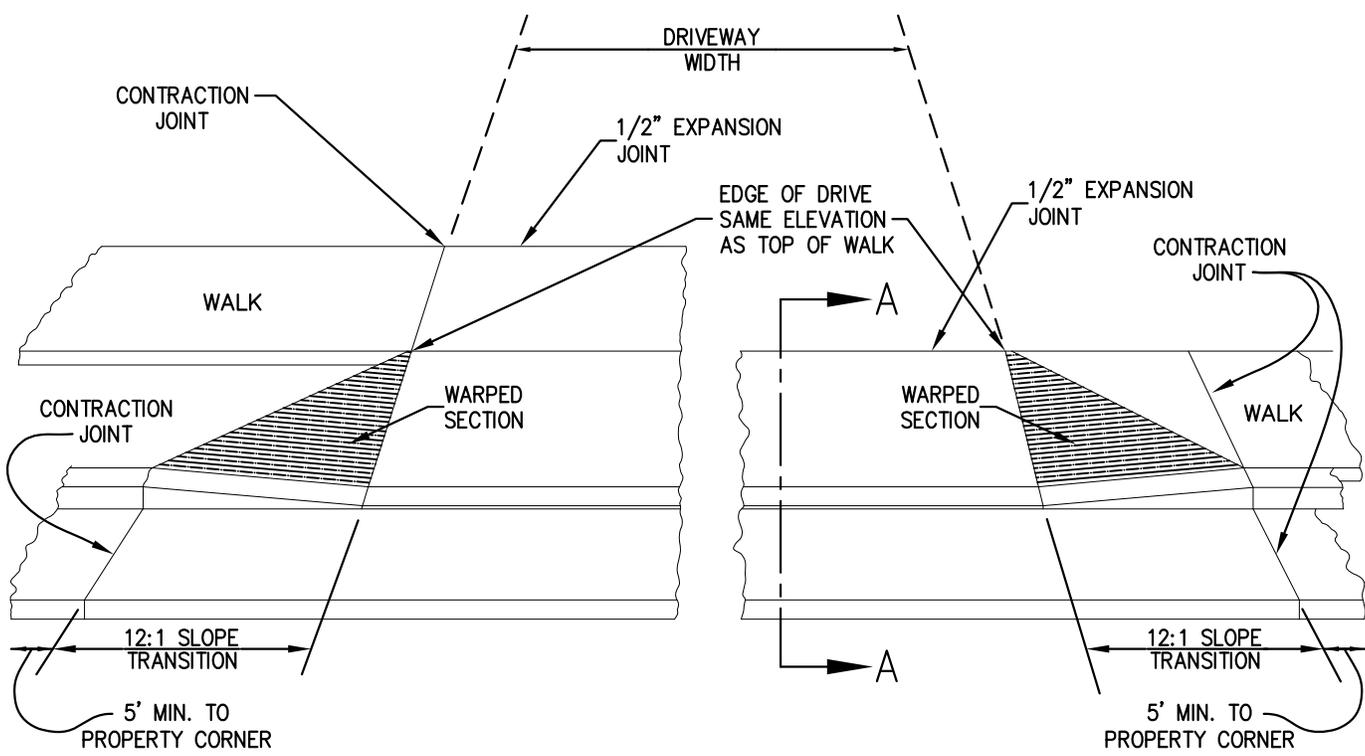


PEDESTRIAN RAMP DETAIL

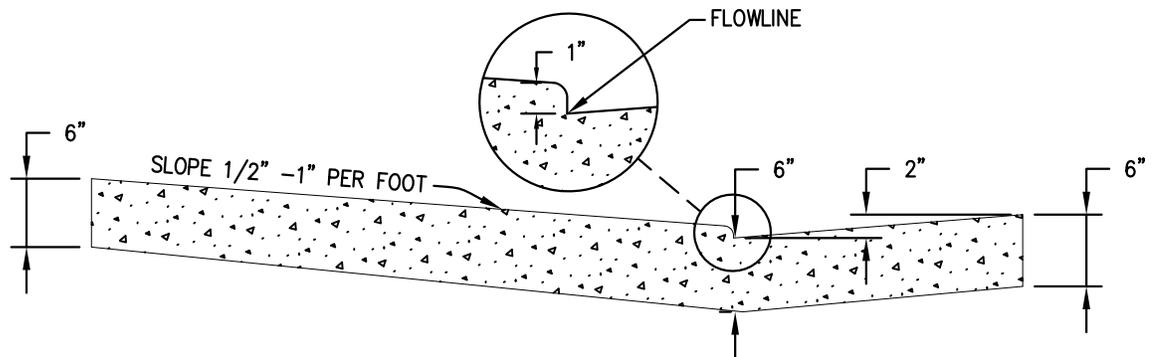
DATE: FEB, 2011

REV. -/-/-

FIG. 6.4.6



PERSPECTIVE VIEW



SECTION A-A

DRIVEWAY WIDTH

SINGLE FAMILY
RESIDENTIAL MIN. = 12 FT.

MULTI FAMILY
RESIDENTIAL MIN. = 16 FT.
RESIDENTIAL MAX. = 25 FT.

SINGLE FAMILY
RESIDENTIAL MAX. = 24 FT.

COMMERCIAL MIN. = 25 FT.
COMMERCIAL MAX. = 35 FT.



DRIVEWAY DETAILS
VERTICAL CURB & GUTTER

DATE: FEB, 2011

REV. -/-/-

FIG. 6.4.7

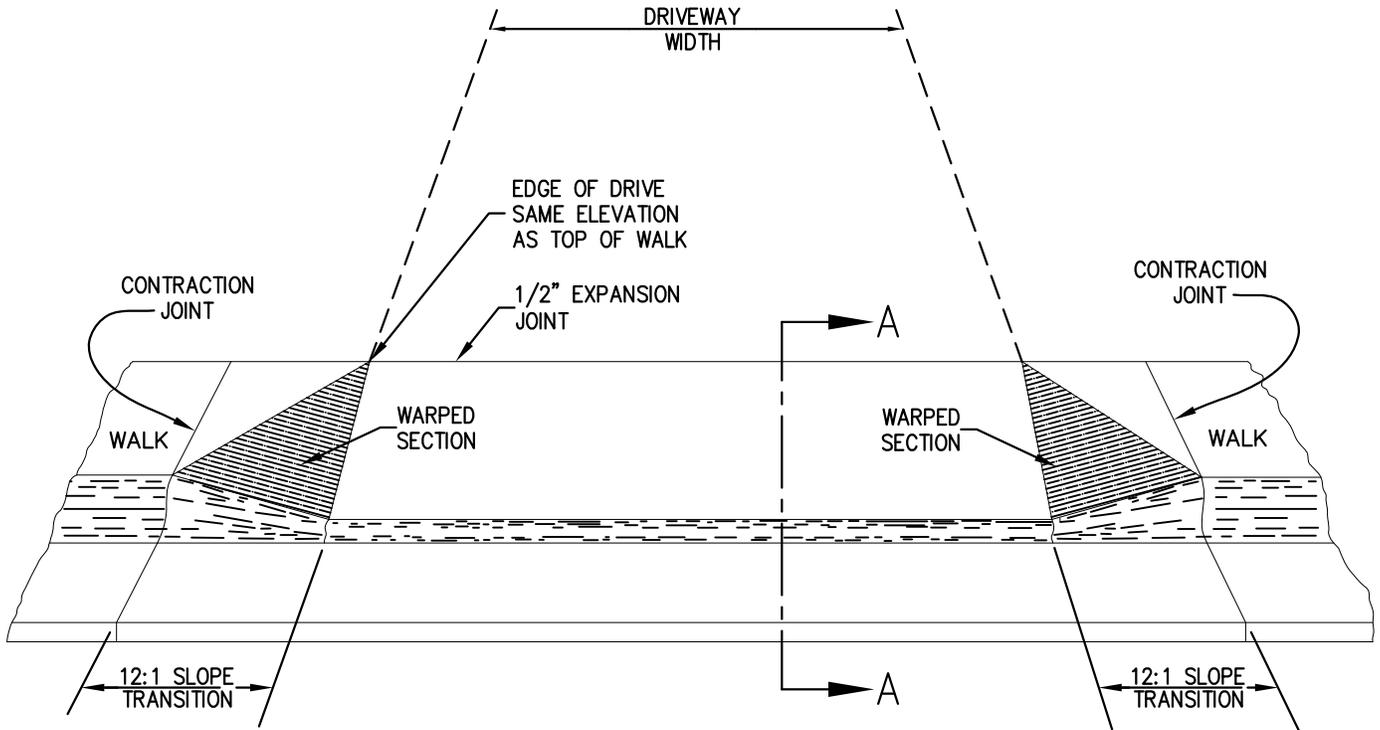
DRIVEWAY WIDTH

SINGLE FAMILY
RESIDENTIAL MIN. = 12 FT.

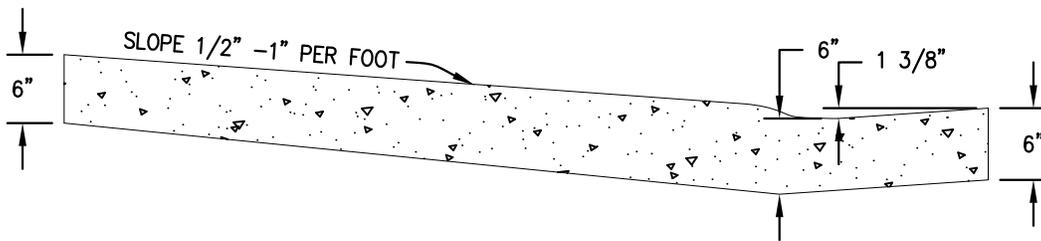
MULTI FAMILY
RESIDENTIAL MIN. = 16 FT.
RESIDENTIAL MAX. = 25 FT.

SINGLE FAMILY
RESIDENTIAL MAX. = 24 FT.

COMMERCIAL MIN. = 25 FT.
COMMERCIAL MAX. = 35 FT.



PERSPECTIVE VIEW



SECTION A-A



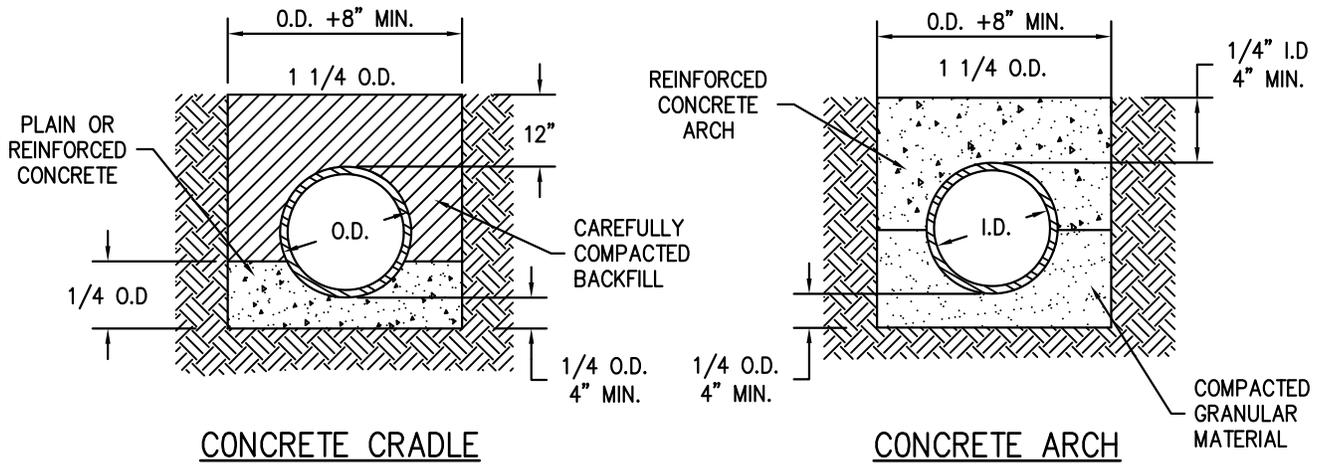
DRIVEWAY DETAILS
DRIVE -OVER CURB , GUTTER
AND SIDEWALK

DATE: FEB, 2011

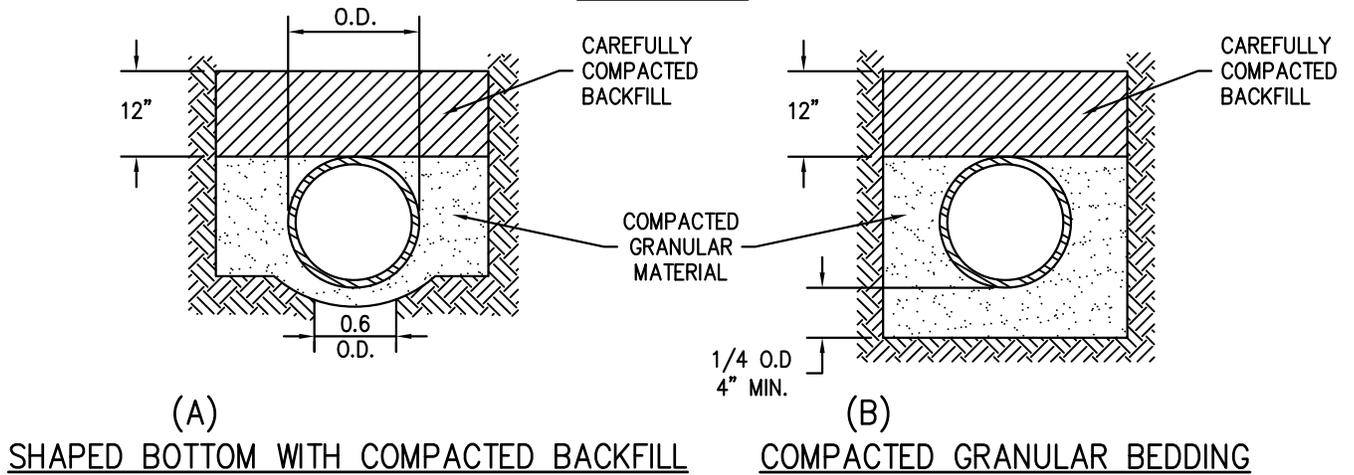
REV. -/-/-

FIG. 6.4.8

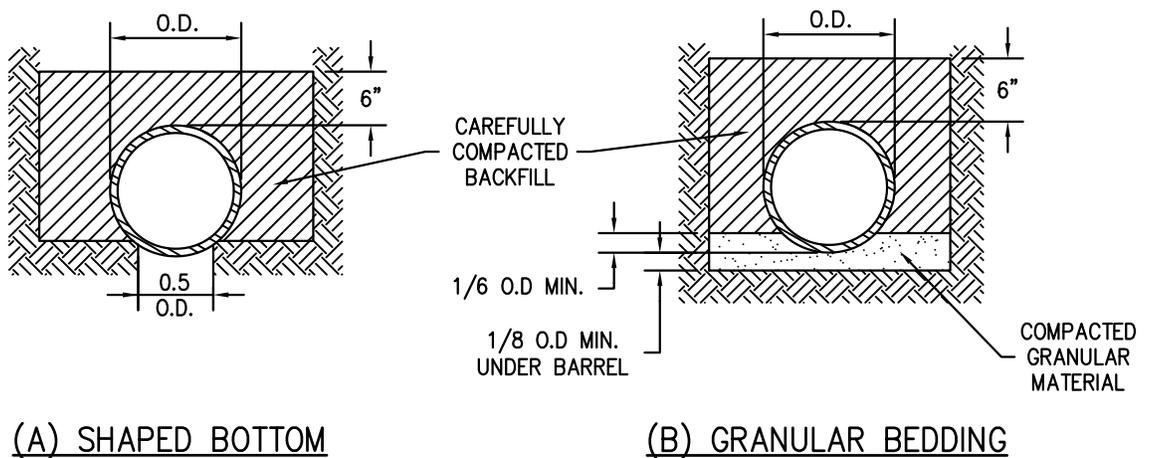
CLASS-A



CLASS-B



CLASS-C



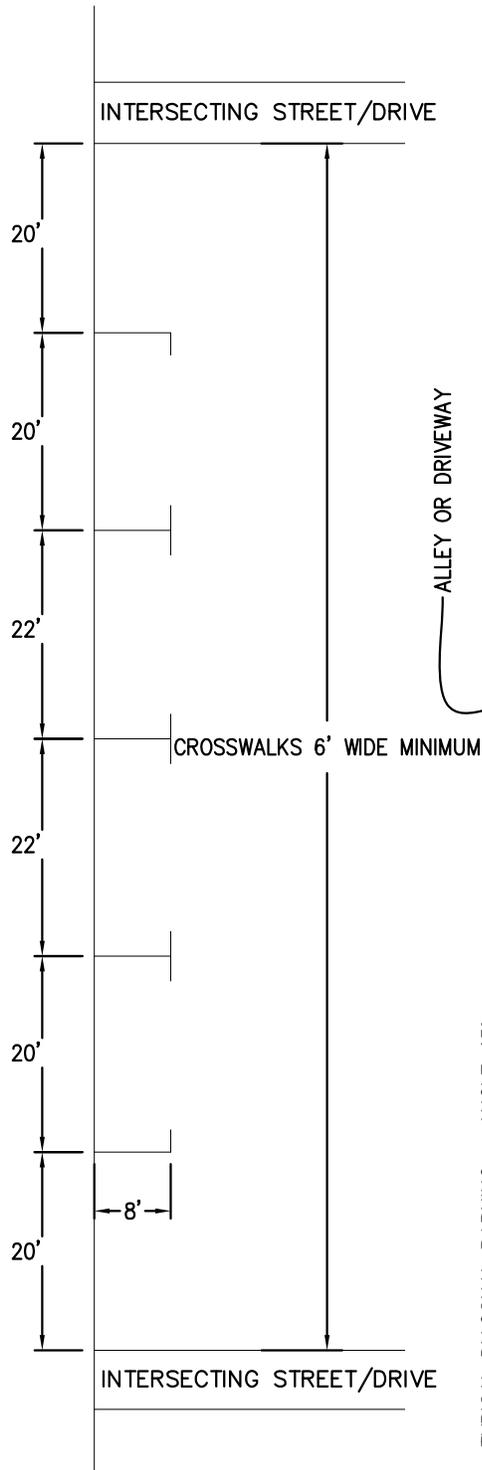
TYPICAL BEDDING & MATERIAL DETAIL

DATE: FEB, 2011

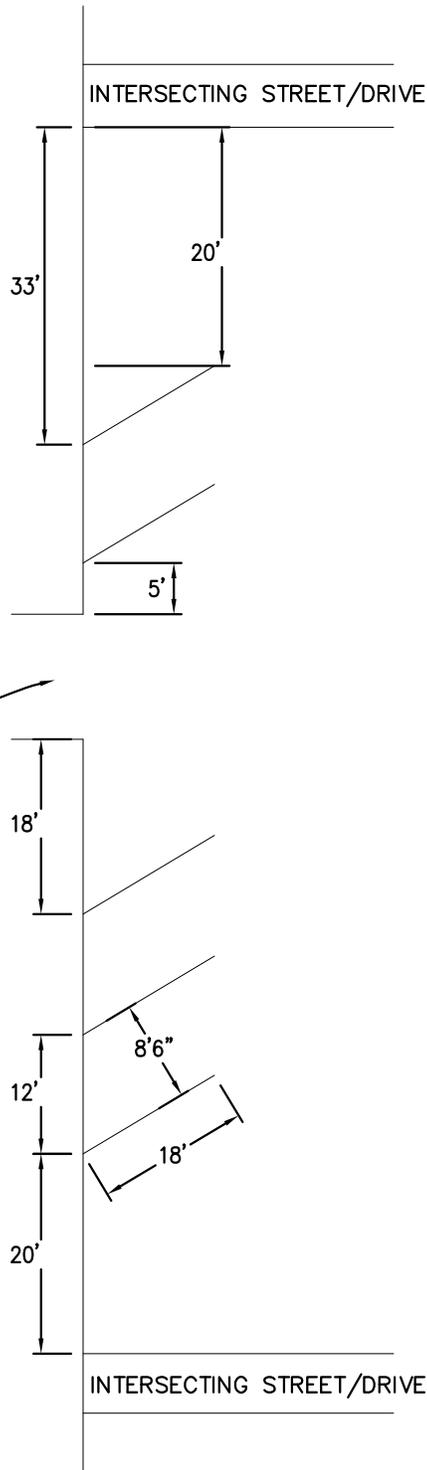
REV. -/-/-

FIG. 7.8.1

TYPICAL / PARALLEL PARKING



TYPICAL DIAGONAL PARKING - ANGLE 45°



ADDITIONAL PARKING RESTRICTIONS:
FROM MODEL TRAFFIC CODE, NO PARKING WITHIN:

1. 5' OF A DRIVEWAY
2. 15' OF A FIRE HYDRANT
3. 20' OF A CROSSWALK
4. 30' OF A STOP OR YIELD SIGN
5. 50' OF A RAILROAD CROSSING

ADEQUATE CLEAR ZONE FOR EMERGENCY ACCESS SHALL BE PROVIDED TO ALL MULTI-STORY DWELLING UNITS.
MINIMUM CLEAR ZONE - 20' OF YELLOW CURBING.



ON STREET PARKING PAVED STREETS

DATE: FEB, 2011

REV. -/-/-

FIG. 8.3.1



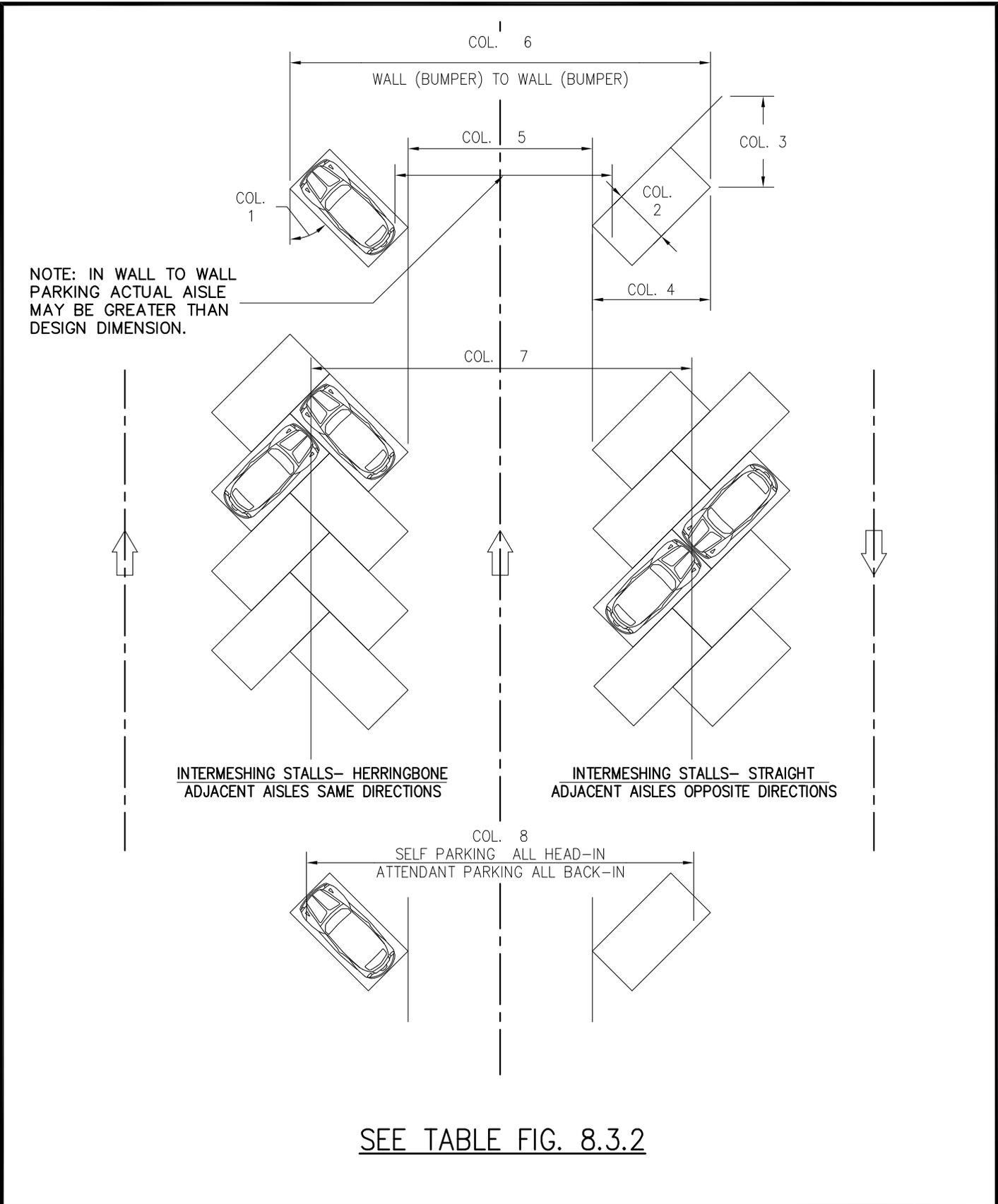
OFF STREET PARKING TABLE

DATE: FEB, 2011

REV. -/-/-

FIG. 8.3.2

TABLE A - SELECTED STALL AND AISLE DIMENSIONS FOR HEAD-IN SELF-PARKING FIELDS									
REMARKS	SEE FIG. 8.3.3					SEE FIG. 8.3.3			
	COL.1	COL. 2	COL. 3	COL. 4	COL. 5	UNIT PARKING	DEPTH		
ANGLE OF PARKING (DEGREES)	STALL WIDTH	WIDTH OF STALL PARALLEL TO AISLE	DEPTH OF STALL PERPENDICULAR TO AISLE	WIDTH OF AISLE	WIDTH OF AISLE	COL. 6	COL. 7	COL. 8	
NOTES: DIMENSIONS VARY WITH VEHICLE SIZE, PARKING FUNCTION, AND DEGREE OF ACTIVITY. STALL AND AISLE WIDTHS GENERALLY HAVE AN INVERSE RELATIONSHIP. WHEN SPACE IS NO PROBLEM, MINIMUM STALL WIDTH SHOULD BE 9' 0".									
GENERAL ALL PURPOSE STANDARD	90	8'-9"	8'-9"	18'-0"	26'-0"	62'-0"	--	58'-2"	PARKING HEAD-IN TO CURB
ALL-DAY AND LOW TURNOVER LOTS (MIN. COL. 5-23; COL. 6- 59')	90	8'-6"	8'-6"	18'-0"	26'-0"	62'-0"	--	58'-2"	
LARGE ALL-DAY PARKING LOTS (APPROX. 170 CARS/ACRE)	90	8'-6"	8'-6"	18'-0"	24'-0"	60'-0"	--	--	
INADEQUATE ROOM FOR OPENING CAR DOORS. RARELY USED.	90	8'-0"	8'-0"	18'-0"	32'-0"	68'-0"	--	64'-2"	
TYPICAL PAY PARKING FIELD (HIGH TURNOVER)	90	8'-6"	8'-6"	18'-0"	27'-6"	63'-6"	--	59'-8"	
DESIRED DIMENSIONS (FOR 8'-6" STALLS)	90	8'-6"	8'-6"	18'-0"	29'-0"	65'-0"	--	61'-2"	
DESIRED DIMENSIONS (FOR 9'-0" STALLS)	90	9'-0"	9'-0"	18'-0"	27'-0"	63'-0"	--	59'-2"	
ACTIVE SHOPPING CENTERS WITHOUT SEPARATE PEDESTRIAN WALKWAYS AND HIGH TURNOVER LOTS WHERE AMPLE LAND IS AVAILABLE.	90	9'-0"	9'-0"	18'-6"	30'-0"	67'-0"	--	63'-2"	
GENERALLY RECOMMENDED MINIMUM (8'-6" STALLS)	60	8'-6"	9'-10"	19'-10"	18'-0"	57'-8"	53'-5"	52'-7"	
GENERALLY RECOMMENDED MINIMUM (9'-0" STALLS)	60	9'-0"	10'-5"	20'-1"	17'-0"	57'-2"	52'-8"	51'-10"	
GENERAL ALL-PURPOSE MINIMUM AND IN CLEAR SPAN, ONE-WAY AISLE, SELF-PARK GARAGES.	45	8'-6"	12'-0"	18'-9"	12'-6"	50'-0"	44'-0"	44'-10"	
MINIMUM, FOR SPECIAL PURPOSES ONLY	45	8'-0"	11'-4"	18'-5"	12'-0"	48'-10"	43'-2"	44'-0"	
MINIMUM FOR SHORT AISLES	45	9'-0"	12'-9"	19'-1"	11'-4"	49'-6"	43'-2"	44'-0"	
GENERALLY RECOMMENDED MINIMUM (8'-6" STALLS)	30	8'-6"	17'-0"	16'-5"	10'-0"	42'-10"	35'-9"	40'-11"	
GENERALLY RECOMMENDED MINIMUM (9'-0" STALLS)	30	9'-0"	18'-0"	16'-10"	9'-0"	42'-8"	35'-6"	40'-9"	
SELECTED STALL AND AISLE DIMENSIONS FOR BACK-IN PARKING. USED PRIMARILY FOR ATTENDANT PARKING.									PARKING BACK-IN TO CURB
ATTENDANT PARKING ONLY	90	8'-0"	8'-0"	18'-0"	22'-0"	58'-0"	--	51'-2"	
MINIMUM FOR CUSTOMER SELF-PARKING. AISLE AND UNIT DEPTH PREFERABLY INCREASED BY 1' OR 1'-6"	90	8'-6"	8'-6"	18'-0"	21'-0"	57'-0"	--	50'-2"	
USED WHERE MAXIMUM NUMBER OF TWO-WAY AISLES IS DESIRED	90	9'-0"	9'-0"	18'-0"	20'-0"	56'-0"	--	49'-2"	



OFF STREET PARKING LAYOUT

DATE: FEB, 2011

REV. -/-/-

FIG. 8.3.3