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**STANDARD CONSTRUCTION REQUIREMENTS AND DETAILS**

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# DEFINITIONS AND ABBREVIATIONS

## 1.01 DEFINITIONS

**CITY MANAGER**-The City Manager or his designee (s).

**CONTRACTOR**-The successful Bidder to whom a contract has been awarded and who has executed the contract documents.

**CUL-DE-SAC**-A street with only one outlet that terminates in a vehicular turnaround. A turnaround may be circular or T-shaped/hammerhead design.

**DEDICATION**-The granting by a landowner of specified permanent rights or land for public use, as shown by a written instrument or drawing.

**EASEMENT**-A lawful right or privilege of use for a specified purpose over land owned by another party.

**ENGINEER**-The City Engineer of the City of Oak Ridge or other representative duly authorized by the City Engineer.

**INSPECTOR**-The Engineering Technician or other representative duly authorized by the City Engineer.

**INVERT**-The lowest point in the internal cross section of a pipe or other culvert.

**PLANS**-The approved plans, profiles, standard details, supplemental plans, and working drawings, which show the location, dimensions, and details of the work to be done.

**RIGHT-OF-WAY**-Land owned by a government agency, reserved for streets, utilities and other public uses.

**STANDARD REQUIREMENTS**-The general term comprising all the directions, provisions, and requirements contained or referred to in this book entitled "Standard Construction Requirements and Details" (SCRD) and in any subsequent revisions or additions to this book.

**SUBGRADE**-That portion of the roadbed prepared as a foundation for the pavement structure.

**VARIANCE**-The official provision, by the Planning Commission, of an exemption from compliance with the terms of conditions of these regulations due to a unique hardship related to physical characteristics of the property as provided in Article I, G of the Subdivision Regulations.

## 1.02 ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
A.B.S.	Acrylonitrile Butadiene Styrene
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
F	Fahrenheit
ft.	Foot
fps	Feet per second
gpd	Gallons per day
gpm	Gallons per minute
ID	Internal Diameter
lbs.	Pounds
MSL	Mean Sea Level
TDEC	Tennessee Department of Environment and Conservation
TDOT	Tennessee Department of Transportation
NFPA	National Fire Protection Agency
N.E.C.	National Electric Code
OD	Outside Diameter
P.C.	Point of Curvature
P.E.	Professional Engineer
psi	Pounds per square inch
P.T.	Point of Tangency
P.V.C.	Point of Curvature on Vertical Curve
P.V.T.	Point of Tangency on Vertical Curve
$Q_{max}$	Maximum Discharge
$Q_{min}$	Minimum Discharge
RH	Relative Humidity
RLS	Registered Land Surveyor
SCRD	Standard Construction Requirements and Details
SCS	Soil Conservation Service
sec.	Second
s.f.	Square feet
V	Volts
VAC	Voltage-Alternating Current

## **Section 2.00**

### **GENERAL PROVISIONS**

#### **2.01 GENERAL**

The intent of these construction requirements and details is to describe the level of performance to be met when constructing any infrastructure public improvements within the City.

All construction shall conform to the requirements and dimensions on the approved construction plans, Subdivision Regulations, Erosion Control and Storm Water Management Ordinance, Zoning Ordinance, Code of Ordinances of the City of Oak Ridge, the requirements of the Electric Department, or as stated in these SCRD. All work not explicitly described in these documents shall be constructed in accordance with applicable standards to be found in the latest edition of the TDOT Standard Specifications for Road and Bridge Construction and its applicable amendments, or the TDEC, Division of Water Pollution Control and Division of Water Supply. The design of streets, storm drainage systems, and grading plans shall be signed and sealed by a qualified Engineer, Architect or Landscape Architect licensed in the State of Tennessee. The design of water systems, sanitary sewer systems and flood control projects shall be signed and sealed by a qualified Engineer licensed in the State of Tennessee.

#### **2.02 MATERIALS AND PRACTICES**

It is the intent of this document to provide guidance for the designer, developer and constructor of developments and facilities within the City. The City, based on technical merit and justification by the project designer, will consider materials and practices differing from or not covered by this document for approval during the design development stage. The primary interest of the City is to require materials and methods that employ practices meeting or exceeding standards known to the trade. Current specifications and/or the latest revisions shall apply in all cases where materials are referenced by this document.

During the construction phase of a project, equal or better materials not specified may be used provided documentation and samples, necessary for the City to determine their acceptability, are submitted a MINIMUM of FOURTEEN days before they are to be used on the construction site. The City will issue a WRITTEN APPROVAL if the submitted data and samples are acceptable as an equal material.

#### **2.03 CONCRETE**

Concrete shall be only plant-mixed or transit-mixed concrete conforming to ASTM C33 for aggregates and to ASTM C94 for ready-mixed concrete. Any concrete placed that has a slump over four inches as per ASTM C143, or has a batched time of more than 90 minutes is unacceptable. Concrete shall not be deposited on frozen subgrade. Concrete shall not be placed when the air temperature is below 40 degrees Fahrenheit, and the predicted low temperature for the next 24 hour period is less than 32 degrees Fahrenheit unless proper freeze protection is provided. All concrete when placed in the forms shall have a temperature of between 50 and 90 degrees Fahrenheit and shall be maintained at a temperature of not less than 50 degrees Fahrenheit for at least 72 hours for normal concrete and 24 hours for

high early strength concrete, or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

Concrete shall be air entrained with five to seven percent air. Retarders and accelerators shall be used only if approved by the City.

## **2.04 CLEARING AND GRUBBING**

The work of clearing and grubbing shall consist of the cutting, removal, and satisfactory disposal of all vegetation and all surface debris.

Clearing and grubbing shall be conducted in a manner to prevent damage to vegetation that is intended to remain and to prevent damage to adjacent property.

Open burning of vegetative materials cleared from land is allowed only under certain conditions. A burning permit must be obtained from the Fire Department. Material larger than six inches in diameter may not be burned unless an approved pit burning operation, including the use of an air curtain destructor, is employed.

## **2.05 EARTHWORK**

Earthwork shall be defined as removal of earth from its natural location, or as the depositing of such material into the proper fill areas as designated on the plans.

Rock excavation shall be defined as removal of all rock or boulders that cannot be economically excavated by proper use of a power shovel or without the use of explosives. A written PERMIT FOR BLASTING must be obtained from the Fire Department in accordance with paragraph 2.08 A.

## **2.06 MAINTENANCE OF TRAFFIC**

Existing public streets or highways shall be kept open to traffic at all times by the contractor unless permission to close these streets, or portions thereof, is granted by the City. Public notice of street closures may be required by the City.

Proper and sufficient traffic control such as barricades, lights, signing and other protective devices shall be required to be installed according to the latest edition of the "Manual on Uniform Traffic Control Devices." The City may require the submission of a Traffic Control Plan showing traffic control measures during all phases of construction.

## **2.07 INSPECTIONS**

The presence of a City Inspector at the work site shall in no way lessen the contractor or developer's responsibility for conformity with the approved plans and specifications. City inspectors perform inspections based on availability of time and all elements of construction cannot be reviewed at the time of their construction. Any materials and/or workmanship found not to be in conformance to the approved plans and specifications, at any stage of development, shall be rejected by the City. The contractor/developer shall have no claim for losses suffered due to any necessary removals or repairs resulting from unsatisfactory work or unacceptable materials. Any work, which has been covered without the inspector's

approval, shall, at the inspector's request, be uncovered and be made available for inspection at the contractor's expense.

## **2.08 PERMITS**

During the course of designing, and prior to construction of a utility or street project, permits from the City, State and Federal government, if applicable, must be obtained. It is the responsibility of the owner/developer to ensure that all fees and applications for permits are submitted.

### **A. City Permits and Approvals**

#### **(1) Grading Permits**

A grading permit application may be obtained at the Municipal Building in the Community Development Department. See Section 4.00, Soil Erosion and Sedimentation Control for further details.

#### **(2) Residential Driveway Approval**

A curb cut permit including a site plan must be submitted to the City for approval. A permit application may be obtained at the Municipal Building in the Community Development Department. A minimum of five working days should be allowed for approval/disapproval except for arterial street curb cuts. Access to an arterial street must be reviewed by the Traffic Safety Advisory Board and approved by City Council, which will take approximately one month.

#### **(3) Burning Permit**

A burning permit shall be obtained a minimum of 24 hours prior to any burning. This permit is obtained from the Fire Department.

#### **(4) Blasting Permit**

A written permit for blasting is required any time there is to be transportation, use or storage of explosive materials. This permit is required a minimum of 24 hours before bringing such materials into the City and can be obtained from the Fire Department. Proof of insurance (original policy in the amount of \$1,000,000 public liability) and a State of Tennessee Explosive Users Identification card are required.

### **B. State Permits**

After approval by the City, plans for sanitary sewer/water extensions and State highway entrances shall be submitted to the appropriate State agency as required. It is the responsibility of the owner/developer to ensure that all submittals of plans, permit applications and fees are made.

**(1) Sanitary Sewer and Water System Extension**

For any proposed extension of the public sewer or water system, approval from the TDEC is required. Privately maintained sewer or water systems may require approval by the TDEC as directed by the City. Fee schedules and application forms may be obtained from the TDEC.

**(2) Storm Water Permitting**

Owners/developers must obtain permission from the TDEC to discharge storm water from any construction or grading activity that disturbs five acres or more of land. Application for permission can be obtained by submitting a Notice of Intent (NOI) on a State NOI form to the TDEC with a copy provided to the City.

Owners/developers may be required to obtain permits from the TDEC and/or US Army Corps of Engineers and/or Tennessee Valley Authority for work in or around "Waters of the State", wetlands or other watercourses.

**(3) Highway Entrance Permit**

A permit from TDOT is required for any proposed entrance onto a State highway. The State highways include State Routes 58, 61, 62, 95, and 170. Contact TDOT, Region 1 Traffic Division office in Knoxville.

**2.09 TREE/SHRUB PLANTING IN THE RIGHT-OF-WAY**

When allowed by the City, tree/shrub planting in the right-of-way shall be controlled by the following planting methods:

**A. Location**

Trees planted in the right-of-way shall be positioned so that when mature, intersection sight distances will not be limited and street safety will not be adversely affected. Trees shall not be located over existing water mains, sewer mains, or electric power lines and shall be at least 15 feet from a fire hydrant.

**B. Maintenance**

All trees planted in the right-of-way shall be watered and maintained by the owner/developer for a period of one year after planting or until suitable maintenance is provide by the City or by occupants of properties by prior agreement with the City.

## **SECTION 3.00**

### **STREETS**

#### **3.01 GENERAL**

All streets within the City of Oak Ridge shall conform to the City Comprehensive Plan both as to the general alignment and right-of-way widths.

#### **3.02 DESIGN**

All public streets shall be designed and constructed as specified herein and in accordance with Subdivision Regulations unless the TDOT Standard Specifications are applicable. The TDOT standards shall be used on all existing State roads, extensions of existing State roads, or roads to be maintained by the TDOT.

When a street is planned for future extension or to additional developable property, a temporary turn-around shall be provided and paved and roadway standards shall meet overall requirements of the future full build-out roadway. Curb for such turn-arounds need not be provided unless it is essential to control drainage. Additional right-of-way for such turn-arounds may be provided by a temporary easement, which would lapse when the road is extended.

##### **A. Street Classification**

###### **(1) Arterial Streets**

Arterial streets shall have a minimum right-of-way width of 90 feet with a minimum lane width of 12 feet. Where on-street parking is desired, an additional eight feet of pavement shall be required for each parking lane. When arterial streets are also State highways, the TDOT may require higher standards.

**NOTE: ALL STREETS THAT FOLLOW ARE DESCRIBED IN THE OAK RIDGE ZONING ORDINANCE AS SECONDARY AND MINOR ROADS.**

###### **(2) Major Collector Streets**

Collector streets are used for through traffic rather than for providing access to adjoining properties. Access to adjacent property should be planned and controlled so that minimum disturbance is made to the traffic-moving efficiency of the collector street. Major collector streets shall have a minimum right-of-way width of 80 feet and a minimum lane width of 12 feet. Where parking is desired on the right-of-way, an additional eight feet of pavement shall be required for each parking lane.

**(3) Minor Collector Streets**

Minor collector streets have two open ends once completely developed; each end generally connects with another street. One or more other streets may intersect it between its two open ends. Property fronting on either side of the street may have access to the street. Minor collector streets may carry through traffic within the immediate vicinity. Minor collector streets shall have a minimum right-of-way of 70 feet and a minimum lane width of 12 feet.

**(4) Local Streets**

Local streets are used primarily for providing access to adjacent properties. Vehicles moving on these streets should have an origin or destination in the immediate vicinity, and all types of through traffic should be minimized through initial design of its connections with other streets. Local streets should have a minimum right-of-way width of 50 feet and a minimum pavement width of 28 feet. Marginal access streets, dead-end streets, or one of several other types may perform the function of local streets. Minimum design standards for streets in low-density developments are provided in Standard Detail 3.17.

**(5) Marginal Access Street**

Marginal access streets may be required along expressways, arterials and collector streets to provide access to abutting properties and shall be located on the right-of-way. The right-of-way shall be contiguous with right-of-way of the major street and extend a minimum of 10 feet beyond the back of the outside curb of the marginal access streets. The minimum roadway width shall be 24 feet. The Zoning Ordinance further regulates such streets.

**(6) Dead-End Streets (Cul-de-Sacs)**

Dead-end streets are local streets having only one open end providing no access to another street. No other street intersects between the two ends, and dead-end streets shall have a minimum right-of-way width of 50 feet and a minimum pavement width of 28 feet. They shall be provided at the closed end with a turn-around having an outside street diameter of at least 80 feet and a street right-of-way diameter of at least 100 feet as detailed in Standard Detail 3.01

A “hammer-head” or other non-circular turn-around design may be approved by the Planning Commission as a variance in cases of difficult topography or similar unusual situations, provided that such design can accommodate the turn-around of fire, solid waste collection, and delivery vehicles as determined by the City.

**(7) Alleys**

Alleys are minor roadways which afford a secondary means of vehicular access to the back or side of properties otherwise abutting a street, and which may be used for public utility purposes. Alleys generally have two open ends, and each end connects

with a street. Alleys shall have sufficient pavement width to adequately serve the anticipated vehicular traffic.

## **(8) Exception to Standards**

When a subdivision has a unified plan which utilizes a more innovative approach to street standards not meeting the above standards in Section A(1-7), the Planning Commission with advice from the City, may approve a different standard which should be equal to or better than the above standards. A traffic engineering impact study may justify sections of reduced roadway and right-of-way width.

## **B. Horizontal Street Design**

### **(1) General Layout and Conformity to Comprehensive Plan**

All streets shall conform to the City Comprehensive Plan when applicable or shall be designed and located in proper relation to existing streets and environment. The alignment of arterial and collector streets should be direct as possible but consistent with topography and preserving developed properties and community values. Residential streets shall be designed to discourage high-speed traffic and minimize excessive cuts, fills and through traffic. Traffic calming principles may be required if the basic design does not discourage traffic speeds, which are inappropriate for the type of street being planned.

### **(2) Standards for Curves**

The design of streets shall conform to the curve controls in Table 3.2 at the end of this section.

### **(3) Tangent Sections**

Minimum tangent lengths between reverse curves on arterial and collector streets shall be computed to provide for superelevation transition lengths in accordance with the TDOT Standards Specifications. Local streets and other lower classified streets not requiring superelevation should provide a minimum tangent length of 75 feet between reverse curves. The minimum tangent length of an approaching intersection should be 50 feet for local and lower classified streets measured from pavement edge. All intersections of streets classified as collector or greater should have a tangent section not less than 100 feet approaching the intersection.

### **(4) Angles of Intersections and Compound Curves**

Compound horizontal curves with the same direction of curvature shall have the radius of the flatter circular arc no more than one and one-half times the radius of the sharper circular arc. Streets shall intersect each other at right angles whenever possible. The minimum desirable intersection angle is 80 degrees unless physically

impossible, but at no time shall a street intersect any other street at less than 60 degrees.

**(5) Spacing of Intersections**

Intersections with arterial streets should be at least 800 feet apart. There should be a minimum of 200 feet between centerlines of street jogs on collectors and 125 feet between centerlines along other streets.

**(6) Superelevation**

Superelevation is to be used on all arterials and collectors. Superelevation shall conform to the TDOT and AASHTO standards for superelevation design.

**C. Vertical Street Design**

**(1) Conformity to Existing Grades**

Street grades shall be established with respect to existing topography to avoid excessive grading and filling, and the removal of existing trees and vegetation whenever practical.

**(2) Minimum and Maximum Grades**

The minimum grade allowed on any street shall be one-half of one percent. Maximum grade allowed shall be seven percent for arterial streets, nine percent for collector streets and 12 percent for other streets.

**(3) Street Intersection Grades**

At every street intersection, one street will be considered the major street and the other will be considered the minor intersecting street. Questions regarding which intersecting street is to be the major/minor street will be resolved by the City. Major street grades will be carried through the intersection with no break in centerline grade or cross slope to the outside edge of through lane. Minor street grades shall connect at the edge of the major street with a smooth connection using crest or sag vertical curves or spline curves if necessary to approximate a vertical curve. Grades approaching an intersection through vertical curves should not exceed five percent for the last 100 feet before the intersection. Minor grade breaks (less than two percent) at the intersecting edge of pavement will be acceptable for local streets. Minor street intersecting road grades should be set to direct storm drainage away from the major street edge and toward the beginning (PC) of curve at the curb return.

#### **(4) Vertical Grade Standards**

Maximum grades and vertical curve controls found in Table 3.2 shall be followed at all times.

### **D. Geometrics**

#### **(1) Radii**

A minimum radius of 25 feet measured to the face of curb shall be required where local streets intersect.

A minimum radius of 30 feet measured to the face of curb shall be required where a local street intersects with a collector street. It is recommended that the designer consider larger radii or three centered compound curves where needed to provide for turning movements of larger vehicles.

A minimum radius of 40 feet will be required where collectors intersect arterial streets.

#### **(2) Cul-de-Sac and “Hammer Head” Turn-Arounds**

Cul-de-sac and “hammerhead” turn-arounds shall be designed as shown in Standard Detail 3.01.

#### **(3) Driveways (Non-Residential and Residential)**

Non-residential and residential driveways shall conform to the City Zoning Ordinance, Section 6-603, “Vehicle Access Control” for driveway width, radii, spacing, etc. Where new driveways are constructed at an existing curb and gutter or sidewalk section, the driveway must be constructed in accordance with Standard Details 3.02 and 3.03 for concrete driveway aprons. New residential curb cuts on existing streets with curb and gutter that are maintained by the City shall be installed by the City at the owner’s expense unless otherwise approved by the City.

When a residential driveway serves a residence located more than 150 feet from a public roadway, the driveway should be at least 12 feet wide, be minimally passable in all weather conditions, and constructed at a maximum slope of 12 percent to assure proper fire protection.

#### **(4) Curb and Gutter**

To eliminate numerous driveway curb breaks and to reduce maintenance costs, the use of valley curb and guttering similar to Standard Detail 3.09, is preferred in residential areas. Street curb and gutter shall be standard 2’ 3” or 2’ 6” curb and gutter as shown on Standard Details 3.05 and 3.09 unless otherwise approved by the City. Curb and gutter shall be machine formed unless otherwise approved by the

City. Where curb and gutter is used, mineral aggregate base course shall be required to extend beyond the curb and gutter in accordance with Standard Detail 3.04. Standard Detail 3.06 shows a standard method of removing existing concrete curb and gutter. Standard Detail 3.08 shows a minor drain through a curb.

## **(5) Curbs**

In all subdivisions the owner/developer shall provide a cement concrete curb or curb and gutter, the face of which shall not be less than six inches in height unless otherwise approved by the City. Backfill shall normally slope toward the curb. Curbs or curb and gutter shall be machine formed unless otherwise approved by the City. Standard Detail 3.07 shows a typical machine formed curb section.

## **(6) Parking Lots**

All Parking Lots shall conform to the City Zoning Ordinance, Section 6-606, "Required Off-Street Parking."

## **(7) Sidewalks**

Sidewalks shall be constructed in accordance with the latest edition of the TDOT, Standard Specifications for Road and Bridge Construction with the following incorporated changes:

- (a) The width of sidewalks shall be in accordance with the City Subdivision Regulations.
- (b) Minimum thickness of a sidewalk shall be four inches. At locations where a driveway crosses a sidewalk, a six-inch minimum depth is required. Sidewalks shall have a uniform slope toward the roadway of two percent with a tolerance of one percent unless otherwise indicated on the plans. The unpaved utility strip between the sidewalk and the back of curb shall have a grade of not less than four percent nor greater than six percent sloped toward the roadway. For typical sidewalk sections and details, see Standard Detail 3.10.
- (c) Sidewalk construction shall meet the requirements of the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities found in 36 CFR (Code of Federal Regulations) Chapter XI, Part 1191. Typical handicap ramp details for sidewalk construction are shown on Standard Details 3.11, 3.12 and 3.13.
- (d) Materials
  - Concrete: Concrete used shall meet the requirements of the TDOT Standard Specifications for Class "A" Structural Concrete.
  - Asphalt Walkways: Where permitted, asphalt walkways shall be constructed of the TDOT-approved "E" mix (min. two inch thickness) for asphaltic concrete material with four inch minimum thickness of base material over compacted subgrade.
  - Curing Compound: A membrane-curing compound shall be applied on concrete sidewalks as soon as possible after finishing. The compound shall conform to the requirements of Liquid Membrane-Forming Compounds for Curing Concrete, ASTM C309.
  - Base Material: All concrete sidewalks shall have four inches of base material consisting of one and one-half inch maximum size mineral aggregate base

from an approved material plant and shall meet requirements of Section 3.04.

(e) Construction Methods

- Excavation: Excavation required for the construction of sidewalks and driveways shall be to the established lines and grades as shown on an approved plan.
- Fine Grading: The contractor shall do all necessary filling, leveling and fine grading required to bring the subgrade to the exact grades specified and compacted to 90 percent standard density in accordance with ASTM D698. Any undercutting excavation may be filled with gravel thoroughly compacted in place to the satisfaction of the City.
- Forms: Forms shall be of a material and section satisfactory to the City, straight, free from warp and of a depth equal to the thickness of the finished work. They shall be securely staked to line and grade maintained in a true position during the depositing of concrete.
- Finishing: Concrete sidewalks shall be finished to a true, even surface. They shall be troweled and then brushed transversely to obtain a smooth uniform brush finish. Joints and sides shall be edged with suitable tools.
- Joints: Expansion joints for sidewalks shall be formed, using expansion joint material of an approved type and shaped to the section. Expansion joints shall be placed in the sidewalk at 40-foot intervals or as otherwise approved by the City. Expansion joints shall also be placed at all intersections, sidewalks with concrete driveways, curbs, formations and other sidewalks and at other locations adjacent to old concrete work. Similar material shall be placed around all obstructions protruding into or through sidewalks or driveways. All expansion joints shall be one-half inch in thickness. Edges of all construction and expansion joints and other edges of all sidewalks shall be finished to approximately a one-fourth inch radius with a suitable finishing tool. Sidewalks shall be grooved with a grooving tool on five-foot spacing in accordance with the TDOT Standard Specifications. When sidewalk is against the curb, expansion joints and tooled grooves shall match those in the curb.

**E. Intersection Sight Distance**

Intersections shall be designed to meet the minimum horizontal and vertical sight distance standards provided in the latest edition of A Policy on Geometric Design of Highways and Streets published by AASHTO. Minimum sight distances for street intersection designs governed by passenger vehicles are provided in Table 3.1. Design sight distances for vehicle turning movements shall be listed on all roadway plans submitted to the City for approval and shall meet the minimum requirements as shown below.

**Table 3.1**

**Minimum Sight Distance Along Major Street  
For a Passenger Vehicle Stopped on the Cross Road**

Design Speed MPH	Sight Distance (Feet) for Two Lane Major Road	
	Passenger Vehicle Crossing Intersection	Passenger Vehicle Turning Left or Right
25	240	285
30	300	350
40	400	570
50	500	840

**Table 3.1 (Cont'd)**

Design Speed MPH	Sight Distance (Feet) for Four Lane (Undivided) Major Road	
	Passenger Vehicle Crossing Intersection	Passenger Vehicle Turning Left or Right
25	290	300
30	340	360
40	450	580
50	560	855

For Single Unit and Semi-trailer sight distance requirements, refer to the latest version of A Policy on Geometric Design of Highways and Streets published by AASHTO when design is governed by the larger design vehicles.

Sight distances shown are based on driver eye height of 3.5 feet and height of object at 4.25 feet. Driver's eye position located 20 feet from edge of through lane on the major road. Sight distance shall be measured along the path on the major street.

Table values are based on level grades and right angle intersections. See AASHTO Policy for sight distance adjustments when necessary.

**F. Utility Placement**

Utility placement in the right-of-way shall be in accordance with Standard Detail 3.15. Deviations from standard placement requirements will be considered by the City.

**3.03 RESIDENTIAL STREET CONSTRUCTION AND PAVEMENT DESIGN**

The following standards will be required for the grading, soil stabilizing, preparation of the subgrade, placement of crushed stone base, priming, and application of pavement for all residential streets and right-of-ways.

**A. Typical Street Section**

All streets shall be graded to such a width that pavements and sidewalks can be constructed generally to the plans indicated on Standard Detail 3.14. A utility strip six feet or more behind the back of curb is required on both sides of the roadway. Sidewalk may occupy some or all of this utility strip. This utility strip shall normally be sloped toward the roadway.

**B. Subgrade Preparation**

All boulders, tree stumps, organic material, soft clay, spongy material and any other objectionable material shall be removed to a depth of at least two feet below the graded surface in cuts, and the natural ground in fills. This objectionable matter shall be removed from within the right-of-way limits and disposed of in such a manner that it will not become incorporated in the fills, nor in any manner hinder proper operation of the roadway drainage systems. Rock, when encountered, shall be removed to a depth of 12 inches below the subgrade. Where necessary, additional easements shall be required over and above normal right-of-way dedication to maintain banks and drainage where fill or cut extends beyond the

right-of-way. Trees, stumps and all other vegetation in fill areas shall be removed prior to filling.

**C. Binding Fill to Original Ground**

In order to ensure proper bond and prevent slipping between the original ground and the fill, the surface of the original ground shall be scarified to a reasonable depth. Where fills are made on hillsides or slopes steeper than 4:1 (4 Horizontal:1 Vertical), steps shall be cut into the original ground before filling is begun.

**D. Placing, Spreading and Compacting Fill Material**

The selected fill material shall be placed in layers which, when compacted, shall not exceed eight inches. Each layer shall be spread evenly and shall be thoroughly blade mixed during spreading to ensure uniformity of material in each layer.

**E. Moisture Content**

The moisture content of the fill material shall be such that the fill can be compacted to the specified standard Proctor dry density as determined by ASTM D698. If the moisture content of the fill material is below the amount needed to create the necessary density, the proper amount of water shall be added. Similarly, if the moisture content of the fill material is above the needed amount necessary to create the specified density, the fill material shall be aerated by blading or other satisfactory method until the moisture content of the fill material is satisfactory.

**F. Placing and Compacting**

After each layer has been placed, mixed and evenly spread, it shall be compacted to 95 percent of maximum density as determined by ASTM D698. However, not less than 98 percent maximum density, standard Proctor method, at optimum moisture will be acceptable for a depth of nine inches below the subgrade under all proposed paving areas shown on the plans. Compaction shall be by means of tamping or sheeps foot rollers, multiple-wheel pneumatic-tired rollers or other types of rollers or equivalent which will be able to compact the fill to the desired density. Rolling shall be accomplished while the fill material is at the optimum moisture content range. Rolling of each layer shall be continuous over its entire area and sufficient trips shall be made by the rolling equipment to ensure that the specified density has been obtained.

**G. Completion of General Grading**

Excavating of cut areas shall continue until these areas conform to the lines, grades, slopes, and typical cross-sections shown on the accepted plans. Placing, spreading, filling, and compacting areas to be filled shall also be continued alternately until these areas conform with the lines, grades, slopes, and typical cross-sections shown on the accepted plans.

Banks of cuts and fills shall be graded to slopes not exceeding 2:1 (2 horizontal:1 vertical). The City may grant an exception in instances where unusual soil or topographic conditions warrant a deviation from these established maximum slopes. When slopes in excess of 2:1

are deemed necessary, the slope must be adequately stabilized to prevent erosion and degradation. Slopes 2:1 or less shall be sodded or planted with soil-fixing grass, shrubs or vines. The viability of such soil-fixing grass, shrubs and/or vines shall be guaranteed by the subdivider for a period of one year from date of planting or final acceptance whichever is latest. For additional cut and fill slope requirements, the City's "Erosion Control and Storm Water Management Ordinance" should be consulted.

**H. Subgrade Bearing Strength and Pavement Design-Residential Streets**

Soil samples for California Bearing Ratio (CBR) tests shall be collected by an independent testing laboratory to determine the required pavement design. Subgrade conditions shall be based upon corrected soaked CBR values at 0.1-inch penetration as per ASTM D1883. Soil samples used for the CBR tests shall be obtained at intervals not greater than 1,000 feet. Where field conditions warrant, the City may require additional tests at intervals less than 1,000 feet. The CBR of the soil tested will be compared to those in the following Table CBR-1. The Table indicates the three major soil types found in the area and the usual range of CBR values to be expected.

**TABLE CBR-1**

Soil Type	CBR Range	Relative Subgrade Strength
Cherty-Clay	7.01-or greater	Good
Weathered Shale	4.01-7.00	Fair
Silty-Clay	1-4.00	Poor

Required pavement design Structural Numbers for respective subgrade CBR values are as follows:

**TABLE CBR-1**

CBR Range	Required Structural Number
7.01 or greater	2.30
4.01-7.00	2.85
1-4.00	3.25

Structural Number values per inch of thickness are provided below for each of the major pavement components:

**TABLE CBR-1**

Material Type	Structural Number Value per Inch Thickness
Mineral Aggregate Base	0.14
TDOT "BM" Mix Bituminous Base	0.40
TDOT "D" or "E" Mix Asphaltic Surface	0.40

The maximum dept of "D" or "E" Mix shall be two inches, and the minimum depth of "BM" mix shall be two and one-half inches on any project. The following Table CBR-2 lists typical depths of pavement materials suggested to meet the required Structural Numbers for various subgrade CBR ranges.

**TABLE CBR-2**

CBR Range	Required Structural No.	Base (Inches)	"BM" Mix	"D" or "E" Mix
7.01 or greater	2.30	5	2 1/2"	1 1/2"
4.01-7.00	2.85	6	3 1/2"	1 1/2"
1-4.00	3.25	6	4 1/2"	1 1/2"

## **I. Alternative Paving of Equivalent Strength**

Alternative paving materials and methods, such as concrete, may be used if the developer provides a professional engineer's report, acceptable to the City, to substantiate that the proposed design meets the established bearing strength guidelines for soil types identified. Rigid pavement design shall follow the latest AASHTO method.

## **J. Seasonal Limits**

No fill material shall be placed, spread, or rolled while the ground or fill is frozen or thawing or during unfavorable weather conditions. When heavy rains interrupt the work, fill operations shall not be resumed until the moisture content of the fill material is within a range that will permit compaction to a minimum density of 95 percent (98 percent for top nine inches of subgrade) in accordance with ASTM D698.

## **K. Bridge Design**

All public bridges or private bridges serving more than one property are to be designed to withstand HS-20 highway loading unless otherwise approved by the City and shall be properly signed and sealed by a Tennessee Professional Engineer. Bridge design and construction should be in accordance with the AASHTO, Standard Specifications for Highway Bridges.

## **L. Pavement Markings**

All streets and parking lots shall be marked in accordance with the TDOT Standard Specifications or the latest revisions of the MUTCD. Thermoplastic pavement markings shall be required in areas of existing thermo-plastic markings, on arterial streets, high volume collector streets, and may be required on other streets if deemed necessary by the City for improved safety and durability such as high volume intersections. All specialty markings (i.e. pavement arrows, stop bars, etc.) shall be thermoplastic markings. The City may require painted guide markings prior to placement of thermoplastic permanent markings.

## **3.04 MATERIALS**

### **A. Mineral Aggregate Base**

Mineral Aggregate Base material shall be in conformance with the TDOT Type A, Grade D, Section 903.05, and shall be placed in accordance with the TDOT Section 303. The compacted density shall not be less than 95 percent of maximum density determined in accordance with ASTM D698. The minimum thickness shall be five inches in accordance with Table CBR-2.

### **B. Prime Coat**

If required, the prime coat shall be applied in accordance with the TDOT Section 402 at a rate of approximately 0.35 gallons per square yard of base stone.

### **C. Bituminous Base Course**

All roads must have a layer of bituminous base applied in accordance with the TDOT Section 307, Grade BM. The depth of the layer will be determined by the results of the CBR test performed on a representative subgrade soil sample. Table CBR-2 lists the required pavement layer thickness for typical soil CBR values expected to be found in this region.

### **D. Wearing Surface**

The wearing surface shall consist of a minimum one and one-half inch asphaltic concrete surface course conforming to the TDOT Section 411, Grade D or E and shall be installed in conformance to the TDOT Section 407.

## **3.05 INSPECTION AND TESTS**

No construction shall be conducted until the following applicable items have been obtained: all grading permits, state permits (if applicable), performance bonds if required, and City of Oak Ridge subdivision and plan approval if required.

### **A. Streets**

No base materials shall be placed on a roadway until the subgrade, underlying utilities including storm, water, sewer, and all appurtenances have been inspected and meet or exceed these requirements.

Field density testing should be completed for each layer of fill placed and, as a minimum, will be required for every other layer of fill placed in accordance with Section 3.03. A minimum of one test per 1,000 square yards of surface area placed will be required for each tested layer of fill. Field density testing of the finished subgrade in cuts and fills will be required with a minimum of one test per 1,000 square yards of subgrade surface area. Proof rolling of finished subgrade with a loaded tandem dump truck shall be required.

Field density testing of mineral aggregate base construction will be required at a frequency of one test per 1,000 square yards of surface area for each layer of mineral aggregate base constructed. Proof rolling of finished mineral aggregate base shall be required before placement of bituminous layers.

Field density testing of Bituminous Base and Asphaltic Concrete surface courses will be required as specified in the TDOT Section 407.15 except that frequency of testing shall be based on division of the pavement into 5,000 square yard lots with five density tests per lot.

All field and laboratory testing of earthwork, subgrade, mineral aggregate base, bituminous base and asphaltic concrete surface shall be performed by a city-approved independent testing laboratory and provided at the expense of the developer. Test reports shall be submitted to the City. The City may also require the submittal of an asphalt job mix formula before paving operations begin.

## **B. Curb and Gutter, Driveways**

No concrete shall be placed until the forms have been set and the City has approved subgrades.

### **(1) Subgrade**

Subgrade shall be excavated to the required depth, and shaped to the proper cross-section. Where tree roots are encountered, they shall be removed to a depth of one foot below finished subgrade for the full width of excavation. The subgrade shall be stable and thoroughly compacted.

### **(2) Forms**

Forms shall be set and maintained true to the required lines, grades, and dimensions. Forms shall be constructed with material of such strength and rigidity to prevent any appreciable deflection between supports. Straight forms shall be within a tolerance of one-eighth inch in ten feet from a true line horizontally or vertically. Forms shall be thoroughly cleaned of all dirt, mortar and foreign material before being used. All inside form surfaces shall be thoroughly coated with commercial quality form oil.

## **3.06 FIRE LANES**

When required, fire lanes shall be a minimum width of 20 feet and shall be properly marked and signed to designate the access as a "fire lane" as specified by the Fire Chief. The surface of the fire lane shall be paved with an all weather-driving surface suitable for fire fighting equipment.

## **3.07 STREET SIGNS**

Street signs within subdivisions, which will be maintained by the City, shall be installed by the developer and shall be consistent with the Manual for Uniform Traffic Control Devices and Supplements. All signs shall be purchased and installed by the developer before recording of the final plat so as to be in place prior to any issuance of building permits. All signs on the public right-of-way, which are not consistent with the Manual for Uniform Traffic Control Devices, must be approved by the City and privately maintained.

## **3.08 CONNECTION TO EXISTING STREET**

Where new streets connect to existing streets, saw cutting and/or milling of the existing city street shall be performed along the edge of the existing street at a length equal to the width of the new street's pavement. The width and depth of milling shall be determined by the City.

	Horizontal Curve Controls			Vertical Curve Controls			
	Minimum Design Speed (MPH) (1)	Maximum Superelevation (ft/ft) (2)	Minimum Radii (ft)	Maximum Grade	Length Crest	Absolute Minimum Length Crest	Length Sag
Expressways	Design standards shall conform to Federal and TDOT standards						
Arterial Streets	50	0.06	850	7%	160A	150'	110A
Collector Streets	40	0.04	575	9%	80A	100'	70A
Local Streets	30	Normal Crown	300	12%	30A	80'	40A
Marginal Access Streets	30	Normal Crown	300 (3)	12%	30A	80'	40A
Dead End Streets (Cul-de-Sacs 600 ft or less)	25	Normal Crown	150	12%	20A	50'	30A

A - Algebraic difference in grades

1. Design speed shall be at least five-(5) mph greater than posted speed.
2. The superelevation tables found in A Policy on Design of Urban Highways and Arterial Streets – 1990 or latest edition published by the American Association of State Highway and Transportation Officials will be used for determining the actual rate of superelevation “e” at various radii. Superelevation transitions shall be designed in accordance with TDOT standards.
3. Radii may be reduced at turnouts and intersections.

**Table 3.2**

## **SECTION 4.00**

### **SOIL EROSION AND SEDIMENTATION CONTROL**

#### **4.01 SCHEDULING**

Temporary and permanent erosion control measures shall be provided for all land disturbing work in accordance with the City of Oak Ridge Erosion Control and Storm Water Management Ordinance and a storm water management plan approved by the City. A grading permit shall be obtained from the City prior to beginning site work. Temporary measures shall be installed and inspected by the City for compliance prior to any other land disturbing activity. All temporary measures shall be maintained until the permanent measures have taken effect. All permanent erosion control measures shall be incorporated into the work at the earliest practical time. Temporary and permanent measures shall be coordinated to provide effective and continuous erosion control throughout the construction and post-construction period to minimize siltation of streams, lakes, reservoirs and other impoundments, ground surfaces, and other property.

#### **4.02 TEMPORARY MEASURES**

##### **A. Silt Fences**

Silt fences shall be installed at the toe of all fill slopes and any other necessary locations as directed by the City. Silt fences shall be erected in accordance with Standard Detail 4.01.

##### **B. Diversion Ditches**

To minimize erosion, diversion ditches/berms should be designed for and installed at the top of major cut and fill slopes and at any other necessary locations as directed by the City. Berms and slope drains on fill sections should be considered as needed. Diversion ditches shall be installed in accordance with Standard Detail 4.08.

##### **C. Construction Entrances**

Construction entrances shall be installed at all points of access to construction sites. Any access point, which is not a construction entrance, should be barricaded to prevent its use. Construction entrances shall be installed in accordance with Standard Detail 4.07. The City may require additional measures, such as vehicle washing, to assure control of sediments on site.

##### **D. Sediment or Filter Basins**

Sediment/filter basins shall be installed at all points where accumulated runoff is released to natural drainage channels required by design or as directed by the City. Sediment/filter basins shall be sized to hold 1,800 cubic feet of sediment for every acre of denuded area

tributary to the structure. Typical sediment/filter basins are shown on Standard Details 4.02 and 4.05.

## **E. Seeding and Mulching**

Seeding and mulching is required immediately upon completion of construction phases. All disturbed areas shall be dressed with topsoil to a depth of three inches. The top two inches shall be pulverized to provide a uniform seedbed. Agricultural lime should be applied at the rate of 100 lbs./1,000 square feet immediately before plowing. Seed should be tall fescue applied at the rate of 2.5 lbs./1,000 square feet.

Fertilizer (5-10-10 or equivalent) should be applied to all disturbed areas at a rate of 20 lbs./1,000 square feet. Mulching should consist of small grain straw applied at a rate of 100 lbs./1,000 square feet.

If active construction ceases in any area for more than 30 days, all disturbed areas shall be seeded, mulched, and tacked unless written approval is granted by the City.

All vegetation shall be maintained for a period of one year from planting or until suitable maintenance is provided by the City or occupants of properties. Planting should be done during favorable weather conditions.

## **4.03 PERMANENT MEASURES**

### **A. Ground Cover**

After construction is complete, all disturbed areas shall receive a permanent ground cover in accordance with the seeding and mulching schedule as identified in the latest edition of the TDOT Standard Specifications unless temporary measures are acceptable by the City.

### **B. Riprap Dissipation Pads**

After construction is complete, all points of storm water release shall be protected by riprap dissipation pads or other measures designed to reduce discharge velocities to non-erosive levels. The dissipation pads shall be designed and constructed with either an engineering fabric or washed stone barrier between the dissipation pad and the natural ground. Calculations shall be furnished to indicate the sufficiency of the dissipation pads specified. Riprap pad design shall be in accordance with SCS or other commonly accepted methods.

## **4.04 COMPUTATIONS**

All computations and assumptions used to formulate a storm water management plan shall be submitted to the City for review. Refer to the TDEC requirements for storm water management plans and the City Erosion Control and Storm Water Management Ordinance for design criteria.

## **SECTION 5.00**

### **PIPE TRENCHES**

#### **5.01 EXCAVATION AND PREPARATION OF PIPE TRENCHES**

Trenches for water distribution lines, sanitary sewer lines, force mains, and storm sewer lines shall be excavated to the required depth to permit installation of the pipe along the lines and grades shown on the construction drawings. The minimum trench width at the top of the pipe shall be at least 16 inches greater than the outside diameter of the pipe to allow for proper compaction. Where excavation is in rock, the rock shall be removed to a depth of at least six inches below finished pipe grade and shall be backfilled with materials in accordance with these specifications. Where wet soil conditions are encountered, trenches shall be stabilized with #2 stone and with a base layer of #57 stone.

#### **5.02 PIPE LAYING AND BACKFILLING**

All pipes shall be laid in accordance with the manufacturer's recommendations. The subgrade at the bottom of the trench shall be shaped to secure uniform support throughout the length of the pipe. A space shall be excavated under the bell of each pipe to provide space to relieve bearing pressure on the bell and to provide room to adequately make the joint. Open ends of water and sanitary sewer pipe shall be plugged with a standard plug or cap at all times when pipe laying is not in progress. Trench water shall not enter the pipe. Backfill material shall be free from construction material, debris, frozen material, organic material, or unstable material. Backfill material shall be free from stones greater than four inches in diameter.

Trench backfill under new and existing roadways and extending to three feet beyond the back of curb or edge of shoulder, measured perpendicular from the centerline shall be in accordance with Standard Details 5.01 and 7.12.

All pavement cuts must have approval from the City. All trenches shall be properly backfilled at the end of each working day unless otherwise approved by the City. All pavement cuts shall be repaired within a maximum of three days from the date the cut is made. If conditions do not permit a permanent repair within the given time limit, permission to make a temporary repair must be obtained from the City.

#### **5.03 BORING AND JACKING**

In locations where open pipe trenches are not allowed as determined by the City, dry bore and jack operations may be allowed. Smooth wall steel pipe may be jacked through dry bores slightly larger than the pipe bored progressively ahead of the leading edge of the advancing pipe. The spoil material shall be mucked by the auger back through the pipe during the boring operation. As dry boring progresses, each new section of the encasement pipe shall be butt-welded to the section previously jacked into place.

In the event that an obstruction is encountered during the boring and jacking operation, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 cement grout at a sufficient pressure to fill all voids before moving to another boring site.

Size and wall thickness of smooth wall encasement pipe shall be as follows:

Pipe Size (O.D.in.)	Wall Thickness (in.)
12 <sup>3</sup> / <sub>4</sub>	0.188
16	0.250
18	0.250
20	0.250
24	0.250
30	0.312
36	0.375

Casing pipe shall be installed with a minimum cover of four feet under pavement surface.

All carrier pipe shall be mechanical joint ductile iron pipe resting on treated timber skids as shown on Standard Detail 5.02 so as to prevent damage to the pipe joints. Pipe joints shall not contact the interior of the casing pipe. No blocks or spacers shall be wedged between the pipe and the top of the casing. Casing pipe shall have the following minimum sizes:

Carrier Pipe Size (in.)	Wall Thickness (in.)
4	12 <sup>3</sup> / <sub>4</sub>
6	12 <sup>3</sup> / <sub>4</sub>
8	18
10	20
12	24
14	26
16	28

## **SECTION 6.00**

### **WATER DISTRIBUTION**

#### **6.01 WATER DISTRIBUTION**

##### **A. General Design Criteria**

Water distribution systems shall be constructed in accordance with the latest edition of the TDEC "Public Water Systems Design Criteria." If discrepancies are found between the TDEC and City requirements, the more stringent shall apply.

##### **(1) Location and Layout**

All public water mains shall be located within dedicated right-of-ways and/or dedicated easements with a minimum width of 10 feet, centered about the pipe. An easement of 15 feet shall be required where the depth is greater than five feet but less than eight feet. An easement of 20 feet shall be required where depths are greater than eight feet. Pipe systems shall be arranged in loops unless otherwise permitted by the City. No part of any structure, including foundations and overhangs are permitted in an easement.

Where deemed appropriate by the City, all systems in non-residential areas will have proper metering and backflow prevention devices installed as close to the existing city-owned main as possible. Final determination of their location shall be at the sole discretion of the City.

##### **(2) Sizing**

In residential areas, in order to obtain maximum available fire flow, mains shall be a minimum of six inches in diameter. Four-inch mains are permitted on residential cul-de-sacs less than 400 feet in length provided no fire hydrants are required on the cul-de-sac and adequate pressure is available. Use of two-inch mains shall be considered for short cul-de-sacs and permanent dead ends where future growth is not feasible and where justified by hydraulic analysis.

In non-residential districts, six-inch water mains are acceptable where fire flows of 1,000 gpm at 20-psi residual pressure can be achieved.

##### **B. Installation**

##### **(1) Deflection**

Maximum deflection for PVC pipe shall be five percent. Cast iron or ductile iron fittings are required if deflection will be more than five percent.

**(2) Locator Wire for PVC Pipe**

When PVC pipe is installed, an insulated solid copper locator wire, minimum size #12, shall be installed with the pipe. The wire shall be installed under the pipe prior to pipe placement. The locator wire shall be pulled up to the ground surface in all valve boxes and splices should be made in valve boxes. All splices should be made with a corrosive resistant connection as approved by the City. The locator wire shall follow the entire length of the main.

**(3) Bedding**

No water mains shall be laid on rock until the rock has been covered by a minimum of six inches of fine graded stone. PVC water mains shall be bedded in #57 stone with three inches minimum under the main and six inches minimum over the main in accordance with Standard Detail 6.01. Ductile iron pipe may optionally be bedded with Class I, II or III materials in accordance with ASTM D2321 and Section 7.01F(6).

**(4) Service Taps**

PVC pipe will require brass or bronze saddles for all service taps. Direct taps are permissible on ductile iron pipe.

**(5) Minimum Cover**

All water mains shall be installed with a minimum cover of 30 inches measured from the top of the pipe to the finish grade.

**(6) Horizontal Separation**

Water mains shall be at least 10 feet measured horizontally edge-to-edge from existing or proposed sanitary sewer, storm sewer or sewer manhole. If the elevation of the bottom of the water main is at least 18 inches above the top of the sewer, a horizontal separation of at least three feet is allowed.

**(7) Vertical Separation**

Under normal conditions, water mains crossing sanitary sewers or storm sewers shall be laid to provide a vertical separation of at least 18 inches between the bottom of the water main and the top of the sewer.

Where a water main crosses over an existing sanitary or storm sewer and the vertical separation is less than 18 inches, the water main shall be encased in concrete or in one length of steel encasement ductile iron pipe centered at the point of crossing.

Where a water main crosses over a new sanitary or storm sewer and the vertical separation is less than 18 inches, the sewer line shall be constructed of water pipe

for a distance of at least nine feet on either side of the point of crossing. The water line pipe shall have one pipe length centered at the point of crossing.

Where water mains cross under sewers, a minimum vertical separation of at least 18 inches shall be provided between the bottom of the sewer and the top of the water main. Both the water main and the sewer line shall be constructed of water line pipe with a length of water line pipe centered at the point of crossing. Adequate structural support shall be provided to prevent excessive deflection of joints and settling on and breaking the water mains.

**(8) Stub Outs**

When mains are to be installed to a dead end or stubbed out for future extension, at least one 18-foot joint of pipe shall be installed with a thrust collar. A main line valve and blow-off assembly shall be installed on a water line proposed for future extensions per Standard Detail 6.02. Permanent dead end mains shall be installed with a blow-off valve in accordance with Standard Detail 6.04.

**(9) Manufacturer Markings**

All pipes shall be installed so that the manufacturer markings are positioned on the topside of the pipe.

**C. Material**

All pipe and appurtenances shall comply with the latest applicable AWWA and ASTM standards.

**(1) PVC Pipe-Residential**

Pipe shall be SDR 21, Class 200 pressure rated pipe as long as the working pressure does not exceed 135 psi. Joints shall provide for expansion and contraction with the use of rubber rings and tapered ends as an integral part of each full joint. Joints for Class 200 pipe shall be manufactured per ASTM D3139. Gasket materials shall meet the requirements of ASTM F477. Pipe shall be clearly marked with manufacturer's name, nominal diameter, SDR, ASTM D2241, pressure rating, and NSF approval seal. No solvent cement couplings will be permitted.

**(2) PVC Pipe Non-Residential**

Pipe shall meet the requirements of AWWA C900. Pipe shall be Class 200, DR 14, integral bell with strength equal to the pipe wall, cast iron OD, 18-foot length, with joints using a solid elastomeric ring. Pipe, appurtenances, and fittings shall conform to AWWA C900. All pipes must be clearly marked with the manufacturer's name, nominal diameter, DR, pressure class, AWWA C900, and NSF approval seal.

### **(3) Ductile Iron Pipe**

Pipe shall be Pressure Class 350 up to and including pipes 12 inches in diameter in accordance with ANSI/AWWA C150/A21.50. Pipes greater than 12 inches in diameter shall be designed for Pressure Class in accordance with ANSI/AWWA C150/A21.50. Pipe shall be manufactured as per AWWA C151 in 18-foot lengths.

Joints shall be of the push-on type as per AWWA C111. Pipe lining shall be cement mortar with a seal coat of bituminous material in accordance with AWWA C104.

Mechanical joint pipe may be required at the discretion of the City at locations such as stream crossings, fill sections, etc.

## **6.02 FIRE HYDRANTS AND FIRE PROTECTION**

### **A. General Design Criteria**

#### **(1) Required Flow**

Based on available water flow data provided by the City, water mains shall provide required fire flow for an area and shall be large enough in all cases to deliver the flow required for fire suppression purposes. The amount of water required and therefore delivered by each fire hydrant shall be no less than 500 gpm with 20 pounds per square inch residual pressure in residential areas and no less than 1,000 gpm with 20 pounds per square inch residual pressure in non-residential areas during times of peak system demand. The requirements of the Insurance Services Office Commercial Risk Services and related agencies with regulator authority shall be investigated and complied with, if more stringent than the minimum flows set forth above. The City may require a higher flow where building conditions warrant such action.

#### **(2) Adequate Fire Protection**

In any one or more of the conditions listed below, the developer or builder shall provide a means for adequate fire protection including but not limited to the installation of a domestic sprinkler system complying with applicable codes, the installation of an additional fire hydrant capable of supplying adequate flow, or the installation of a booster pump to increase flow to an acceptable level at the structure.

- a. Any part of the building is more than five hundred (500) feet from a hydrant measured along an accessible roadway: or
- b. The nearest hydrant provides a water supply of less than five hundred (500) gpm in residential areas and 1,000 gpm in non-residential areas at twenty pounds per square inch residual pressure at periods of peak demand.
- c. The elevation difference between the highest floor of the referenced structure and the nearest hydrant prevents adequate water flow and pressure for fire protection at that structure.

**(3) Fire Hydrant Obstruction**

No objects or obstructions such as fences, trees, bushes, shrubbery, plants, etc., shall be located within five feet of any fire hydrant.

**(4) Steamer Cap**

Steamer cap shall face the paved road (or parking area) so that it will be accessible to a fire department pumper. The center of the steamer cap will be no less than 18 inches and a maximum of 24 inches from finished grade level at the hydrant as determined by the final grade of the completed project. For standard fire hydrant installation, see Standard Detail 6.03.

**B. Location**

**(1) Residential**

The maximum distance between fire hydrants, measured along street centerlines shall be 450 feet.

**(2) Non-Residential**

In buildings required to have a sprinkler fire protection system installed, one accessible hydrant (either public or private) will be located not more than 100 feet from the fire siamese connection. For buildings with a sprinkler system, there will be one accessible hydrant provided on each of two opposing sides of the building. The hydrant required for the sprinkler system may be counted as one of these hydrants. There shall be additional hydrants provided to meet the requirement of a maximum 550-foot distance between a hydrant and any part of the building first floor. The hydrant (s) will be situated not less than two feet and not more than 10 feet from the curb of an access road, parking area, or public road. If situated in a parking area, there will be an area of NO PARKING marked around the hydrant for an area of 15 feet on all sides.

Example: A non-residential building of a 20,000 square feet area, sprinkled, would need a minimum of two hydrants (one within 100 feet of the sprinkler siamese connection and one on the opposing side of the building).

Paved access of a minimum 20 feet in width shall be required within 100 feet of two sides of each non-residential building. Paved access shall be required to be within ten feet of each required fire hydrant.

Emergency access to each side of all buildings three or more stories in height shall be provided by means of an unobstructed area of at least 12 feet in width which would support the weight of a fire ladder truck. This area is not required to be a permanent roadway, but must be accessible during an emergency. Prior to completion of grading and landscaping design, the Fire Department should be consulted.

## **C. Specifications**

Hydrants shall conform to AWWA C502 with a minimum valve opening of five and one-fourth inches. Hydrants shall be furnished with a four and one-half inch steamer and two double two and one-half inch hose connections with caps and chains, National Standard Threads, one and one-half inch bronze pentagon operation nut, open left, painted safety yellow, bronze to bronze seating, a minimum 42-inch bury depth with a break away ground line flange, break away rod coupling, and mechanical joint inlet. The hydrant bonnet will be designed with a sealed oil or grease reservoir with O-ring seals and a Teflon thrust bearing. Hydrants, meeting these requirements, manufactured by Kennedy, Mueller, U.S. Pipe or M&H are acceptable.

## **D. Installation**

Hydrants shall be set plumb, properly located, with the steamer connection facing the closest curb with the center of the connection a minimum of 18 inches above final grade. The back of the hydrant opposite the pipe connection shall be firmly blocked against the vertical face of the trench with a minimum one-third cubic yard of concrete with care taken to prevent the hydrant drain holes from being covered or filled with concrete. Double bridle rods and collars shall be connected from the tee to the valve and from the valve to the hydrant. Rods shall not be less than five-eighths of an inch diameter stock of wrought iron or stainless steel. A minimum of eight cubic feet of stone shall be placed around the drains. The backfill around the hydrants shall be thoroughly compacted. Hydrant installation shall be in accordance with Standard Detail 6.03.

## **6.03 VALVES AND APPURTENANCES**

### **A. Locations**

#### **(1) Gate Valves**

Gate valves shall be installed on all branches from feeder mains and hydrants according to the following schedule: three valves at crossings, two valves at tees, and one valve on each hydrant branch. When a loop section of water line is connected back into the feeder main within a distance of 200 feet or less, only one valve will be required in the feeder main.

Where no water line intersections exist, a main line valve shall be installed at every 100 feet per one-inch diameter main up to a maximum distance of 1,000 feet between valves. The distance between valves for water lines 10 inches or larger in diameter shall not be greater than 1,000 feet.

#### **(2) Blow-Off Valves**

Blow-off valves as detailed in Standard Details 6.02 and 6.04 shall be installed at major low points and at the end of all dead-end water lines as directed by the City

with the exception of water lines six inches diameter and greater which have a fire hydrant located within 20 feet of the end of the line. Fire hydrants may optionally be used at low points as directed by the City.

### **(3) Air Release Valves**

Air release valves as detailed in Standard Detail 6.05 shall be installed at all major high points of water lines six inches in diameter or larger and at other locations as directed by the City. Fire hydrants may be used in lieu of the above requirements.

## **B. Specifications**

### **(1) Gate Valves**

Gate valves shall be approved by the City and shall meet all requirements of AWWA C500 for a working pressure of 200 psi for valves up to 12 inches and 150 psi for valves greater than 12 inches. All gate valves shall be mechanical joint with ductile iron body, Teflon coated interior, resilient seated gate valve with a non-rising stem and open left with a double O-ring seal. Resilient seated gate valves shall meet the requirements of AWWA C509.

Gate valves up to and including 12 inches, shall be installed in a vertical position. Gate valves 16 inches and larger shall be installed only under the direction of the City and shall be horizontally installed and equipped with bevel gears, grease case, rollers, tracks scrapers, and a bypass located on the side of the body. Fully revolving disc valves shall not require rollers.

Valves 12 inches and larger with roller and scraper operators shall be installed in a valve pit. All valves 24 inches and greater shall be installed in a valve pit.

### **(2) Valve Boxes**

Valve boxes as detailed in Standard Detail 6.06 shall be cast iron of the screw or telescopic type as approved by the City, with a five-inch opening and "water" cast on the cover.

### **(3) Blow-Off Assemblies**

Blow-off assemblies shall be constructed as shown on Standard Details 6.02 and 6.04. The valves shall be gate types with a non-rising stem, two-inch operating nut, O-ring seals and mechanical joint ends.

### **(4) Pipe Fittings**

Pipe fittings shall be ductile iron designed and manufactured as per AWWA C110. All sizes of fittings shall be designed for an internal pressure as specified in AWWA C110. Compact ductile iron mechanical joint fittings in accordance with AWWA C153

are also acceptable. Fittings shall be lined with cement mortar and a seal coat of bituminous material or Teflon, all in accordance with AWWA C014.

**(5) Reaction Blocking**

All fittings or components subject to hydrostatic thrust shall be securely anchored by the use of concrete thrust blocks poured in place. The reaction volumes are shown in Standard Detail 6.07. Concrete for reaction blocking shall be placed to minimize interference with future removal of fittings. Material for reaction blocking shall be 3,000 psi concrete.

**(6) Tapping Sleeves**

Tapping sleeves shall be two piece split cast iron or ductile sleeves or stainless steel full circle clamp style. The sleeve shall be mechanical joint to the main line and flanged to the tapping valve. The City shall approve tapping sleeves and valves.

The maximum size saddle outlet for each size of pipe to be tapped shall be as follows:

Pipe Size To be Tapped	Maximum Size Saddle Outlet
6"	4"
8"	6"
10"	8"
12"	8"
16"	8"
18"	8"
20"	10"
24" and larger	12"

Use of stainless steel sleeve may allow full diameter taps.

**(7) Air Release Valves**

Air release valves shall have a one-inch nominal diameter for eight-inch mains and smaller, and a two-inch National Pipe Thread inlet for mains 10 inches in diameter and 150 percent of maximum working pressure in accordance with AWWA C512. All air release valves shall have a separate shut off valve of approved type. An air relief valve is shown in Standard Detail 6.05.

**(8) Valve Installation**

Valves shall be properly located, operable and at the correct elevation. The valve box shall be centered over the wrench nut and seated on compacted backfill without touching the valve assembly. All valve boxes outside of paved areas shall be encased in a trowel finished one and one-half feet by one and one-half feet by six-inch thick pad of 3,000 psi concrete with the concrete and cover flush with the top of the ground. Precast concrete valve box encasements may be used for valve box

encasement outside of paved areas. Concrete pad and valve box installation is shown on Standard Detail 6.06.

## **6.04 WATER SERVICE AND TAPS**

### **A. General**

All connections to existing city water mains shall be made by Public Works personnel at the expense of the developer. Service taps on new residential water lines being installed shall be made by the contractor in accordance with City of Oak Ridge standards. Under certain conditions, the City may allow wet taps to be installed by an approved contractor.

### **B. Maintenance**

After formal Council acceptance of subdivisions, the City will maintain all water service laterals up to the meter. Prior to City acceptance all repairs are the responsibility of the contractor/developer. After acceptance and in the case where a lateral between the main and meter is damaged by construction, the City will make repairs on an actual cost basis with the financial responsibility being borne by the party that caused the damage. Repair of damage to the service between the meter and the structure being served will be the responsibility of the contractor and must be performed by a properly licensed plumber and shall be inspected by the City plumbing inspector.

### **C. House Service Connections**

All services shall be a minimum of three-fourths of an inch. One-inch services are required for double service lines. The service connection consists of the pipe and appurtenances between the main and any property line. All services shall be a minimum of 24 inches deep. Any services under roadways must be backfilled with # 57 stone up to the subgrade surface.

### **D. Materials**

#### **(1) Corporation Stops**

Corporation stops shall be brass, complete with a compression (packed joint) type outlet coupling and AWWA Standard threads as per AWWA C800. Taps shall be located at 10:00 or 2:00 on the circumference of the pipe. Service taps shall be staggered at least 12 inches apart and not in a straight line.

The maximum size of direct taps without a fitting, tapping sleeve or saddle for ductile iron water mains of pressure Class 350 shall be as follows:

4" main	3/4" tap
6" main	1 - 1/2" tap
8" main	1 - 1/2" tap
12" main	2" tap

No burned taps will be allowed and each corporation stop shall have its inlet threads wrapped with Teflon tape and coated with pipe joint compound.

## **(2) Service Saddles**

Service saddles shall be used on all water mains that are not ductile iron pipe. Saddles shall be bronze body (85-5-5 waterworks brass) and double strap for taps over one-inch with silicon bronze nuts and factory installed grade 60 rubber gaskets.

## **(3) Copper Service Tubing**

Copper service tubing shall be type K soft copper tubing as per ASTM B88. No unions shall be used in the installation of the service connection of 100 feet or less. Service lines more than 100 feet shall use a three-piece compression coupling. Only one compression coupling shall be used for each 100 feet or fraction thereof. Fittings will not be permitted under any roadway surface.

## **E. Location**

Residential service lines shall extend from the main to the approved lot corner in a straight line and end no closer than two feet from the property corner or right-of-way line. Non-residential service locations will be considered on a case-by-case basis. All service lines shall be clearly marked with three-eighths inch rebar per Standard Detail 6.08.

## **F. Meters**

All meters and meter boxes shall be installed by Public Works personnel or be installed by a contractor as approved or required by the City. Meters shall not be installed in sidewalk, driveway or other paved surfaces without prior City approval.

## **6.05 BACKFLOW PREVENTION**

When a fire protection system is proposed and no anti-freeze or other chemicals are to be used, a double detector check valve assembly including two check valves, two gate valves, and four test cocks and bypass detector meter shall be installed on the sprinkler fire protection line. If any chemicals are proposed to be added to a sprinkler fire protection system, a reduced pressure principal backflow preventer approved by the City shall be installed. No backflow preventer device shall be installed below ground. All irrigation systems shall be provided with an approved reduced pressure backflow preventer installed above ground or within an interior structure accessible by the City. All backflow preventers and their installations must have prior approval by the City before installation.

A post indicator valve shall be provided at least six feet from the building or on the wall of the building when backflow prevention devices are contained within a building. Clear and unobstructed access shall be provided to the double detector check valve assembly.

All new commercial/industrial facilities shall install a reduced pressure zone backflow preventer on any incoming potable water lines. The device shall be installed on the supply

line at a location that is in advance of any internal distribution branches. The installation and location shall have pre-approval of the City Environmental Compliance Officer.

## **6.06 TESTING AND INSPECTION**

### **A. General**

All materials used must have a preliminary inspection by the City Inspector before they shall be allowed. Materials rejected by the Inspector shall be immediately removed from the job site.

The contractor shall furnish all materials, labor and equipment to perform all testing to the satisfaction of the City. Water mains and appurtenances must be tested and fully functional prior to the approval of any subdivision Final Plat.

### **B. Disinfection/Chlorination**

Calcium Hypochlorite shall be used for disinfecting water lines in accordance with AWWA Standard for disinfecting water mains (AWWA C651). All additions or replacements to the water system shall be chlorinated before being placed in service. Such chlorination must take place under the supervision of the City.

### **C. Bacteriological Sampling**

Free residual chlorine after 24 hours shall be at least 25 ppm or the City will require that the lines be rechlorinated.

Flushing of lines may proceed after 24 hours, provided the free residual chlorine analysis is satisfactory. No flushing shall take place unless the City Public Works Engineering Technician is present. The Technician shall collect samples for bacteriological analysis 24 hours after flushing is completed. The contractor shall furnish such help as may be required to secure these samples.

If test results are unsatisfactory, the contractor shall immediately rechlorinate lines and proceed with such measures as are necessary to secure sterile lines.

The new water system shall be valved off from the existing system until a satisfactory bacteriological sample has been obtained and the Inspector has authorized the use of the new water system.

### **D. Hydrostatic Testing**

Hydrostatic testing shall not be performed until the line segment has been disinfected and passed bacteriological testing. No gate valve in the existing City water system shall be operated without authorization from the City Public Works Department. A section of line, which is to be hydrostatically tested, shall be slowly filled with water at a rate, which will allow complete evacuation of air from the line. No gate valves shall be operated without a City

representative present. Pressure and leakage tests shall be performed in accordance with AWWA C600 procedures.

The line shall be tested to a pressure of 150 psi or 1.5 times the working pressure; whichever is greater, as measured at the highest elevation of the line for duration of two hours. The pressure rating of the pipe, fittings, valves, and thrust restraints shall be at least 1.5 times the working pressure of the pipe. Private lines for fire protection service shall be pressure tested to a minimum 200 psi in accordance with NFPA standards. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 10 psi or less. At the end of the test period, the leakage will, at the request of the Inspector, be measured with an accurate water meter.

Allowable test leakage quantities per 1,000 feet of pipeline in gallons per hour are indicated in the following table:

Avg. Test Pressure-psi	Pipe Diameter - Inches				
	4	6	8	10	12
150	0.37	0.55	0.74	0.92	1.10
175	0.40	0.59	0.80	0.99	1.19
200	0.43	0.64	0.85	1.06	1.28
225	0.45	0.68	0.90	1.13	1.35
250	0.47	0.71	0.95	1.19	1.42

All visible leaks are to be repaired regardless of the amount of leakage and the line may be required to be rechlorinated as determined by the City.

After all underground utility construction and final grading is complete, water lines will be re-tested under working pressure to confirm no loss of pressure within a 15 minute test period before final acceptance by the City.

## 6.07 REPAIR OF WATER LINES

### A. Joint Leaks

Joint leaks shall be repaired as required by the City.

### B. Breaks or Punctures

Line breaks or punctures shall be repaired with a full circle repair clamp or other methods as approved by the City.

### C. Splits or Blow Outs

Line splits or blowouts shall be repaired by replacing the damaged section with equivalent pipe material with a ductile iron mechanical joint solid sleeve at each end.

For pipe of different outside diameter and/or materials and asbestos cement, use an approved transition coupling with different end diameters sized specifically for the pipe materials and pipe outside diameter at each end.

## **D. Service Line Repairs**

Service line repairs shall be repaired as follows:

- A water service line severed between the water main and the water meter shall be repaired using new type K copper tubing and bronze or brass three-piece compression unions.
- A corporation stop pulled out of a PVC pipe water main shall have a new service saddle and a new corporation stop installed on the water main.
- A corporation stop pulled out of a ductile iron pipe water main shall have a full circle repair clamp placed over the old tap hole. A new tap shall be made and a new corporation stop installed on the water main. A tapped repair clamp is also acceptable.

## **6.08 ACCEPTANCE OF WATER SYSTEM**

### **A. Residential**

The water system must be accepted by the City in conformance with the SCRD prior to approval of any subdivision Final Plat. The water system shall be 100 percent complete, including testing, prior to Final Plat recording unless approved by the Planning Commission. NO TEMPORARY OR PERMANENT CERTIFICATE OF OCCUPANCY SHALL BE SIGNED UNTIL THE WATER SYSTEM IS 100 PERCENT COMPLETE AND ACCEPTED BY THE CITY. Formal acceptance of water main systems shall be by City Council Resolution upon the request of the developer and upon submission and approval of "As Built" drawings. The developer shall be responsible for all maintenance and repairs to the system until formal City Council acceptance.

### **B. Non-Residential**

All non-residential water mains that serve only one property shall be privately maintained by the property owner. The City will accept water mains in conformance with the SCRD that serve multiple properties upon the owner's request. Such acceptance includes the submission and approval of "As Built" drawings and, if necessary, Plats of Corrections for easements. Formal acceptance of water mains to be dedicated to the City shall be by City Council Resolution action. The developer/owner shall be responsible for all maintenance and repairs to the system until formal City Council acceptance. The water system must be accepted by the City and shall be 100 percent complete, including testing, prior to the issue of a Certificate of Occupancy.

## **SECTION 7.00**

### **SANITARY SEWER**

#### **7.01 GRAVITY SEWER MAINS**

##### **A. General Design Criteria**

Sanitary sewer construction shall be in accordance with the latest edition of the TDEC "Design Criteria for Sanitary Sewer Systems." If discrepancies are found between the TDEC and City requirements, the more stringent shall apply.

##### **(1) Location**

All public sanitary sewer mains shall be located in dedicated street right-of-ways and/or in dedicated easements with a minimum width of 10 feet, centered about the pipe. An easement of 15 feet shall be required where the depth is greater than five feet, but less than eight feet. An easement of 20 feet shall be required where the depths below finished grade is greater than eight feet. Special conditions may warrant greater widths as required by the City. No part of any structure, including foundations and overhangs, are permitted in an easement.

##### **(2) Creek Crossing**

Proposed sewers shall be designed to a proper depth such that all creek crossings shall have at least three feet of cover between it and the streambed unless otherwise approved by the City. Concrete encasement and ductile iron pipe with mechanical joints, in accordance with Standard Detail 7.01, shall be required at stream crossings. All stream crossings will include check dams in the conduit trench on both sides of the crossing.

Sanitary sewer mains shall not be installed under any part of water impoundments, such as detention/retention basins, except as approved by the City.

##### **B. Sizing**

##### **(1) Minimum Size**

The minimum size of public gravity sanitary sewer mains shall be eight inches.

Sewer extensions should be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension.

Pipe diameter changes shall occur in a manhole with the invert of the larger pipe lowered sufficiently to maintain the same energy gradient. An approximate method of

securing these results is to place the eight-tenths depth point of both sewers at the same elevation.

**(2) Flow Factors**

New sewer systems shall be designed based on the maximum potential development of the contributory area as determined in consultation with the City. If a proposed use is known to have a design flow greater than listed below, the greater flow factor shall be used; otherwise the following flow factors shall be used:

Land Use	Flow Factor
Residential	350 gpd/dwelling unit/24 hour period
Office and Institutional	25 gpd/employee/8 hour shift
Commercial	150 gpd/1,000 square feet building space/12 hour period
Industrial	25 gpd/employee/8 hour shift

These figures cover normal infiltration; however, an additional allowance shall be made where conditions are unfavorable. Additional flow factors and requirements should be reviewed in Appendix 2-A of the latest edition of the TDEC handbook on "Design Criteria for Sanitary Sewer."

For existing sewer systems, an additional allowance shall be made to the above flow factors where the existing flow exceeds these values.

The relation of peak-to-average daily flow shall be as follows:

$Q_{max}/Q_{avg}$	Flow (gpd)
4.0	3,000 or less
2.5	Greater than 3,000

Sanitary sewers shall be designed to carry the projected peak flow at no more than three-fourths full. The recommended minimum velocity for sanitary sewer lines is three fps. The absolute minimum velocity allowed is two fps.

**C. Slopes**

**(1) Minimum Slope**

The minimum slope for public sanitary sewers shall be as follows:

Main Size (in.)	Minimum Slope (ft/100 ft)
8	0.260
10	0.193
12	0.151

Minimum slope values are based on a Manning's  $n$  value of 0.0115. Minimum slopes for larger size pipes are provided in the latest edition of the TDEC "Design Criteria for Sanitary Sewers."

The minimum slope for the uppermost reach of a sewer line where no future extensions are planned shall be one percent regardless of sewer line size.

## **(2) Maximum Slope**

The maximum slope for sanitary sewers is 18 percent and the maximum velocity is 15 fps. These limits may be exceeded with the approval of the City and the incorporation of the following provisions:

- a. High velocity manholes, in accordance with Standard Detail 7.02 shall be used on all sewers with a slope greater than 18 percent.
- b. Concrete anchors shall be installed on all sewers of greater than 18 percent slope at the following spacing:
  1. Not over 36 feet center to center on grades from 18 percent to 25 percent.
  2. Not over 24 feet center to center on grades from 25 percent to 35 percent.
  3. Not over 16 feet center to center on grades exceeding 35 percent.

## **D. Installation**

### **(1) Minimum Cover**

Sanitary sewer mains shall be deep enough to serve the adjoining property and allow for sufficient slope in lateral lines. All sanitary sewer mains shall have the following minimum covers:

- a. Two and one-half feet from the top of pipe to finished subgrade when under a roadway.
- b. Two and one-half feet from the top of pipe to finished grade when outside a roadway.

The above requirements may be waived in exceptional circumstances at the discretion of the City, in which case ductile iron pipe shall be installed.

### **(2) Sewer Depths**

Materials for sewer mains to pipe invert depths of 12 feet below finished grade may be selected from Section 7.01E, Pipe Materials. Sewer mains greater than 12 feet in depth shall be Pressure Class 350 ductile iron or PVC C900 for the entire run between manholes.

### **(3) Excavation and Backfilling**

Pipe trench excavation and backfilling shall be performed in accordance with Section 5.01. Pipe bedding shall be in accordance with Section 7.01F(6).

**(4) Material Transitions**

Transitions of pipe material shall occur only at manholes unless otherwise approved by the City.

**(5) Horizontal Separation**

Sanitary sewers shall be laid at least 10 feet horizontally apart from existing or proposed water mains. However, if the top of the sewer main is at least 18 inches below the bottom of the water main, a horizontal separation of at least three feet from the closest edges of the pipes is allowed. There shall be a minimum of five feet horizontal separation between sewer gravity mains and force mains unless otherwise approved by the City.

**(6) Vertical Separation**

Under normal conditions, water mains crossing sanitary sewers or storm sewers shall be laid to provide a vertical separation of at least 18 inches between the bottom of the water main and the top of the sewer.

Where a water main crosses over an existing sanitary or storm sewer and the vertical separation is less than 18 inches, the water main shall be encased in concrete or in one length of steel encasement ductile iron pipe centered at the point of crossing.

Where a water main crosses over a new sanitary or storm sewer and the vertical separation is less than 18 inches, the sewer line shall be constructed of water pipe for a distance of at least nine feet on either side of the point of crossing. The water line pipe shall have one pipe length centered at the point of crossing.

Where water mains cross under sewers, a minimum vertical separation of at least 18 inches shall be provided between the bottom of the sewer and the top of the water main. Both the water main and the sewer line shall be constructed of water line pipe with a length of water line pipe centered at the point of crossing. Adequate structural support shall be provided to prevent excessive deflection of joints and settling on and breaking the water mains.

**(7) Grading of Easement**

Sewer line easements shall be finished and graded smooth, free from rocks, boulders, roots, stumps, and other debris and seeded and mulched upon the completion of construction.

**(8) Plugging**

The downstream manhole (s) of a sanitary sewer line extension under construction shall be appropriately plugged to prevent the passage of groundwater, runoff and sediment into the sanitary sewer system. All water upstream of the plug shall be pumped out of the sanitary sewer line and all sediment and solids shall be removed and properly disposed of by the contractor. The plugs shall not be removed until the

entire upstream system is complete and the lines have been inspected by the City to insure that all possible points of inflow or infiltration have been secured and all debris removed.

## **E. Pipe Materials**

### **(1) Ductile Iron Pipe**

Ductile Iron Pipe shall be designed as per ANSI/AWWA C150 (A21.50) for a Pressure Class of 350 psi, laying condition Type 4 Trench.

Pipe joints shall be of the push-on type as per ANSI/AWWA C111/A21.11. Pipe lining shall be cement mortar with a seal coat of bituminous material, all in accordance with AWWA C104.

### **(2) Polyvinyl Chloride (PVC) Pipe**

PVC pipe shall be made of PVC plastic as defined in ASTM D1784. PVC pipe shall have integral wall bell and spigot joints with rubber gaskets for the conveyance of domestic sewage. Fittings shall be made of PVC plastic as defined in ASTM D-1784. Fittings must be manufactured by pipe supplier or approved equal, and have bell and/or spigot configurations compatible with that of the pipe.

All pipe 15 inches in diameter and less shall have a maximum Standard Dimension Ratio (SDR) of 35 in accordance with ASTM D3034. Where lying conditions so warrant, and in accordance with manufacturer's recommendations, lower SDR values (stronger pipe) may be required.

PVC pipe meeting the requirements of AWWA C900 may be used for trench depths of 12 feet or greater. Pipe shall be Class 150, DR18, integral bell with strength equal to the pipe wall, cast iron, O.D., 18 feet lengths, with a solid elastomeric ring in accordance with ASTM F-477.

PVC pipes 15 inches in diameter and larger must be manufactured as defined in ASTM F794. Pipe strength shall be equal to or exceed that required for pipe less than 15 inches in size.

Installation shall consist of either Class I or Class II bedding material placed six inches below the pipe barrel and continuing to a minimum of six inches above the pipe in accordance with ASTM D2321.

## **F. Additional Requirements for Sewer Pipe Installation**

The installation shall satisfy the requirements of the manufacturer and/or the following whichever is more stringent:

**(1) Installation**

Installation of PVC pipe shall follow the recommendations of ASTM D2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe." Flexible pipe bedding and embedment material shall be either Class I or Class II. For semi-rigid pipe such as ductile iron pipe or PVC Truss Pipe, Class III materials may also be used. In any area where the pipe will be installed below existing or future ground water levels or where the trench could be subject to inundation, only Class I material shall be used for bedding and embedment.

**(2) Specifications**

The manufacturer's specifications or otherwise approved method shall be used in determining the stiffness class of the pipe to be installed so as to attain the required deflection control. The class of the pipe must be approved by the City prior to installation.

**(3) Deflection**

The maximum allowable deflection after installation shall be less than five percent of the pipe diameter. The mandrel (go/no-go) deflection test must be performed on each line prior to acceptance and no less than 30 days after installation.

**(4) Pipe Joints**

PVC pipe shall be produced with bell and spigot end construction. Joining will be accomplished by rubber gasket in accordance with manufacturer's recommendation, unless otherwise directed or approved by the City. Flexible watertight elastomeric seals in accordance with ASTM D3212 may also be used. Each pipe length shall be clearly marked with information including pipe size, profile number and class number. The pipe shall be installed so that the manufacturer markings are positioned on the topside of the pipe.

**(5) Trench Width**

A minimum trench width shall be the pipe outside diameter plus 16 inches.

**(6) Bedding**

Bedding and embedment material classifications shall be generally defined as follows and in accordance with ASTM D2321 and Standard Detail 7.12.

CLASS I – Angular, (one-fourth to one and one-half inches) graded stone, including a number of fill materials that have regional significance such as crushed stone and crushed gravel. The material shall be non-plastic with 100 percent passing the one and one-half inch sieve, less than 50 percent passing the # 4 sieve and less than five percent passing the # 200 sieve.

CLASS II – Coarse sands and gravels with maximum particle size to one and one-half inches, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Material shall be non-plastic with 100 percent passing the one and one-half inch sieve, 50 percent more or less of course fraction passing the # 4 sieve and less than five percent passing the # 200 sieve.

CLASS III – Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Material may be slightly plastic with plasticity index (PI) less than seven containing 12 percent to 50 percent fines passing the # 200 sieve and 100 percent passing the one and one-half inch sieve and 50 percent more or less of the course fraction passing the # 4 sieve.

CLASS IV – Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. These materials are not recommended for embedment.

The bedding (four inch minimum/six inch minimum over rock) and embedment materials shall be per ASTM D2321. The embedment materials shall be installed from trench wall to trench wall and from the invert to a minimum of six inches above the crown of the pipe. Minimum distance between outside pipe and edge of trench wall shall be eight inches.

Class II and III bedding and embedment material shall be compacted to a minimum of 90 percent Standard Proctor density. All sewer lines in the roadway or within three feet of the back of curb (measured from the center of utility) shall be backfilled above embedment material to within one foot of finished ground elevation with # 57stone.

## **(7) Check Dams**

Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit the drainage area subject to the french drain effect of gravel bedding. Major rehabilitation projects should also include check dams in the design. Dams shall consist of compacted clay bedding and backfill at least three feet thick to the top of the trench and cut into the walls of the trench two feet. Alternatively, concrete may be used, keyed into the trench walls. Dams shall be placed no more than 500 feet apart with the preferred location upstream of manholes. All stream crossings will include check dams on both sides of the crossing.

## **(8) Shoring**

Proper sloping of banks or use of shoring shall be required on all excavations in accordance with applicable OSHA guidelines. If hydraulic jack shoring is utilized for trench walls, it shall not interfere with placement of the pipe or embedment material.

## **7.02 SEPTIC SYSTEMS**

Septic systems shall meet the requirements specified in the Oak Ridge Subdivision Regulations.

## **7.03 FORCE SEWER MAINS**

### **A. Sizing**

The minimum pipe size for force sewer mains is four inches in diameter.

### **B. Materials**

#### **(1) Ductile Iron Pipe**

Ductile iron pipe shall be designed as per ANSI/AWWA C150 (A21.50) for a pressure class of 350 psi, laying condition Type 3 trench. Pipe shall be manufactured as per AWWA C151 in 18-foot lengths. Pipe lining shall be cement mortar with seal coat of bituminous material, all in accordance with AWWA C104.

#### **(2) Pipe Joints**

Pipe joints shall be the push-on type as per ANSI/AWWA C111/A21.11. All solvent weld joints shall be prohibited.

#### **(3) PVC Pipe**

Pipe shall be Class 200 PVC SDR 21 integral bell with strength equal to the pipe wall, with a solid elastomeric ring in accordance with ASTM F477. If design conditions warrants, pipe of greater strength may be required.

#### **(4) Pipe Fittings**

Pipe fittings shall be ductile iron designed and manufactured as per AWWA C110. Sizes of fittings up to and including 12 inches shall be designed for an internal pressure of 250 psi; larger size fittings shall be designed for an internal pressure of 150 psi.

Pipe fittings shall be mechanical joint type and lined with cement mortar with a seal coat of bituminous material, all in accordance with AWWA C104.

### **C. Force Main Installation**

#### **(1) PVC Pipe**

PVC pipe will require the installation of an insulated solid copper locator wire, minimum size # 12, installed with the pipe. The wire shall be installed under the pipe

while the pipe is being placed in the ditch line. Joint lubricant shall be in accordance with manufacturer's recommendation.

**(2) Reaction Blocking**

Reaction blocking for all fittings or components subject to hydrostatic thrust shall be securely anchored by the use of concrete thrust blocks poured in place. The reaction volumes are shown in Standard Detail 6.07. No concrete shall interfere with the removal of fittings. Material for reaction blocking shall be 3,000 psi concrete.

**(3) Force Main Pipe Cover**

Force mains shall be installed in accordance with Section 7.01D(1).

**(4) Bedding**

No force main shall be laid on rock until the rock has been covered with a minimum of six inches of fine graded stone. PVC force mains shall be bedded in # 57 stone with three inches minimum under and six inches minimum over the main in accordance with Standard Detail 6.01. Ductile iron pipe may optionally be bedded with Class I, II or III material in accordance with ASTM D2321 and Section 7.01F(6).

**(5) Valves**

Air release valves shall be installed at all major high points of force mains and other locations as directed by the City.

Force main valves shall be installed at maximum intervals of 2,000 feet or as determined by the City, and shall have valve box caps marked "SEWER." Force main valves shall be Teflon coated resilient seat wedge gate type.

**(6) Receiving Manhole**

The receiving manhole for a force main shall receive an interior coating of Koppers "Super Service Black" or an approved equal with a total dry film thickness of 10 mils. All nicks and scratches shall be touched up prior to acceptance of the manhole. The force main shall discharge at the invert of the receiving manhole unless otherwise approved by the City and shall be as close as possible to 180 degrees from the outlet pipe.

**(7) Identification**

Force mains shall be appropriately identified upon installation so they will not be confused with potable water lines. Warning tape shall be applied to the top of pipe clearly marked "SEWER."

## **7.04 MANHOLES**

### **A. Design**

#### **(1) Spacing**

Manholes shall be spaced at a maximum distance of 300 feet unless otherwise approved by the City, not to exceed 400 feet.

#### **(2) Size**

Manholes for sewers less than 21 inches in diameter shall be a minimum of four feet inside diameter. Manholes for sewers 21 inches in diameter or greater shall be five feet inside diameter.

### **B. Installation**

#### **(1) Inverts**

Manholes shall be installed at each deflection of line and/or grade. The flow channel through manholes should be smooth and shall conform to the shape and slope of the entering/exiting sewer line. Invert troughs shall have a minimum fall of one-tenth foot and provide a consistent slope from the pipe outlet to the inlets with a maximum fall of up to four inches. Invert benches shall have a float finish with a uniform slope of two and one-half inches, plus or minus one inch, from the high point at the manhole wall to the low point at invert trough. A one-fourth inch radius shall be provided at the edge of the bench and trough.

#### **(2) Manhole Drops**

Outside drops shall be used when free drops exceed 24 inches in accordance with Standard Detail 7.03.

#### **(3) Finished Top Grade**

Manholes not located in roadways but within right-of-way limits shall have a top elevation a minimum of one inch and a maximum of six inches above finished grade unless otherwise approved by the City. Manhole tops located outside the right-of-way shall have a minimum of six inches and a maximum of 18 inches above finished grade, unless otherwise approved by the City.

Manhole tops shall be elevated above the 100-year flood plain elevation or shall be equipped with watertight frames and covers per Standard Detail 7.06.

#### **(4) Manhole Foundations**

All manholes shall have six-inch, 3,000 psi concrete bottoms resting on a minimum of six inches of # 57 stone. Sewer mains shall enter and exit radially through the manhole.

#### **(5) Manhole Joints**

Manhole sections shall be joined by unrolling the butyl sealant rope directly against base of spigot without stretching per Standard Detail 7.04. The rope should be overlapped from side to side to provide one thickness. Leave protective wrapper attached until sealant is entirely unrolled against spigot. After joining manhole sections, apply the butyl sealant sheet around the outside perimeter of the joint.

#### **(6) Manhole Connectors**

Pipe to manhole connectors shall be of the resilient type and conform to ASTM C923. The manhole entrance coupling with the entry pipe shall be fitted with a resilient connector insert. Specially designed flexible products may be approved for use in adding a pipe entrance to a previously installed manhole where materials meet the requirements of ASTM C923. Rigid cement or synthetic type grouts are not acceptable as a seal between manhole and entry pipe. Opening for connections to existing manholes shall be made by core drilling.

#### **(7) Exterior Surface**

The exterior surface of all new manholes shall be coated with a minimum of one coat of waterproofing material during vacuum testing procedures. The coating and sealing material shall be DRYCON waterproofing/sealer (gray and white) as manufactured by IPA Systems, Inc., PRECO waterproofing/sealer (gray and white) as manufactured by FOSROC PRECO Industries, LTD., or an approved equal.

### **C. Materials**

#### **(1) Precast Concrete Manholes**

All manholes except shallow manholes shall have eccentric cone sections. Precast concrete manholes shall meet ASTM C478 as to design and manufacture. For precast concrete manholes, see Standard Detail 7.04. Brick manholes shall be allowed.

Precast base sections shall be cast monolithically without construction joints or with an approved galvanized or PVC waterstop in the cold joint between the base slab and the walls. The bottom step in base sections shall be a maximum of 26 inches from the top of the base slab. Joint surfaces between bases, risers and cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C361. The minimum height of the joint shall be four inches.

Precast riser sections shall have a minimum lay length of 16 inches.

Precast eccentric cone sections shall have a minimum inside diameter opening at the top of 27 inches. The width of the top ledge shall be no less than the thickness required for the cone section.

Precast transition cone sections shall provide an eccentric transition from 60 inch and larger manholes to 48-inch diameter risers, cones and flat slab top sections. The minimum slope angle for the cone wall shall be 45 degrees.

Precast flat slab top sections shall have a minimum circular opening at the top of 27 inches and shall be designed for HS-20 traffic loadings in accordance with ASTM C478.

Precast grade rings shall be used to adjust frames and covers to finished grade. No more than 12 vertical inches of grade rings will be allowed per manhole. Grade rings shall conform to ASTM C478 and shall be no less than four inches in height. Clay brick shall only be used for grade adjustment on slopes or in paved areas where precast concrete grade rings or gray iron adjustment rings cannot be used to achieve the required grade.

Flexible joint sealants shall be butyl rubber based conforming to Federal Specifications SS-S210A, AASHTO M-198, Type B – Butyl Rubber and as follows: maximum of three percent volatile matter and suitable for application temperatures between 10 and 100 degrees Fahrenheit. Material shall have a nominal cross section dimension of one inch for four feet diameter manholes and one and one half inch for five feet and six feet diameter manholes.

Lift inserts and holes shall be sized for a precision fit with the lift devices, complying with OSHA 1926.704, and not penetrate through the manhole wall. Lift loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars are not allowed. Lifting devices for handling precast components shall comply with OSHA Standard 1926.704.

Epoxy gels for interior patching of wall penetrations when used shall be a two component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C881, Type I and II, Grade three, Class B and C, Epoxy Resin Adhesive.

## **(2) Frames and Covers**

Manhole frames and covers shall be gray iron, Class 30 unless otherwise specified, meeting AASHTO M-105 with "Sanitary Sewer" cast into the cover and in accordance with Standard Detail 7.05. Frame and cover shall be capable of supporting a HS-20 wheel load.

Manhole frames rings and covers shall be put in place with butyl sealant rope and banding in accordance with Standard Detail 7.04.

### **(3) Watertight Frames and Covers**

Watertight manhole frames and covers shall be constructed at all locations within the 100-year flood plain or in other areas subject to periodic flooding as directed by the City in accordance with Standard Detail 7.06.

### **(4) Manhole Steps**

Manhole steps shall be furnished with the precast sections. The steps shall be Copolymer Polypropylene Plastic reinforced with a one-half inch diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be 400 pounds minimum when tested according to ASTM C497. Steps shall be set 16 inches on center. Holes for the installation of manhole steps shall not project through the manhole wall and there shall be a minimum of one-inch wall thickness from the deepest penetration of the step installation hole and the outside wall. Steps shall be at least 10 inches clear width and shall project at least four inches from the wall into which it is embedded. Steps shall be secured to the wall with compression fit in tapered holes or cast in place. Steps shall not be vibrated or drive into freshly cast concrete or grouted in place.

## **7.05 SERVICE CONNECTIONS**

### **A. Materials**

#### **(1) PVC Pipe**

PVC pipe shall be a minimum of SDR 35 in accordance with ASTM D3034 for six-inch services in accordance with Standard Detail 7.08.

#### **(2) Service Saddles**

Service saddles for sanitary sewer services shall be "ROMAC CB" sewer saddles or equal consisting of a virgin SBR gasket compounded for sewer service, a ductile iron saddle casting, a type 304 stainless steel adjustable strap for fastening the gasket and the saddle casting to the sewer main and a type 304 stainless steel adjustable circle clamp for securing the service line into the SBR gasket.

The opening in the sewer main for the "ROMAC CB" sewer saddle shall be cut with a hydraulically driven or a pneumatically driven circular tapping saw of the same nominal diameter as the sewer service line.

## **B. Installation**

### **(1) Service Taps**

All service connections to existing city sanitary sewer mains shall be made by the City Public Works Department unless otherwise approved by the City.

A bell tee or wye fitting shall be provided at all known or planned service connection points on new sanitary sewer mains.

Service taps into mains shall be made on the top quarter of the main with the wye saddle angled with the direction of flow in the main in accordance with Standard Detail 7.08.

### **(2) Bedding**

It is recommended that all service lines be bedded with Class I bedding from four inches below the service line to six inches above the service line.

### **(3) General Requirements**

Service connections to the main lines shall be perpendicular to the main line. Four-inch lines shall have a minimum fall of one-fourth inch per foot and six-inch lines shall have a minimum fall of one-eighth inch per foot unless otherwise approved by the City. Cleanouts shall be required on all sewer services with a maximum spacing of 80 feet. A cleanout shall be placed on all service lines two feet inside property lines. All cleanouts in new subdivisions shall extend a minimum of three feet above finished grade until the service connection is made. See Standard Detail 7.07 for cleanout details. Sewer cleanouts located in paved areas must have cast iron risers and brass caps.

All service connections into a manhole shall be made by core drilling and fitted with a resilient connector insert unless otherwise approved by the City. All sewer laterals under public streets shall be a six-inch minimum diameter.

Service lines, which are connected into manholes, shall be terminated at the bottom and three inches inside the manhole wall. Service lines shall not be installed through manhole cone sections or manhole joints. No common sewer laterals are allowed.

## **7.06 TESTING AND INSPECTION**

All materials used must have a preliminary inspection by the City before materials are used for construction purposes. Material not meeting these specifications will be rejected and such materials shall be immediately removed from the job.

Sanitary sewer lines shall be free and clean from obstructions and shall be visually inspected from every manhole to ensure all lines exhibit a fully circular pattern. Flexible pipe shall be tested with a mandrel to assure less than five percent deflection after backfilling operations

have been completed for at least 30 days. Lines, which do not exhibit a true line and grade or have structural defect, shall be corrected.

The contractor shall furnish all materials, labor and equipment to perform all sewer system testing to the satisfaction of the City. Low pressure air testing shall be performed on new or rehabilitated gravity flow sewer lines and vacuum testing shall be performed on all new or rehabilitated manholes.

Low-pressure air testing shall be performed in accordance with ASTM C828 when all laterals or stubs are installed on the line, after the main has been backfilled to finish grade, after completion of all other underground utility construction and after final grading of the area is complete. Plugs shall be installed at each manhole and service lateral to seal off the test section. The line will be pressurized with a single hose and monitored by a separate hose connection from the plug. Air then shall be slowly introduced into the sealed line until the internal air pressure reaches four psi. The air pressure shall then be allowed to stabilize for a minimum of two minutes at no less than three and one-half psi. When the pressure reaches three and one-half psi, the time required for the pressure to drop one psi will be observed and recorded. The line shall be termed "acceptable" if the pressure does not drop more than one psi in the time prescribed for the test by ASTM C828 and Standard Detail 7.09.

If the pipe section fails to meet these requirements, the source of leakage shall be determined and repaired. The pipe section shall then be retested to meet the specified requirements.

All new or rehabilitated manholes shall be vacuum tested to assure water-tightness before backfilling. The exterior surface must be painted with waterproofing material as the vacuum is being pulled to seal the pores of the concrete. Vacuum testing procedures for manholes shall be in accordance with Appendix 2C of the TDEC "Design Criteria" except that a final vacuum testing of manholes will also be required after completion of all underground utility construction and final grading.

As an alternative to field application of waterproofing material, precast manhole sections can be coated and vacuum tested at the factory if certification is provided that the sections have been tested and meet the requirements of Appendix 2C of the TDEC "Design Criteria." Field vacuum testing of manholes will also be required after completion of all underground utility construction and final grading to assure that the installed manhole is watertight.

## **7.07 REPAIR OF SANITARY SEWER LINES**

The repair of damaged sanitary sewer lines shall be as follows:

PVC Pipe – replace damaged section of sewer with PVC pipe cut to fit with maximum one-fourth inch opening at joints and install a Fernco coupling or repair coupling at each end as approved by the City.

DIP – replace damaged section with a solid sleeve mechanical joint coupling at each end.

Repairs to new lines, not yet accepted by the City, shall be tested in accordance with Section 7.06.

All damage to existing City owned mains shall be repaired by the Public Works Department at the expense of the developer or contractor causing the damage.

## **7.08 SEWAGE PUMP STATIONS**

### **A. General Requirements for Sewage Pump Stations**

These specifications are provided as a basis for design of sewage pumping stations for the City. All proposed deviations from these specifications shall be submitted in writing (three copies) to the City for review and consideration to allow a decision on the issuance of a written variance prior to final plans being completed and submitted for approval.

Gorman-Rupp seven feet by ten feet prepackaged above ground insulated suction lift stations utilizing the "T" series pumps are to be utilized whenever possible. The conditions supporting the selection of submersible pumps shall be submitted in writing (three copies) to the City for review and consideration to allow a decision on the issuance of a written variance prior to completing the final design.

In the event that the Gorman-Rupp suction lift station cannot be used due to engineering considerations, a Flygt submersible pumping station shall be utilized.

Sewage pumping stations shall be located as far as practicable from present or proposed built-up residential areas, and an all-weather paved access road shall be provided. Noise control, odor control, ease of maintenance, and station architectural design shall be taken into consideration. The site for stations shall be of sufficient size for future expansion or addition.

The stations operational components shall be located above the 100-year floodplain or shall be adequately protected against 100-year flood damage.

Where the wet well is at a depth greater than the water table elevation, special provisions shall be made to ensure watertight construction of the wet well. Any connections to the pump station shall be made at an elevation higher than the maximum water table elevation, where possible. Provisions shall be made to facilitate removing pumps, motors, and other equipment, without interruption of system service.

The site shall be graded to drain away from the pump station and to remove storm water runoff from the site in a non-erosive manner.

The site shall be stabilized by the use of crushed stone, low maintenance ground cover or other suitable pre-approved material. If the pump station is visible from residential lots where homes are or will be in the future, evergreen shrubs shall be planted to screen the pump station, but shall not interfere with proper access or maintenance.

The site shall have a frost-free water hydrant located near the pump station. This hydrant shall be metered and installed with an approved backflow preventer, and shall be connected to the City water system.

The site shall have adequate turn around space for service vehicles and provide a 12 feet wide (minimum) access road to the site, with grades not to exceed 12 percent unless otherwise approved by the City.

## **B. Pumping Rates and Number of Units**

A minimum of two pumps shall be provided, each capable of handling the expected maximum flow. Pump head curves shall be submitted and approved by the City with the submittal of design plans. Three copies of system plans and specifications are to be submitted.

When the station is expected to operate at a flow rate less than one-half the average design flow for an extended period of time (six months), the design shall address measures taken to prevent septicity due to long holding times in the wet well.

Consideration shall be given to the use of variable-speed or multi-staged pumps, particularly when the pump station delivers flow directly to a treatment plant, so that sewage will be delivered at approximately the same rate as it is received at the pump station.

Pumps shall be sized to produce a minimum velocity in the force main of two fps. Each pump shall be supplied with a run time meter to indicate the cumulative running time of each pump individually.

## **C. Piping Valves**

Pumps shall be capable of passing spheres of at least three inches in diameter. Pump suction and discharge piping shall be at least four inches in diameter. Suction and discharge piping shall be Pressure Class 350 ductile iron flanged pipe and as manufactured under AWWA C151. A check valve and either a resilient seat gate or clear throat type plug valve shall be provided for the discharge piping of each pump. A wye with a four-inch flanged resilient seat gate valve shall be installed on the common discharge line in the valve vault.

## **D. Priming**

Pumps shall be so placed that under normal operating conditions they will operate under a positive suction head (except for suction lift pumps).

## **E. Controls and Control Panels**

### **(1) General**

Controls shall be either a Consolidated Electric model D-152 or a Gorman-Rupp EPS. These controllers must utilize their appropriate submersible level transducer. Controls must be protected from voltage and lightning surges by the manufacturers surge protectors. Full electrical schematic and parts list must be approved by the City prior to construction (three copies required).

All control panels are to have phase monitors, full size Square-D starters, separate Square-D three pole breakers for each pump and single pole control breaker, automatic pump alternation, Hand/Off/Automatic for each pump, high and low water alarms with audible and warning lights, and silence button. All control panels are to have a thermostat controlled condensation heater installed within the panel.

Incoming service shall have a stainless steel NEMA 3R service disconnect located outside the station and in direct view of pumping equipment.

A backup power supply, such as a battery pack with an automatic switchover feature, should be provided for the alarm system, such that a failure of the primary power source will not disable the alarm system. Test circuits should be provided to enable the alarm system to be easily tested and verified that it is in good working order.

Control panels shall be mounted on four-inch diameter galvanized steel posts.

## **(2) Submersible Pumping Stations**

Controls for submersible pumping stations shall be enclosed in a NEMA 4X stainless steel enclosure. This enclosure is to have a dead front panel so that all control devices can be locked. This panel is to be located a minimum of three feet from the wet well and the bottom of the panel shall be at least three feet from the surface elevation. A typical submersible pumping station layout is shown on Standard Detail 7.10.

## **(3) Above Ground Suction Lift Station**

Controls for above ground suction lift stations shall be enclosed in a NEMA 3R enclosure. This enclosure is to be located within the station itself. Failure lights and horns are to be located outside the station. A typical above ground suction lift station layout is shown on Standard Detail 7.11.

## **F. Materials**

In the selection of materials, consideration shall be given to the presence of hydrogen sulfide and other corrosive gases, greases, oils, and other materials frequently present in sewage. No carbon steel hardware will be accepted. Station components shall be non-corroding in nature, i.e., aluminum, stainless steel, or fiberglass. Only the pumps, the suction and discharge piping and assorted valves may be painted iron.

## **G. Wet Well**

The wet well shall be pre-cast concrete wet well sections conforming to ASTM C478, latest revision. Wet wells shall be in conformance with Section 7.04C(1) in this document and the following specifications:

1. Openings shall be provided for the required number and size pipes and shall be marked to insure installation at proper locations.
2. Coatings
  - a. All concrete components including both inside and outside surfaces of all new wet wells shall be coated with one coat of specified coating and sealing material. Coatings shall be applied and cured to required thickness and in strict accordance with all coating manufacturers' requirements.

- b. Coating and sealing material shall be:
  - DRYCON water proofing/sealer (gray and white) as manufactured by IPA Systems, Inc.
  - PRECO Waterproofing/sealer (gray and white) as manufactured by FOSROC PRECO Industries, LTD.
  - The level transducer must be located within a PVC or stainless steel pipe large enough for the transducer to slide up and down. This pipe must be strapped to the wall of the wet well at least every six feet. The pipe must have a stainless steel bolt through the bottom to hold the transducer one-foot off the bottom of the well. The pipe shall be located so that the transducer can be pulled and inserted without entering the wet well.

## **H. Electrical**

Electrical service to all pump stations shall be 208Y/120 or 480Y/120 Volt, 4-wire. The electrical power entrance shall be through a meter base, followed by a NEMA 3R heavy duty, single throw, three pole, fusible safety switch with a solid neutral, enclosed in a stainless steel enclosure. All electrical components shall be suitably sized to be capable of service with both pumps running.

All electrical components, including control panel shall be sealed off in accordance with the National Electrical Code. The control panel at submersible lift station shall have three conduits running from the wet well, each sized appropriately for the conductor within. Each motor lead shall be within its own conduit, with the transducer wire in its own conduit. All electrical systems and components in enclosed or partially enclosed spaces where flammable mixtures may occasionally be present shall comply with N.E.C. requirement for class one, division one locations.

## **I. Ventilation**

All pump stations and wet wells shall be vented. Switches and thermostats for heating and ventilating shall be marked. Automatic controls shall be used where intermittent operation is used. The fan wheel shall be fabricated from non-sparking material. Wet well ventilation shall consist of a breather vent with no electrical or mechanical ventilation, and covered with one-eighth of an inch galvanized hardware cloth secured by stainless steel bands.

## **J. Suction Lift Stations**

### **(1) Priming**

Conventional suction-lift pumps shall be the T3 or T4 series self-priming type pumps, as demonstrated by a reliable record of satisfactory operation. The maximum recommended lift for a suction lift station is 15 feet, using pumps of 200 gpm capacity or less.

**(2) Capacity**

The capacity of suction lift pump stations shall be limited by the net positive suction head and the specific speed requirements, as stated on the manufacturer's pump curve, for the most severe operating conditions.

**(3) Air Relief**

All suction lift stations must be provided with an air relief line on the pump discharge piping. This line should be located at the maximum elevation between the pump discharge flange and the discharge check valve to ensure the maximum bleed-off of entrapped air. Air relief piping shall be sized appropriately. A separate air relief line shall terminate in the wet well, and be open to the atmosphere.

Air relief valves shall be provided in air relief lines on pumps not discharging to gravity sewer collection systems. The air relief valve shall be located as close as practical to the discharge side of the pump.

**K. Submersible Pumping Stations**

KSB Corporation shall manufacture all submersible pumps for design heads in excess of capabilities of Flygt pumping equipment. These pumps shall be designed for the pumping of wastewater.

**(1) Pump Removal**

Submersible pumps shall be readily removable and replaced without dewatering the wet well or requiring personnel to enter the wet well. Continuity of operation of other units within the station shall be maintained.

Submersible stations shall be equipped with a minimum of a three-eighths inch stainless steel aircraft cable and stainless steel guide rails for the lifting and setting of pumps.

**(2) Controls**

Either the Gorman-Rupp Company or Consolidated Electric Company shall manufacture the control panel. These controls shall be located outside the wet well and suitably protected from weather, humidity, and vandalism.

**(3) Valves**

All control valves on the discharge line of each pump shall be placed in a convenient location outside the wet well in a separate pit and be suitably protected from weather and vandalism. Aluminum doors over the valve pit shall be installed. See Standard Detail 7.10 for additional valve box requirements.

#### **(4) Submergence**

Positive provision, such as backup controls, shall be made to assure submergence of the pumps.

### **L. Warranties and Documentation**

#### **(1) Warranties**

The developer shall warrant to the City of Oak Ridge, that the pumps, motors and controls supplied shall be free of defects in workmanship and material for a warranty period of one year after formal City Council acceptance as specified in Oak Ridge Subdivision Regulations.

#### **(2) Documentation**

Documentation to be supplied to the City shall be three complete job specific Operation and Maintenance manuals, which include the following:

- a. Cover Sheet Listing: pump manufacturer; source of repair parts, complete with address and phone number; operating conditions-rated capacity and TDH of each pump; model number, serial number, impeller diameter of each pump; all data plate information from each pump motor; data on other equipment included as components in the pump station.
- b. Pump performance curve with operating conditions indicated on it.
- c. Detailed dimensional drawings of the pump and pump base elbow.
- d. Detailed dimensional drawings of the pump motor.
- e. A control panel wiring diagram with brand and part number for each component in the cabinet.
- f. Pump and motor installation and Service Manual.
- g. Detailed information related to other components of the pump station.

### **M. Testing and Inspection**

#### **(1) Hydrostatic Testing of Force Main**

- a. All newly installed sewer pressure lines shall be tested before being placed in service. For piping in non-traffic areas, trenches may be backfilled as the pipe is laid, or where practicable and at the option of the contractor, trenches or bell holes may be left open for visual inspection during tests. Prior to conducting tests, all air shall be expelled from the pipe. Contractor shall install taps at high points of the line for the purpose of expelling air.
- b. Pressure Test - A two-hour test shall be performed in accordance with AWWA C600 or as approved by the City on the pipe line between valves or temporary plugs at a test pressure of one and one-half times the working pressure of the pipe. The pressure rating of the pipe, fittings, valves and thrust restraints shall be at least 1.5 times the working pressure of the pipe. Any open trench or bell holes over dry joints may be backfilled following the

test. Where trenches have been backfilled prior to making tests, any leaks evident at the surface shall be uncovered. All leaking joints disclosed by this test shall be remade and tested. All pipe, fittings, valves, and other materials found defective under this test shall be removed and replaced at the contractor's expense.

c. Leakage Test

- A leakage test shall be performed on the pipeline concurrently with the pressure test between valves or temporary plugs at the constant test pressure as specified in "b" above. The test shall be run in accordance with AWWA C600.
- No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = SD \frac{\sqrt{P}}{133200}$$

Where: L = allowable leakage, in gallons per hour  
S = length of pipe tested, in feet  
D = nominal diameter of the pipe, in inches  
P = average test pressure during the leakage test, in pounds per square inch (gauge)

- The contractor shall provide a straight-walled test tank of adequate volume to supply the maximum allowable leakage to the system. The test tank shall have an accurate scale to measure the volume of water pumped to the nearest one-half gallon. Leakage through the system shall be measured as the volume of water pumped from the test tank to maintain the line segment being tested within five psi of the initial test pressure.
- Should test disclose leakage greater than the allowable amounts, the contractor, at his expense shall locate and repair any and all defects until the leakage is within the specified tolerance.
- All exposed piping, valves and appurtenances shall be pressure and leak tested in the accordance with the foregoing requirements except that they shall have the added requirement that no visible leaking, dripping or weeping will be allowed for the test segment to be accepted.

## (2) Operational Test

Before the operational test is conducted, the required copies of the Operation and Maintenance Manuals shall be delivered to the City. All sewer mains shall be cleaned and cleared of dirt, mud, gravel and other foreign debris. Line cleaning shall be performed by the contractor using a sewer cleaning jet rodding truck or other acceptable method. This shall be performed at the expense of the contractor. The operational test shall check the proper functioning of the pumps and pump controls. All components including pumps and motor serial numbers shall be verified. All components of the pump station shall be checked to ensure that they are capable of performing the service intended to the complete satisfaction of the City, with the actual head and flow rate of each pump determined by on-site testing and certification by the manufacturer's representative. The contractor or developer shall ensure that a representative from the pump station equipment manufacturer is present at the operational test to review proper operation of the equipment with the City personnel. No station will be accepted without this review.

## **N. Developer's Responsibility**

The developer shall furnish all materials, labor and equipment to perform all testing. Water for testing purposes will be provided by the City. The developer shall coordinate with the City for the use of water for testing. The developer shall be responsible for all associated cost for the operational test including payment for the manufacturer's presence at the operational test. The developer is also financially responsible for all internal electrical wiring and setting of the meter base by a licensed electrician. The City Electrical Inspector shall inspect all secondary wiring. A representative of the City Electric Department shall inspect all primary ditching, conduit installation, and transformer pad requirements.

## **7.09 ACCEPTANCE OF SANITARY SEWER SYSTEMS**

All sanitary sewer systems must be accepted by the City for conformance with these SCRD prior to approval of any subdivision Final Plat, except that an acceptable bond, as referenced in the City Subdivision Regulations, Article V, development prerequisite to Final Plat approval, may be posted for incomplete items at Final Plat stage. The sanitary sewer system shall be at least 75 percent complete prior to Final Plat recording unless otherwise approved by the Planning Commission. NO TEMPORARY OR PERMANENT CERTIFICATE OF OCCUPANCY SHALL BE ISSUED UNTIL THE SANITARY SEWER SYSTEM IS 100 PERCENT COMPLETE AND ACCEPTED by the City. Formal acceptance of sewer systems shall be by City Council Resolution upon the request of the developer and upon submission and approval of "As Built" drawings and Final Plat. The developer shall be responsible for all maintenance and repairs on the sewer system until formal acceptance by the City Council.

## **SECTION 8.00**

### **STORM DRAINAGE**

#### **8.01 STORM SEWERS**

##### **A. Design**

###### **(1) Location**

All public storm sewers shall be installed in dedicated street right-of ways or dedicated easements. Minimum widths of storm sewer easements shall be 10 feet for pipes up to 24 inches in diameter that are less than five feet in depth measured from the pipe invert, 15 feet for pipes greater than 24 inches up to and including 48 inches in diameter and a minimum of 20 feet for pipes greater than 48 inches in diameter. For multiple pipe installations, the width of the easement shall be as specified above, but measured from the centerline of each outside pipe. The City shall maintain only the storm sewer systems, which receive drainage from city right-of-ways, that cross the right-of-way or that lies in dedicated easements. The property owner shall maintain storm drainage systems located on private property. Storm sewers should be piped completely from the street to the nearest natural drainage ditch with appropriate easements provided. Beginning at the rear lot setback limits, open swales or ditches for conveying street drainage to a natural drainage ditch are acceptable. The design consultant shall submit two copies of all drainage calculations and an impact report, which outlines the downstream path and impact that the drainage will have on properties located outside the area of development.

###### **(2) Sizing**

Storm sewer systems shall be designed on the basis of the five-year storm for inlet spacing and street drainage pipe sizing, the 50-year storm for cross-street drainage, and the 100-year storm for flooding fringe areas. Cross street drainage systems should be checked for potential damage relating to the 100-year storm event. Pipes shall generally be designed to flow at less than seven-eighths full for open channel conditions. Pipes should be designed for inlet or outlet control using U.S. Department of Transportation, Federal Highway Administration procedures found in Hydraulic Engineering Circular Number Five and related publications. Other equivalent hydraulic design procedures may also be used for pipe design. Runoff rates shall be calculated by the Rational Method, SCS Method, or other acceptable calculation procedures. Runoff computations shall be based on rainfall data published by the National Weather Service for this area. For drainage areas less than 100 acres, the Rational Method is an acceptable procedure, which can be used to calculate peak runoff rates. For drainage areas requiring inflow and/or outflow hydrographs, such as for detention/sedimentation basins, procedures outlined in the SCS Technical Release 55 entitled "Urban Hydrology for Small Water sheds" will be acceptable. For drainage areas greater than 100 acres, an SCS Method or other recognized method is recommended to calculate rates or volumes of runoff.

Time of concentration, with a minimum time of eight minutes, shall be appropriate for the drainage area in question using the procedure outlined in Urban Hydrology for Small Watersheds Technical Release 55 or other commonly accepted hydrologic procedures.

Storm duration shall be set to equal the time of concentration for computing peak rates of flow using the Rational Method.

Computer software adaptations of these runoff calculation methods are acceptable provided that their data and graphic printout allow review and evaluation and an executive summary is provided detailing assumptions, approach method and results.

### **(3) Installation**

All storm sewers shall be installed to provide a true line between structures. Structures shall be installed at each deflection of line and/or grade. The maximum length between drainage structures shall not exceed 400 feet for pipes 36 inches and less in diameter or 800 feet for pipes greater than 36 inches in diameter. Storm drainage structures (manholes, junction boxes, catch basins, etc.) shall be sized to accommodate inlet/outlet pipes based on the manufacturer's recommendation for precast structures. No inaccessible storm drainage structures shall be allowed unless approved by the City. Pipe shall not enter a structure through its corners. A reinforced concrete slab may be constructed over an enlarged structure or corbelled in the back wall to adjust to standard structure dimensions. The minimum cover for storm sewer pipe shall be two feet from finish subgrade to the top of pipe under a road and one foot under a no load-bearing area unless otherwise approved by the City. Storm drainage piping trench excavation and backfilling shall be in accordance with Section 5.00.

All storm drainage pipes shall be installed with Class I, II or III bedding material in accordance with Section 7.01(6), unless otherwise approved by the City.

### **(4) Pipe Outlets**

At all storm water pipe inlets and outlets, headwalls and endwalls shall be provided. On all arterial roadways and on other high volume roadways as determined by the City, traffic safety headwalls shall be provided if located less than 30 feet from the edge of the through traffic lane that is approaching the headwall. Energy dissipaters shall be required at all discharge points and shall be properly sized to ensure that storm water is released at a non-erosive velocity. All riprap shall be designed and constructed with an engineering fabric between the energy dissipation pad and the natural ground. The storm water design shall account for the scour pool protection of the drainageway. Grouting of riprap may be required in areas of excessive velocity.

Riprap shall consist of field stone or rough quarry stone of approximate rectangular shape. The stone shall be of such quality that it will not disintegrate on exposure to water or weathering and shall be suitable in all other respects for the purpose intended. Riprap design shall be in accordance with SCS or other commonly accepted method.

Storm sewer channels and ditches shall be designed to carry the design flow at non-erosive velocities. Computation results indicating design velocities shall be provided

along with typical channel cross-sections. The maximum allowable cross-sectional velocity for grass channels is four feet per second.

The City may require additional information on the impact of discharge of storm water on adjacent properties.

#### **(5) Street Drainage**

Storm water shall not be allowed to flow across street intersections. Drainage structures shall be provided to intercept flow prior to the radius of an intersection or the design of the street shall indicate a continuous grade around the radius to allow flow to continue down the intersecting street. Curb inlets shall be spaced using a five-year storm frequency. Curb inlet opening efficiency shall be designed using the five-year storm frequency supported by calculations or data to show amounts of design flow intercepted and/or bypassed at each inlet. Maximum inlet spacing shall be 400 feet. Curb inlet spacing shall be verified by checking for gutter spread not to exceed eight feet during a two-year return frequency storm for non-arterial streets and six feet for arterial streets.

#### **(6) Design Data**

Design data shall be tabulated on construction drawings to show design flow rates and interception/bypass amounts for all storm drainage structures except at non-intercepting manholes and junction boxes. Drainage areas (in acres) shall be tabulated on drawings for all cross drains.

### **8.02 MATERIALS**

#### **A. Pipe Materials**

##### **(1) Reinforced Concrete Pipe**

Reinforced concrete pipe shall be as per ASTM C76, Class III or Class IV with a minimum 15 inch inside diameter. Joints shall meet the requirements of ASTM C443 for flexible gasket joints.

##### **(2) Corrugated Steel Pipe or Pipe-Arch**

Corrugated steel pipe (CMP) installations shall be a minimum of 14 gauge. CMP or pipe-arch shall have a minimum 15-inch nominal diameter or equivalent pipe arch size of 17 by 13 inches and conform to AASHTO M36 with pipe ends having no less than two annular corrugations on each end. Bands for connecting pipes shall be corrugated to match the annular corrugations on pipe ends. Coupling bands shall be furnished with rubber o-rings or other gasket material to provide a watertight joint. If corrosive or acidic soils are encountered, pipe shall be fully bituminous coated in accordance with the requirements of AASHTO M190.

**(3) High Density Polyethylene Corrugated Storm Sewer Pipe**

Rigid (smooth interior wall) high-density polyethylene corrugated storm sewer pipe shall have a minimum 15-inch nominal diameter and may be used for special applications with specification submittal to the City. This pipe must be installed with Class I or Class II bedding in accordance with Section 7.01(6). This pipe material shall meet the product specifications of ASTM F667.

**B. Structure Materials**

All storm drainage structures such as manholes, inlets, junction boxes, catch basins, etc., shall be constructed of either brick, block, poured in place concrete, or precast concrete. All manholes shall be eccentric type or flattop.

**(1) Clay Brick**

Clay brick shall be rough, sound clay brick conforming to ASTM C32, Grade MS. The brick shall be laid with full shove joints, English bonded, filling up the joints with mortar. The thickness of the joints on the inside of the walls must not be more than three-eighths of an inch in width.

**(2) Concrete Masonry Units**

Concrete masonry units shall conform to ASTM C139 as to design and manufacture. Open cell concrete block shall be filled with concrete. The block or brick shall be embedded in a mortar bed to form a three-eighths inch mortar joint.

**(3) Precast Concrete Manholes**

Precast concrete manholes shall meet ASTM C478 as to design and manufacture.

**(4) Manhole Frames and Covers**

Manhole frames and covers shall be cast iron or ductile iron with "STORM" cast in the cover and shall be in accordance with Section 7.04C(2). Castings shall be machined to give even and continuous bearing on the full length of the frame and shall be free of porosity and blowholes.

**(5) Manhole Steps**

Manhole steps shall be furnished and installed according to Section 7.04C(4).

## **(6) Catch Basin Grates**

Catch basin inlets for street drainage shall have vaned grates and meet the TDOT and city standards. Vane grates are required unless otherwise approved by the City.

All curb inlet grates must be safe for bicycle traffic. No two-piece grates are permitted. Catch basin inlets outside of paved areas shall be a minimum of 24 inches by 24 inches. All grates shall be constructed of ductile iron.

## **8.03 PERFORMANCE CRITERIA**

See Section 9-420 of the Erosion Control and Storm Water Management Ordinance for specific storm drainage performance criteria.

## **8.04 STORM WATER IMPOUNDMENTS**

### **A. General**

Storm water impoundments (sediment basins, detention/retention basins) shall be used for limiting the peak outflow from a developed site. The City shall receive executive summaries and design calculations including design hydrographs, storm routing, selection of the size and shape of the storage volume, and selection of the size and type of outlet device. Maintenance of storm water impoundments shall be the responsibility of the developer or, in special cases, the City of Oak Ridge, as specified in Section 9-441 of the Erosion Control and Storm Water Management Ordinance and the Administration Policy and Procedure Manual Number D-370.

Sediment basins and detention/retention basins shall not be constructed in an area, which conflicts with proper operation and maintenance of an existing or proposed utility line. Basins and impoundments shall not be constructed in areas of known karst activity unless designed to properly seal the basin.

### **B. Minimum Design Requirements For City Acceptance**

#### **(1) Executive Summary**

A licensed engineer shall submit calculations and design drawings of the detention basin and sizing of storm drainage structures to the City at the time of submission of the development site plan. This design concept should be reviewed with Public Works Department, Engineering Division prior to formal submission of the design to the City. An executive summary is required that details how the storm water management plan meets the intent of the City Erosion Control and Storm Water Management Ordinance. The summary shall detail all assumptions, pre/post development discharge volumes, storage volume, AMC, function of discharge structure and emergency spillway, function of discharge structure and emergency spillway, function of any basin used as a sediment basin. A drawing may be necessary to show the basin drainage area.

**(2) Detailed Drawings**

The submission shall show detailed design drawings of the inlet/outlet structures, access roads, emergency spillway, paved ditches, headwalls, riprap, trash racks, anti-vortex structure, temporary/permanent vegetation, fences, gates, anti-seep collars, etc. A detailed cross section of the earthen berm shall be provided.

**(3) Sediment Basin**

Detail design drawings and construction notes are required for basins used as sediment basins during construction. The method of controlling/removing siltation and preventative maintenance procedures must be provided. All sediments shall be removed and the discharge structure cleaned after permanent vegetation has been established.

**(4) Emergency Spillway**

Each basin shall be capable of routing the 100-year storm flow through it without damage to the basin or its berm. An emergency spillway shall be provided, and it shall be capable of discharging the 100-year storm over-flow without damaging the basin berm.

**(5) Spillway Construction**

A spillway constructed over any basin berm shall be constructed of 3,000-psi concrete and shall traverse down the backside of the berm with appropriate energy dissipation at the tow of the spillway.

**(6) Discharge Structure**

Discharge structures shall be designed to minimize maintenance, clogging and vandalism. Rectangular weirs, hooded overflow risers and discharge structures with vertical slits are recommended to minimize maintenance. V-notched or triangular weirs are not desired.

**(7) Orifice Plate**

If a restrictor plate is necessary for proper sizing of the discharge orifice, it shall be a minimum of three-eighths inch thick steel and the orifice diameter shall be machine cut smooth with square edges. The plate shall be mounted with three-eighths inch anchor bolts or welded. If welded, the weld shall be painted with a corrosion resistant paint.

**(8) Basin Aesthetics**

Detention basins shall be designed as aesthetically as possible and with design features that provide maximum safety of structures and surrounding grounds including adjacent downstream areas.

**(9) Basin Swale**

The bottom of the basin shall have a minimum four-foot wide concrete paved swale of 3,000 psi concrete that carries low volume flow from the inlet structures to the outlet structure. The minimum design of the swale shall carry a two-year storm event with a minimum one percent slope to maintain cleansing velocity. The minimum thickness of the concrete shall be four inches.

**(10) Concrete Headwalls**

Pre-cast or poured in place concrete headwalls are required at all outlet structures. Energy dissipater devices shall be constructed downstream of all headwalls. Minimum size of riprap energy dissipater pad shall be 1.5 times the diameter of the discharge pipe in width and three times the diameter of the discharge pipe in length.

**(11) Soil Type and Compaction**

Samples of the soil to be used for the basin berm shall be tested and its capabilities determined. The berm shall be designed to meet the minimum requirements for small earthen dams as specified by United States Department of the Interior, Bureau of Reclamation, Design of Small Dams, latest edition. An independent laboratory shall conduct soil sample and berm compaction testing during construction and reports shall be submitted to the City.

**(12) Seeding Basin Slopes**

Basin shall be seeded with a mix of Kentucky 31 Tall Fescue, Bluegrass and Rye. A viable vegetated growth shall be established before acceptance by the City.

**(13) Basin Slopes**

Basin side slopes shall be a minimum of 3:1 or flatter. A minimum 2:1 slope on the downstream portion of the basin berm is acceptable. The use of riprap as side slope stabilization is not acceptable. The basin floor shall have a minimum possible drainage slope of one percent from any point on the floor to the outlet pipe.

**(14) Sodding**

Areas around paved ditches, spillways, and head walls shall be sodded or covered with an erosion control blanket. The ground cover shall be placed five feet in width each side of paved ditches, 10 feet in width on each side of a spillway, and within a 10-foot radius of all headwalls. The City may waive the requirement for ground cover if vegetation has been established at the time of city acceptance.

**(15) Trash Rack**

A trash rack shall be placed on all outlet structures. The rack should be angled at no less than 45 degrees from vertical to minimize clogging, unless a riser pipe assembly is used. Bar spacing shall be a nominal four inches in both directions. The net open area of the rack shall be no less than four times the area of the outlet. The outlet structure should be directly accessible from the outer basin rim to allow cleaning of the trash rack during a storm.

**(16) Basin Floor**

The basin floor shall be reinforced with concrete mats or pavers when the floor is determined inadequate for city maintenance vehicles such as a turf tractor.

**(17) Access Road**

An all weather access road shall be installed from the nearest paved city street to the basin and outlet discharge structure. The road shall be designed with a maximum slope of 15 percent and a minimum width of 10 feet. If the access road exceeds three percent in grade, the minimum pavement thickness shall be six inches of compacted base stone and four inches of TDOT "E" mix asphalt. Six inches of base stone with no asphalt surface is permissible on roads of three percent and less. Requirements for roadway density shall comply with the SCRD. A flat area, which is a minimum of 12 feet in width, shall be constructed at the top of the basin berm.

**(18) Landscaping**

Landscaping of detention basin to screen from adjacent roadways shall comply with the City Zoning Ordinance Section 6-921(C). Landscape screening of adjacent residential areas should be provided.

**(19) Basin Storage Volume**

Detention basin storage volume shall be certified to the City by a licensed land surveyor after complete construction of the basin.

## **SECTION 9.00**

### **“AS BUILT” DRAWING REQUIREMENTS**

All entities that construct water lines, sewer lines, storm drainage and/or streets with associated appurtenances to be maintained by the City shall submit to the Public Works Department, Engineering Division a set of “As Built” construction drawings certified by a registered professional engineer or land surveyor licensed in the State of Tennessee as part of the City’s acceptance process. NO REPRODUCTION OF PRELIMINARY PLATS SHALL BE ACCEPTED AS “AS BUILTS.” “As Built” drawings shall also be submitted in electronic format using current city version of AutoCAD or DXF format. This file may be on 3.5-inch diskettes or CD-ROM. The City should be consulted for format to be used regarding layer names, line type and line color. The following applicable information shall be included on all “As Built” drawings.

#### **9.01 STREETS**

1. Horizontal and vertical survey control points used for construction layout
2. Horizontal alignment with radii, P.C.’s, and P.T.’s of all curves if significantly different from the Final Plat document
3. Vertical alignment with centerline grade if significantly different from the design profile
4. Dimensioned right-of-way and street widths
5. Typical cross section if significantly different from the design sections

#### **9.02 STORM DRAINAGE**

1. Pipe material and size.
2. Structure invert and top elevations
3. Pipe slope and distance
4. Tabulation of design flows to each drainage structure if significant design changes are made during construction
5. Details and elevations of permanent storm water impoundments and discharge structures and verification of design storage volume

#### **9.03 WATER SYSTEM**

1. Pipe sizes for mains and laterals
2. Location of mains by bearings and distances, coordinates, or by offset distances to permanent structures
3. Locations of valves, fire hydrants, meters, and blow-offs with distance references or Oak Ridge grid coordinate values
4. Location of all laterals reference by distance to a property corner

#### **9.04 SANITARY SEWER SYSTEM**

1. Location of manholes located by Oak Ridge grid coordinate values
2. Pipe sizes for mains and laterals
3. Pipe slopes and distances if significantly different from design

4. Manhole inverts and top elevations
5. Distance from manhole to manhole and distances from manholes to all service laterals
6. Length of laterals
7. Clean-out locations with distances referenced

## **SECTION 10.00**

### **STANDARD DETAILS**

#### **STREETS**

You can view the Bookmarks with the Tab to the Left to  
Navigate to each Drawing (Click Bookmarks Tab)

- 3.01 CIRCULAR AND HAMMER HEAD TURN –AROUND DIMENSIONS
- 3.02 CONCRETE DRIVEWAY WITH SIDEWALK AND GRASS STRIP
- 3.03 CONCRETE DRIVEWAY WITH SIDEWALK
- 3.04 MINERAL AGGREGATE BASE UNDER CURB & GUTTER
- 3.05 CURB & GUTTER DETAILS
- 3.06 STANDARD METHOD OF REMOVING EXISTING CURB & GUTTER
- 3.07 STANDARD CONCRETE MACHINE FORMED CURB
- 3.08 STANDARD CURB DRAIN
- 3.09 C.O.R. STANDARD CONCRETE CURB AND GUTTER
- 3.10 STANDARD CONCRETE SIDEWALK
- 3.11 TYPICAL HANDICAP RAMP “A”
- 3.12 TYPICAL HANDICAP RAMP “B”
- 3.13 TYPICAL HANDICAP RAMP “C”
- 3.14 TYPICAL RESIDENTIAL STREET SECTION
- 3.15 RELATIVE UTILITY PLACEMENT-RESIDENTIAL STREETS
- 3.16 STUB-OUT FOR FUTURE STREET
- 3.17 LOW-DENSITY DEVELOPMENT ROAD
- 3.18 MINIMUM TYPICAL STREET DESIGN STANDARDS
- 3.19 STANDARD CONCRETE SIDEWALK-ELECTRICAL DETAILS
- 3.20 RELATIVE UTILITY PLACEMENT-RESIDENTIAL STREETS-ELECTRICAL DETAILS
- 3.21 TYPICAL SERVICE CONNECTION LOCATIONS-ELECTRICAL DETAILS
- 3.22 TYPICAL ELECTRICAL EASEMENT WIDTHS

### **SOIL EROSION AND SEDIMENT CONTROL**

- 4.01 STANDARD TEMPORARY SILT FENCE
- 4.02 TEMPORARY SEDIMENT/BASIN FILTER SCHEMATIC
- 4.03 GRAVEL AND RIPRAP SEDIMENT/FILTER BASIN
- 4.04 GRAVEL AND RIPRAP SEDIMENT/FILTER BERM BASIN
- 4.05 CATCH BASIN SEDIMENT FILTER
- 4.06 CHECK DAM
- 4.07 TEMPORARY CONSTRUCTION ENTRANCE
- 4.08 DIVERSION DITCH
- 4.09 RIPRAP LINE CHANNELS
- 4.10 INLET PROTECTION METHODS

### **PIPE TRENCHES**

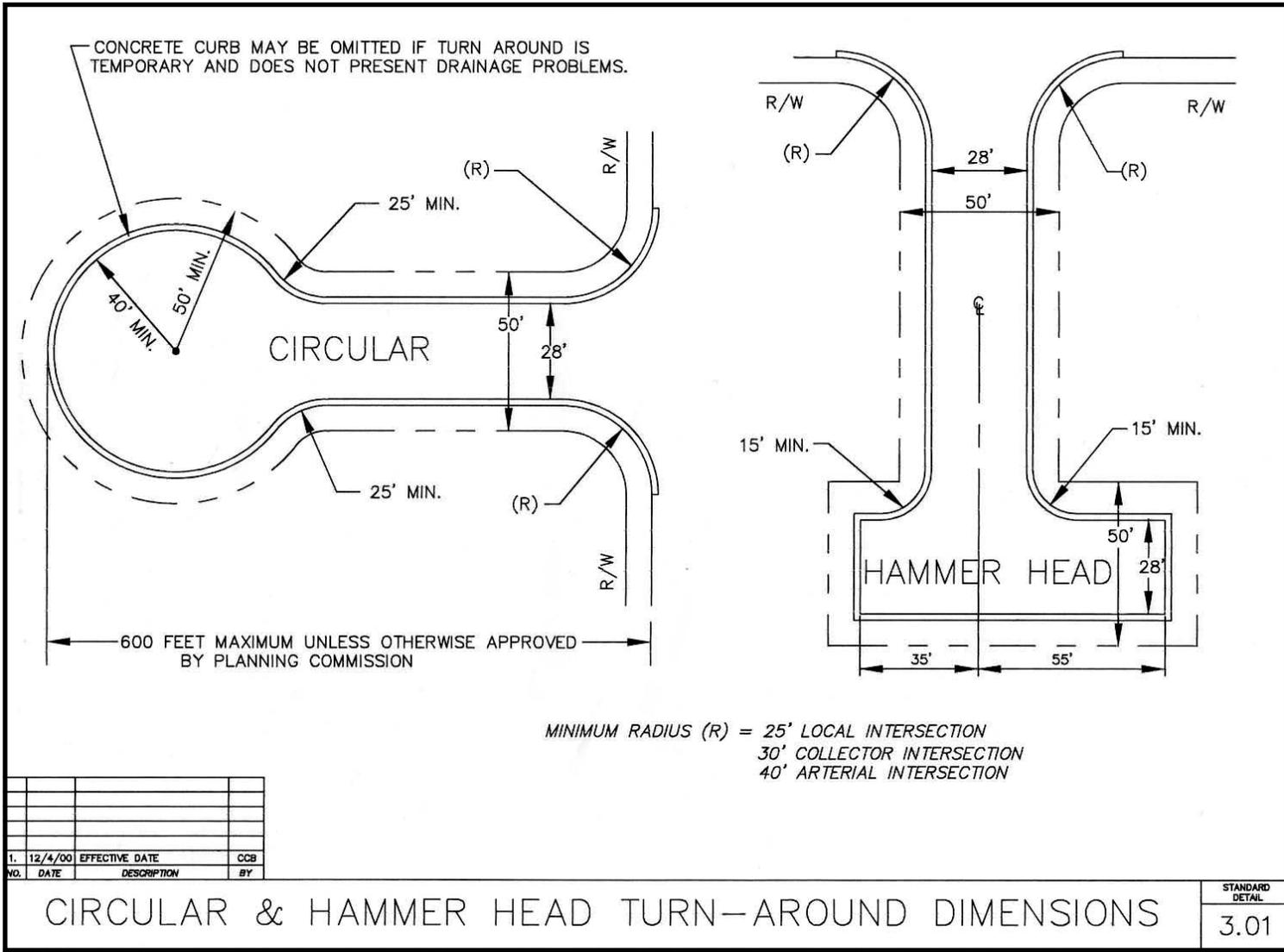
- 5.01 STANDARD TRENCH AND PAVEMENT REPAIR SECTION
- 5.02 PIPE ENCASEMENT DETAIL

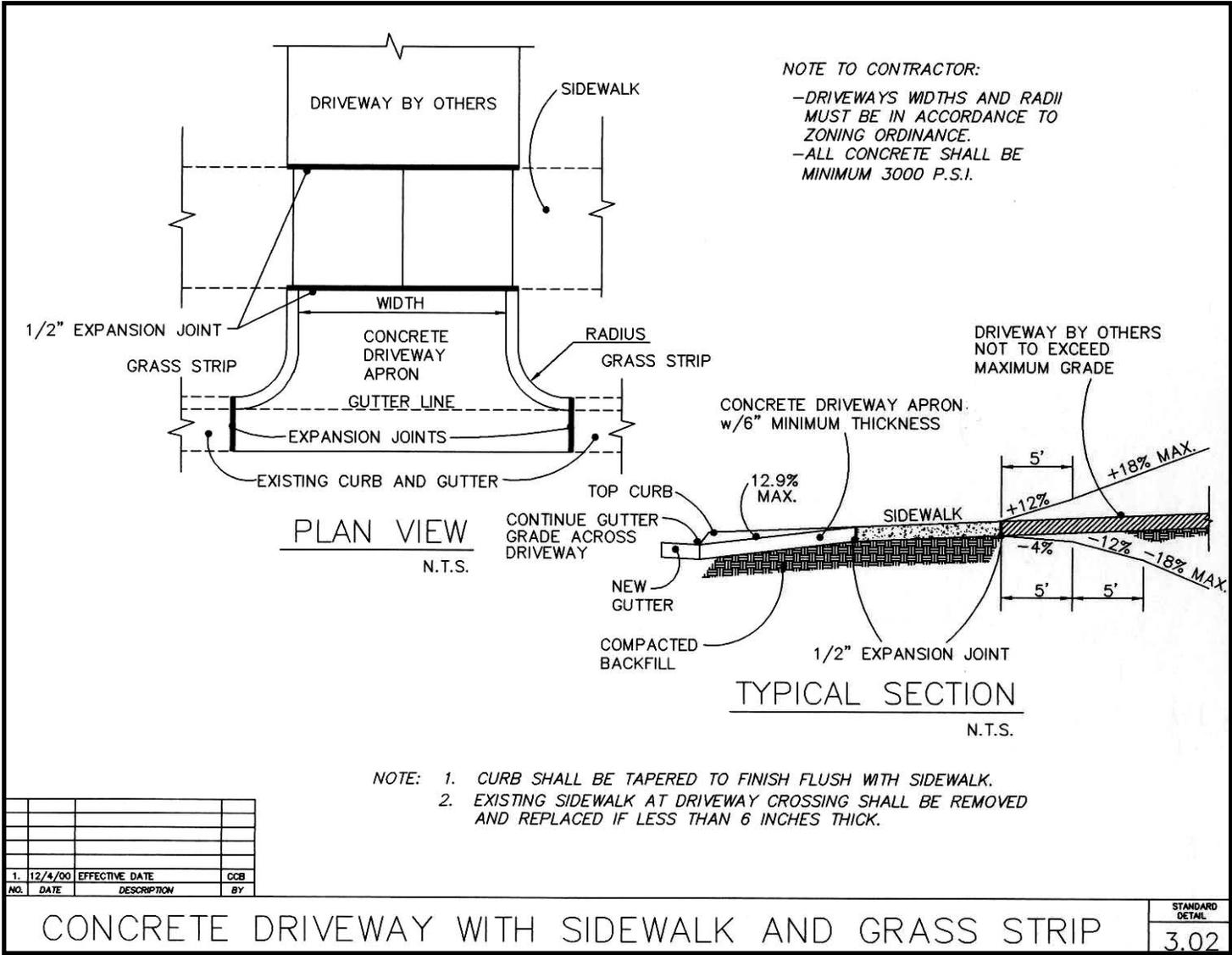
## **WATER DISTRIBUTION**

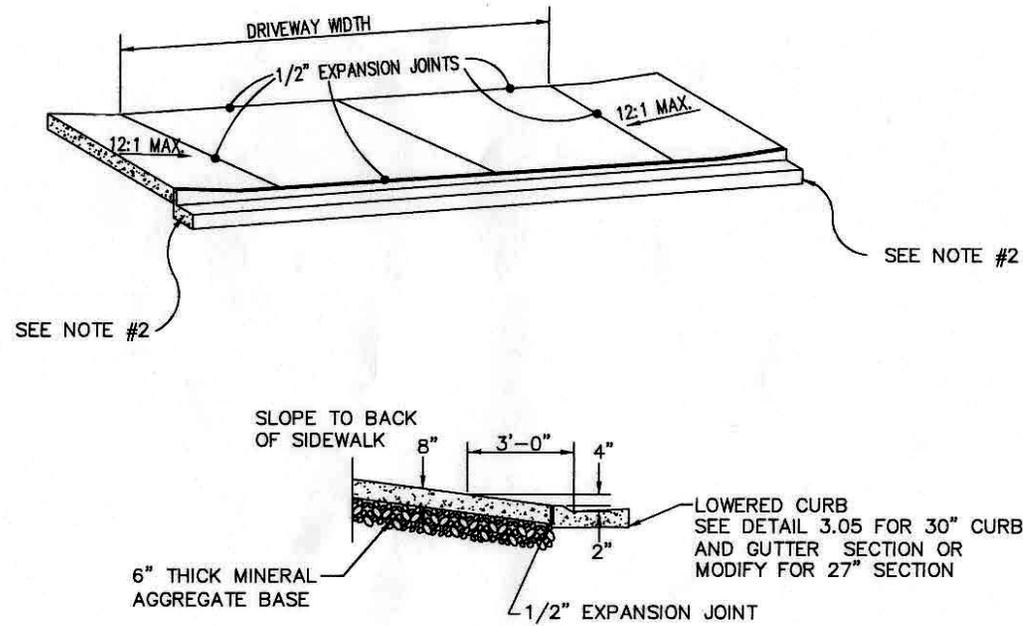
- 6.01 BACKFILLING & COMPACTION OF WATER LINES
- 6.02 STANDARD CAPPING AND BLOW-OFF ASSEMBLY DETAIL FOR FUTURE EXTENSION
- 6.03 STANDARD FIRE HYDRANT INSTALLATION
- 6.04 STANDARD 2" BLOW-OFF ASSEMBLY FOR PERMANENT DEAD END MAIN
- 6.05 AIR RELEASE VALVE
- 6.06 STANDARD VALVE BOX INSTALLATION
- 6.07 STANDARD REACTION BLOCKING-HORIZONTAL BEND
- 6.07A STANDARD REACTION BLOCKING-VERTICAL BEND
- 6.08 WATER LATERAL DETAILS
- 6.09 COMMERCIAL WATER LATERAL LAYOUT/METER VAULT
- 6.10 METER VAULT

## **SANITARY SEWERS**

- 7.01 STANDARD CONCRETE ENCASEMENT FOR STEAM CROSSING
- 7.02 STANDARD HIGH VELOCITY MANHOLE INVERT & CONCRETE ANCHORING
- 7.03 STANDARD OUTSIDE DROP MANHOLE
- 7.04 STANDARD PRECAST CONCRETE MANHOLE
- 7.05 MANHOLE FRAME AND COVER
- 7.06 WATERTIGHT MANHOLE FRAME AND COVER
- 7.07 EXTERIOR CLEANOUT
- 7.08 STANDARD SANITARY SEWER TAP AND SERVICE
- 7.09 STANDARD AIR TEST TABLE
- 7.10 TYPICAL SUBMERSIBLE PUMP STATION
- 7.11 TYPICAL ABOVE GROUND PUMP STATION
- 7.12 NEW CONSTRUCTION PIPE BEDDING DETAILS







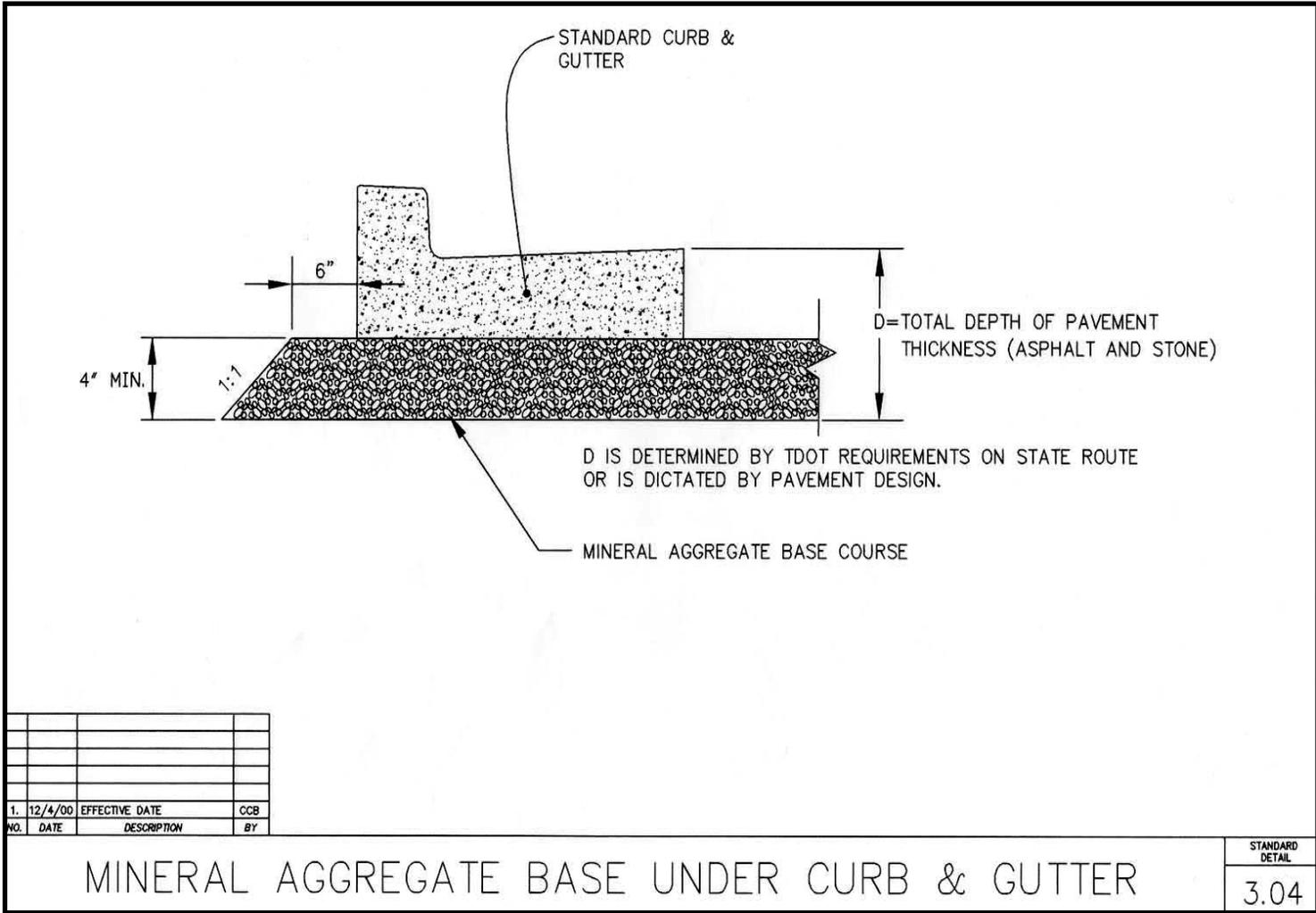
### COMMERCIAL CONCRETE DRIVEWAY – ENTRANCE

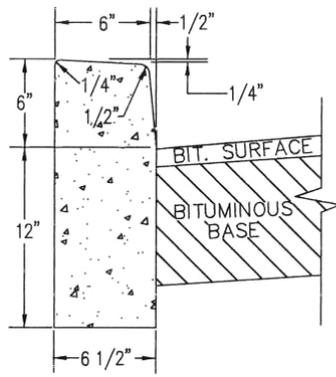
- NOTES: 1. DRIVEWAY WIDTHS AND RADII, MUST BE IN ACCORDANCE WITH THE ZONING ORDINANCE.
2. CURB AND GUTTER TO BE SAW-CUT FOR COMPLETE REMOVAL.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

CONCRETE DRIVEWAY WITH SIDEWALK

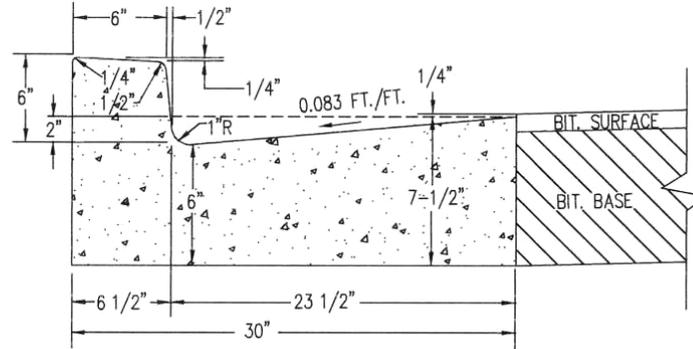
STANDARD  
DETAIL  
3.03



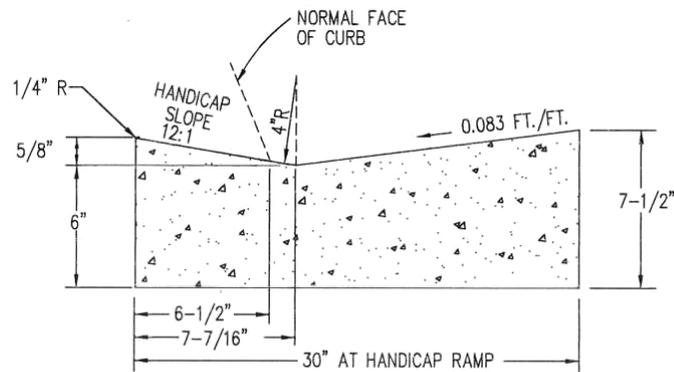
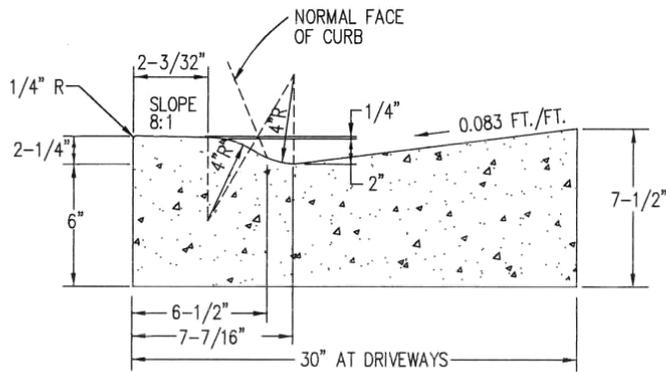


TYPE "A"

6" DETACHED  
CONCRETE CURB



STANDARD 6" CONCRETE  
CURB & GUTTER



LOWERED CONCRETE CURBS

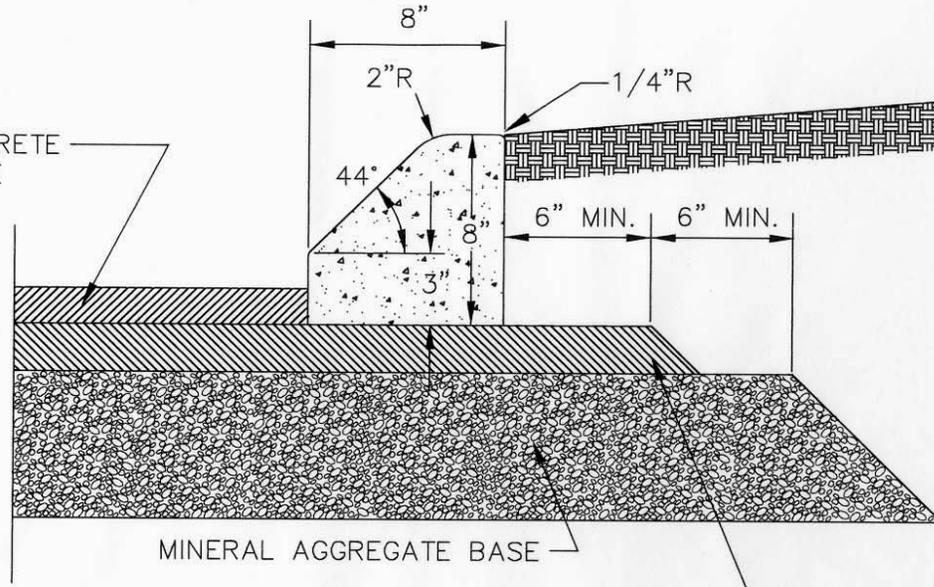
NO.	DATE	EFFECTIVE DATE	DESCRIPTION	BY
1.	12/4/00		EFFECTIVE DATE	CCB

CURB & GUTTER DETAILS

STANDARD  
DETAIL  
3.05



ASPHALTIC CONCRETE  
SURFACE COURSE  
1-1/2" MINIMUM



MINERAL AGGREGATE BASE

BITUMINOUS BASE  
TDOT "BM" MIX

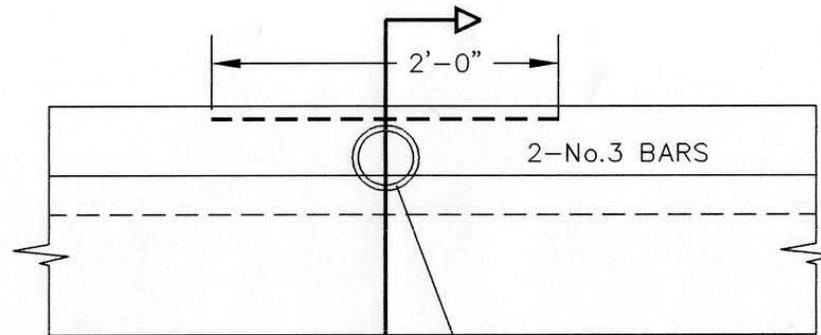
NOTE: THICKNESS OF MINERAL AGGREGATE BASE  
AND BITUMINOUS BASE LAYERS SHALL BE  
DETERMINED BY CBR SUBGRADE VALUES.

1.	12/4/00	EFFECTIVE DATE	CCB
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STANDARD CONCRETE MACHINE FORMED CURB

STANDARD  
DETAIL

3.07



**NOTES:**

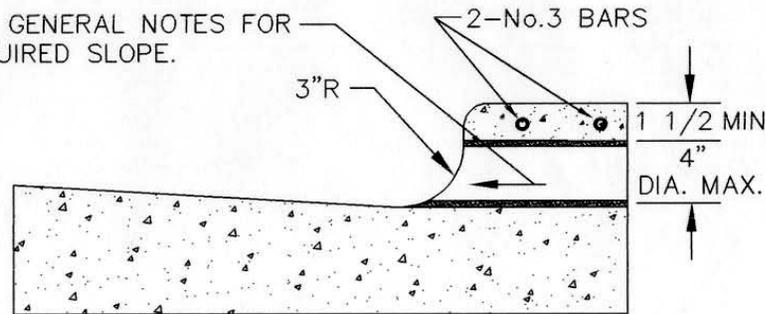
-CURB DRAINS SHALL NOT BE CONSTRUCTED WITHIN 18" OF CONTRACTION OR EXPANSION JOINTS

-OPENING GRADE MAY VARY BETWEEN A MAXIMUM SLOPE OF 1/2" PER FT. AND A MINIMUM OF 1/4" PER FT.

-MORE THAN ONE HOLE MAY BE INSTALLED PROVIDED THE HOLES ARE LOCATED WITH 18" MINIMUM SPACING

THE EDGES OF THE DRAIN HOLE MUST BE FINISHED SMOOTH TO MATCH THE FACE OF CURB.

SEE GENERAL NOTES FOR REQUIRED SLOPE.

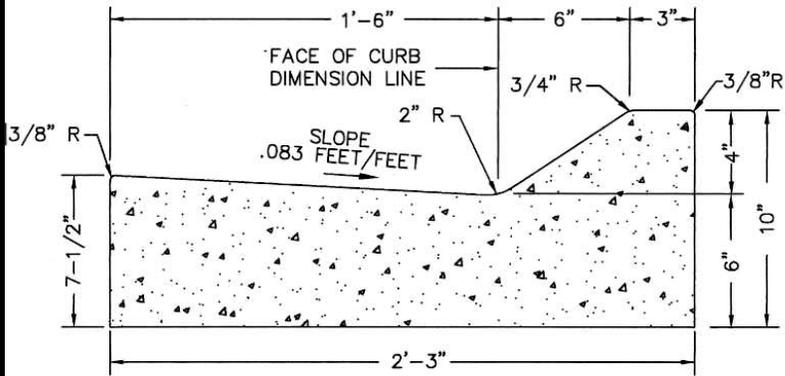


1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

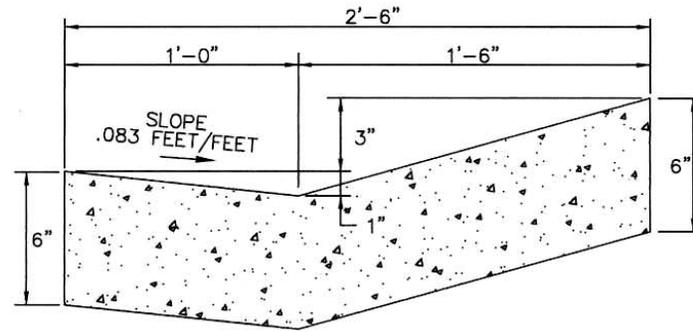
# STANDARD CURB DRAIN

STANDARD  
DETAIL

3.08

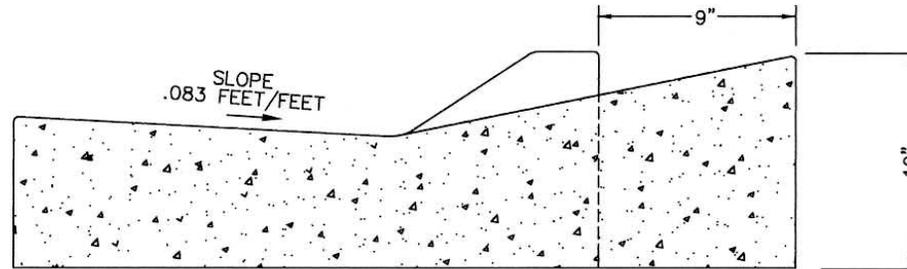


CURB AND GUTTER SECTION



VALLEY GUTTER SECTION

FOR NEW RESIDENTIAL AREAS



RESIDENTIAL LOWERED CONCRETE CURB

FOR EXISTING CITY CURB & GUTTER SECTIONS

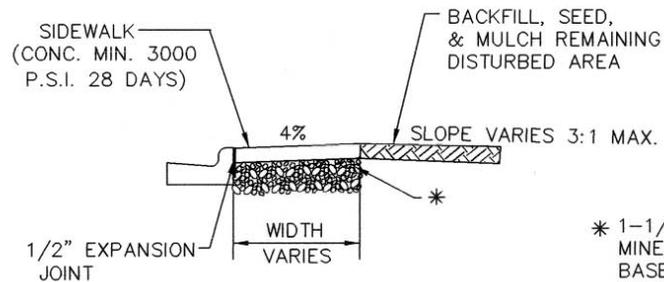
NOTE: ALL DIMENSIONS ARE THE SAME AS STANDARD CURB AND GUTTER EXCEPT FOR EXTENDING THE BACK 9 INCHES AS SHOWN.

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

C.O.R. STANDARD CONCRETE CURB AND GUTTER

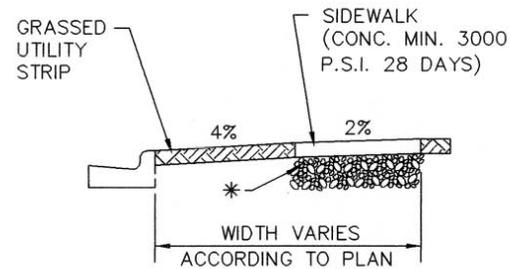
STANDARD  
DETAIL

3.09



TYPICAL SECTION  
WITHOUT GRASS STRIP

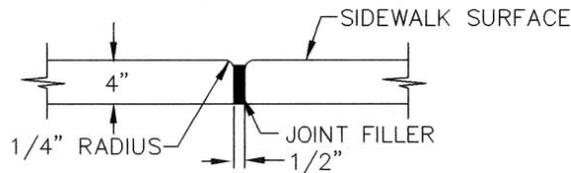
\* 1-1/2" MAXIMUM SIZE  
MINERAL AGGREGATE  
BASE COMPACTED  
TO 4" DEPTH AT 95%  
STANDARD PROCTOR.  
INCREASE TO 6" DEPTH  
AT DRIVEWAYS.



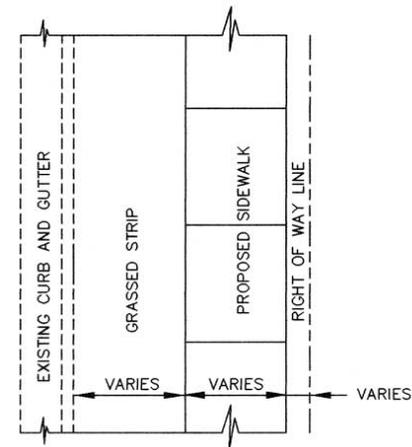
TYPICAL SECTION  
WITH GRASS STRIP

NOTES:

- 1.) TRANSVERSE EXPANSION JOINTS TO BE A MAXIMUM OF 40 FEET
- 2.) ALL FINISHED CONCRETE TO BE COATED WITH LIQUID MEMBRANE-FORMING CURING COMPOUND, ASTM C-309
- 3.) ALL CONSTRUCTION TO MEET TENNESSEE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGES CONSTRUCTION, LATEST EDITION.
- 4.) WHEN ELECTRIC EQUIPMENT IS TO BE INSTALLED WITHIN THE SIDEWALK, THE DEVELOPER SHALL INSURE PROPER INTERFACE BETWEEN THE CONCRETE SIDEWALK AND THIS EQUIPMENT (e.g. MANHOLES, SERVICE PEDESTALS, ETC.) SEE ELECTRICAL STANDARD DETAIL 3.19.



TRANSVERSE EXPANSION JOINT

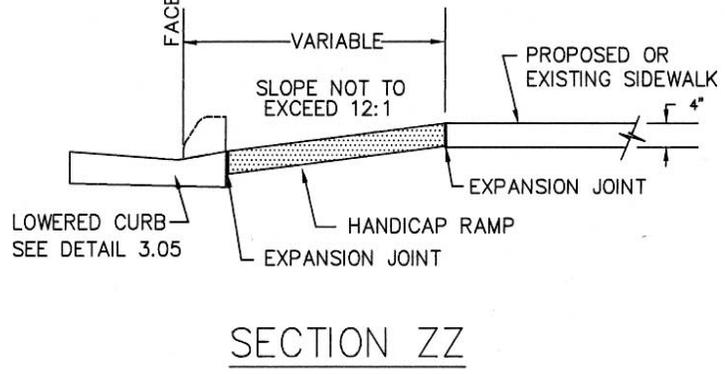
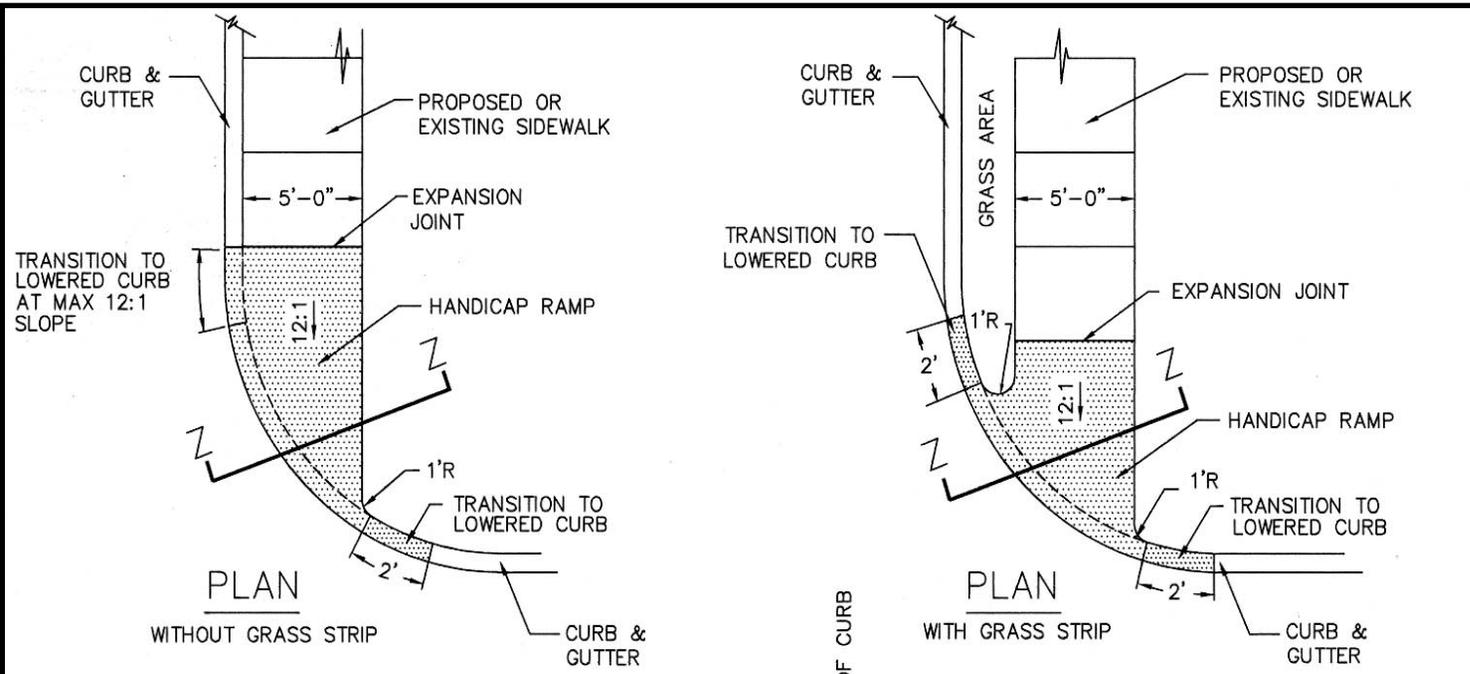


PLAN VIEW

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

STANDARD CONCRETE SIDEWALK

STANDARD  
DETAIL  
3.10

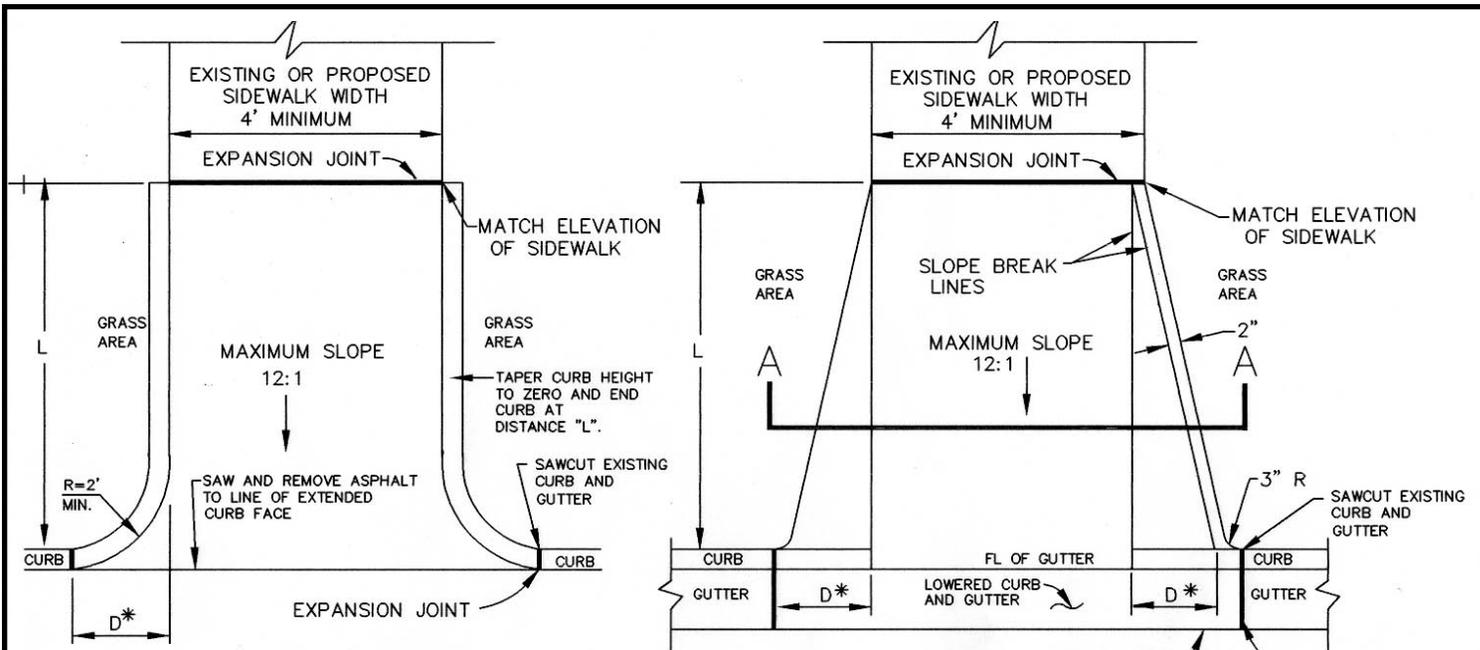


**NOTE:**  
 HANDICAP RAMPS REQUIRED AT ALL INTERSECTION CROSSWALKS.  
 FOR ADDITIONAL HANDICAP RAMP DETAILS, SEE STANDARD DRAWINGS 3.11 AND 3.12  
 SURFACE CONTRAST REQUIRED ON ALL HANDICAP RAMPS

1.	12/4/00	EFFECTIVE DATE	COB
NO.	DATE	DESCRIPTION	BY

# TYPICAL HANDICAP RAMP "A"

STANDARD  
 DETAIL  
 3.11



**PLAN VIEW**

PAVEMENT WITH CONCRETE CURB ONLY

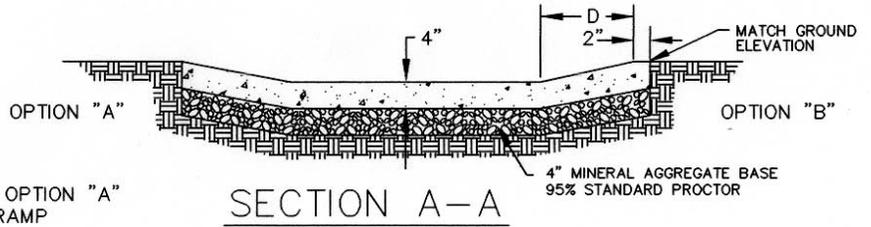
**PLAN VIEW**

PAVEMENT WITH CONCRETE CURB & GUTTER

D\* DIMENSION D IS TRANSITION LENGTH TO LOWERED CURB AND GUTTER SECTION.

FOR 4" CURB:  
D=12" L=4' MINIMUM  
(MAX. SLOPE CONTROLS)

FOR 6" CURB:  
D=18" L=6' MINIMUM  
(MAX. SLOPE CONTROLS)



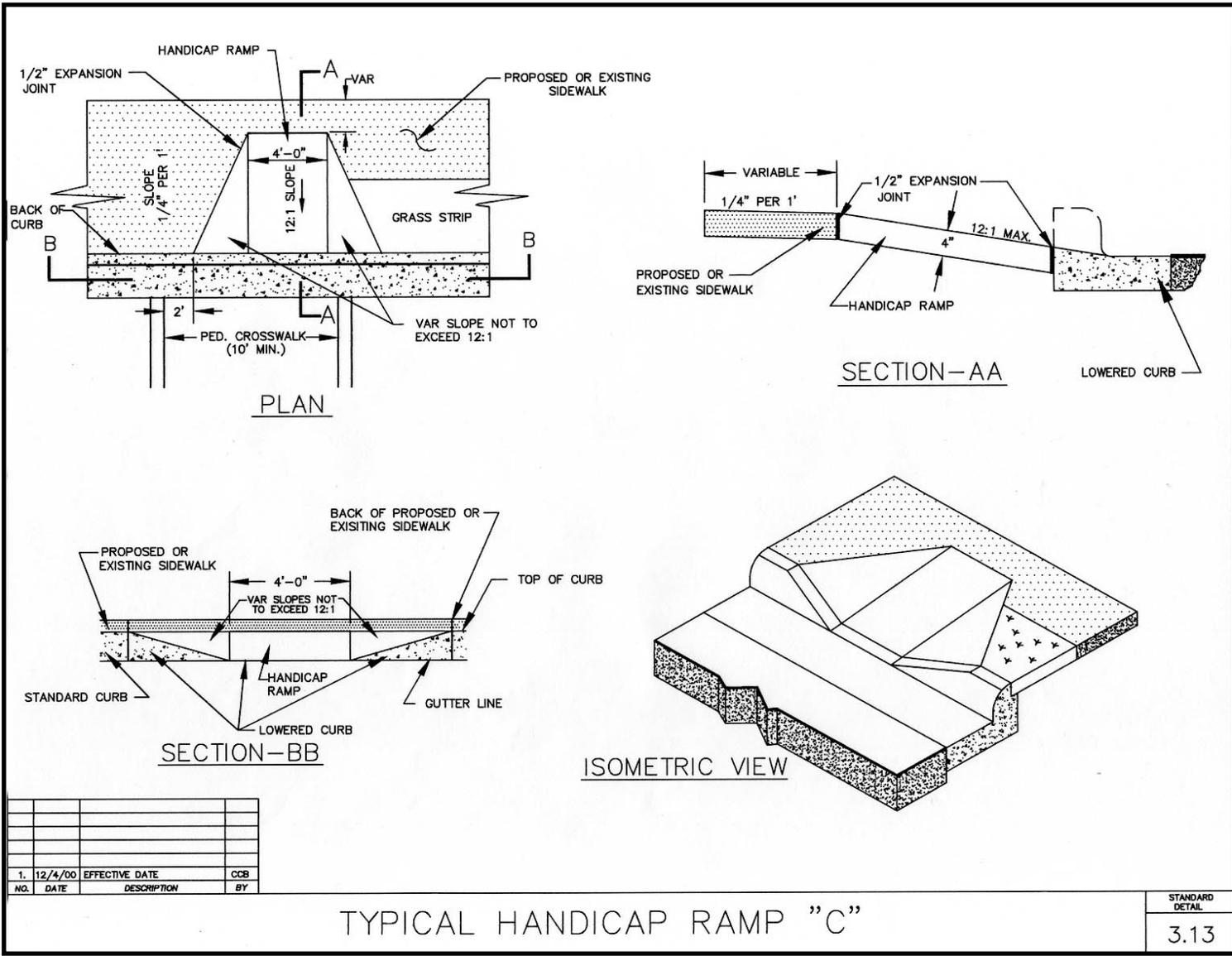
**SECTION A-A**

**NOTE:**  
CONTRACTOR MAY USE OPTION "A"  
OR "B" FOR EDGE OF RAMP

NO.	DATE	EFFECTIVE DATE	DESCRIPTION	CCB	BY
1.	12/4/00				

**TYPICAL HANDICAP RAMP "B"**

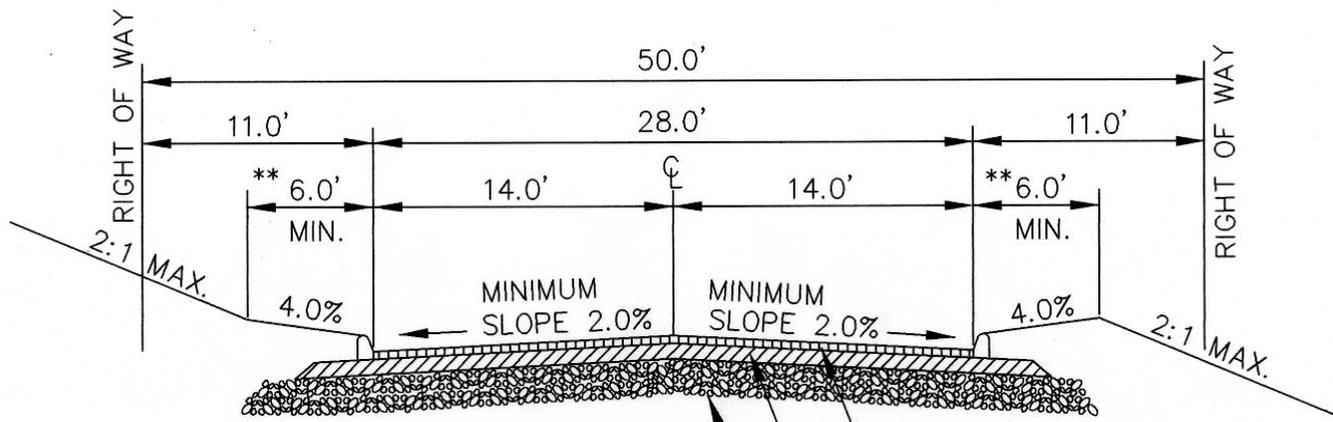
STANDARD  
DETAIL  
3.12



1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

TYPICAL HANDICAP RAMP "C"

STANDARD  
DETAIL  
3.13



- 1-1/2" ASPHALTIC CONCRETE SURFACE
- \* 3-1/2" BITUMINOUS BASE TDOT "BM" MIX
- \* 6" MINERAL AGGREGATE BASE

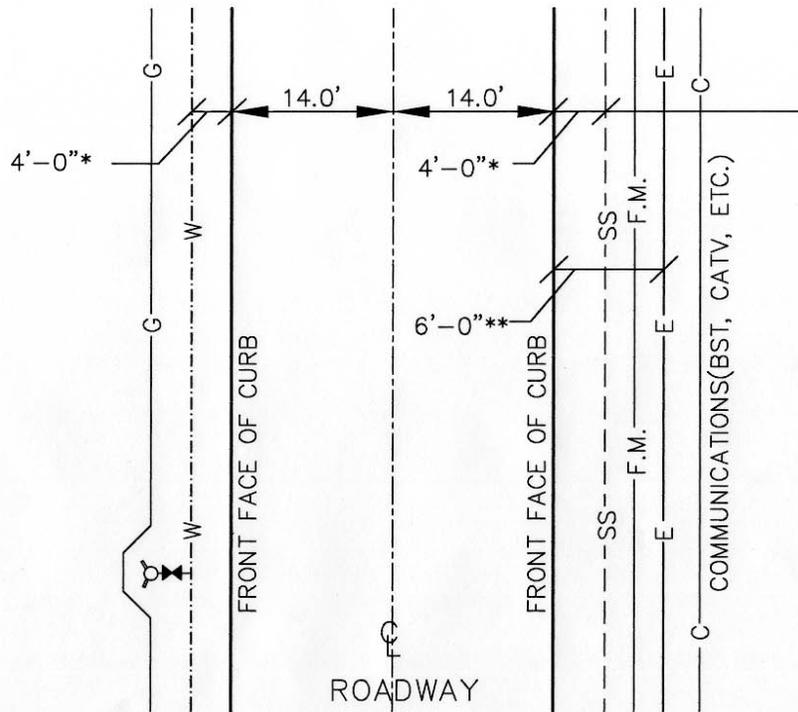
\*\* SUBDIVISION REGULATIONS ARTICLE IV, GENERAL DESIGN STANDARDS, SECTION E7f ON SIDEWALK LOCATIONS, SHOULD BE CONSULTED FOR SIDEWALK REQUIREMENTS WHICH WILL CHANGE THIS ROADSIDE TYPICAL SECTION. WHEN CURBSIDE LOCATIONS FOR ELECTRIC EQUIPMENT IS NOT POSSIBLE, THE DEVELOPER SHALL ADJUST THE MINIMUM UTILITY STRIP DIMENSION TO ELECTRIC DEPARTMENT REQUIREMENTS.

\* NOTE:  
THICKNESS OF MINERAL AGGREGATE BASE AND BITUMINOUS BASE LAYERS SHALL BE DETERMINED BY CBR SUBGRADE VALUES.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

## TYPICAL RESIDENTIAL STREET SECTION

STANDARD  
DETAIL  
3.14



NOTE: \* MINIMUM DESIRABLE DIMENSION TO WATER, SANITARY SEWER OR OTHER UTILITY NEAREST CURB.

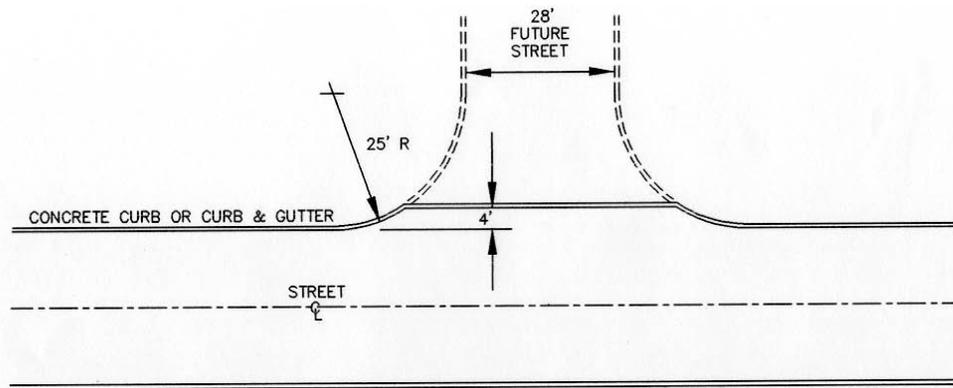
UTILITY PLACEMENT AT NON-RESIDENTIAL SITES SHALL BE BASED ON INDIVIDUAL SITE PARAMETERS.

\*\* WHEN REQUIRED CLEARANCES TO ADJACENT UTILITIES CAN NOT BE MET, THE DEVELOPER SHALL CONTACT THE CITY OF OAK RIDGE ELECTRIC DEPARTMENT. (SEE ELECTRICAL STANDARD DETAIL 3.20)

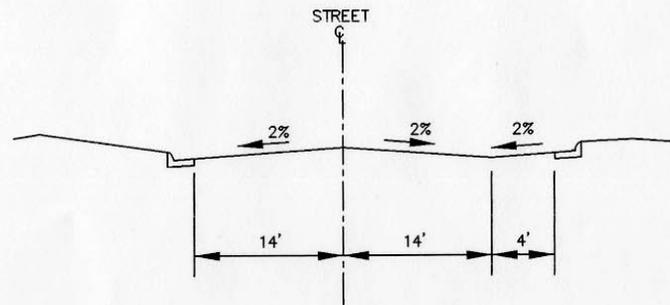
NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	COB

## RELATIVE UTILITY PLACEMENT—RESIDENTIAL STREETS

STANDARD  
DETAIL  
3.15



PLAN VIEW

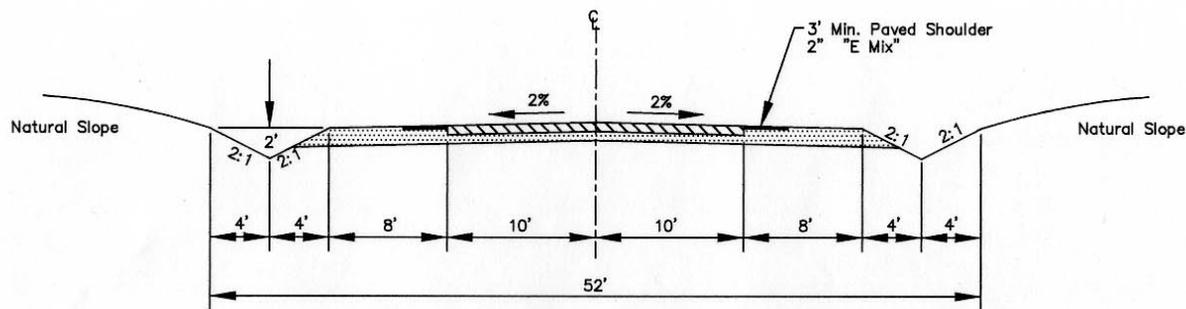


CROSS SECTION

1.	12/4/00	EFFECTIVE DATE	COB
NO.	DATE	DESCRIPTION	BY

STUB-OUT FOR FUTURE STREET

STANDARD  
DETAIL  
3.16



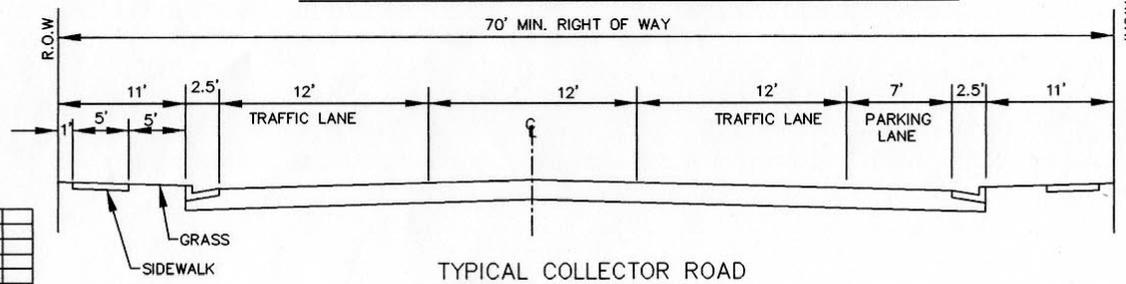
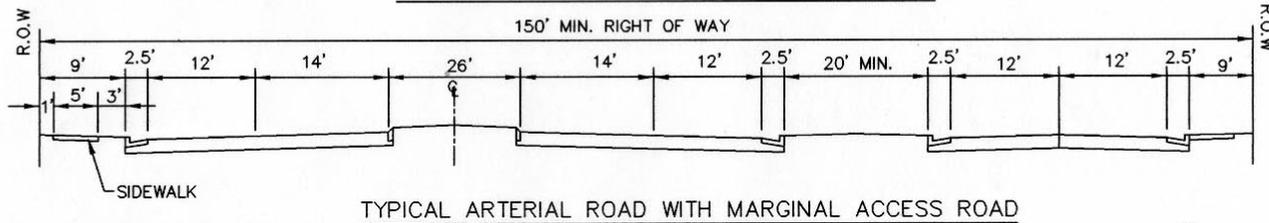
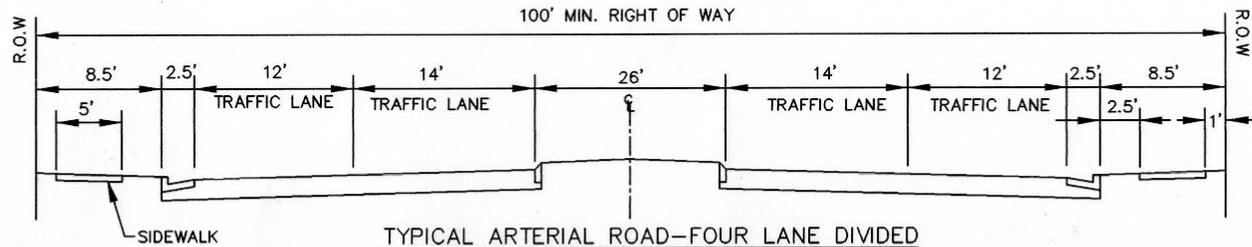
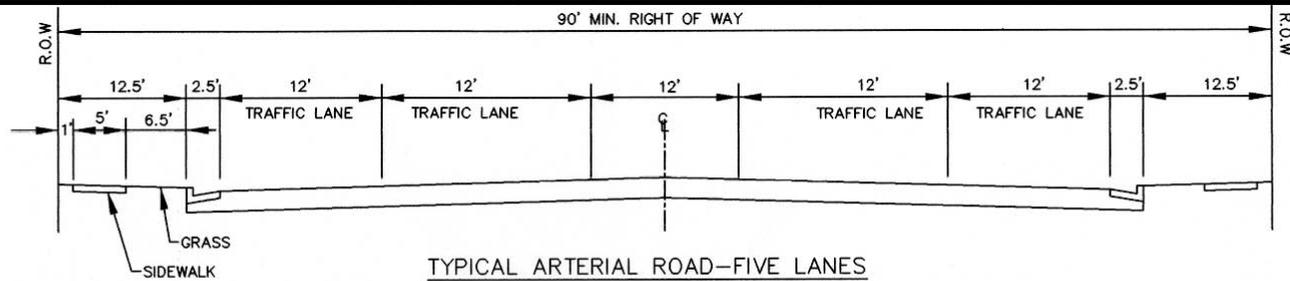
NOTES

- 1) Minimum ditch line standard shown. Actual depth may be greater based on design storm runoff capacity.
- 2) Shoulder pavement may be omitted with 22' Roadway width.
- 3) Single solid white line four inches in width shall be painted on roadway edge.
- 4) The developer shall install curbed utility islands for the installation of electric facilities as required by the Electric Department.
- 5) When curbside locations for electric equipment is not possible, the developer shall adjust the minimum utility strip dimension to Electric Department requirements.

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

LOW-DENSITY DEVELOPMENT ROAD

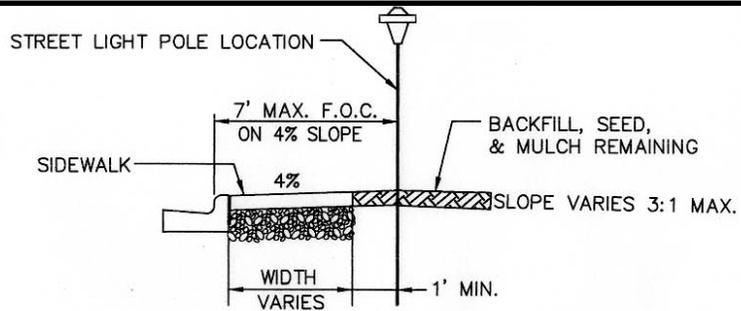
STANDARD  
DETAIL  
3.17



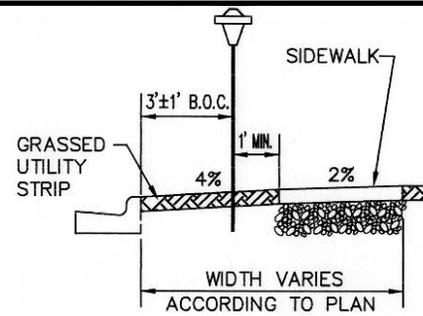
NO.	DATE	EFFECTIVE DATE	DESCRIPTION	CCB BY
1.	12/4/00			

# MINIMUM TYPICAL STREET DESIGN STANDARDS

STANDARD  
DETAIL  
3.18



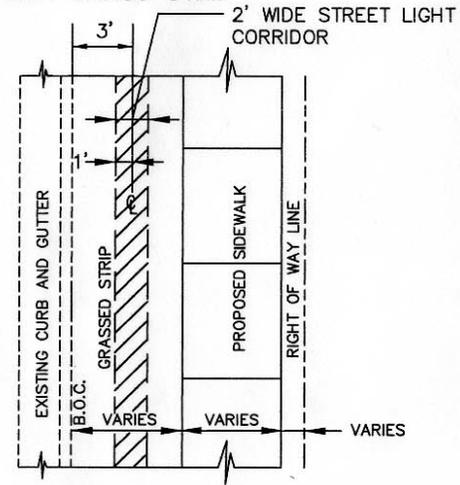
TYPICAL SECTION  
WITHOUT GRASS STRIP



TYPICAL SECTION  
WITH GRASS STRIP

NOTES:

- 1) B.O.C. = BACK OF CURB
- 2) F.O.C. = FRONT OF CURB
- 3) WHEN ELECTRIC EQUIPMENT IS TO BE INSTALLED WITHIN THE THE SIDEWALK, THE DEVELOPER SHALL INSURE PROPER INTERFACE BETWEEN THE CONCRETE SIDEWALK AND THIS EQUIPMENT (E.G. MANHOLES, SERVICE PEDESTALS, ETC.)



PLAN VIEW

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

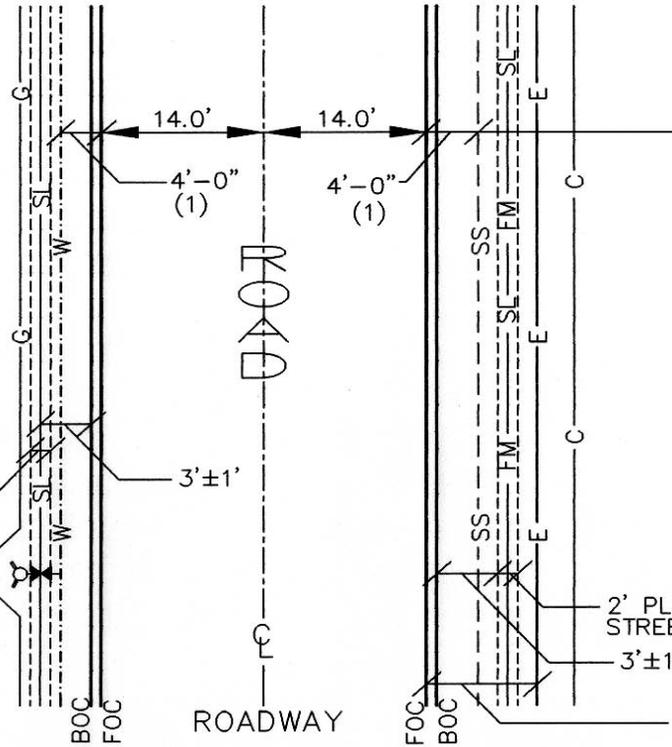
STANDARD CONCRETE SIDEWALK—ELECTRICAL DETAILS

STANDARD  
DETAIL  
3.19

**LEGEND**

- FOC = FRONT OF CURB
- BOC = BACK OF CURB
- G ——— NATURAL GAS LINE
- SL - - - STREET LIGHT CORRIDOR
- W - - - WATER LINE
- SS - - - SANITARY SEWER LINE
- FM ——— FORCE MAIN
- E ——— ELECTRIC LINE
- C ——— COMMUNICATION LINE (BST, CATV, ETC.)
-  FIRE HYDRANT

2' PLACEMENT AREA FOR STREET LIGHT POLES



2' PLACEMENT AREA FOR STREET LIGHT POLES

**NOTES:**

- 1) MINIMUM DESIRABLE DIMENSION TO WATER, SANITARY SEWER OR OTHER UTILITY NEAREST CURB.
- 2) UTILITY PLACEMENT AT NON-RESIDENTIAL SITES SHALL BE BASED ON INDIVIDUAL SITE PARAMETERS.
- 3) MAXIMUM DIMENSION FROM FRONT OF CURB
- 4) WHEN REQUIRED CLEARANCES TO ADJACENT UTILITES CANNOT BE MET, THE DEVELOPER SHALL CONTACT THE CITY OF OAK RIDGE ELECTRIC DEPARTMENT.

NO.	DATE	EFFECTIVE DATE	DESCRIPTION	CCB	BY
1.	12/4/00				

**RELATIVE UTILITY PLACEMENT-RESIDENTIAL STREETS-ELECTRICAL DETAILS**

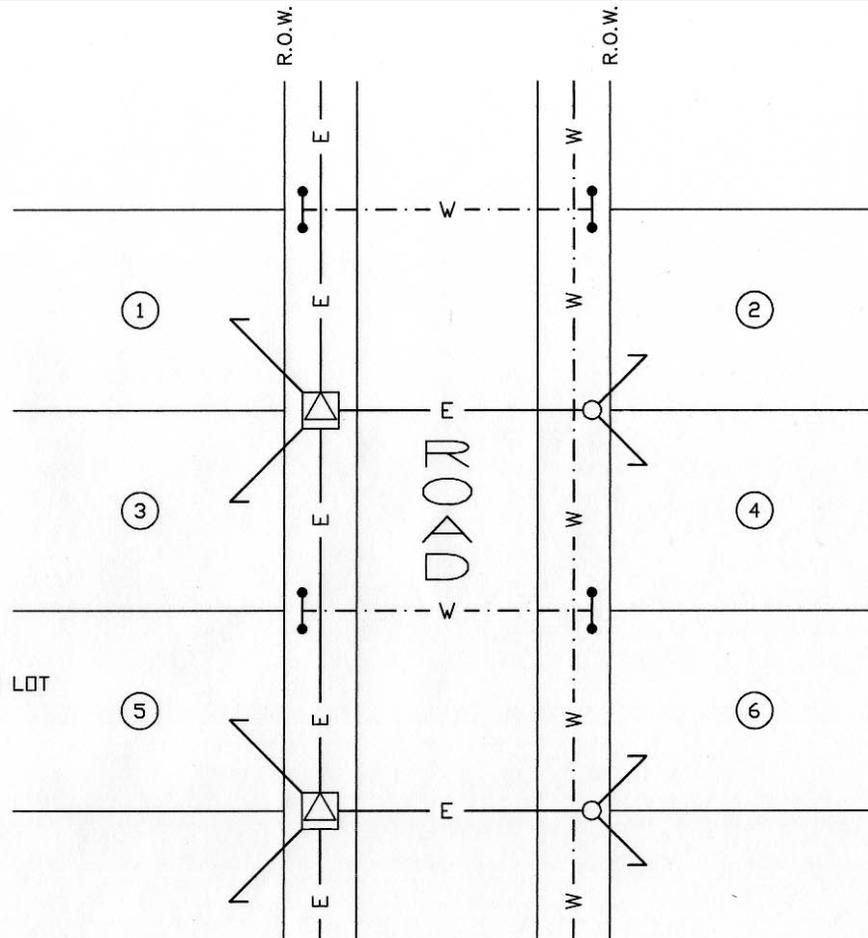
STANDARD  
DETAIL  
3.20

LEGEND

- ① LOT DESIGNATION
- R.O.W. RIGHT-OF-WAY LOCATION
- E — ELECTRIC LINE
- W — WATER LINE
- ⊠ ELECTRIC TRANSFORMER
- ELECTRIC SERVICE PEDESTAL
- ↗ ELECTRIC SERVICE LINE TO LOT
- WATER METER FOR SERVICE LINE TO LOT

NOTE

1.) TYPICAL ELECTRIC AND WATER SERVICE PROVISIONS SHOULD BE LOCATED ON OPPOSING CORNERS OF INDIVIDUAL LOT LINE LOCATIONS.



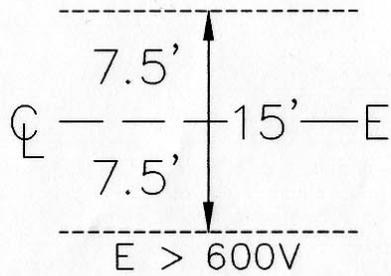
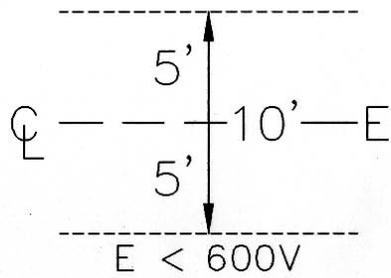
PLAN VIEW

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

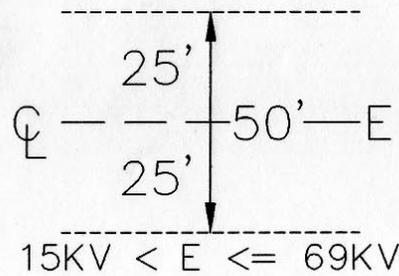
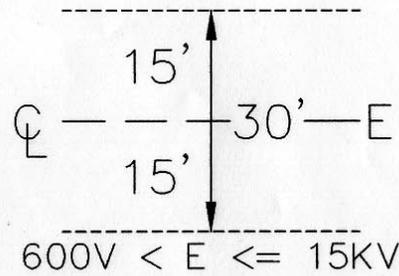
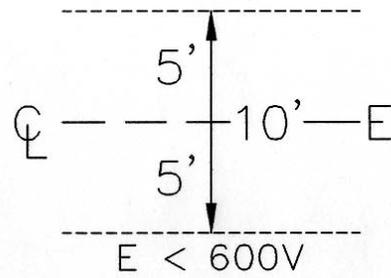
TYPICAL SERVICE CONNECTION LOCATIONS—ELECTRICAL DETAILS

STANDARD  
DETAIL  
3.21

## UNDERGROUND



## OVERHEAD



1.	12/4/00	EFFECTIVE DATE	OCB
NO.	DATE	DESCRIPTION	BY

TYPICAL ELECTRICAL EASEMENT WIDTHS

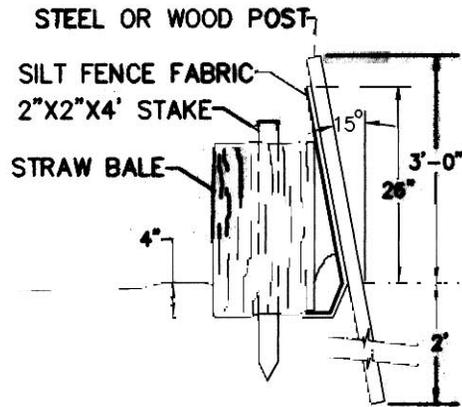
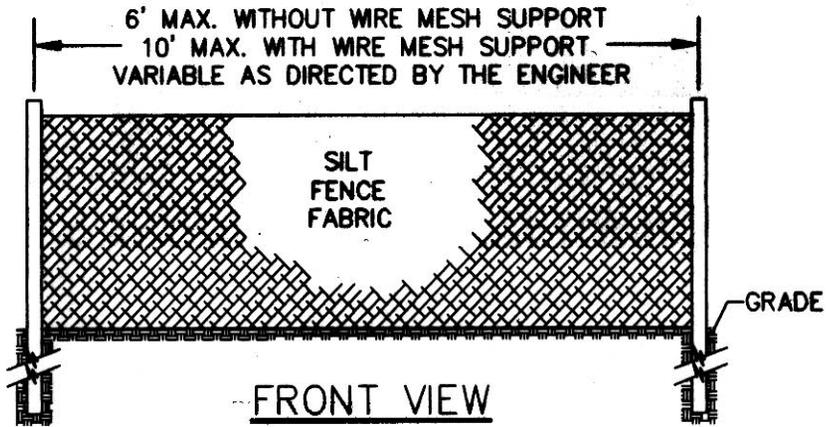
STANDARD  
DETAIL

3.22

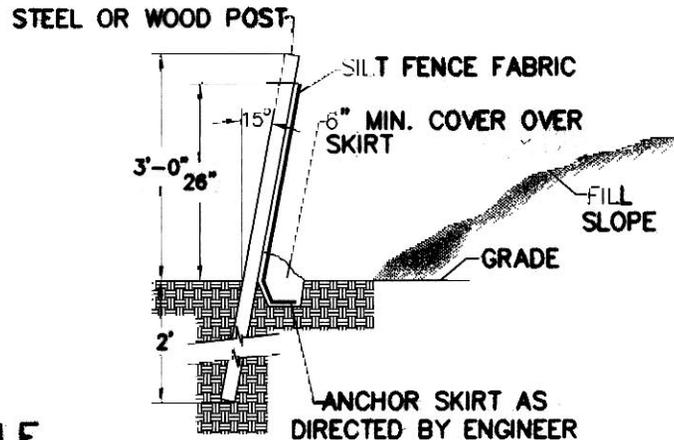
**NOTE:**

-USE SILT FENCE ONLY WHEN DRAINAGE AREA DOES NOT EXCEED 1/4 ACRE PER 100 FEET OF FENCE AND NEVER IN AREAS OF CONCENTRATED FLOW GREATER THAN ONE CUBIC FEET PER SECOND

-SILT FENCE/STRAW BALE CHECK DAM PLACEMENT SUGGESTED AT MINOR SWALES



SILT FENCE/STRAW BALE  
CHECK DAM



SIDE VIEW

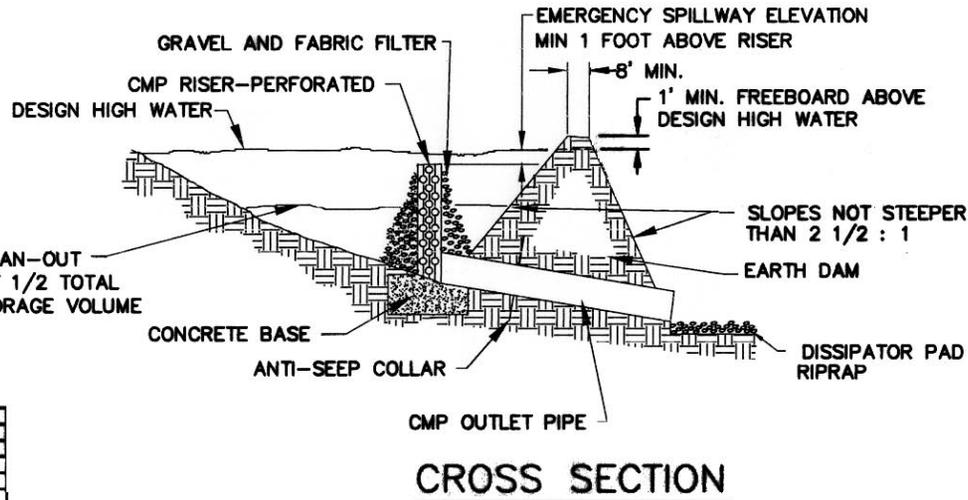
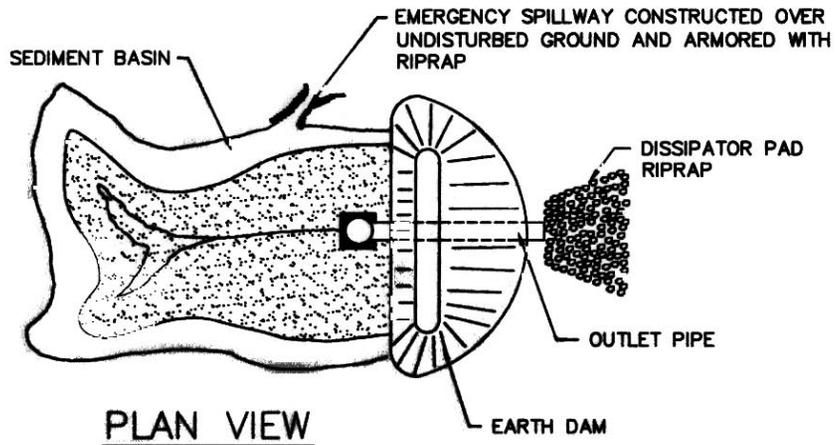
1.	12/4/00	EFFECTIVE DATE	GCB
NO.	DATE	DESCRIPTION	BY

**STANDARD TEMPORARY SILT FENCE**

STANDARD  
DETAIL  
4.01

**NOTES:**

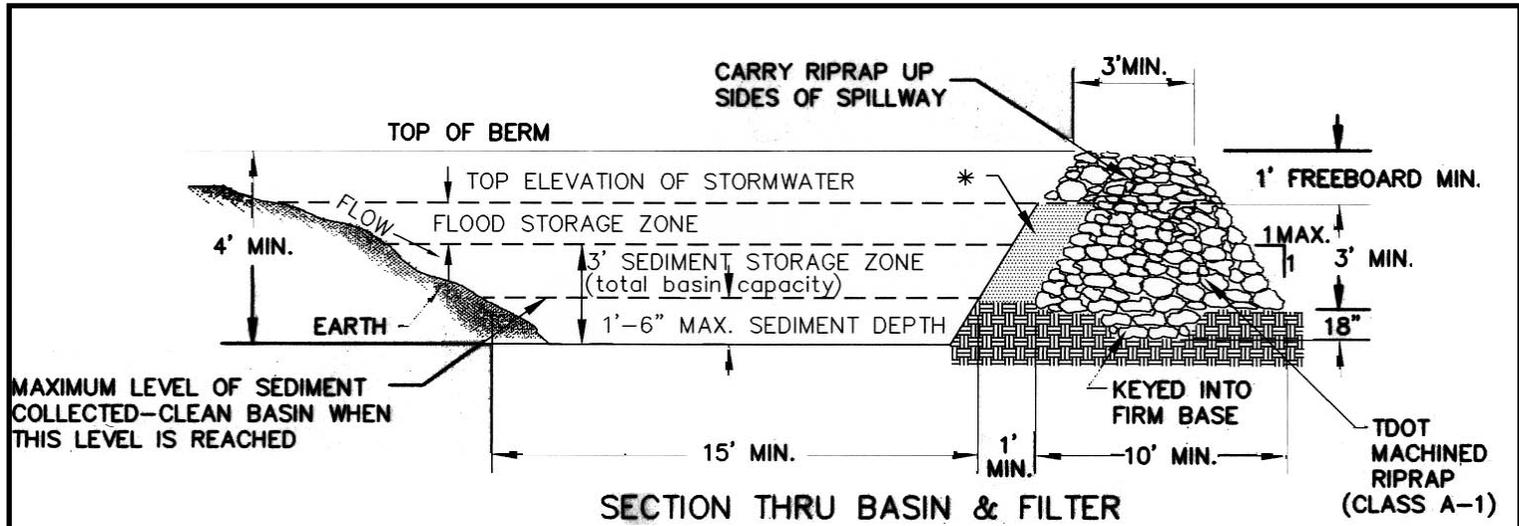
- 1) TRASH RACK AND ANTI-VORTEX DEVICE OPTIONAL
- 2) TOP WIDTH  
MIN. 8' FOR DAM LESS THAN 10' HEIGHT  
MIN. 10' FOR DAM GREATER THAN 10' HEIGHT  
TO 20' MAX HEIGHT
- 3) SHAPE FACTOR APPROX. 2:1 LENGTH/WIDTH



NO.	DATE	EFFECTIVE DATE	BY
1.	12/4/00		COB

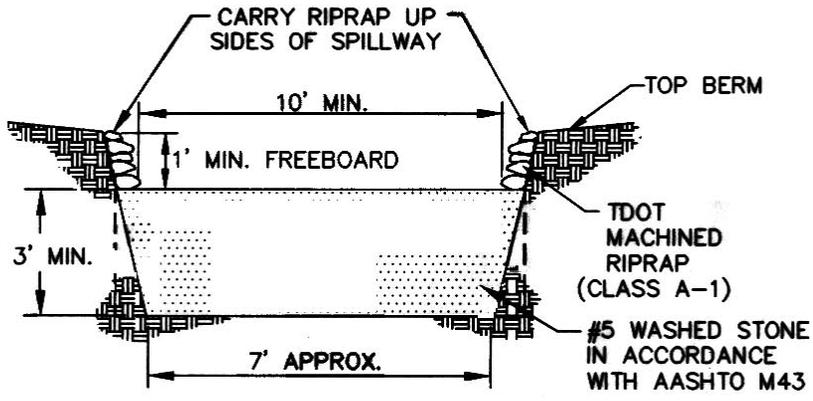
**TEMPORARY SEDIMENT/FILTER BASIN SCHEMATIC**

STANDARD  
DETAIL  
4.02

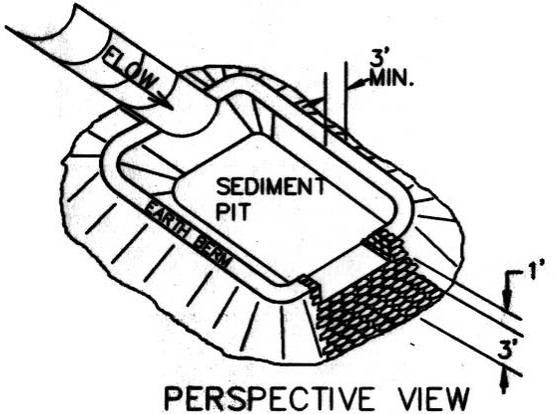


SECTION THRU BASIN & FILTER

\* #5 WASHED STONE  
IN ACCORDANCE  
WITH AASHTO M43



SECTION THRU BERM AT FILTER



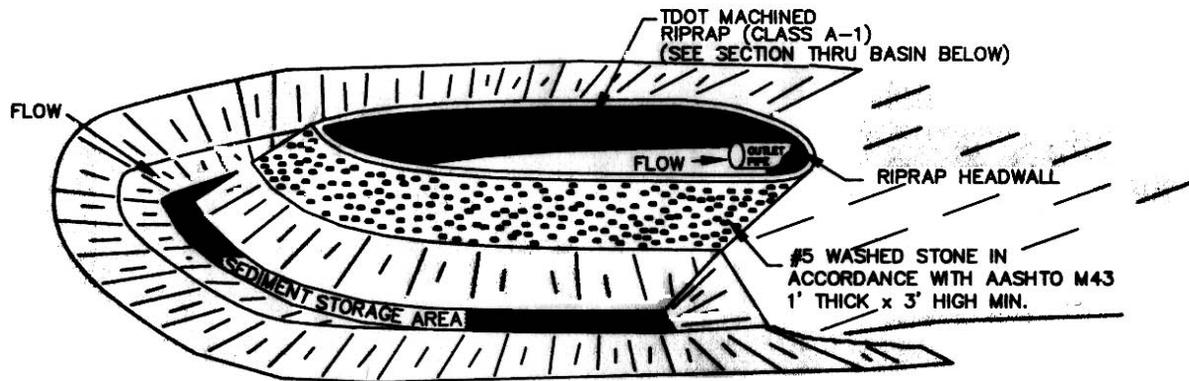
PERSPECTIVE VIEW

NOTE:  
USE FOR DRAINAGE AREAS NOT EXCEEDING 5 (five) ACRES.  
RIPRAP AT THE DAM SHALL BE KEYED INTO THE DAM.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

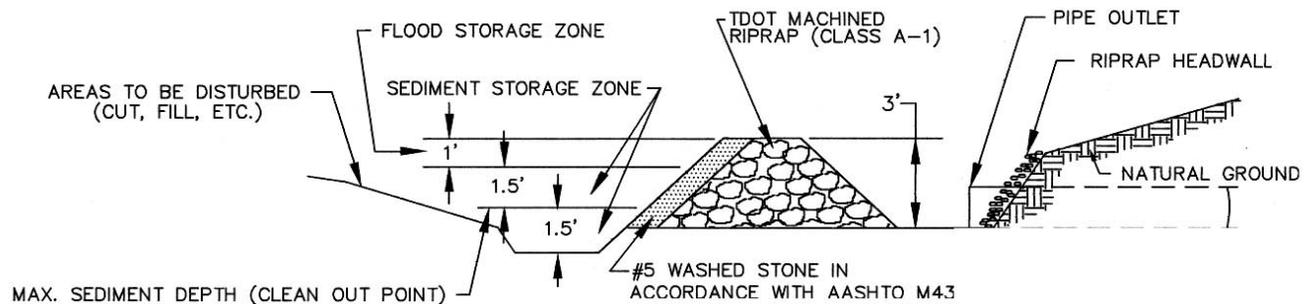
GRAVEL AND RIPRAP SEDIMENT/FILTER BASIN

STANDARD  
DETAIL  
4.03



**PERSPECTIVE VIEW**

NO SCALE



**SECTION THRU BASIN, FILTER AND CULVERT PIPE**

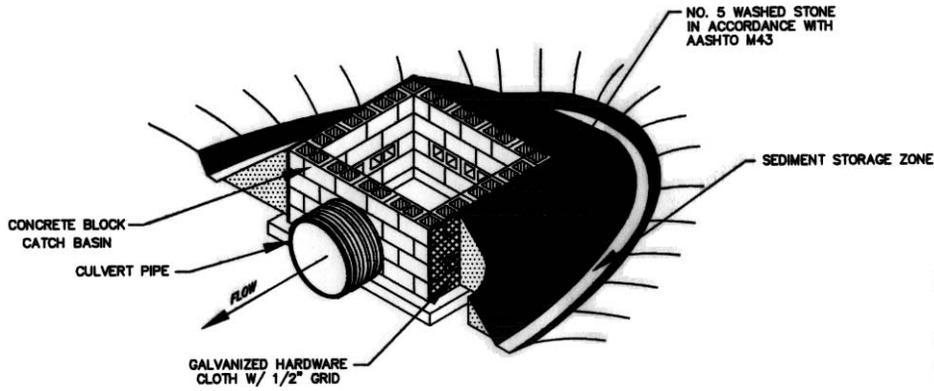
NO SCALE

**NOTE: GRAVEL AND RIPRAP FILTER BERM BASIN DETAIL IS DESIGNED TO PROTECT EXISTING PIPE INVERTS THAT DRAIN 5 ACRES OR LESS. DIMENSIONS ARE MINIMUM ACCEPTABLE UNLESS OTHERWISE NOTED. SEDIMENT STORAGE VOLUME IS 1800 CUBIC FEET PER ACRE.**

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	REVISION	BY

**GRAVEL AND RIPRAP SEDIMENT/FILTER BERM BASIN**

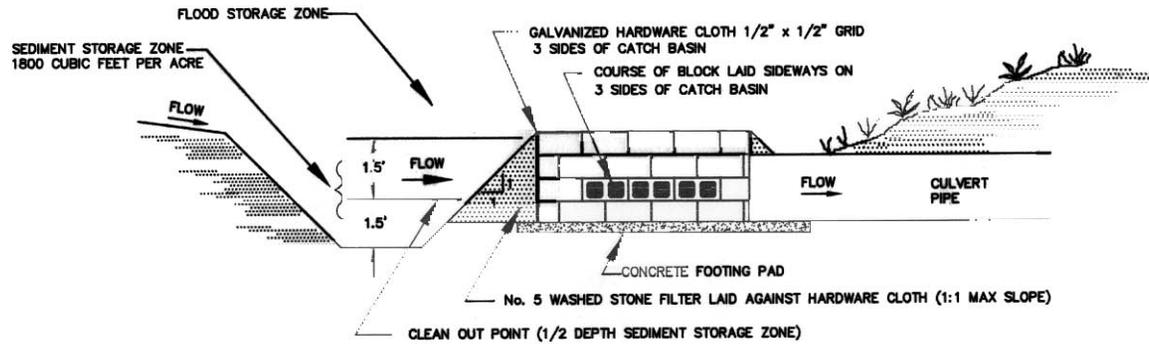
STANDARD  
DETAIL  
4.04



**NOTE:**

WHEN DRAINAGE AREA IS STABILIZED OR AT END OF PROJECT, CATCH BASIN CAN BE RAISED AS NEEDED PLUGGING OPEN COURSE OF BLOCK WITH MORTAR.

PERSPECTIVE VIEW



SECTION VIEW

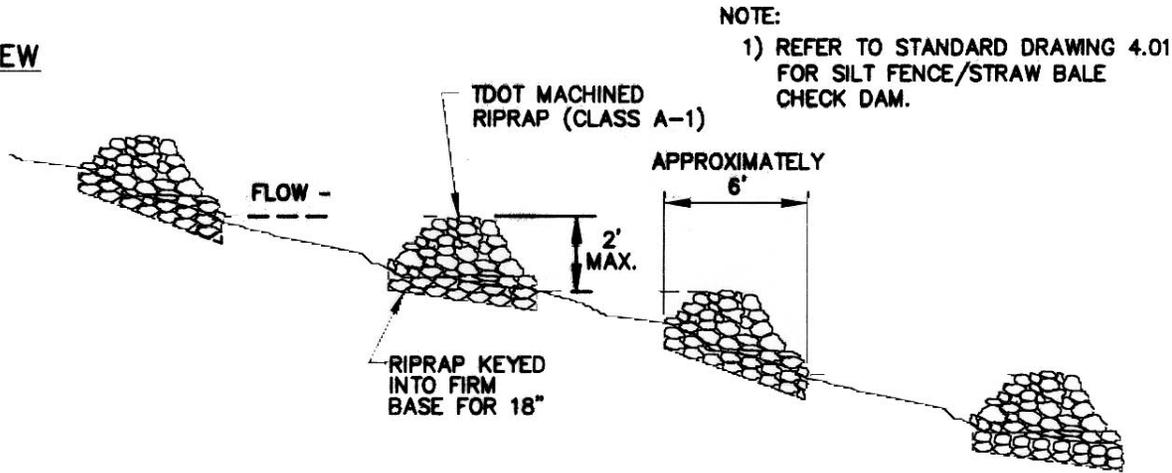
1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

CATCH BASIN SEDIMENT FILTER

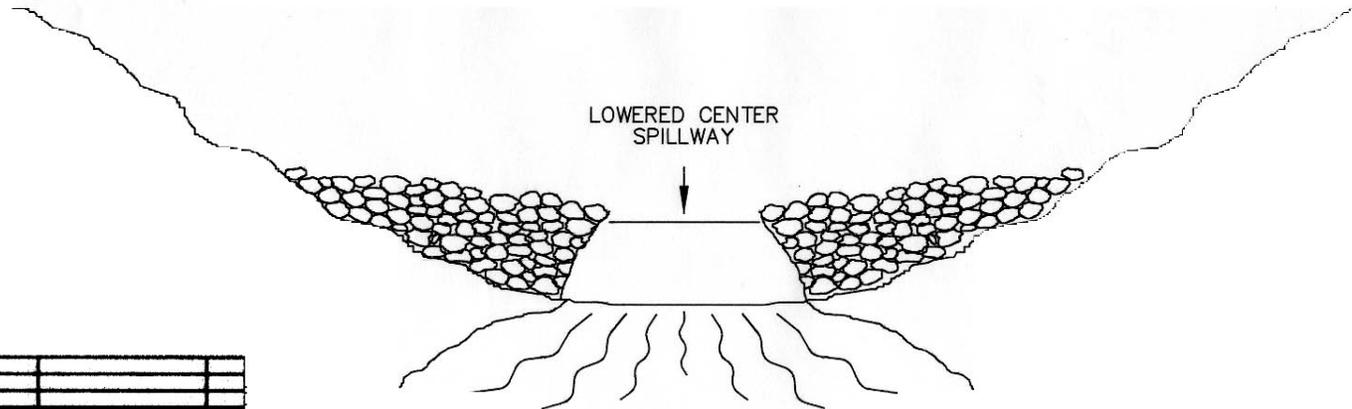
STANDARD  
DETAIL

4.05

**PROFILE VIEW**



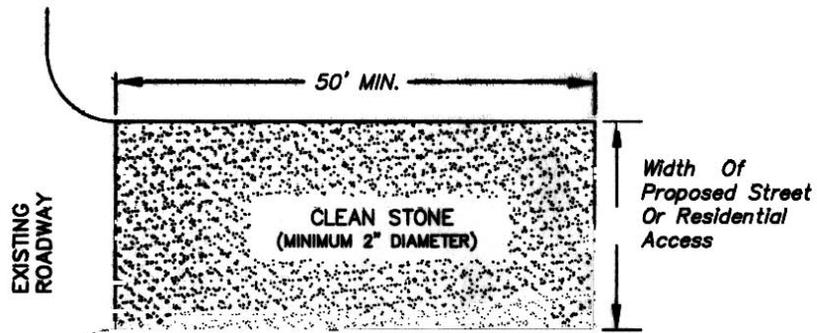
**SECTION VIEW**



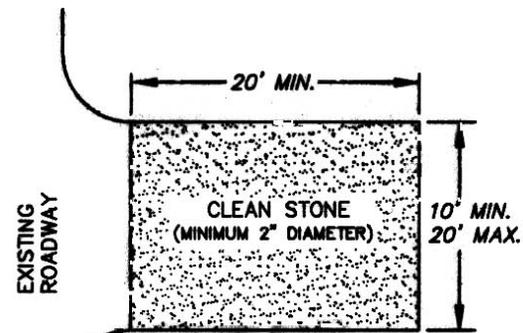
1.	12/4/00	EFFECTIVE DATE	OCB
NO.	DATE	DESCRIPTION	BY

**CHECK DAM**

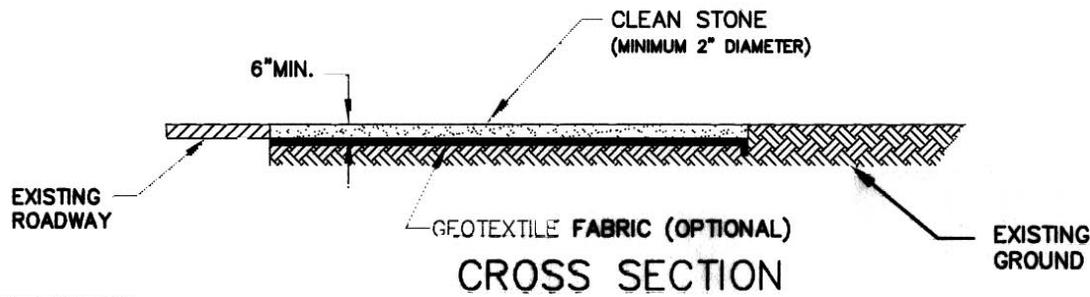
STANDARD  
DETAIL  
**4.06**



COMMERCIAL  
ENTRANCE  
PLAN VIEW



RESIDENTIAL  
ENTRANCE  
PLAN VIEW

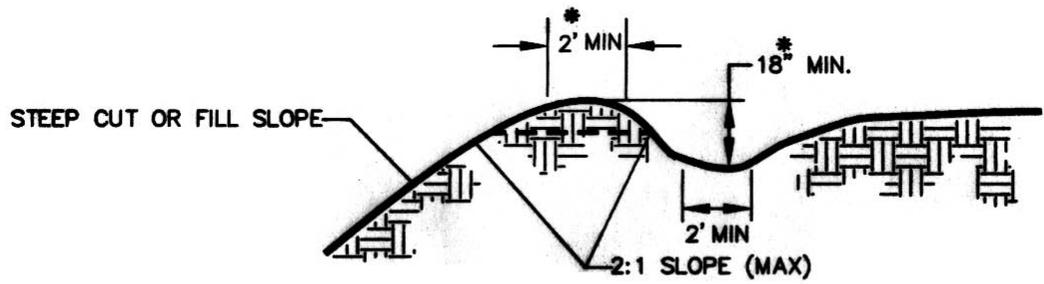


CROSS SECTION

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

TEMPORARY CONSTRUCTION ENTRANCE

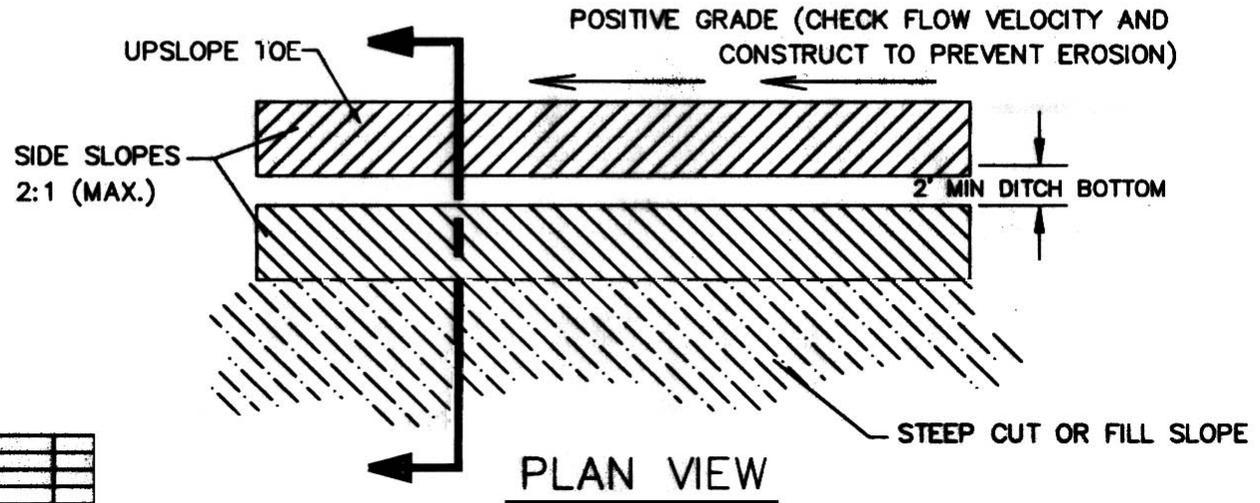
STANDARD  
DETAIL  
4.07



NOTE:

\* DEPTH AND WIDTH OF DITCH/BERM SHALL DEPEND ON RUNOFF QUANTITY AND VELOCITY

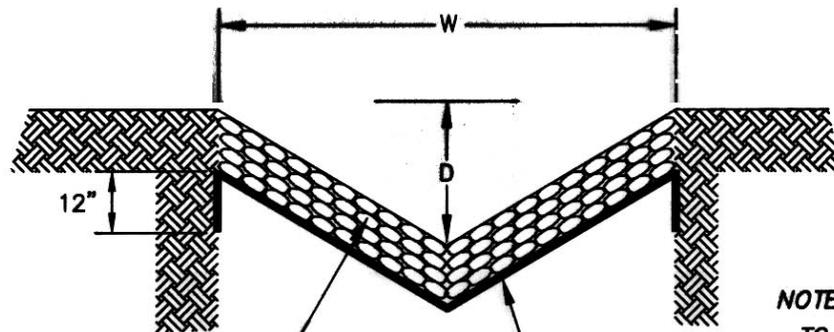
CROSS SECTION



1.	12/4/00	EFFECTIVE DATE	DOB
NO.	DATE	DESCRIPTION	BY

DIVERSION DITCH

STANDARD  
DETAIL  
4.08



RIPRAP STONE SIZE AND DEPTH  
BASED ON DESIGN FLOW AND  
VELOCITY.(MIN. 12" THICKNESS)

GEOTEXTILE \*  
FABRIC

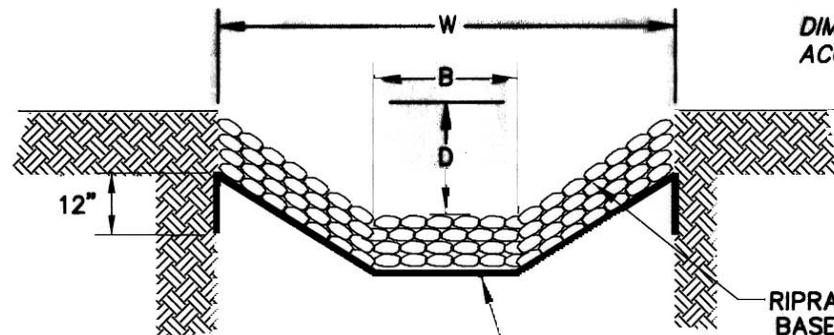
TYPICAL V-BOTTOM DITCH

**NOTE:**

TO BE USED WHERE EXCESSIVE  
STORMWATER VELOCITIES  
PROHIBIT VEGETATIVE LININGS.

SIZE OF STONE MUST BE  
DETERMINED BY APPROPRIATE  
DESIGN PROCEDURE.

DIMENSIONS FOR D, B & W VARY  
ACCORDING TO DESIGN.



12"

GEOTEXTILE \*  
FABRIC

RIPRAP STONE SIZE AND DEPTH  
BASED ON DESIGN FLOW AND  
VELOCITY.(MIN. 12" THICKNESS)

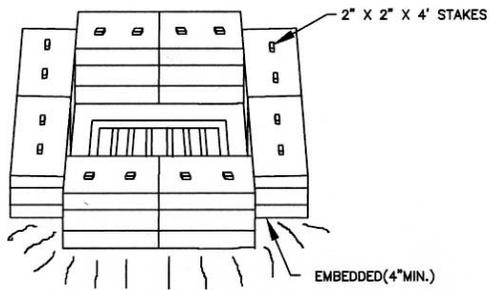
TRAPEZOIDAL DITCH

\*GRAVEL BEDDING (6" THICK) MAY BE  
USED IN LIEU OF GEOTEXTILE FABRIC.

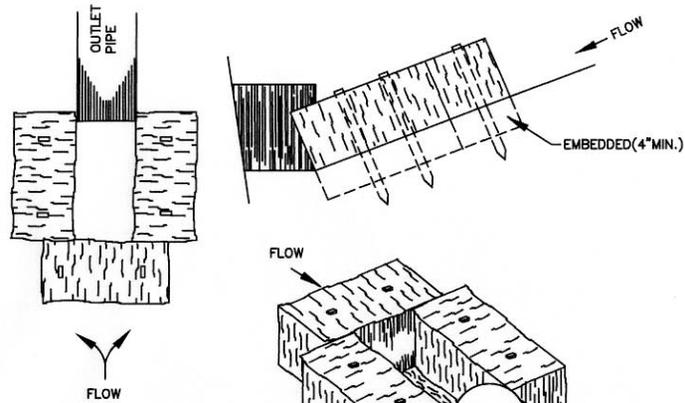
1.	12/4/00	EFFECTIVE DATE	OCB
NO.	DATE	DESCRIPTION	BY

**RIPRAP LINED CHANNELS**

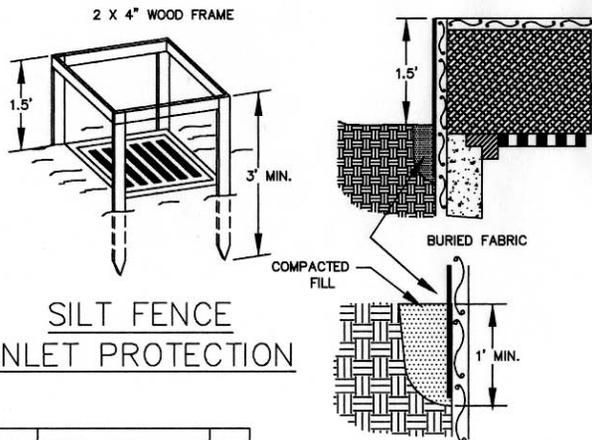
STANDARD  
DETAIL  
4.09



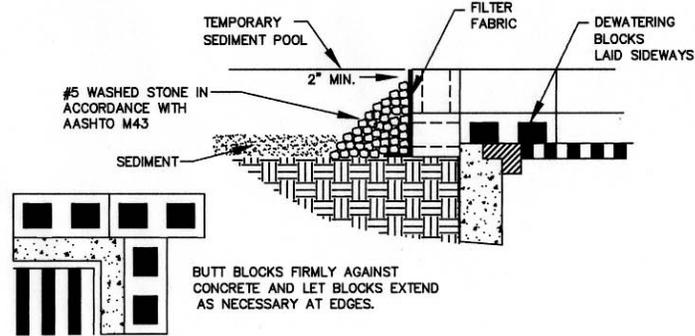
STRAW/HAY BALE  
INLET PROTECTION



STRAW BALE PIPE  
INLET PROTECTION



SILT FENCE  
INLET PROTECTION

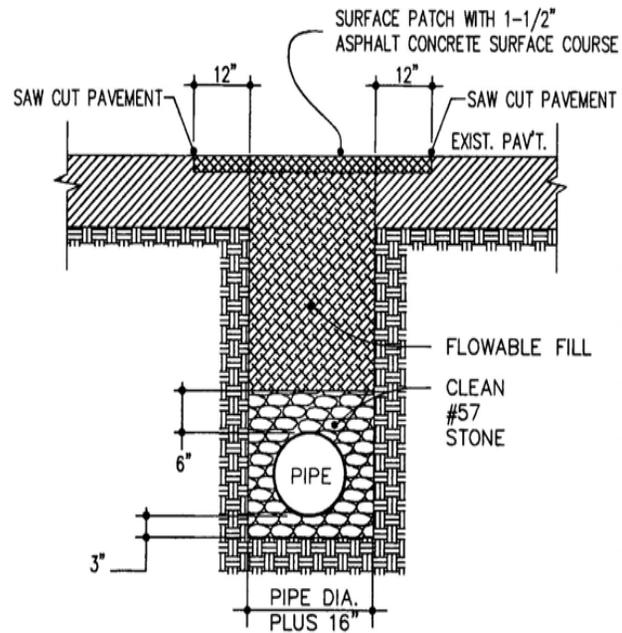


BLOCK AND GRAVEL BLOCK  
DROP INLET PROTECTION

1.	12/4/00	EFFECTIVE DATE	COB
NO.	DATE	DESCRIPTION	BY

INLET PROTECTION METHODS

STANDARD  
DETAIL  
4.10



ASPHALT PAVEMENT

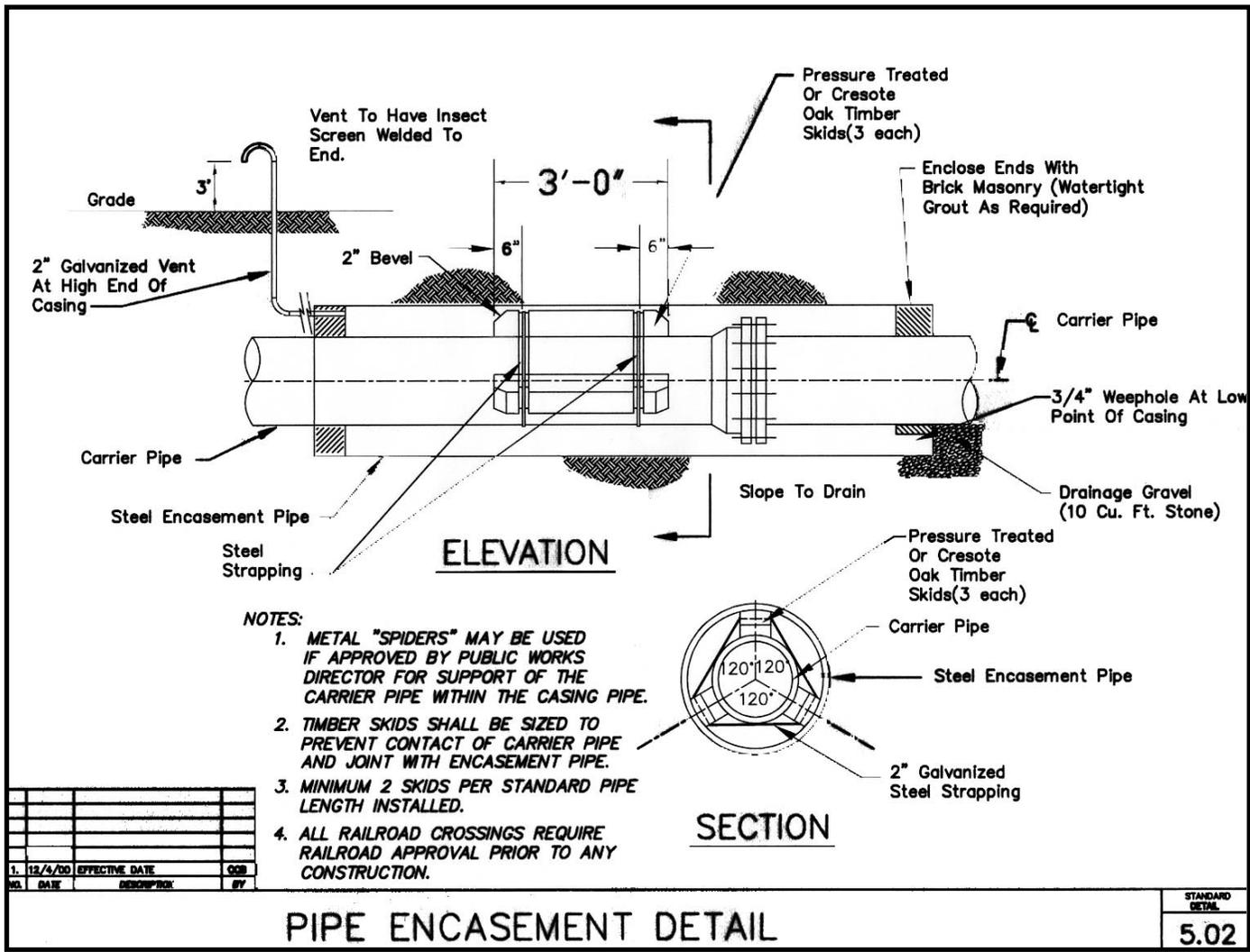
*NOTE TO CONTRACTOR:*

*ALL PAVEMENT CUTS SHALL BE REPAIRED WITHIN A MAXIMUM OF THREE (3) DAYS FROM THE DATE THE CUT IS MADE. IF CONDITIONS DO NOT PERMIT A PERMANENT REPAIR WITHIN THE GIVEN TIME LIMIT, PERMISSION TO MAKE A TEMPORARY REPAIR MUST BE OBTAINED FROM THE PUBLIC WORKS DIRECTOR.*

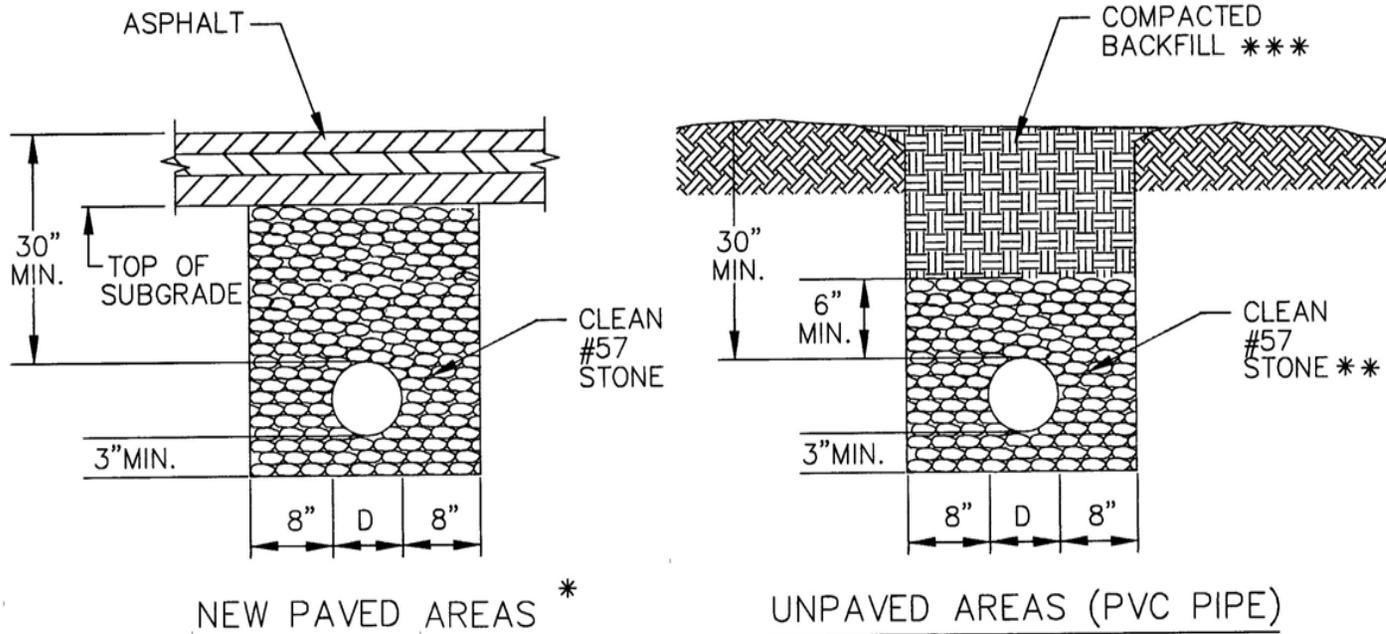
1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

STANDARD TRENCH AND PAVEMENT REPAIR SECTION

STANDARD  
DETAIL  
5.01



\*\*\* ALL WATER LINES WITHIN THREE FEET OF BACK OF CURB MEASURED FROM CENTER LINE OF PIPE SHALL BE BACKFILLED ABOVE EMBEDMENT MATERIAL TO WITHIN ONE FOOT OF FINISHED GROUND ELEVATION WITH NO. 57 STONE.



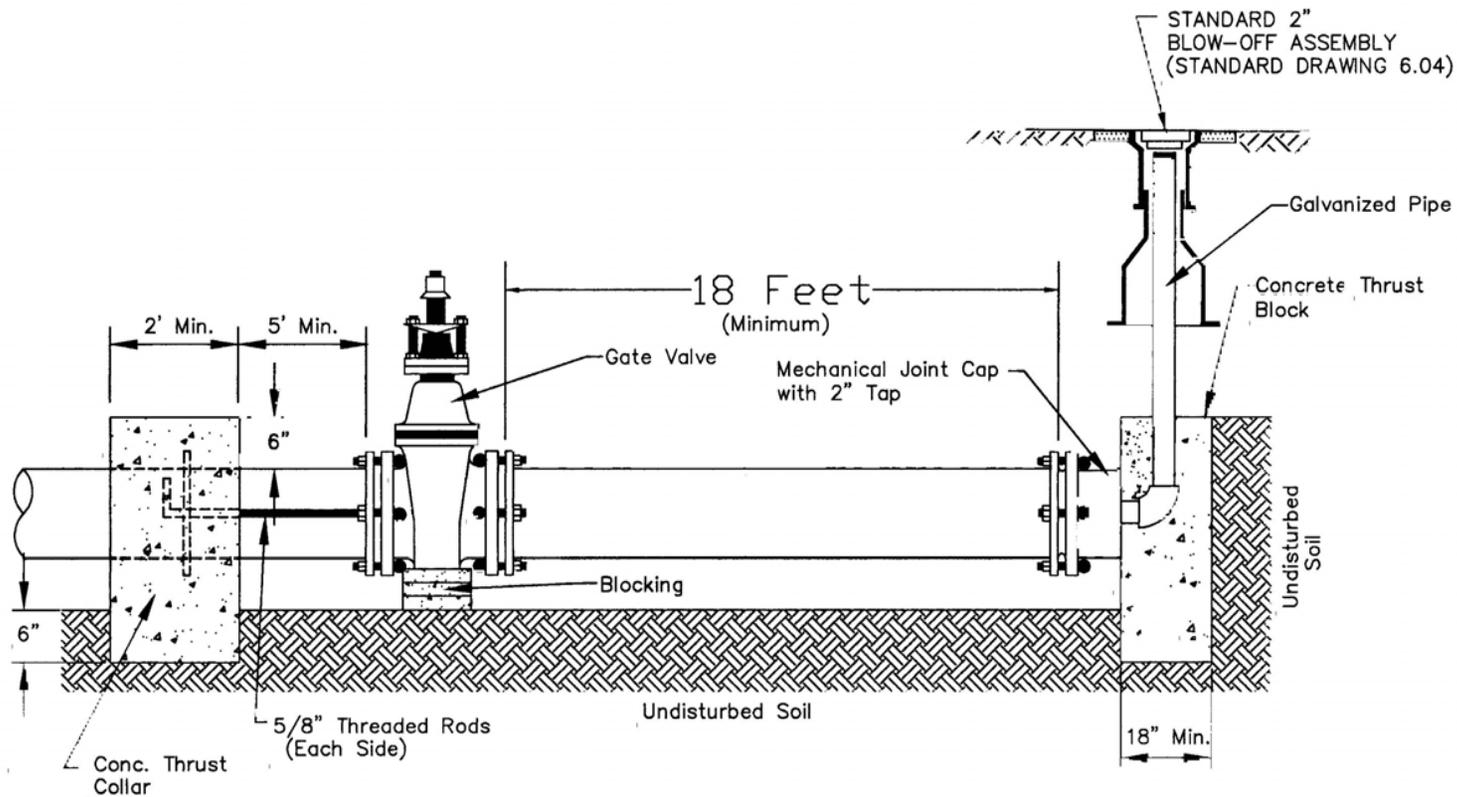
\* SEE STANDARD DRAWING 5.0 FOR INSTALLATION UNDER EXISTING ROADWAYS.

\*\* DUCTILE IRON PIPE MAY OPTIONALLY BE BEDDED WITH CLASS I, II, OR III MATERIALS IN ACCORDANCE WITH ASTM D2321.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

## BACKFILLING & COMPACTION OF WATER LINES

STANDARD  
DETAIL  
6.01

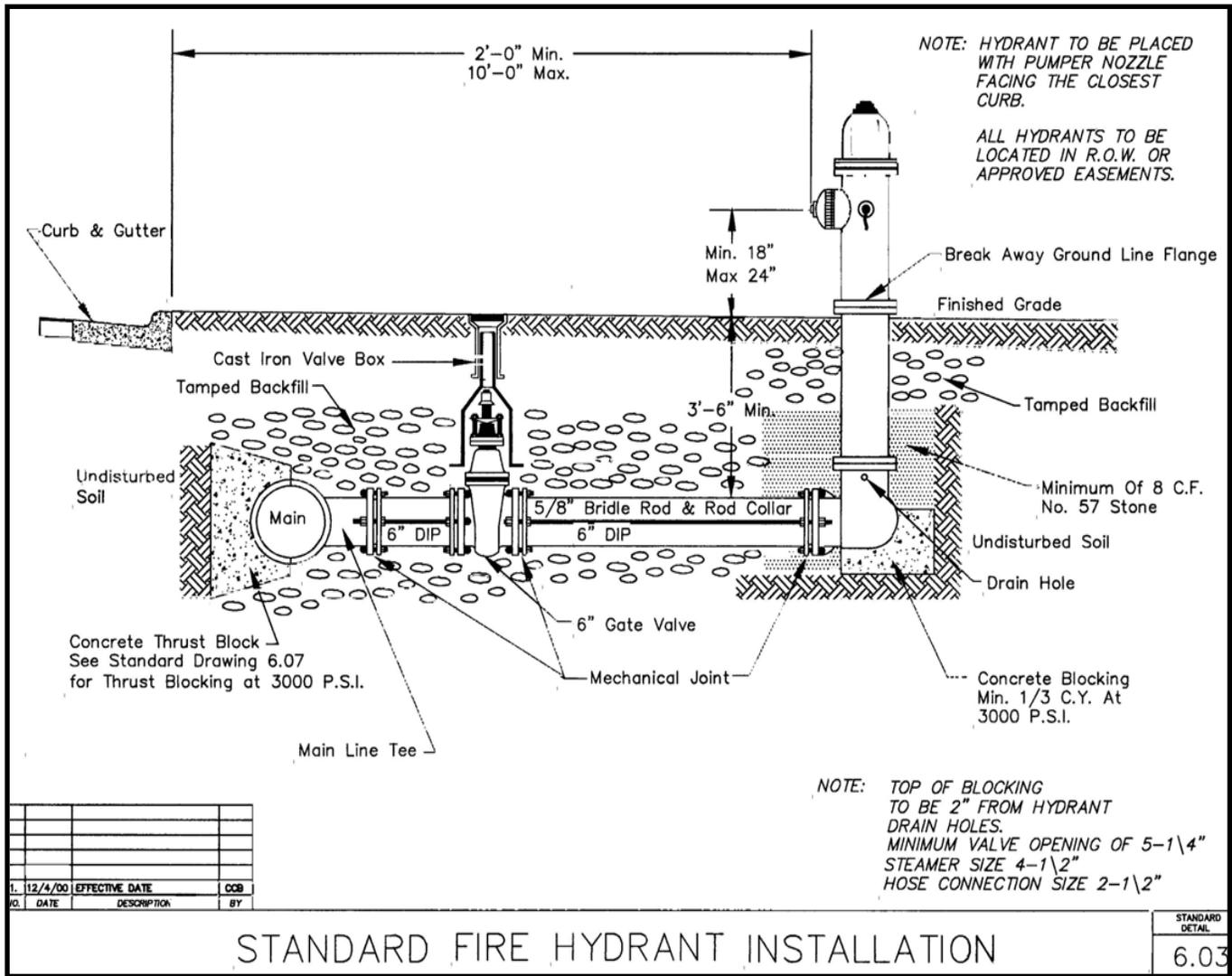


NOTE: THIS DETAIL SHALL APPLY ONLY TO TEMPORARY CAPPING. PERMANENT DEAD END LINES TO BE IN ACCORDANCE W/STANDARD DETAIL NO. 6.04.

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

STANDARD CAPPING AND BLOW-OFF ASSEMBLY DETAIL  
FOR FUTURE EXTENSION

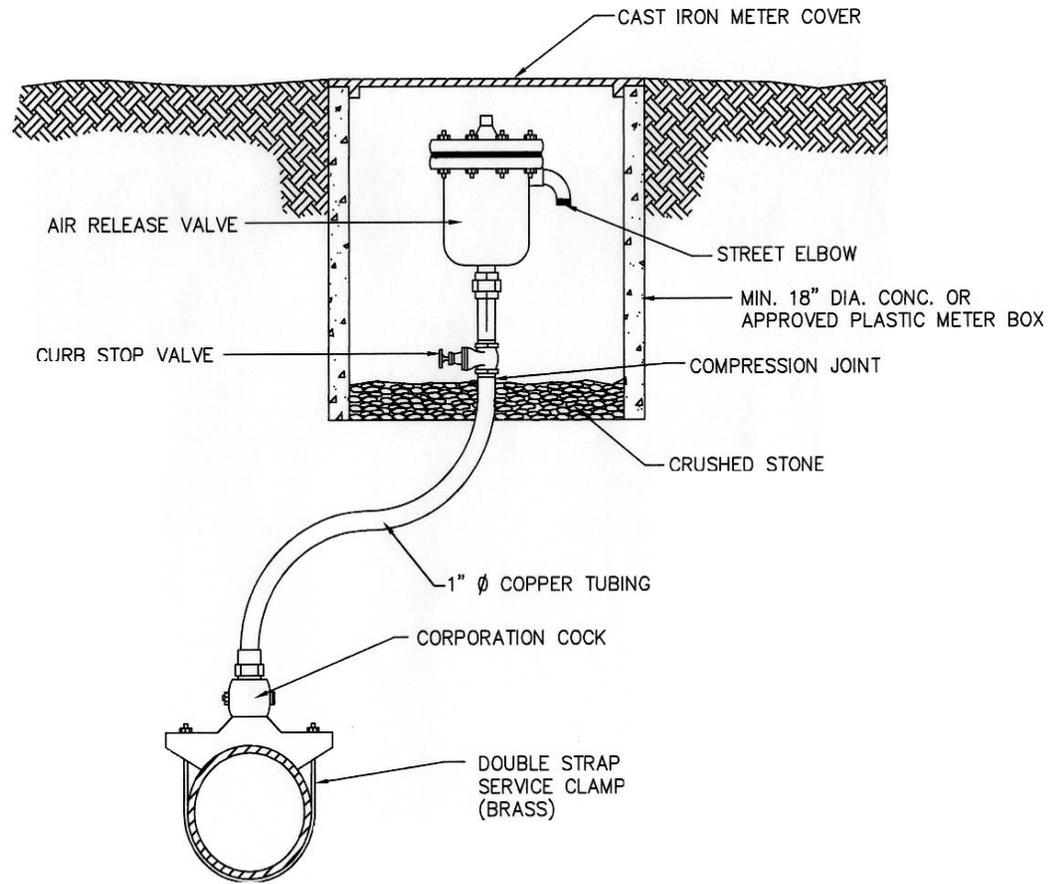
STANDARD  
DETAIL  
6.02



# STANDARD FIRE HYDRANT INSTALLATION

STANDARD  
DETAIL  
6.03

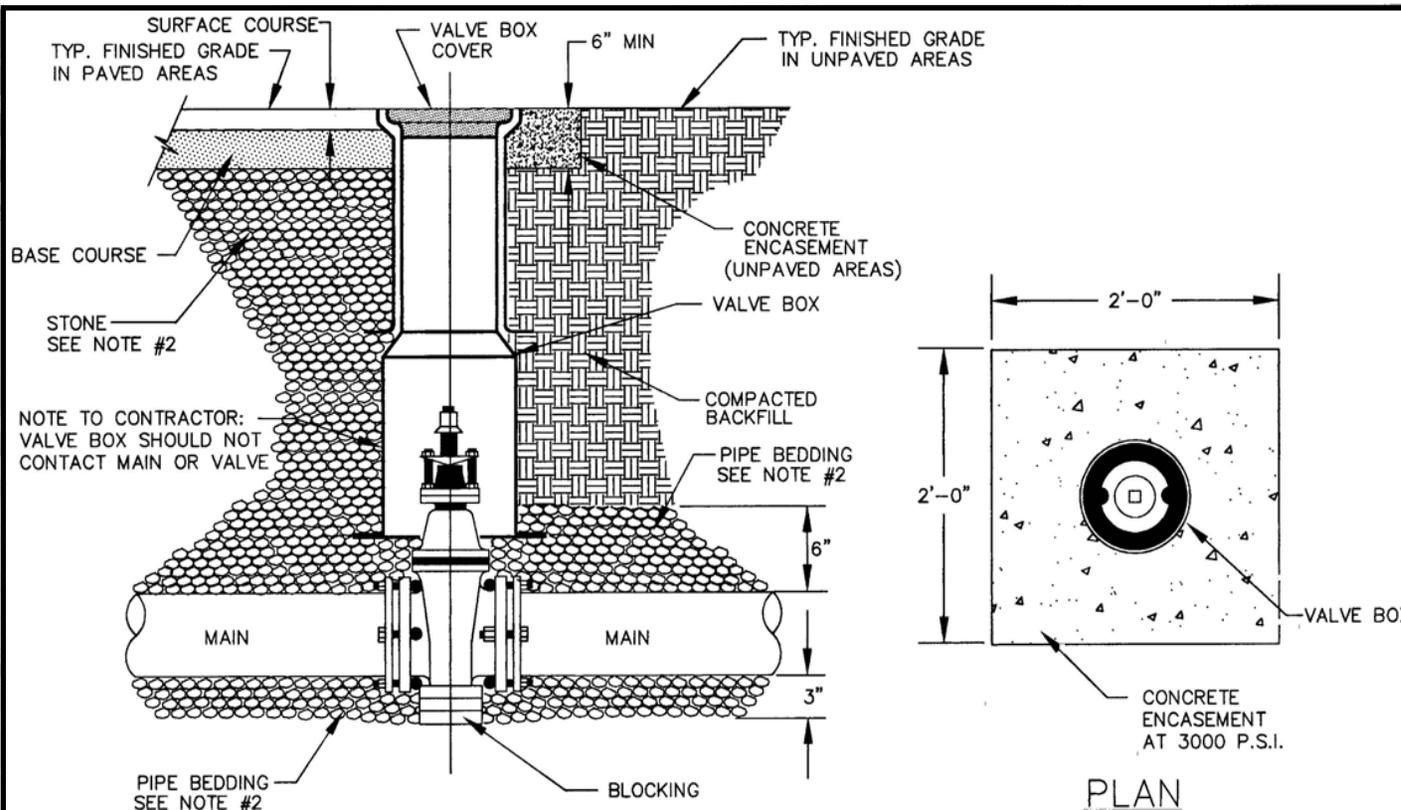




1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	REVISION	BY

# AIR RELEASE VALVE

STANDARD  
DETAIL  
**6.05**



SECTION

PLAN

- NOTE:
1. VALVE OPERATING NUT MUST BE NO MORE THAN FOUR FEET FROM THE SURFACE.
  2. SEE STANDARD 6.01 FOR BEDDING/BACKFILL REQUIREMENTS.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	REVISION	BY

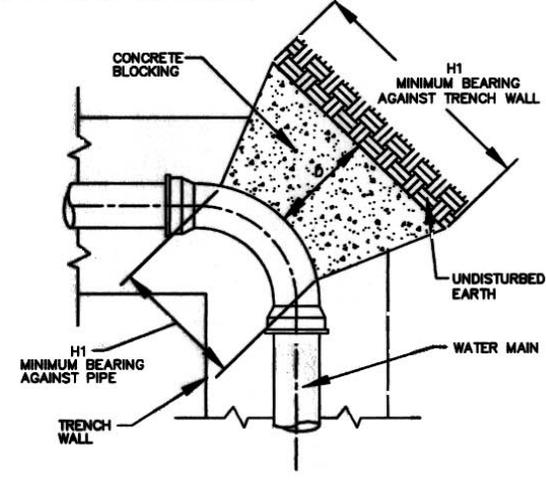
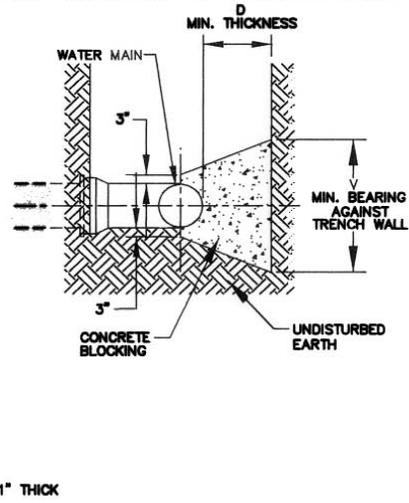
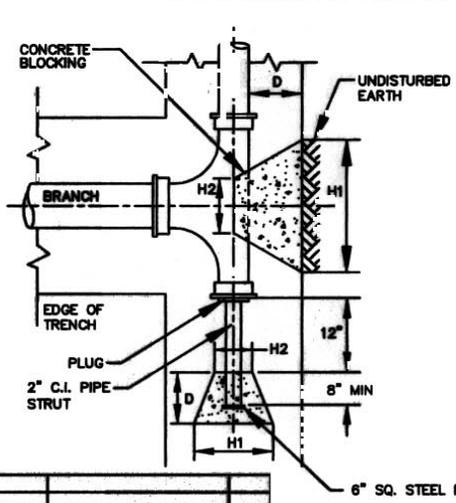
STANDARD VALVE BOX INSTALLATION

STANDARD  
DETAIL  
6.06

TABLE OF DIMENSIONS FOR CONCRETE BLOCKING—HORIZONTAL BENDS

PIPE SIZE	90 DEGREE					45 DEGREE					22 1/2 DEGREE					11 1/4 DEGREE					TEES AND PLUGS				
	H1	H2*	V	D	CU.FT.	H1	H2*	V	D	CU.FT.	H1	H2*	V	D	CU.FT.	H1	H2*	V	D	CU.FT.	H1	H2*	V	D	CU.FT.
3"	18"	10"	12"	8"	0.71	14"	5.5"	9"	8"	0.40	10"	5.5"	7"	8"	0.27	7"	5.5"	5"	8"	0.19	16"	10"	10"	8"	0.58
4"	24"	12"	16"	8"	1.16	18"	7"	12"	8"	0.66	13"	7"	9"	8"	0.43	9"	7"	6"	8"	0.28	21"	12"	14"	8"	0.95
6"	36"	15"	24"	11"	3.31	27"	9"	18"	9"	1.54	19"	9"	13"	8"	0.81	14"	9"	9"	8"	0.53	31"	15"	21"	8"	1.92
8"	48"	16"	32"	16"	8.13	36"	10"	24"	13"	3.76	26"	10"	17"	8"	1.33	18"	10"	12"	8"	0.81	41"	17"	27"	12"	4.66
10"	60"	20"	40"	20"	15.72	45"	12"	30"	16"	7.12	32"	12"	21"	10"	2.48	23"	12"	15"	8"	1.22	51"	20"	41"	16"	11.14
12"	72"	22"	48"	25"	27.83	53"	13"	36"	20"	12.36	38"	13"	26"	13"	4.56	27"	13"	18"	8"	1.63	61"	22"	41"	20"	16.73

BASED ON 1000 PSF SOIL BEARING VALUE AND 150 PSI WATER PRESSURE IN PIPE W/NO SF  
 \* DIMENSIONS FOR STANDARD FITTINGS SHOWN. MODIFY COMPACT FITTINGS  
 ALL CONCRETE TO BE 3000# (28 DAY STRENGTH). NO CONCRETE SHALL COVER BOLTS OR GLANDS.



1.	12/4/00	EFFECTIVE DATE	OCB
NO.	DATE	DESCRIPTION	BY

NOTE: DIMENSIONS ARE CONTROLLED BY DIAMETER OF BRANCH MAIN.

STANDARD REACTION BLOCKING—HORIZONTAL BEND

STANDARD DETAIL  
6.07

**GRAVITY BLOCKING VOLUMES FOR VERTICAL BENDS(CU. FT.)**  
Based on 150 psi pressure and 140 pcf concrete

Pipe Size	45 Deg Bends	22 1/2 Deg Bends	11 1/4 Deg Bends	Area Pipe(Sq. In.)
3"	5.36	2.90	1.48	7.0686
4"	9.52	5.15	2.63	12.5664
6"	21.42	11.59	5.91	28.2743
8"	38.08	20.61	10.51	50.2655
10"	59.50	32.20	16.42	78.5398
12"	85.68	46.37	23.64	113.0973

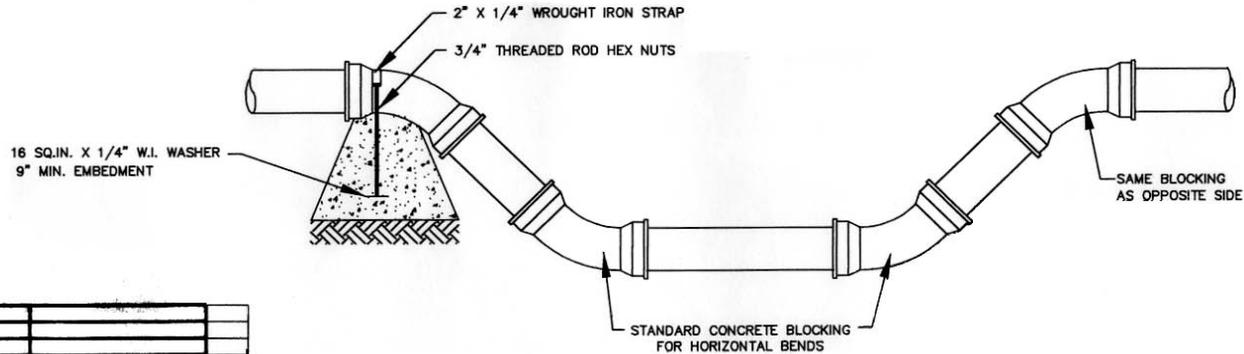
**MINIMUM AREA(Sq. Ft.) REQ'D. TO RESIST HORIZONTAL THRUST @ VERTICAL BENDS**  
Based on 1000 pcf Soil Bearing Value & 150 psi Water Pressure

Pipe Size	45 Deg Bends	22 1/2 Deg Bends	11 1/4 Deg Bends
3"	0.31	0.08	0.02
4"	0.55	0.14	0.04
6"	1.24	0.32	0.08
8"	2.21	0.57	0.14
10"	3.45	0.90	0.23
12"	4.97	1.29	0.33

**HORIZONTAL THRUST IN POUNDS FOR 150 PSI WATER PRESSURE @ VERTICAL BENDS**

Provide adequate bearing area to resist Horizontal Thrust

Pipe Size	45 Deg Bends	22 1/2 Deg Bends	11 1/4 Deg Bends	Area Pipe(Sq. In.)
3"	311	81	20	7.0686
4"	552	143	36	12.5664
6"	1242	323	81	28.2743
8"	2208	574	145	50.2655
10"	3451	897	226	78.5398
12"	4969	1291	326	113.0973



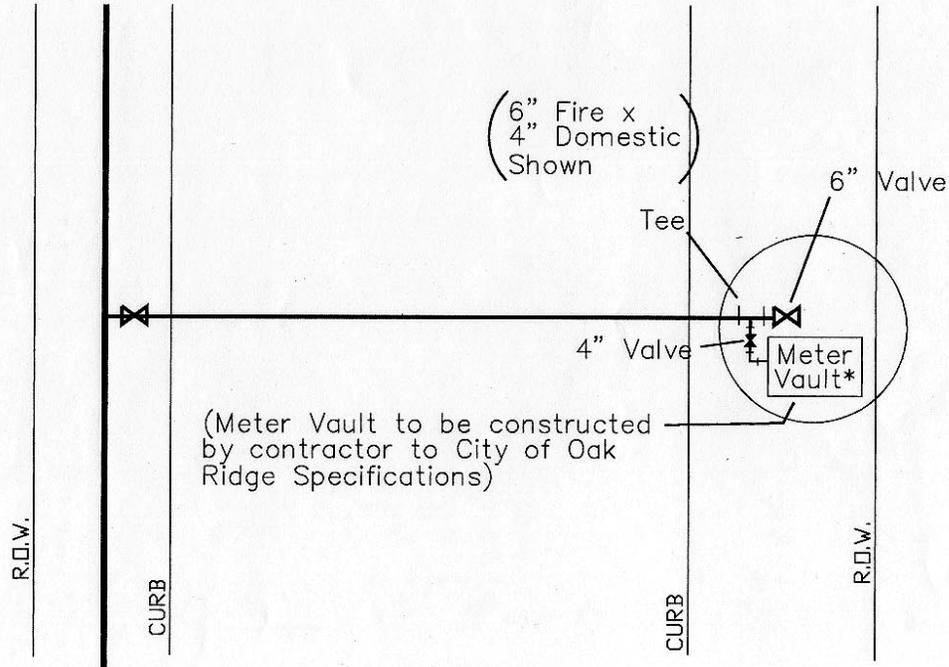
NO.	DATE	DESCRIPTION	BY
1.	12/4/89	EFFECTIVE DATE	CHB

**STANDARD REACTION BLOCKING—VERTICAL BEND**

STANDARD  
DETAIL  
**6.07A**



For providing valves and connections  
for both fire line and domestic meter



\*SEE METER VAULT DETAIL—STANDARD DETAIL 6.10

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

COMMERCIAL WATER LATERAL LAYOUT/METER VAULT

STANDARD  
DETAIL

6.09

SIZE	2"	3"	4"	6"	8"
Min. Size Access Dia.	24"	24"	24"	30"	36"
Min. Size Access Rec.	14"X22"	14"X22"	14"X22"	20"X22"	24"X32"
A	86"	88"	91"	114"	120"
B	68"	68"	72"	78"	78"
C	36"	39"	41-1/2"	45-1/2"	34-1/2"
D	-	-	-	-	-
E	4-1/2"	8"	9"	10-1/2"	11-1/2"
F	2-1/4"	4"	5"	6"	7-1/2"
G (OPEN)	14-1/2"	22-1/16"	25"	32-3/4"	41-1/2"
H	17-11/16"	20"	24"	30"	30"
J	42-7/8"	62"	73"	90"	96-1/2"
K	8-3/16"	10-1/2"	12-3/4"	17"	20-1/4"
# L (STRAINER)	8-1/2"	8-1/2"	9"	9"	-

"D" DIMENSIONS

2" METER

ROCKWELL	15-1/2"
BADGER	17"
NEPTUNE	17"
HERSEY	17"

3" METER

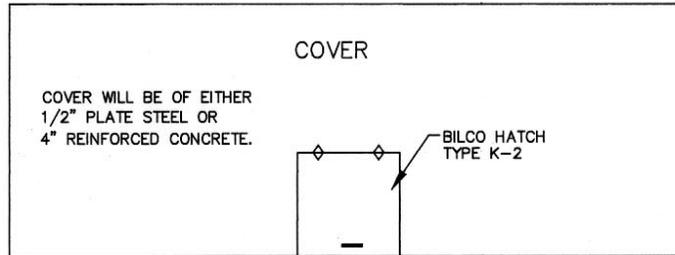
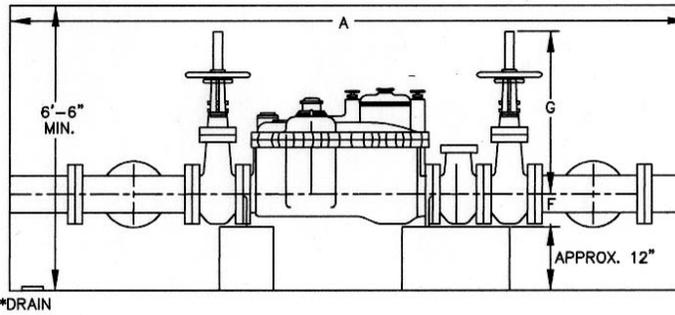
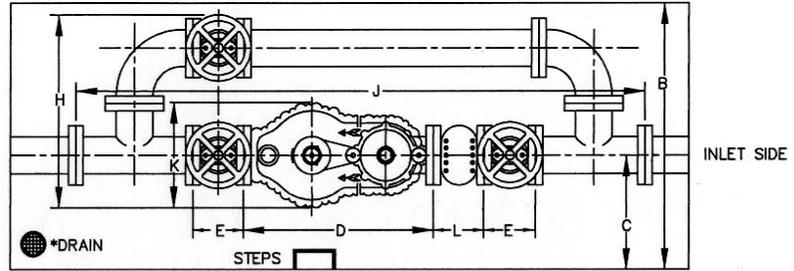
ROCKWELL	17"
BADGER	17"
NEPTUNE	17"
HERSEY	24"

4" METER

ROCKWELL	20"
BADGER	24"
NEPTUNE	20"
HERSEY	29"

6" METER

ROCKWELL	24"
----------	-----



\*THE METER PIT MUST BE DESIGNED AND INSTALLED TO BE FREE FROM STANDING WATER. EITHER A PIPED GRAVITY FLOW DRAIN OR AN ELECTRIC SUMP PUMP MUST BE PROVIDED.

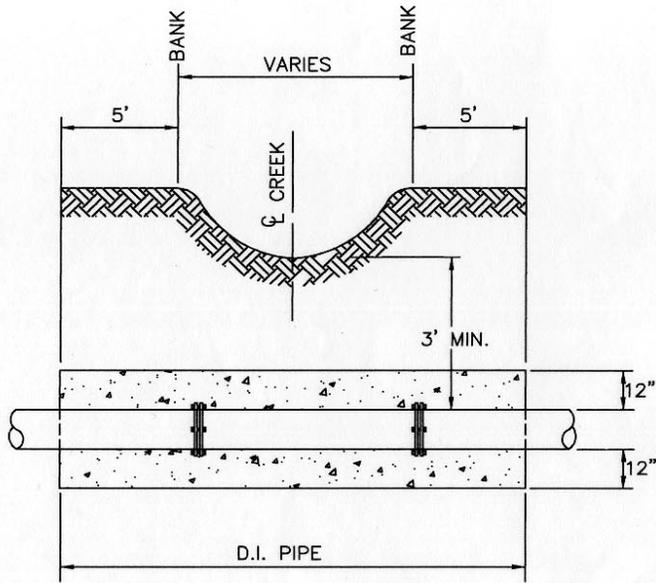
#VERIFY STRAINER LENGTHS PRIOR TO ACTUAL PLUMBING INSTALLATION.

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

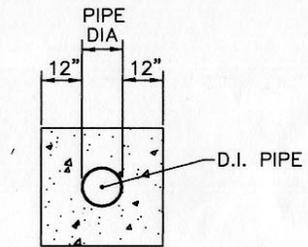
# METER VAULT

STANDARD  
DETAIL

6.10



CROSS SECTION



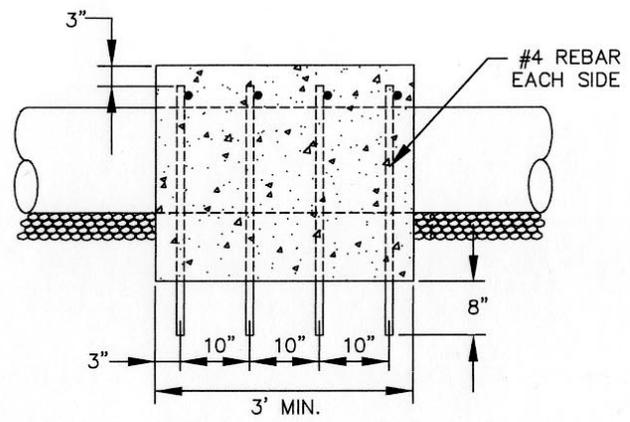
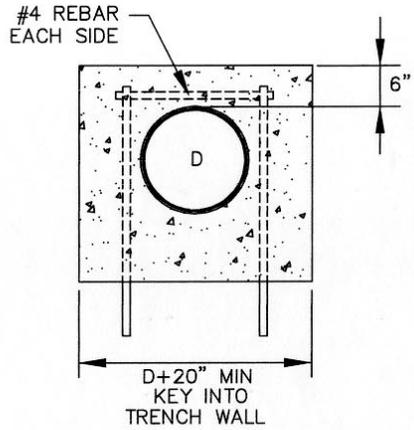
END VIEW

NOTE:  
CONCRETE SHALL BE 3,000 P.S.I.

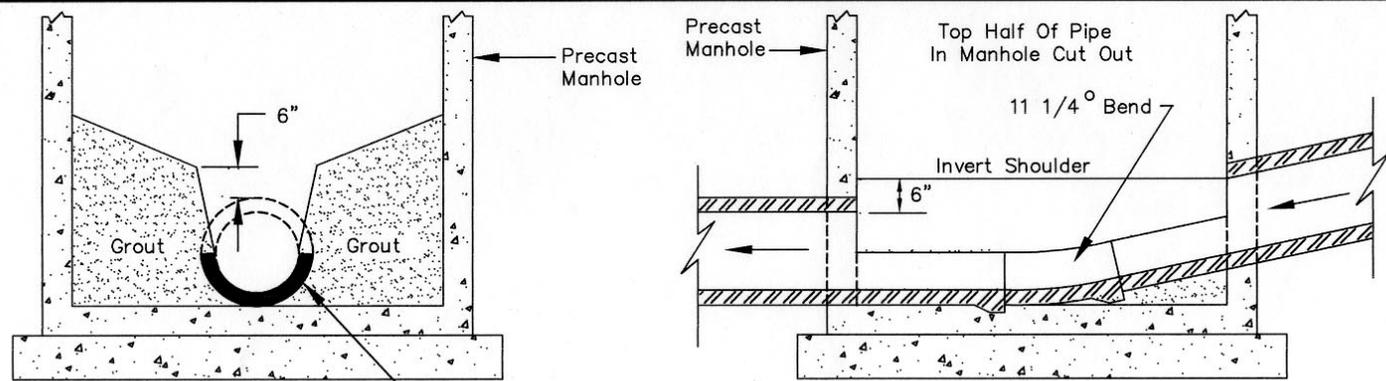
1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

STANDARD CONCRETE ENCASEMENT FOR STREAM CROSSING

STANDARD  
DETAIL  
7.01



DETAIL-CONCRETE ANCHORS



Half-Round Thru Manhole

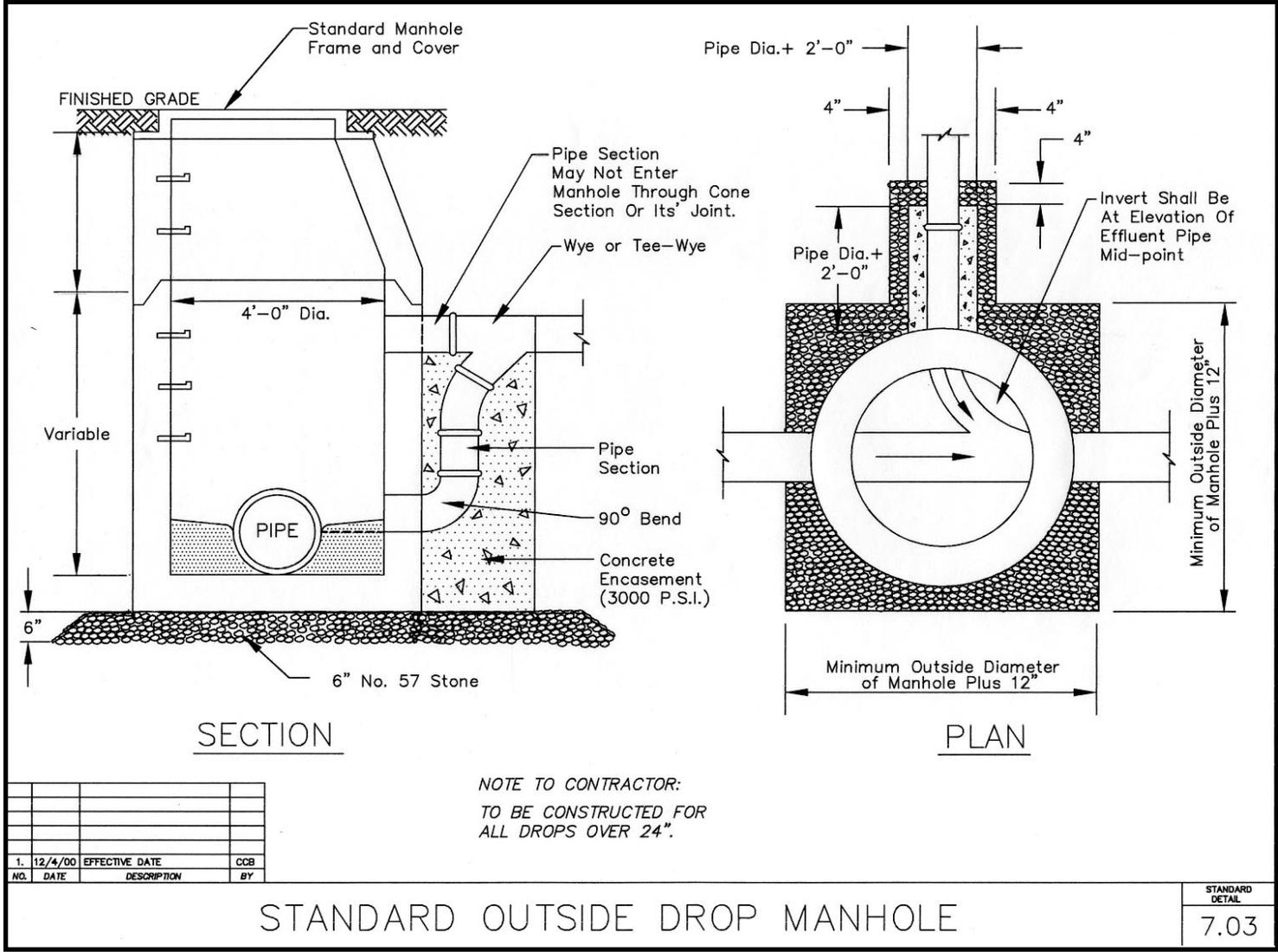
NOTE: 1) NO HORIZONTAL ALIGNMENT CHANGE CAN BE MADE WITHIN THIS MANHOLE TYPE. USE ON GRADES 18% OR GREATER.  
 2) CONSTRUCT ANCHORS BELOW BELL WHEN POSSIBLE.

HIGH VELOCITY MANHOLE

STANDARD HIGH VELOCITY MANHOLE INVERT AND CONCRETE ANCHORING

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

STANDARD  
DETAIL  
7.02



SECTION

PLAN

NOTE TO CONTRACTOR:  
TO BE CONSTRUCTED FOR  
ALL DROPS OVER 24".

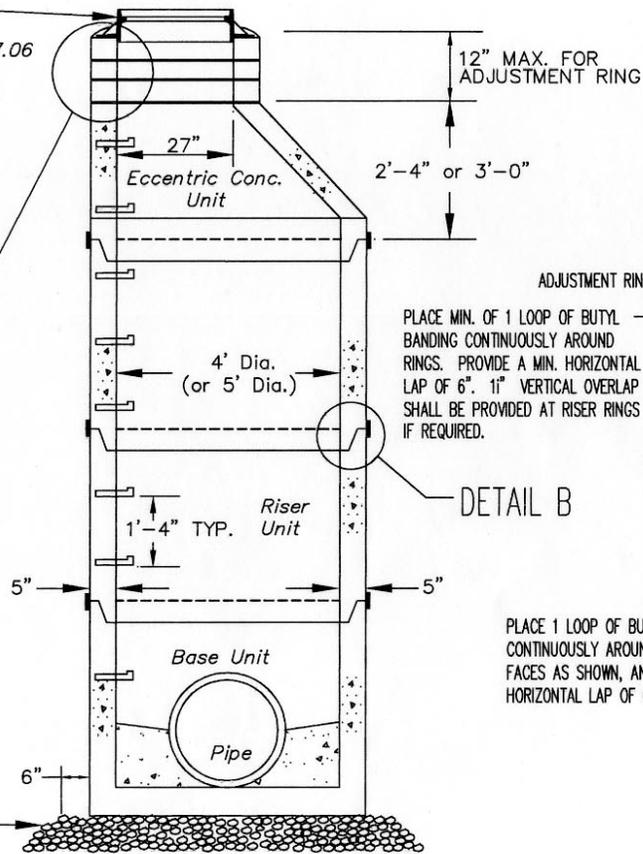
1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

STANDARD OUTSIDE DROP MANHOLE

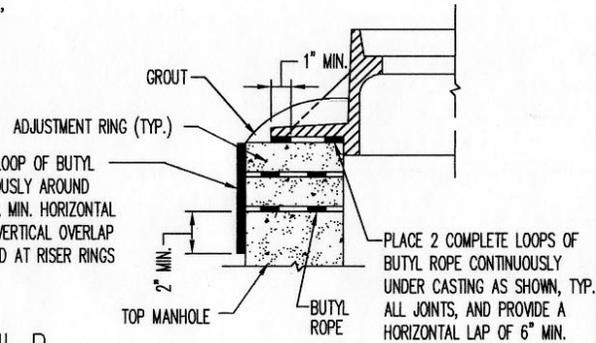
STANDARD  
DETAIL  
7.03

Standard Manhole  
Ring and Cover  
Standard No. 7.05 or 7.06

DETAIL A

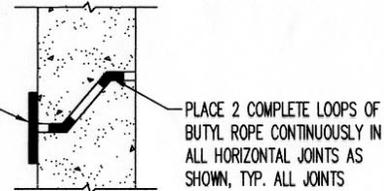


DETAIL B



DETAIL A

PLACE 1 LOOP OF BUTYL BANDING CONTINUOUSLY AROUND ALL HORIZ. FACES AS SHOWN, AND PROVIDE A HORIZONTAL LAP OF 6\"/>



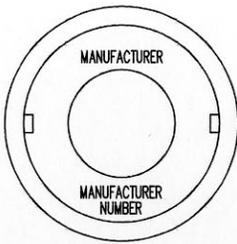
DETAIL B

BUTYL ROPE MATERIAL SHALL HAVE A NOMINAL CROSS SECTION DIMENSION OF ONE INCH FOR 4 FT. DIA. MANHOLES AND ONE AND ONE HALF INCHES FOR 5 FT. AND 6 FT. DIA. MANHOLES.

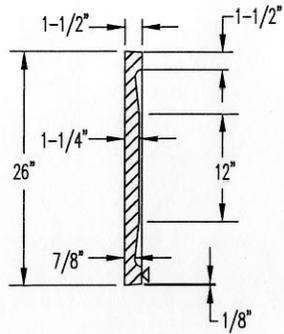
NO.	DATE	DESCRIPTION	CCB BY
1.	12/4/00	EFFECTIVE DATE	CCB
			BY

STANDARD PRECAST CONCRETE MANHOLE

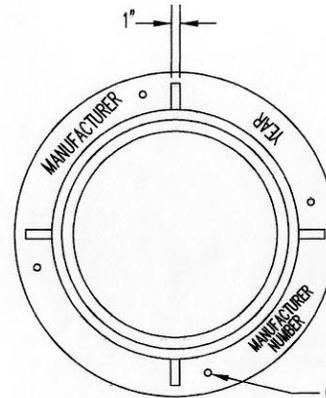
STANDARD  
DETAIL  
7.04



COVER BACK

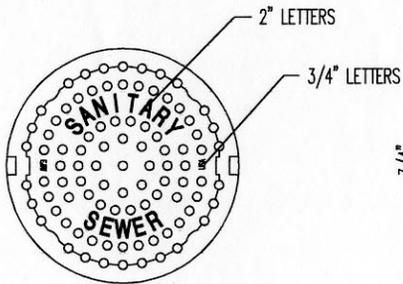


COVER SECTION



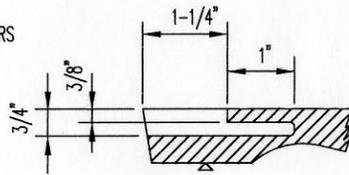
FRAME TOP VIEW

(4) 1" HOLES  
EQUALLY SPACED ON  
32-1/2" DIA.  
BOLT CIRCLE



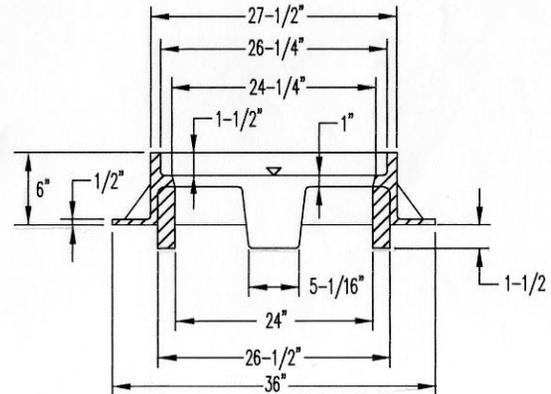
COVER FACE

▽ MACHINED BEARING SURFACE



(2) TYPE TWO NON-PENETRATING PICKHOLES

PICKHOLE DETAIL



FRAME SECTION

ESTIMATE WEIGHT

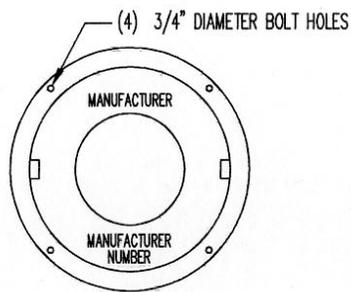
COVER 165 LBS  
FRAME 250 LBS  
TOTAL 415 LBS

NO.	DATE	EFFECTIVE DATE	DESCRIPTION	BY
1.	12/4/00			CCB

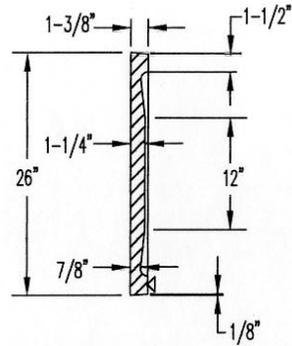
MANHOLE FRAME & COVER

STANDARD  
DETAIL

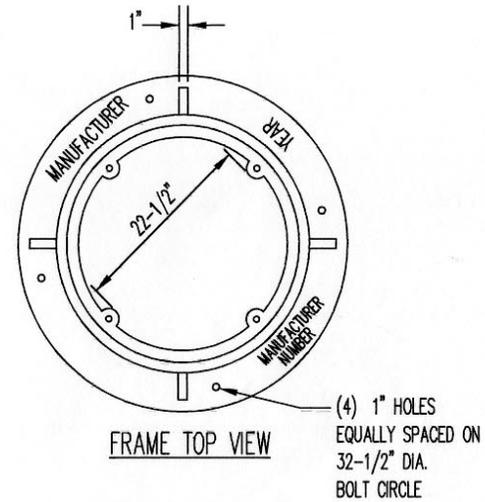
7.05



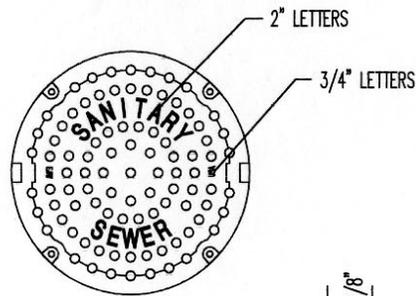
COVER BACK



COVER SECTION

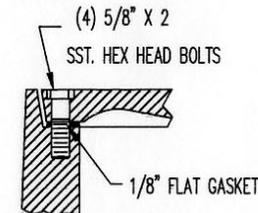


FRAME TOP VIEW

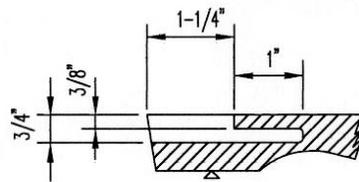


COVER FACE

▽ MACHINED BEARING SURFACE



WATERTIGHT DETAIL

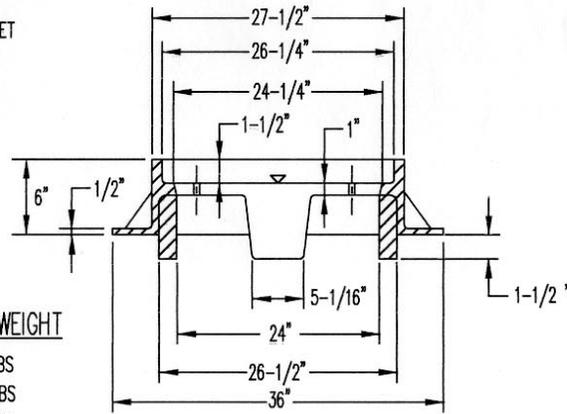


(2) TYPE TWO NON-PENETRATING PICKHOLES

PICKHOLE DETAIL

ESTIMATE WEIGHT

COVER 165 LBS  
 FRAME 250 LBS  
 TOTAL 415 LBS



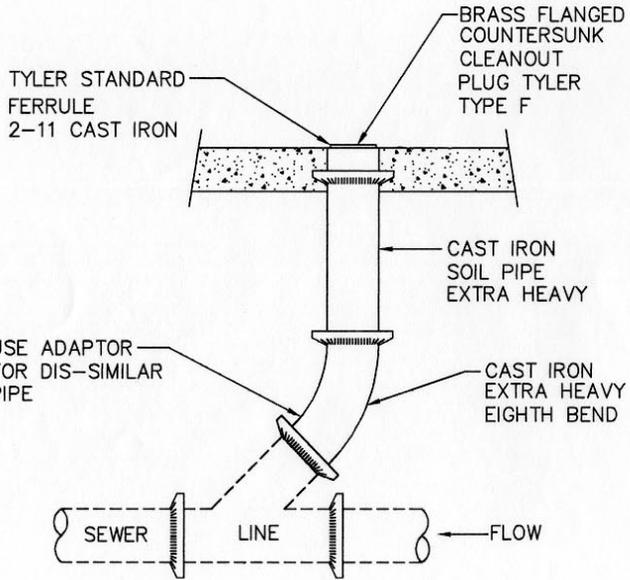
FRAME SECTION

NO.	DATE	EFFECTIVE DATE	DESCRIPTION	BY
1.	12/4/00			CCB

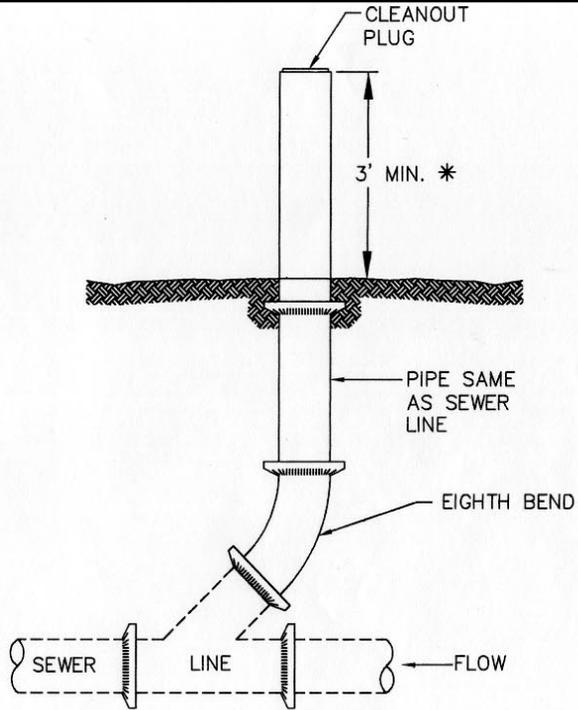
WATERTIGHT MANHOLE FRAME & COVER

STANDARD  
 DETAIL

7.06



TRAFFIC AREA



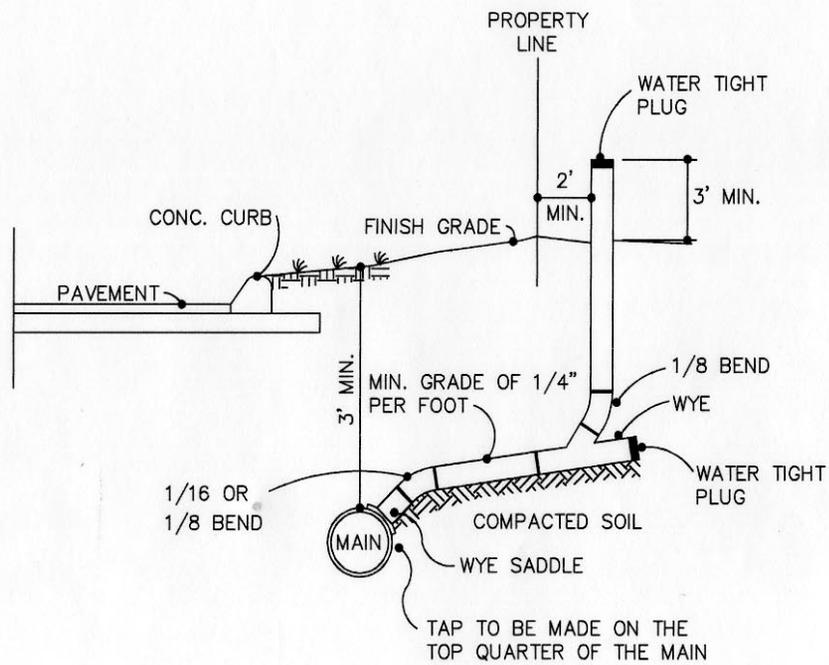
NON-TRAFFIC AREA

\* CLEANOUT SHALL EXTEND 3' ABOVE FINISHED GRADE TO MARK SEWER SERVICE CONNECTIONS UNTIL BUILDING CONNECTION IS MADE.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

EXTERIOR CLEANOUT

STANDARD  
DETAIL  
7.07



NOTE: MINIMUM SDR 35 PIPE FOR SANITARY SEWER SERVICES TO 14' DEPTH. SANITARY SEWER SERVICES WHICH ARE OVER 14' DEEP SHALL REQUIRE WATER LINE QUALITY PIPE.

1.	12/4/00	EFFECTIVE DATE	COB
NO.	DATE	DESCRIPTION	BY

# STANDARD SANITARY SEWER TAP AND SERVICE

STANDARD  
DETAIL  
7.08

MINIMUM TEST TIMES AND ALLOWABLE AIR LOSS VALUES  
FOR VARIOUS PIPE SIZES PER 100 FEET OF PIPE

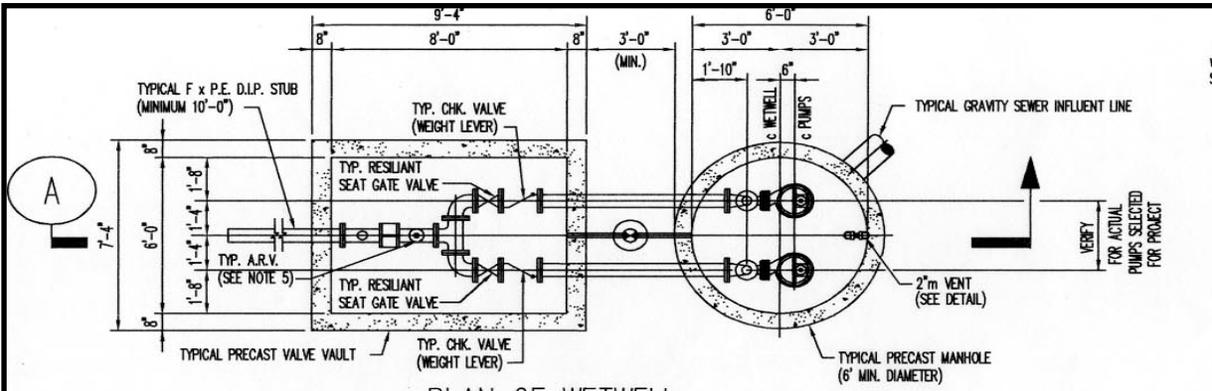
PIPE DIAMETER INCHES	TIME, T (SEC/100 FT)	ALLOWABLE AIR LOSS, Q (FT <sup>3</sup> /MIN)
6	42	2.0
8	72	2.0
10	90	2.5
12	108	3.0
15	126	4.0
18	144	5.0
21	180	5.5
24	216	6.0
27	252	6.5
30	288	7.0

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

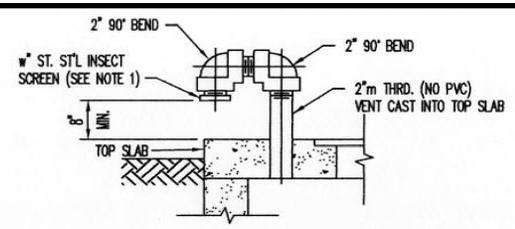
STANDARD AIR TEST TABLE

STANDARD  
DETAIL

7.09

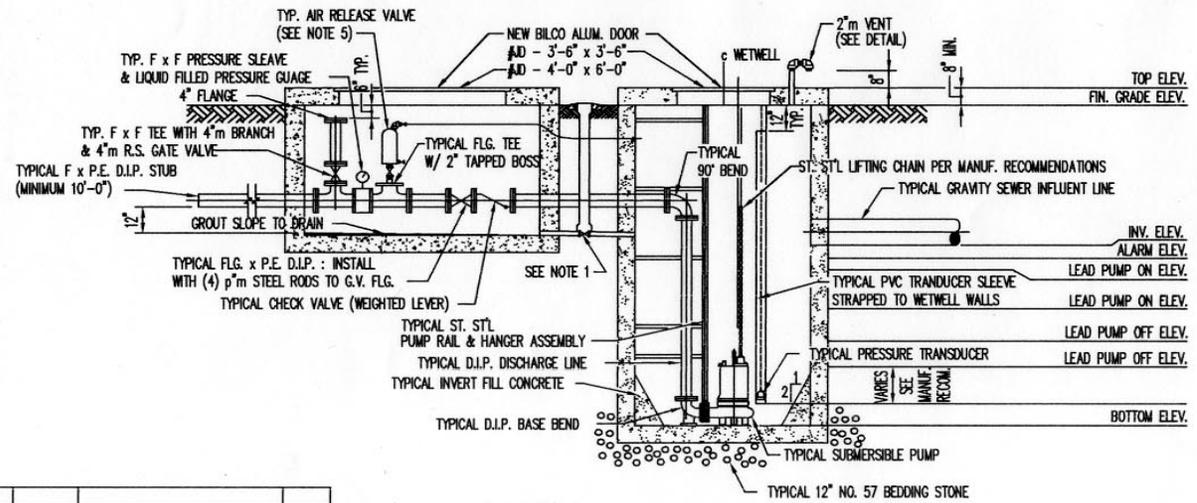


PLAN OF WETWELL  
NO SCALE



- VENT NOTES:
1. INSTALL  $\frac{1}{2}$ " INSECT SCREEN OVER A SHORT NIPPLE WITH ONE ST. STL. BAND CLAMP.
  2. MATERIAL ABOVE EMBEDDED STUB TO BE PAINTED SCH. 80 PVC OR GALVANIZED DRAIN PIPE.

TYPICAL VENT DETAIL  
NO SCALE



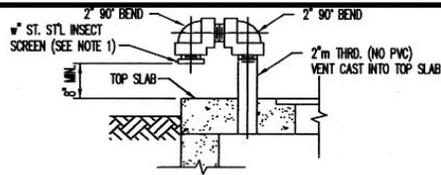
SECTION A  
NO SCALE

- NOTES:
1. INSTALL 2" PVC DRAIN BETWEEN WETWELL AND VALVE VAULT WITH 2" BRASS VALVE & C.I. VALVE BOX. SLOPE DRAIN 1" PER FOOT.
  2. VERIFY PIPE PENETRATIONS AND ALL OTHER DIMENSIONS WITH PUMP MANUFACTURER.
  3. PIPING TO INCLUDE A.R.V.'S AND PRESSURE GAUGES (WITH DIMENSIONS IN FEET OF HEAD) FOR EACH PUMP.
  4. PRESSURE GAUGE & PRESSURE SLEEVE TO BE OIL FILLED ASSEMBLY BY "RED VALVE".
  5. A.R.V. TO BE 2" APCO MODEL 400S ARV & 2" ISOLATION VALVE, FULL ACCESSORY PACKAGE. PIPE AIR & BLOW-OFF DISCHARGE TO WETWELL.
  6. ELECTRICAL CONTROL PANEL LOCATION TO BE DETERMINED BY THE OWNER.
  7. ALL MOUNTING HARDWARE TO BE STAINLESS STEEL, NO EXCEPTIONS.
  8. THE DEVELOPER OR THEIR CONTRACTOR SHALL CONTACT THE CITY OF OAK RIDGE ELECTRIC DEPARTMENT TO DETERMINE THE SERVICE REQUIREMENTS FOR THE PUMP STATION.

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

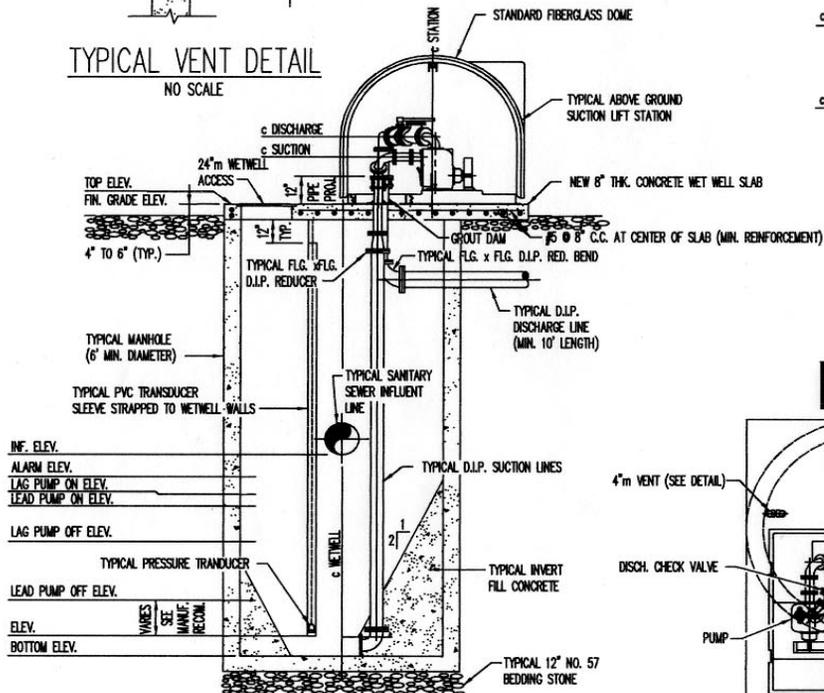
# TYPICAL SUBMERSIBLE PUMP STATION

STANDARD  
DETAIL  
7.10

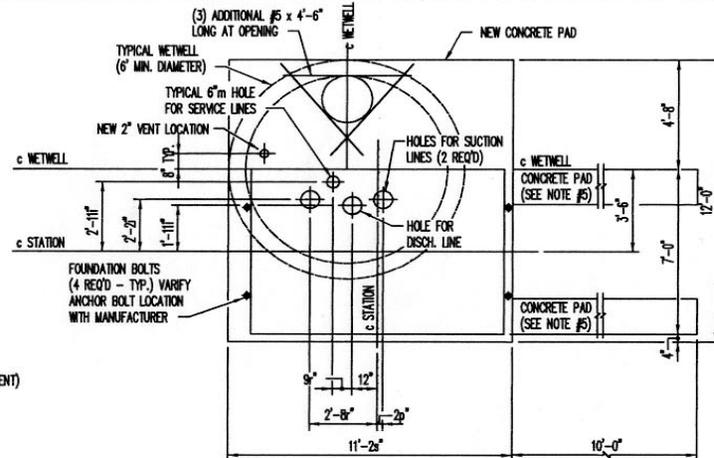


TYPICAL VENT DETAIL  
NO SCALE

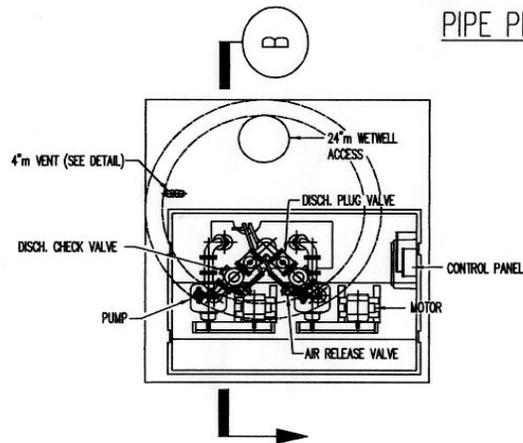
**VENT NOTES:**  
 1. INSTALL 1/2" INSECT SCREEN OVER A SHORT NIPPLE WITH ONE ST. STL. BAND CLAMP.  
 2. MATERIAL ABOVE EMBEDDED STUB TO BE PAINTED SCH. 80 PVC OR GALVANIZED DRAIN PIPE.



SECTION B  
NO SCALE



PIPE PENETRATION PLAN  
NO SCALE



TYPICAL LIFT STATION PLAN  
NO SCALE

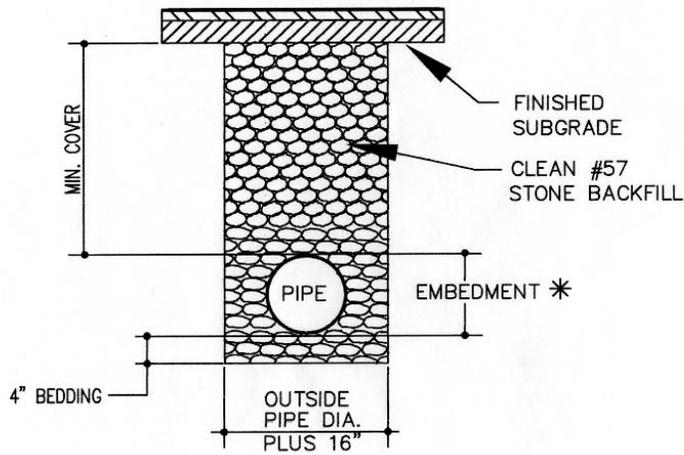
**NOTES:**  
 1. VERIFY PIPE PENETRATIONS AND ALL OTHER DIMENSIONS WITH PUMP STATION MANUFACTURER.  
 2. PIPING TO INCLUDE A.I.R.V.'S AND PRESSURE GAUGES (WITH DIMENSIONS IN FEET OF HEAD) FOR EACH PUMP.  
 3. PRESSURE GAUGE TO BE OIL FILLED AND MOUNTED ON RED-VALVE PRESSURE SLEEVE.  
 4. A.I.R.V. TO BE 2" APCO MODEL 400 WITH FULL ACCESSORY PACKAGE. PIPE AIR AND BLOW-OFF DISCHARGE TO WETWELL.  
 5. NEW 8" THICK CONCRETE PADS (2 REQ'D). 18" WIDE x 10'-0" LONG WITH #5 AT 8" C.C. AT CENTER OF PAD. ALIGN TO ALLOW DOME TO ROLL AT LEVEL GRADE.  
 6. ALL MOUNTING HARDWARE TO BE STAINLESS STEEL. NO EXCEPTIONS.  
 7. THE DEVELOPER OR THEIR CONTRACTOR SHALL CONTACT THE CITY OF OAK RIDGE ELECTRIC DEPARTMENT TO DETERMINE THE SERVICE REQUIREMENTS FOR THE PUMP STATION.

NO.	DATE	DESCRIPTION	BY
1.	12/4/00	EFFECTIVE DATE	CCB

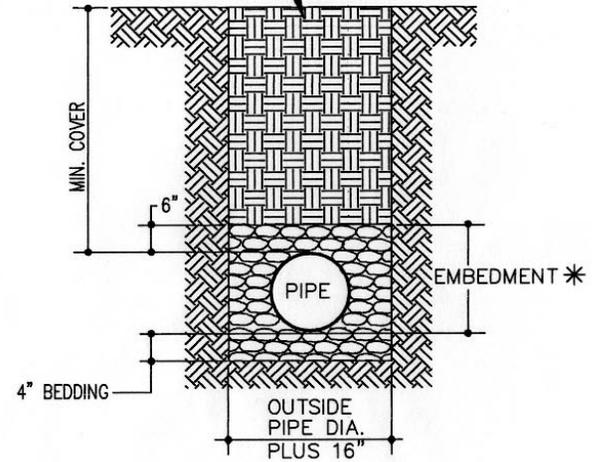
TYPICAL ABOVE GROUND PUMP STATION

STANDARD  
DETAIL  
7.11

\* \* COMPACTED BACKFILL  
AS REQUIRED  
BY PUBLIC WORKS  
DIRECTOR



PAVEMENT AREA



UNPAVED AREA

NOTE TO CONTRACTOR:

ALL PAVEMENT CUTS SHALL BE REPAIRED WITHIN A MAXIMUM OF THREE (3) DAYS FROM THE DATE THE CUT IS MADE. IF CONDITIONS DO NOT PERMIT A PERMANENT REPAIR WITHIN THE GIVEN TIME LIMIT, PERMISSION TO MAKE A TEMPORARY REPAIR MUST BE OBTAINED FROM THE DIRECTOR OF PUBLIC WORKS.

\* FOR ACCEPTABLE CLASSES OF EMBEDMENT MATERIALS, SEE SECTION 7.01 F (1 AND 6)

\* \* ALL PIPE LINES WITHIN 3 FEET OF BACK OF CURB SHALL BE BACKFILLED ABOVE EMBEDMENT MATERIAL TO WITHIN ONE FOOT OF FINISHED GROUND ELEVATION WITH #57 STONE.

1.	12/4/00	EFFECTIVE DATE	CCB
NO.	DATE	DESCRIPTION	BY

NEW CONSTRUCTION PIPE BEDDING DETAILS

STANDARD  
DETAIL  
7.12