CITY OF BRIDGEPORT, TEXAS

ENGINEERING DESIGN MANUAL

Updated September 2009
By:
Baird, Hampton & Brown, Inc.
Engineering and Surveying
Grapevine, Texas

Prepared by:
Freeman Millican, Inc
Consulting Engineers
Dallas, Texas
April 1998

CITY OF BRDGEPORT, TEXAS

ENGINEERING DESIGN MANUAL

TABLE OF CONTENTS

LIST OF TABLES

FIGURES

APPENDICES

PART 1 - GENERAL

1.1 PURPOSE

The purpose of the Engineering Design Manual is to provide a set of standards for designing streets, thoroughfares, drainage facilities, water lines, sanitary sewer lines and preparing construction plans for such facilities that are to be owned, operated and/or maintained by the City of Bridgeport, Texas. These standards will be used by the City Staff and consulting engineers employed by the City for the above described improvement projects, and engineers for private developments in the City of Bridgeport. Unusual circumstances or special designs requiring variance from the standards in this manual may be approved by the Director of Infrastructure Services.

This manual was prepared by Freeman-Millican, Inc in April 1998 and updated by Baird, Hampton & Brown, Inc in September 2009.

1.2 STANDARDS OF DESIGN

The Standards of Design, as adopted by the City of Bridgeport, are set forth herein. These standards shall be considered as the minimum requirements, and it shall be the responsibility of the developer to determine if more stringent requirements are necessary for a particular development. For those elements omitted, the developer will be expected to provide designs and facilities in accordance with good engineering practice and to cause to be constructed facilities utilizing first class workmanship and materials.

1.3 STANDARD SPECIFICATIONS FOR CONSTRUCTION

Standard specifications for construction as adopted by the City of Bridgeport shall be in accordance with the most current version of the “Standard Specifications for Public Works Construction” as published by the North Central Texas Council of Governments (copies obtained from N.C.T.C.O.G. offices) and the Addendum to the N.C.T.C.O.G. specification bound in this document (see Appendix E: Addendum to NCTCOG Standard Specifications). These specifications shall be considered as minimum requirements, additional requirements the City or the developer may consider appropriate, should be added as supplements.

1.4 UTILITY LINE LOCATIONS

In general, utility lines are to be located in public rights-of-way in the location shown in 0
Utility Assignments. The City Engineer shall determine the location of utilities where special circumstances prevent the standard utility assignments from being used.

1.5 GENERAL NOTES

All construction plans for the projects described above shall contain the applicable general notes listed in Appendix C: General Notes for Construction Plans.

1.6 OWNER’S DEDICATION

All plats shall use all applicable portions of the Standard Owner’s Certificate shown in Appendix D: Standard Owner’s Certificate.

1.7 STANDARD DETAILS

Standard construction details are shown in Appendix F: Construction Details. All construction plans shall either contain these details or details from the Standard Specifications for Public Works

Construction as published by the N.C.T.C.O.G. Additional details shall be prepared as required to describe the construction required.

1.8 Benchmarks

A. HORIZONTAL CONTROL

The plat shall identify no less than two (2) perimeter monuments, either found or set, upon which plane coordinate values have been determined and shown in US State Plane Coordinate System 1983(2007), Texas North Central, Zone No. 4202, US Feet. Coordinate Positions shown must be tied to at least two (2) of the City's published geodetic control monuments and these must be indicated on the plat. If coordinate positions are derived independently from the City's published geodetic control network, the method used to establish stated positions shall be indicated on the plat (for example: OPUS solution, VRS, privately generated post-processed solution) and the metadata submitted as well.

B. VERTICAL CONTROL

Elevations shall be referenced to the city's geodetic control network. Elevations shown thereon are listed in the North American Vertical Datum 1988 definition (NAVD88).

1.9 RECORD DRAWINGS

Record Drawings ("As Built Drawings") are required to be submitted for all public works construction in the City of Bridgeport. Record Drawings shall indicate all supplied material to make the systems operational. Upon completion of work, the contractor or engineer shall submit to the City two (2) sets of prints, one (1) set of mylar drawings and a CD-ROM or DVD of the electronic files indicating the "as-Built" condition.

Record drawings are a final record of what was actually installed, and include all deviations or changes from the approved plan. Record drawings are required to reflect the same degree of precision and detail as the original plans. Record drawings are necessary as a basis to plan and design future projects in the same location and to make repairs to damaged components or other non-working facilities. They are required to show all changes that occurred during construction, including changes in materials, distances, lengths, locations, elevations, slopes, volumes, etc.

During the construction phase of the project, the Contractor/Developer for the project shall maintain one set of full size plans for record drawings at the construction site. The contractor's superintendent or authorized representative shall update the plans with record information on an as needed basis. Record information includes the final locations of all new materials incorporated into the work and all existing improvements encountered during construction.

Upon completion of construction, the record information will be provided to the city. As-built changes to text: invert elevations, dimensions, notes, etc. will be lined out with the record drawing text placed near it. Do not alter, modify or erase original approved construction drawing text.

Submit the record drawings with the as-built changes noted and PDF's of them to the City. Submit digital files of the record drawings in AutoCad (.dwg) format for input into the City's GIS database. File names should make sense to a viewer who may not be familiar with the consulting firms naming conventions and be indicative of the contents of the file.

PART 2 - PAVING

2.1 STREET AND THOROUGHFARE CLASSIFICATIONS

City streets and thoroughfares are classified into several types according to their use and locations as indicated in Table 2-1. The basic types include the residential streets that provide direct access and frontage to adjacent properties, collectors that serve as distributor-collector arteries and provide direct access to adjacent properties, and parkways and major arterial streets thoroughfares that carry higher volumes of traffic through urban areas. Each traffic artery is made up of elements that are related to the use of that particular facility. These elements include right-of-way, pavement width, median width, if required, arrangement of traffic lanes and parking lanes, curb radii at intersections and other characteristics.

2.2 STREET AND THOROUGHFARE GEOMETRICS

A. GENERAL

Geometrics of the City streets and thoroughfares may be defined as the geometry of the curbs or pavement areas that governs the movement of traffic within the confines of the right-of-way. Included in the geometrics are the pavement, widths, degree of curvature, width of traffic lanes, parking lanes, or turning lanes, median width separating opposing traffic lanes, median nose radii, curb radii at street intersections, crown height, cross slope, geometric shapes of islands separating traffic movements and other features. Since City streets and thoroughfares are differentiated by their functions and location, there is also a variance in the geometry that describes the path vehicular traffic should follow. All streets and alleys shall be reinforced concrete pavement.

B. DESIGN VEHICLES

The geometrics of City street and thoroughfare intersections vary with the different dimensions of the intersection facilities. Criteria for the geometric design of intersections must be based on certain vehicle operating characteristics, and vehicle dimensions. The American Association of State Highway and Transportation Officials (AASHTO) has standardized vehicle criteria into three general designs, and this vehicle data is published in the AASHTO Publication, “A Policy on Geometric Design of Highways and Streets.” In the design of street and thoroughfare intersections for Bridgeport, these vehicle designs are adopted for use. Table 2-2, Design Vehicle Criteria, shall serve as a guide in the selection of the design vehicle to be used in the design of intersections.

TABLE 2-1 STREET AND THOROUGHFARE GEOMETRIC STANDARDS

Street Type	Street Classification	Minimum Pavement Width F-F	Minimum ROW Width	Lane Configuration	Parking	Parkway Width	Median Width F-F	Minimum Concrete Pavement Thickness	Minimum Design Speed
Collector A	1	64’	85’	4 lane divided 2-12’ lanes per direction	0	10’	16’	7”	45
Collector B	1	48’	65’	4 Lane 2-12’ lanes per direction	0	8’	0	7”	40
Collector C	1	40’	60’	3 Lanes 1-12’ Lane Per direction + 1-16’ Turn Lane	0	9.5’	0	7”	35
Commercial/ Industrial Street	2	36’/40’	60’/65’	2-12’ Lanes + 1-(12’ / 16’) Center Turn Lane	0	11.5’/12’	0	6”	35
Historic District	2	64’	85’	2 Lane undivided 1-12’ Lanes per direction	45° Angle	10’	0	6”	30
Local Street	2	30’	60’	2 Lane undivided 1-11’ lane per direction	8’	14.5’	0	6”	30
Local Street (Low Density Residential)	2	26’	50’	2 Lane undivided 1-10’ lane per direction	6’	11.5’	0	5”	30
Country Lane	2	24’	60’	2 Lane undivided 1-12’ lane per direction	0	18.0’	0	5”	30
Alley[1]	3	15’	25’	1-15’ Lane	0	5.0’	0	5”	10
Alley[2]	3	15’	20’	1-15’ Lane	0	2.5’	0	5”	10
Alley[3]	3	10’	15’	1-10’ Lane	0	2.5’	0	5”	10

NOTE: All dimensions are to face of curb or edge of pavement. Minimum pavement thickness for concrete streets.
[1] Business & Industrial District
[2] Residential with Rear Access
[3] Residential with Front Access. Alley flares to 12 feet wide are required at turns and tees.

TABLE 2-2 DESIGN VEHICLES

Intersecting Streets Classification	Design Vehicle Used in Intersection Design	
	Single Unit Truck (SU)	Tractor Semi-Trailer Combination (WB-50)
Class 1 with Class 1		X
Class 2 with Class 1		X
Class 2 with Class 2		X
Class 3 with Class 1	X	
Class 3 with Class 2	X	
Class 3 with Class 3	X	

NOTES:

1) Single Unit Trucks Design shall use a minimum of 30 ft. radius on curbs and turnouts.
2) Tractor Semi (WB-50) design shall use a minimum of 20 ft. radius.
3) Streets that intersect at something different from 90º shall have a radius that will accommodate the specified design.
4) All alleys shall be designed for SU vehicles.

C. DESIGN SPEED

The design speed is a primary factor in the horizontal and vertical alignment on City streets and thoroughfares. Design features such as curvature, superelevation, radii for turning movements and sight distance are directly related to the design speed. The design speed also affects features such as lane widths, pavement width, pavement cross-fall, pavement crown, and clearance.

The design speed is defined as the approximate maximum speed that can be maintained safely by a vehicle over a given section of road when conditions are so favorable that the design features of the roadway govern. The speed limit of posted speed is the maximum legal speed set by local authorities for a certain roadway or area. The design speed should always be greater than the likely legal speed limit for secondary and major thoroughfares.

The various street and thoroughfare classifications, which make up the system within the City, require different design speeds according to their use and location. Presented in Table 2-1 are the minimum design speeds for the various classifications with the City of Bridgeport. Lower design speeds may be approved for all classifications for unusual conditions of terrain or alignment.

D. HORIZONTAL GEOMETRICS

1. General

The horizontal geometrics of City streets and thoroughfares include the segment of geometric design associated with the alignment, intersections, pavement widths, and related geometric elements. The various classifications, utilizing the design speed as a control, must have certain horizontal and vertical geometrics to provide a safe economical facility for use by the public. Centerline off-sets of less than 125 feet shall be prohibited.

2. Horizontal Curves and Super elevation

The alignment of City streets and thoroughfares is usually determined by the alignment of the existing right-of-way or structures that cannot be relocated. Changes in the direction of a street or thoroughfare are minimized by constructing a simple curve having a radius that is compatible with the speed of vehicular traffic. To increase the safety and reduce discomfort to drivers traversing a curved portion of a street or thoroughfare, the pavement may be super elevated.

Curvature in the alignment of major thoroughfares and collectors is allowed under certain conditions, but greater traffic volume and higher vehicle speeds that accompany these facilities tend to increase accidents on curving roadways. Curves in the alignment of residential streets usually provide aesthetic values to the residential neighborhoods without affecting the orderly flow of traffic or sacrificing safety.

A recommended minimum radius of curvature for vehicle design speed and pavement cross-slopes is shown in Table 2-3. These are based on traffic consisting of typical present day automobiles operating under optimum weather conditions. There are other important considerations in the design of curves on City streets and thoroughfares including the location of intersecting streets, drives, bridges and topographic features. When superelevation is required on collectors and major thoroughfares, the following basic formula shall be used:

$$R = \frac{V^2}{15(e + f)}$$

Where:

e = rate of roadway superelevation, foot per foot

f = Side friction factor (See Table 2-4)

V = vehicle design speed, mph

R = radius of curve in feet

For local residential streets, the minimum centerline radius may be no less than 150 feet when the design speed can be considered to be less than 25 MPH. This decision will be made by the City Engineer by considering the type of proposed development, location of street and length of street.

3. Turning Lanes

Turning lanes are provided at intersections to accommodate left-turning and right-turning vehicles. The primary purpose of these turning lanes is to provide storage for the turning vehicles. The secondary purpose is to provide space to decelerate from normal speed to a stopped position in advance of the intersection or to a safe speed for the turn in case a stop is unnecessary. Left turn lanes at intersections are usually 10 feet in width. When turning traffic is too heavy for a single lane and the cross street is wide enough to receive the traffic, two turning lanes may be provided. Availability of right-of-way may limit locations where this is feasible.

TABLE 2-3 MINIMUM CENTERLINE RADIUS FOR THOROUGHFARES

Rate of Superelevation (In./Ft.)	Design Speed (MPH)			
	30	35	40	45
-1/2	510	720	945	1310
-3/8	470	660	865	1190
-1/4	435	610	795	1090
-1/8	405	565	740	1005
0	370	530	690	935
+1/8	355	495	645	870
+1/4	335	465	610	815
+3/8	315	440	575	770
+1/2	300	415	545	725

TABLE 2-4 SIDE FRICTION FACTORS FOR THOROUGHFARES

Street Classification	Side Friction Factor (f)
Class 1	0.155
Class 2	0.160

The location of the median nose at the end of the left turn lane should be so located that left turning traffic will clear the median nose while making a left turn. Other considerations include adequate clearance between the median nose and through traffic on the intersecting thoroughfare and locations of the median nose to properly clear the pedestrian crosswalks.

Length of turn lanes for Class 1 & 2 streets shall be as follows:

TABLE 2-5 LENGTH OF TURN LANES FOR THOROUGHFARES

Design Speed	Storage Length (FT)	Deceleration Length (FT)	Taper Length (FT)	Total Length (FT)
45	100	345	100	445
40	100	275	50	375
35	100	215	50	315

* The Actual length shall be approved by the City Engineer.

4. Street Intersections

a. Standard

The intersection, at grade, of major thoroughfares, collector streets, and residential streets shall be at or near right angles from the standard intersection. At the intersection of these arterial types the various geometrics including pavement widths, lane widths, curb radii, median widths, turning lane data, cross slope, crown height and other features differ.

b. Special Intersections

Street and thoroughfare types in the City often intersect at angles less than 90 degrees. The radii required to fit the minimum paths of the design vehicles are longer than those for standard or 90 degree intersections. Special intersections shall be designed using data for the design vehicles as specified in Table 2-2.

E. VERTICAL ALIGNMENT

1. Street Grades

The vertical alignment of City streets and thoroughfares should be designed to insure the safe operation of vehicles and should allow easy access to adjacent property. A travel way that is safe for vehicles is dependent on criteria that consider: operating speeds, maximum grades, vertical curves and sight distance. In addition to these considerations, other factors related to vertical alignment include storm drainage, crown and cross slope and the grade and right-of-way elevation relationship. The grade of street or thoroughfare, particularly at its intersections with another grade, is of prime importance in providing a safe, comfortable riding surface. The intersection design of two class 1 streets shall include grades that will result in a plane surface or at least a surface that approximates a plane surface. A vehicle traveling on either thoroughfare should be able to traverse the intersection at the design speed without discomfort. To accomplish a smooth transition, cross slope toward the median of one lane of each thoroughfare may be required. The use of storm drainage inlets in the median shall be avoided if possible.

In drawing the grades of intersecting thoroughfares in the profile view of plan/profile sheets, profiles of all four curbs shall be shown as a continuous line through the intersection.

a. Minimum Grades

Minimum longitudinal grades for streets and thoroughfares are required to insure proper flow of surface drainage toward inlets. Minimum grades are five-tenths percent (0.5%) for all pavement, having curbs. Where valley gutters are used for intersecting drainage, the minimum grade for valley gutters is five-tenths percent (0.5%) for concrete.

b. Maximum Grades

Maximum longitudinal grades shall be compatible with the type of facility and the accompanying characteristics including the design speed, traffic conditions and sight distance.

Arterial and Collector streets must move large volumes of traffic at faster speeds and flatter grades will better accommodate these characteristics. Truck and bus traffic on these type facilities often controls traffic movement, particularly if steep grades prevent normal speeds. The normal maximum street grades allowed are shown in Table 2-6.

Steeper grades may be permitted for short lengths where dictated by topographical features or restricted alignment.

TABLE 2-6 MAXIMUM STREET GRADES

Street Classification	Normal Maximum Grade In Percent
Class 1	6%
Class 2	8%

2. Vertical Curves

When two longitudinal street grades intersect at a point of vertical intersection (PVI) and the algebraic difference in the grades is greater than one percent (1.0%), a vertical curve is required. Vertical curves are utilized in roadway design to effect a gradual change between tangent grades and should result in a design that is safe, comfortable in operation, pleasing in appearance and adequate for drainage. The vertical curve shall be formed by a simple parabola and may be a crest vertical curve or a sag vertical curve.

3. Stopping Sight Distance

a. Crest Vertical Curve

When a vertical curve is required, it must not interfere with the ability of the driver to see length of street ahead. This length of street, called the stopping sight distance, should be of sufficient length to enable a person in a vehicle having a height of 3.675 feet above the pavement and traveling at design speed to stop, before reaching an object in his path that is 0.5-foot in height.

The minimum stopping sight distance is the sum of two distances: one, the distance traversed by a vehicle from the instant the driver sights an object for which a stop is necessary, to the instant the brakes are applied; and the other, the distance required to stop the vehicle after the brake application begins.

The minimum safe stopping sight distance and design speeds are shown in Table 2-7. These sight distances are based on each design speed shown and a wet pavement. The length of crest vertical curve required for the safe stopping sight distance of each street type may be calculated using the formula L = KA and the values of K for a crest vertical curve shown in Table 2-7.

b. Sag Vertical Curve

When a sag vertical curve is required, the vertical curve shall be of sufficient length to provide a safe stopping sight distance based on headlight sight distance. The minimum length of sag vertical curve required to provide a safe stopping sight distance may be calculated using the formula L = KA and values of K for a sag vertical curve are shown on Table 2-7.

TABLE 2-7 MINIMUM LENGTH OF VERTICAL CURVE

CREST VERTICAL CURVE		SAG VERTICAL CURVE	
L =	KA where	L =	KA where
L =	Minimum Length Vertical Curve required for safe Stopping	L =	Minimum Length Vertical Curve required for headlight control
K =	Horizontal Distance in feet required to effect a one percent change in gradient	K =	Horizontal Distance in feet required to effect a one percent change in gradient
A =	Algebraic Difference in grade	A =	Algebraic Difference in grade

Design Speed	Minimum Stopping Distance	Normal Crest Vertical Curve K	Normal Sag Vertical Curve K	Minimum Length of Curve
45	400	100	80	120
40	300	65	60	100
35	250	50	50	100
30	200	30	35	100

4. Intersection Grades

   The grade of an intersecting street with the principal street gutter should not be generally more than four percent (4%) either up or down within the first 20 feet beyond the curb line of the principal street. Grade changes greater than one percent (1%) will require vertical curves.

5. Street Cross Section

   For curbed streets, the right-of-way shall be graded to drain to the street at a slope of 1/4" per foot. Street back slopes and embankment slopes shall not be steeper than 4:1.

2.3 SIGHT DISTANCES AT INTERSECTIONS

An important consideration in the design of City streets and thoroughfares is the vehicle attempting to cross the street or thoroughfare from the side street or drive. The operator of the vehicle attempting to cross should have an unobstructed view of the whole intersection and a length of the thoroughfare to be crossed sufficient to permit control of the vehicle to avoid collisions. The minimum sight distance considered safe under various assumptions of physical conditions and driver behavior is related directly to vehicle speeds and to the resultant distance traversed during perception and reaction time and during braking. This sight distance, which is termed intersection sight distance, can be calculated for different street of thoroughfare widths and for various grades upwards and downwards. Intersection sight distance shall be as set forth in AASHTO publication "A Policy on Geometric Design of Highways and Streets".

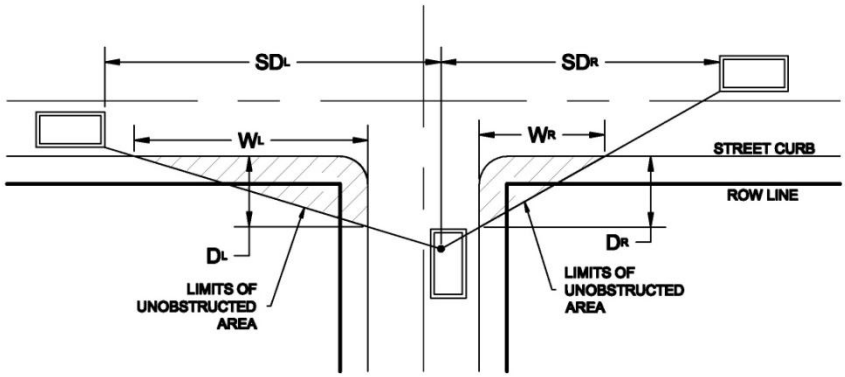


FIGURE 2-1 SIGHT DISTANCES AT INTERSECTIONS

SD_L and SD_R are the required sight distance, in feet, to the left and to the right as measured from the driver's eye on the controlled intersection approach looking towards oncoming cross traffic.

W_L and W_R are the distance, in feet, along the curb line or edge of drive lane of the side of the visibility triangle parallel to the path of traffic on the uncontrolled intersection approach.

D_L and D_R are the distance, in feet, along the curb line of the side of the visibility triangle parallel to the path of the driver on the controlled intersection approach.

The distances given for W_L, W_R, D_L, and D_R are applicable to 90° intersections only.

TABLE 2-8 MINIMUM VISABILITY TRIANGLE DIMENSIONS

Thoroughfare Class		Minimum Sight Distance		90 degree Intersection Only			
	Speed Limit	SD_L	SD_R	W_L	W_R	D_L	D_R
Principal Arterial	70	850	850	690	250	44	44
Principal Arterial	60	650	650	525	190	43	43
Principal Arterial	50	475	475	380	135	40	40
Collector A	45	400	400	265	120	19	19
Collector B	40	325	325	200	120	16	16
Collector C	35	250	250	155	115	17	17
Comm. / Ind.	35	250	250	165	125	20	20
Historical	30	200	200	155	135	35	35
Local Street	30	200	200	150	130	30	30
Local Street (Res)	30	200	200	150	130	25	25
Country Lane	30	200	200	135	115	21	21
15' Alley	10	125	125	95	75	19	18
10' Alley	10	125	125	95	100	21	21

Assumptions:
1. At-grade intersection with approaches of 3.0% or less,
2. 3.5' driver eye height above pavement,
3. Both drivers can see each other.

Triangular public visibility easements will be required at the time of platting. Visibility easements vary in size based upon intersection geometry, roadway speed, vertical alignment and horizontal alignment and should be considered on a case by case basis, but shall not be less than 20'x20' measured from the property line without prior approval of the city engineer.

2.4 MEDIAN OPENINGS

The following standards for median openings are established to facilitate traffic movement and promote traffic safety:

Median openings will normally be permitted at all intersections with dedicated City streets. Exceptions would be at certain class 1 streets where due to unusual conditions a hazardous situation would result.

Midblock median openings or other openings with turns permitted into adjacent property will not normally be permitted unless all the following conditions exist:

A. The property to be served is a significant traffic generator with demonstrated or projected trip generation of not less than two hundred and fifty (250) vehicles in a twelve-hour period.

B. The median opening is not less than 400 feet from an intersection with a major thoroughfare.

C. The median opening is not less than 300 feet from an intersection with a minor street.

D. The median opening is not less than 300 feet from any other existing or proposed midblock median opening.

E. The median width is sufficient to permit the construction of a left turn storage lane.

2.5 STREET AND CUL-DE-SAC DIMENSIONS

The maximum length of any cul-de-sac shall be 600 feet measured from curb line of the intersecting street to the radius point of turn around. The maximum length between intersecting streets shall not exceed 1200 feet. Right-of-way and pavement widths shall be as follows:

STREET TYPE	RIGHT-OF-WAY RADIUS	PAVEMENT RADIUS
Country Lane	50	40
Local Street-Residential	50	40
Local Street-Non-Residential	50	40

All cul-de-sac turnarounds shall be visible from the intersecting street.

2.6 DRIVEWAY STANDARDS

A. MAXIMUM NUMBER OF DRIVEWAYS; MINIMUM CORNER CLEARANCE

The maximum number of driveways per platted lot and the minimum spacing between such driveways shall be as provided for in Table 2-8.

TABLE 2-9 DRIVEWAY SPACING CRITERIA (PER PLATTED LOT)

Land use	Frontage (Feet)	Maximum Number Of Driveways Per Property	Minimum Spacing Between Driveways On Same Property
Single-Family	90' or more	2	20'
Single-Family	Less than 90'	1	N/A
Attached Housing	90' or more	2	20'
Attached Housing	Less than 90'	1	N/A
Non Residential	Less than 250'	1	N/A
Non Residential*	More than 250'	2	100'

* One additional driveway may be added for each additional 500 feet of lot width in excess of 250 feet. For driveways on Class 1 thoroughfares, only one driveway is allowed for each 500 feet of lot width instead of 250 feet of width.

NOTE: State standards, if more restrictive, shall apply for properties fronting state or federal roads.

The minimum corner clearance between a driveway and an intersection shall be as provided for in Table 2-9. Corner clearance shall be defined as follows:

2. For Curbed Streets

   The distance between the intersection of the projected curb lines of the two streets and the point of tangency of the driveway curb returns at the street curb.

3. For Country Lanes

   The distance between the intersection of the projected edge of pavement lines of the two streets and the intersection of the edge of driveway pavement at edge of pavement of the street shall not be less than the corner clearance shown in Table 2-9.

In no case shall the driveway curb return or the edge of the driveway pavement encroach into the curb return or edge of pavement radius of a street intersection. Encroachment by the curb return or edge of pavement of a driveway onto the frontage of an adjoining property is not permitted.

TABLE 2-10 MINIMUM CORNER CLEARANCES BETWEEN DRIVEWAY AND INTERSECTION

		MINIMUM CORNER CLEARANCE	
Type of Street Driveway is On	Type of Street Intersected	Approach Side of Intersection	Departure Side Of Intersection
Class 1	Class 1	150	100
Class 1	Class 2	100	70
Class 1	Class 3	50	30
Class 2	Class 1	100	70

Type of Street Driveway is On	Type of Street Intersected	MINIMUM CORNER CLEARANCE	
		Approach Side of Intersection	Departure Side Of Intersection
Class 2	Class 2	70	50
Class 2	Class 3	40	30
Class 3	Class 1	50	30
Class 3	Class 2	40	30
Class 3	Class 3	30	30

NOTES:

1) The above distances notwithstanding, any platted lot may have at least one (1) minimum width driveway.
2) Service roads shall be classified as an arterial for driveway purposes.
3) New residential driveways on Class 1 and Class 2 streets will not be permitted unless an exception is granted by the City Council.

B. DESIGN STANDARDS; STORAGE LENGTH

1. Driveway design standards shall be provided for in Table 2-10.

TABLE 2-11 DRIVEWAY DESIGN STANDARDS

Land Use	Driveway Approach			
	Approach Width in Feet		Curb* Radius in Feet	
	Minimum	Maximum	Minimum	Maximum
RESIDENTIAL				
Single Family	10	N/A	5	10
Attached Housing	20	24	15	30
NON RESIDENTIAL (Undivided Driveways)				
Office	24	30	10	30
Retail (except Service Station)	24	30	10	30
Service Station	24	40	15	30
Industrial	24	45	25	50
DIVIDED DRIVEWAYS**				
Non-Residential	18	24	15	40

* Or chamfer distances where driveway attaches to a Country Lane or Parkway

** Must have raised, landscaped median at least 6 feet wide; approach widths are for each side.

NOTES:

1) The minimum and maximum approach widths are for the point where curb radii (from the public street) end or the approach width at the right-of-way line.
2) Where the width of an aisle change or where the approach width is different from the width of the aisle or driveway farther into the property, the following formula shall be used to determine the minimum taper length:

L = 20 X W

Where: L = taper length and W = difference in width

2. Driveway storage shall be defined as the distance between the street right-of-way line and the near side of the first intersecting interior aisle. The minimum length of this storage shall be as provided for in Table 2-11.

TABLE 2-12 MINIMUM DRIVEWAY STORAGE LENGTH

Number of Parking Spaces Per Driveway	Minimum Storage Length* (Feet)
Less than 50	18
50 to 200	50
More than 200	78

* Storage length is defined as the distance between the street right-of-way line and the first intersecting aisle way on site.

C. CROSS ACCESS

The development and use of shared driveways, cross-access drives, service drives, and similar means of shared access connecting two (2) or more lots or uses shall be strongly encouraged.

1. Location

New shared driveways, cross-access drives, and service drives shall be aligned with existing drives on adjacent lots where feasible, and parallel or perpendicular to the street right-of-way.

2. Cross-Access Easement

Shared driveways, cross-access drives, and service drives shall be located within a dedicated access easement that permits traffic circulation between lots.

D. DRIVEWAY GRADES

The normal driveway grade within the street right-of-way is set at one-quarter inch (1/4") per foot rise above the top of curb at the property line. The minimum elevation of driveway at the right-of-way line is two inches (2") above the top of curb. Barrier free sidewalk construction shall have a maximum cross slope of 2.0%.

Where driveway construction or reconstruction must occur off the street right-of-way, the usual maximum grade is fourteen percent (14%). The maximum change in grade without vertical

curve is twelve percent (12%) for any 10 feet in distance. Driveways should be profiled for a distance of at least 25 feet outside the right-of-way to insure adequate replacement design.

Due to state laws requiring barrier free construction of sidewalks, steps or other abrupt changes in sidewalk grades are prohibited at driveways.

E. DRIVEWAYS CONNECTING TO COUNTRY LANES

Driveways connecting to Country Lanes and located on public right-of-way shall be constructed according to details adopted by the City. The size of the drainage pipe or opening shall be established by a Registered Professional Engineer design calculations shall be submitted to the City Engineer for review before driveway construction begins.

2.7 PAVEMENT DESIGN

A. STANDARD STREET AND THOROUGHFARE PAVEMENT DESIGN

Table 2-12 shows the required pavement thickness for rigid pavement and the subgrade requirements for various street and thoroughfare types within the City of Bridgeport

B. ALTERNATE PAVEMENT DESIGN

The City Engineer will consider an alternate pavement design in lieu of selecting a design from Table 2-12, particularly when there are circumstances that warrant an individual design.

TABLE 2-13 STANDARD STREET AND THOROUGHFARE PAVEMENT DESIGN

Facility Type	Usual Crown	Subgrade Requirements	Minimum Concrete Pavement Thickness
Collector 'A'	¼" per foot	6" Lime or Cement	7"
Collector 'B' & 'C'	6" Parabolic	6" Lime or Cement	7"
Commercial / Industrial	6" Parabolic	6" Lime or Cement	6"
Historical District	8" Parabolic	6" Lime or Cement	6"
Local Street - Non Residential	6" Parabolic	6" Lime or Cement	6"
Local Street - Residential	5" Parabolic	6" Lime or Cement	5"
Country Lane	5" Parabolic	6" Lime or Cement	5"
10 ft. Alley	5" Invert	6" Compacted	5"
15 ft. Alley	6" Invert	6" Compacted	5"

NOTES:

1) Twenty-eight day concrete compressive strength of rigid pavement shall not be less than 3600 P.S.I.
2) Where the PI is less than 20, lime is not required.

3) Extra thickness of concrete may be used instead of lime treated subgrade with the approval of the City Engineer.

2.8 PERMANENT LANE MARKINGS

A. PURPOSE

The purpose of this section is to describe the typical layout of permanent lane markings used by the City of Bridgeport. These marking standards are designated by number or letter types. Numerical designation (i.e., TYPE 1, TYPE 2, etc.) denotes White markings separating lanes of traffic moving in the same direction. Alphabetical designation (i.e., TYPE A, TYPE B, etc.) denotes Yellow markings separating lanes of traffic moving in opposing directions. Therefore, any street section with pavement markings can be fully described by a TYPE number and/or letter combination.

B. TYPES OF MARKINGS

Lane lines and centerlines will utilize reflectorized thermoplastic hot applied coatings. The width of the marking shall be as indicated below, four (4") inch buttons only, unless otherwise stated. Lane and crosswalk markings are required on all Class 1 and Class 2 thoroughfares. Stop bars are required for each lane at all traffic lights and stop signs.

C. TYPES OF LAYOUTS

The following describes the types of layouts as designated in these standards.

TYPE 1: A 4" wide skipped white line, normally used on streets having four or more lanes. The normal stripe/skip cycle is 15'/25'.

TYPE 2: A 4" wide solid white line, normally to designate special lane control (RIGHT LANE MUST TURN RIGHT).

TYPE 3: An 8" wide solid line white line to designate a left turn bay.

TYPE 4: A 12" wide solid white line to designate each side of a cross walk.

TYPE 5: A 24" wide solid white line to designate a stop bar.

TYPE A: A 4" wide skipped yellow centerline used on roadways of only two lanes of traffic. The normal stripe/skip cycle is 15'/25'.

TYPE B: Double solid 4" yellow lines spaced 4" apart used on four lane roadways.

TYPE C: A 4" wide solid yellow line and a 4" wide skipped yellow line spaced 4" apart used to distinguish a center left turn lane.

2.9 FIRELANES

A. Fire lanes shall have an unobstructed width of not less than 24' and an unobstructed vertical clearance of not less than 14.0'

B. The minimum inside turning radius on a firelane shall be not less than 25'.

C. Dead end firelane in excess of 150' in length shall be provided with approved provisions for turning the fire vehicles around.

D. Striping

Fire access roads shall be marked by painted lines of red paint 6" wide. The lines shall be marked by painting 4" high lettering using a 1" wide stroke of white on the contrasting red background stating: "NO PARKING – FIRELANE". This marking is to be placed at 25' intervals along each side of the fire access road and readable from the centerline of the firelane.

2.10 SIDEWALKS

The purpose of the public sidewalks is to provide a safe area for pedestrians. The City of Bridgeport requires that sidewalks be constructed with the paving of streets or when building construction occurs in residential areas with lot sizes less than 35,000 sq. ft. All sidewalks must conform to state laws for barrier free construction. Sidewalks are not required in industrial areas, but are required in commercial and residential zoning districts.

The standard concrete sidewalk is 4 feet in width for residential and 5 feet in width for commercial. In historical districts, the minimum concrete sidewalk is 6 feet in width and adjacent to the curb. Where installation of a standard sidewalk would result in a grass strip of less than 3 feet wide adjacent to the curb, a 6 foot wide sidewalk should be, constructed adjacent to the back of curb.

The edge of the sidewalk located nearest the street right-of-way is normally 2 feet from the right-of-way line for residential districts and against the curb for commercial districts. Special sidewalk designs to include a 6-foot sidewalk located adjacent to the street will be considered for approval where warranted. In areas where screening walls are required, sidewalks shall be constructed against the screening wall and have a minimum width of 5 feet.

Sidewalk alignments may be varied to avoid the removal of trees or the creation of excessive slopes when approved by City Engineer. Sidewalks should be aligned to avoid manholes and curb inlets where possible.

2.11 STREET SIGNS AND STREET LIGHTING

A. STREET SIGNS

1. The developer shall furnish and install all streets signs required for the development. The minimum signage is as follows:

a. One street sign at each street intersection displaying the name of each street.

b. Stop signs and yield right-of-way signs at locations approved by the City Engineer.

c. Alley speed limit signs located at each entrance to the alley.

d. For each street terminating in a cul-de-sac, a "Dead End Street - No Outlet" sign.

Other signage shall be installed as required by the City Engineer to provide for the safety of the public. All street signs shall be purchased from the City of Bridgeport and be installed on the specified posts in accordance with the Standard Construction Details.

B. STREET LIGHTS

The developer shall erect streetlights meeting the City's standards. Streetlights shall be installed at a spacing of not more than 400 feet and at each street intersection and each cul-de-

sac. Streetlights shall be installed in accordance with the National Electrical Code and the City's Standard Details.

2.12 CONSTRUCTIONS PLAN PREPARATION

A. GENERAL

All paving plans for constructing street and thoroughfare improvements in the City of Bridgeport shall be prepared in accordance with the City of Bridgeport's procedures.

Plans for subdivision construction should be adequate to allow for review and construction inspection.

If the paving project includes storm drainage improvements, the hydraulic design of the proposed storm shall be accomplished based on procedures and criteria outlined in this manual.

Plans shall be prepared on 24" x 36" sheets using common engineering drawings scales such as 1"=10', 20', 30', 40', 50', 60', 100', and 200'. Drawings scales are typically 1"=30' for profile horizontal and 1"=3' for profile vertical scale.

B. PLAN SET

Plans shall include a cover sheet, paving plan-profile sheets, typical paving section, paving cross sections, drainage area map, drainage plan-profile sheets and drainage cross sections if required.

C. PAVING PLAN-PROFILE SHEETS

1. Plan

a. In the plan view the centerline of the street shall be drawn and stationed at one hundred foot intervals and each sheet shall begin and end with even or fifty foot stations.

b. Sufficient data including monuments and other survey controls shall be shown on the plans to permit establishment and staling of the centerline of the project from the construction plans.

c. If a survey line or transit line is required to locate the street or right-of-way, it shall be properly identified and dimensioned form the centerline. Also shown on the plan view shall be the geometrics and dimensions of the proposed paving improvements including curbs, curb and gutter, median, pavement edges, driveways, sidewalks, alley approaches, street headers, temporary pavement. Where the cut or fill at the property line exceeds on foot, the top of the cut slope or the toe of the fill slope shall be shown on the plan.

d. Property line and right-of-way line information shall include dimensions of existing and proposed property lines and right-of-way lines. Right-of-way dimensions shall be shown on the proposed street and on intersecting streets. Each lot fronting on the proposed street shall be dimensioned and the lot and block number, house number, and ownership shown on the plan.

e. The proposed paving improvements may be shaded as necessary to clarify the intent of the plans. Pavement dimensions, unless otherwise noted, shall be to the face of the curbs.

f. Proposed storm drains and inlets shall be shown on the plan and the paving station at the centerline of the inlet shall be shown as well as the inlet size, type inlet, top of curb

elevation and inlet flow line. Existing storm drains and utilities shall be shown located by dimension and the name and size of each noted.

g. Other data shown on the plan shall include a benchmark which will remain after construction of the improvements, flow arrows indicating direction of storm water run-off, street names, match lines, scale and north arrow.

2. Profile

a. The profile portion of the plan-profile sheet shall show the existing ground profile at each right-of-way line, the proposed top of curb profile at each side of the street. If the street has a median, the profiles of the median curbs shall also be shown. At street intersections, the top of the curb elevation at the horizontal P.C. and P.I. of the curb radius and the paving station shall be shown in the profile and the name of the intersecting street shall also be shown.

b. Street grades should be set according to the procedure in Appendix A: Recommended Procedure for setting street grades. Of overriding importance is the safety of all persons and vehicles using the street. The convenience and comfort of thru traffic must be balanced against the necessity to serve the abutting property. Property owners may be assessed for part of the cost of paving.

c. The proposed street grade shall be indicated in percent to the nearest hundredth percent. Vertical curve data shall be shown including length of vertical curve, external distance, station and elevation at point of vertical curvature (PVC) and the station and elevation at point of vertical tangency (PVT).

d. Elevations of the proposed top of curb shall be shown at each one hundred-foot station and fifty-foot station including elevations on vertical curves at these stations. Low points on sag vertical curves and high points on crest vertical curves shall also be shown.

3. At some convenient locations (preferably on a separate detail sheet), one or more typical paving sections shall be presented including the required dimensions of pavement width, lane widths, right-of-way width, type and thickness of pavement, subgrade, curb, driveway grades and the location of walks.

4. Special Details and Specifications

a. Special details not shown on Standard Construction Details shall be included in the plans. Structural details for bridges, special retaining walls, headwalls, junction boxes, culverts, and special inlets shall be provided as well as bridge railings, hard railings, special barricades (permanent and temporary) and warning signs. Material and installation specifications not included in the N.C.T.C.O.G. Specifications for Public Works Construction shall be submitted in writing as a part of the Special Provisions. A sequence of Construction shall be prepared where applicable, which will allow traffic movement through projects along existing streets.

b. Structural analysis computations shall be provided in a legible form for any existing structure which will act as a support or supplement to the designed facility. Items on the plans requiring special provisions and special construction techniques shall be clearly delineated on the plans and specifically called to the City’s attentions by letter prior to final plan submission.

PART 3 - DRAINAGE

3.1 STORM DRAINAGE SYSTEM

A. GENERAL

Drainage facilities shall be designed and constructed at such locations and of such size and dimensions to adequately serve the development and the contributing drainage area above the development. The developer shall provide all the necessary easements and right-of-ways required for drainage structures including storm drains and open channels, lined or unlined. Easement widths for storm drain pipelines shall not be less than fifteen (15') feet, and easement widths for open channels shall be at least twenty-five (25') feet wider than the top width of the channel. In all cases, easements shall be of an adequate size to allow proper maintenance.

The design flows for the drainage system shall be calculated by the Rational Method in accordance with standard engineering practice and in accordance with the requirements set forth in this document. Curbs, inlets, manholes, etc., shall be designed and constructed in accordance with the Standard Details. Materials and construction procedures shall conform to the requirements of the Standard Specifications for Construction.

The developer shall comply all requirements of the Environmental Protection Agency, the Texas Commission on Environmental Quality, and the U.S. Army Corps of Engineers and shall obtain all permits required by these agencies.

The developer shall provide plans and specifications and design calculations for all drainage structures. The drainage facility requirements will depend on the type of street used within the subdivision as follows:

B. SUBDIVISIONS UTILIZING COUNTRY LANES

1. Storm water may be carried in drainage ditches located adjacent to and parallel to the roadway. Outside the roadway, storm water shall be carried in enclosed pipes.

2. Ditch slopes shall not be steeper than 5:1 on the front slope and 4:1 on the back slope.

3. The velocity of the storm water in the drainage way shall not exceed 6 fps at a ten-year frequency storm event unless erosion control devices meeting the approval of the City Engineer are used.

4. Ditch flow lines slopes shall not be less than 0.75%.

5. Ditch depth shall not be less than 1.5 feet measured from the edge of pavement.

6. If any of the above criteria cannot be met, the storm water shall be carried in an enclosed pipe system.

7. Slopes steeper than 6:1 shall be solid block sodded with Bermuda grass sod.

C. SUBDIVISIONS UTILIZING CURBED STREETS

All storm water shall be carried within the paved street surface or in an enclosed pipe system or both.

Where an enclosed pipe system is required, a rock gabion lined open channel may be substituted for the pipe system when the equivalent pipe size exceeds 66-inches. For flows that

exceed the capacity of an equivalent 84-inch pipe, an unlined open channel with a concrete pilot channel constructed in accordance with Figure 3-3 may be used. All open channels that are not rock gabion lined shall be designed to prevent erosion. The methods used to prevent erosion specifically shall be approved by the City Engineer.

The design, size, type and location of all storm drainage facilities shall be subject to the approval of the City Engineer. The requirements set forth herein are considered minimum requirements. The developer and his engineer shall bear the total responsibility for the adequacy of design. The approval of the facilities by the City Engineer in no way relieves the developer of this responsibility.

The developer shall be responsible for the necessary facilities to provide drainage patterns and drainage controls such that properties within the drainage area, whether upstream or downstream of the development, are not adversely affected by storm drainage from facilities on the development.

Storm drainage released from the site will be discharged to a natural watercourse of an adequate size to control the peak runoff expected after development.

3.2 HYDROLOGY

A. DESIGN CRITERIA

The Rational Method for computing storm water runoff is to be used for the hydraulic design of facilities serving a drainage area of less than 100 acres. For drainage areas 100 acres to 1200 acres, the runoff is to be calculated by both the Rational Method and the Unit Hydrograph Method with the larger of the two values being used for hydraulic design. For drainage areas of 1200 acres and larger, the Unit Hydrograph or the U.S. Army Corps of Engineers HEC-RAS Computer program shall be used. For developments which impact designated Federal Emergency Management Agency (FEMA) flood plains, HEC-RAS or other methods designated by FEMA shall be used.

B. RAINFALL INTENSITIES

When calculating the quantity of storm runoff, rainfall intensity will be determined from the North Central Texas Council of Governments iSWM Design Manual. For design hydraulic facilities in the City of Bridgeport, the applicable formulas are as follows:

$$I_{10} = \frac{71.487}{(t_c + 11)^{0.79143}} \qquad I_{100} = \frac{111.129}{(t_c + 14)^{0.78307}}$$

Where: t_c = Rainfall duration in minutes.

I = Rainfall intensity for a 10 year and 100 year storm.

The above equations are represented graphically in Figure 3-1.

The storm frequency used for this determination will be according to the facility to be designed as listed in Table 3-1. Emergency overflows where used are to be located at sags and T-intersections of streets and designed to prevent erosion and surface water damage.

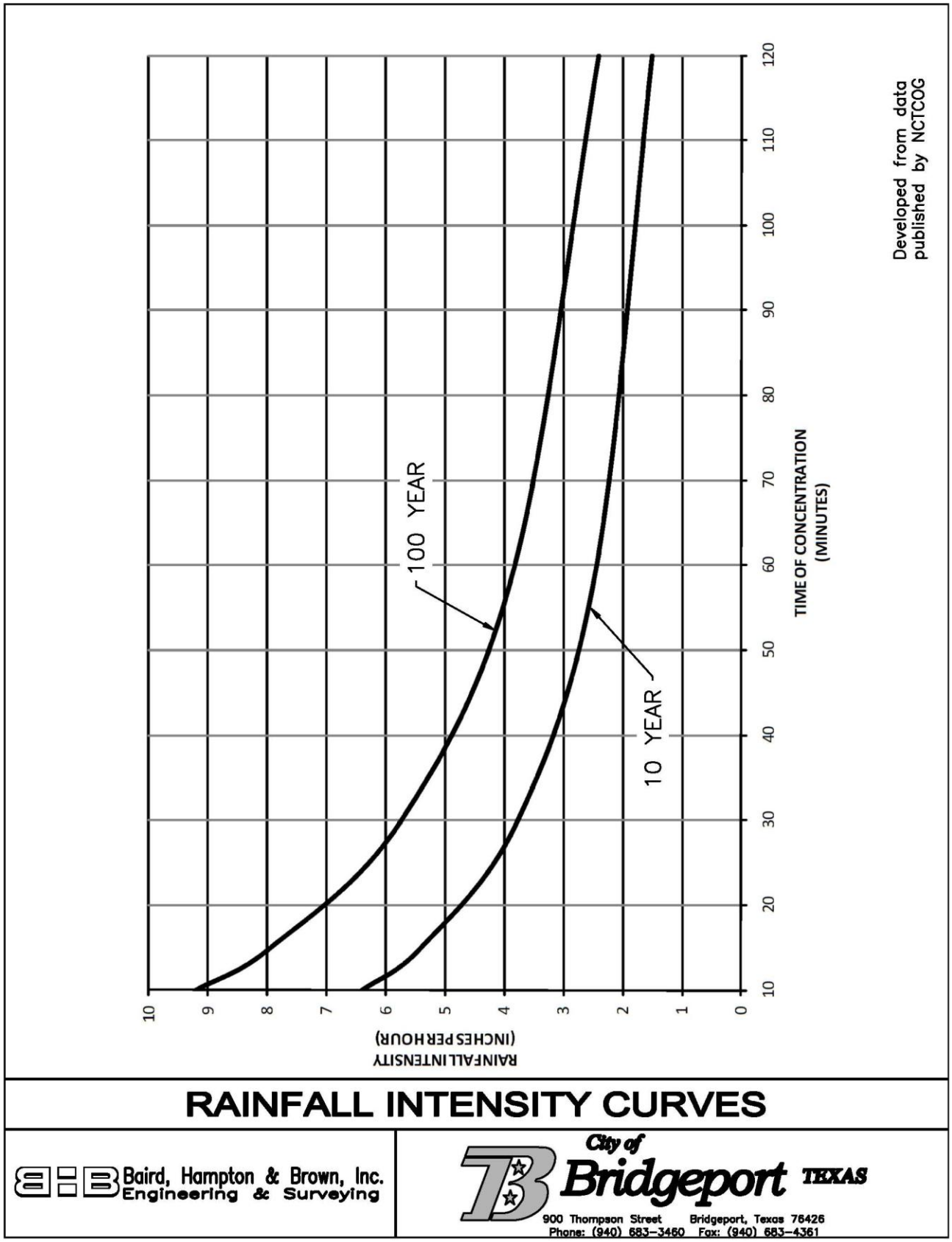


FIGURE 3-1 RAINFALL INTENSITY CURVES

TABLE 3-1 DESIGN STORM FREQUENCY

Drainage Facility	Storm Frequency
Drainage ditches located in street right-of-way used in conjunction with Country Lanes and Parkway street construction with no freeboard.	100 years
Pipe storm sewers with emergency overflow to give a combined capacity of 100-year frequency.	10 years
Pipe storm sewer with no emergency overflow.	100 years
All open channels with a minimum of 2 feet freeboard above to the top of the bank.	100 years
Culverts w/ 2.0' below top of curb. (pipe or concrete box)	100 years
Bridges, low point of bridge beams or similar bridge deck supporting structure to be 2 feet above 100-year storm or highest flood recorded, whichever is greater.	100 years

C. RATIONAL METHOD

The rational method as described in Chapter 2 of the Texas Departments of Transportation "Hydraulic Manual" shall be used to calculate runoff. The storm frequency used for this determination will be according to the facility to be designed as listed in Table 3-1. Emergency overflows, where used, are to be located at sags and T-intersection of streets and designed to prevent erosion and surface water damage.

The time of concentration to any inlet shall be determined from finished grade slopes but in no case may be less than listed in Table 3-3.

D. UNIT HYDROGRAPH METHOD

The Snyder Synthetic Unit Hydrograph method as described in Chapter 2 of the TXDOT "Hydraulic Manual" shall be used. The constants and coefficients shall be used unless documented more specific data is available:

TABLE 3-2 COEFFICIENTS "CT" AND "CP"

Drainage Area Characteristics	Approximate Value of "Ct"	Value of "Cp"
Sparsely Sewered Area		
Flat Basin Slope (less than 0.50%)	0.65	0.55
Moderate Basin Slope (0.50% to 0.80%)	0.60	0.58
Steep Basin Slope (greater than 0.80%)	0.55	0.61

Drainage Area Characteristics	Approximate Value of "Ct"	Value of "Cp"
Moderately Sewered Area		
Flat Basin Slope (less than 0.50%)	0.55	0.63
Moderate Basin Slope (0.50% to 0.80%)	0.50	0.66
Steep Basin Slope (greater than 0.80%)	0.45	0.69
Highly Sewered Area		
Flat Basin Slope (less than 0.50%)	0.45	0.70
Moderate Basin Slope (0.50% to 0.80%)	0.40	0.73
Steep Basin Slope (greater than 0.80%)	0.35	0.78

The rainfall duration shall be two hours. Initial and subsequent losses shall be 1.11 inches.

E. DESIGN ACCORDING TO FEMA-FIA REQUIREMENTS

All streams have floodway or flood plains designation by FEMA-FIA must be designed to meet the requirements of these agencies.

3.3 RUNOFF COEFFICIENTS AND TIME OF CONCENTRATION

Runoff coefficients, as shown in Table 3-3, shall be the minimum used, based on total development under existing land zoning regulations. Where land uses other than those listed in Table 3-3 are planned, a coefficient shall be developed utilizing values comparable to those shown. Larger coefficients may be used if considered appropriate to the project by the City Engineer.

Times of concentration shall be computed as shown in Chapter 7, HYDROLOGY, of the Texas Department of Transportation, "Hydraulic Manual," latest edition.

3.4 DESIGN OF DRAINAGE FACILITIES

A. FLOW IN GUTTERS AND INLET LOCATIONS

Storm drain conduits shall begin at the point where the depth of flow based on the 100-year storm frequency reaches a point not greater than 1-inch over the top of curb. For pavement sections that do not have curbs, including alleys, the 100-year storm shall be contained within the right-of-way. Inlets are then located as necessary to remove the flow based on a 10-year storm frequency. If, in the judgment of the Engineer, the flow in the gutter would be excessive under either of these conditions, then consideration should be given to extending the storm sewer to a point where the gutter flow can be intercepted by more reasonable inlet locations. Multiple inlets at a single location are permitted in extenuating circumstances. Where possible, inlets should be placed upstream from an intersection to prevent large amounts of water from running through intersections. Inlets should also be located on the approach street to an intersection and in alleys where necessary to prevent water from entering these intersections in amounts that would cause the allowed street capacity to be exceeded.

TABLE 3-3 RUNOFF COEFFICIENTS AND MINIMUM INLET TIMES

Zone	Zoning District Name	Run-off Coefficient "C"	Min. Inlet Time in Minutes
A	Agricultural	0.30	20
SF-E	Single Family Residential-1	0.45	15
SF-1	Single Family Residential-2	0.55	15
SF-2	Single Family Residential-3	0.60	15
TF	Two Family Duplex	0.65	15
MH-1	Manufactured home	0.70	10
MH-2	Mobile Home Park	0.90	10
MF	Multi-Family	0.90	10
C-1	Light Commercial	0.90	10
C-2	Heavy Commercial	0.90	10
M-1	Manufacturing - Industrial	0.70 to 0.95	10
FP	Flood Plain	0.40	20
NON-ZONED LAND USES			
Church		0.70 to 0.90	10
School		0.50 to 0.90	10
Park		0.30 to 0.70	10
Cemetery		0.30 to 0.50	15
Street & Highway Right-of-Way		0.95	10

NOTE: Use appropriate "C" coefficient and inlet times for various types of development.

The use of the street for carrying storm water shall be limited to the following:

B. SPREAD OF WATER - 10 YEAR STORM FREQUENCY

Class 1 Streets with curbs and gutters - One traffic lane on each side to remain clear.

Class 2 Street - One traffic lane to remain clear.

Class 3 Streets with curb and gutters - Six-inch (6") depth of flow at curb or no lanes completely clear.

Alleys - Contained within the paved surface.

For Country Lanes thoroughfares, the spread of water shall be based on a 100-year storm frequency. All storm water must be contained within the right-of-way. The depth of flow shall not exceed the roadway crown elevation.

C. SPREAD OF WATER - 100 YEAR STORM FREQUENCY

Notwithstanding the requirements above, all storm water in the 100-year storm frequency shall be contained within the street or alley right-of-way or within the drainage easement. The water depth shall not be greater than 1" over any curb.

D. CAPACITY OF STREETS AND ALLEYS

Computation of the capacity of streets and alleys having a straight cross slope can be determined using the nomograph in figure 3-2 which was adopted from the Texas Department of Transportation, "Hydraulic Manual." The capacity of streets with parabolic crowns may be calculated from this nomograph using the composite section that most closely approximates the parabolic section. All street and alley capacities shall be calculated using a roughness coefficient of n = 0.016.

In residential areas where the standard alley section capacity is exceeded, curbs may be used to provide needed capacity. However, all storm drainage shall be contained in the alley right-of-way and may not encroach onto private property especially at connecting driveways.

E. CAPACITY OF CHANNELS

The capacity of channels and swales can be calculated according to the Manning Equation as given in Chapter 6 of the Texas Department of Transportation "Hydraulic Manual." All calculations shall be made using a roughness coefficient of n = 0.035.

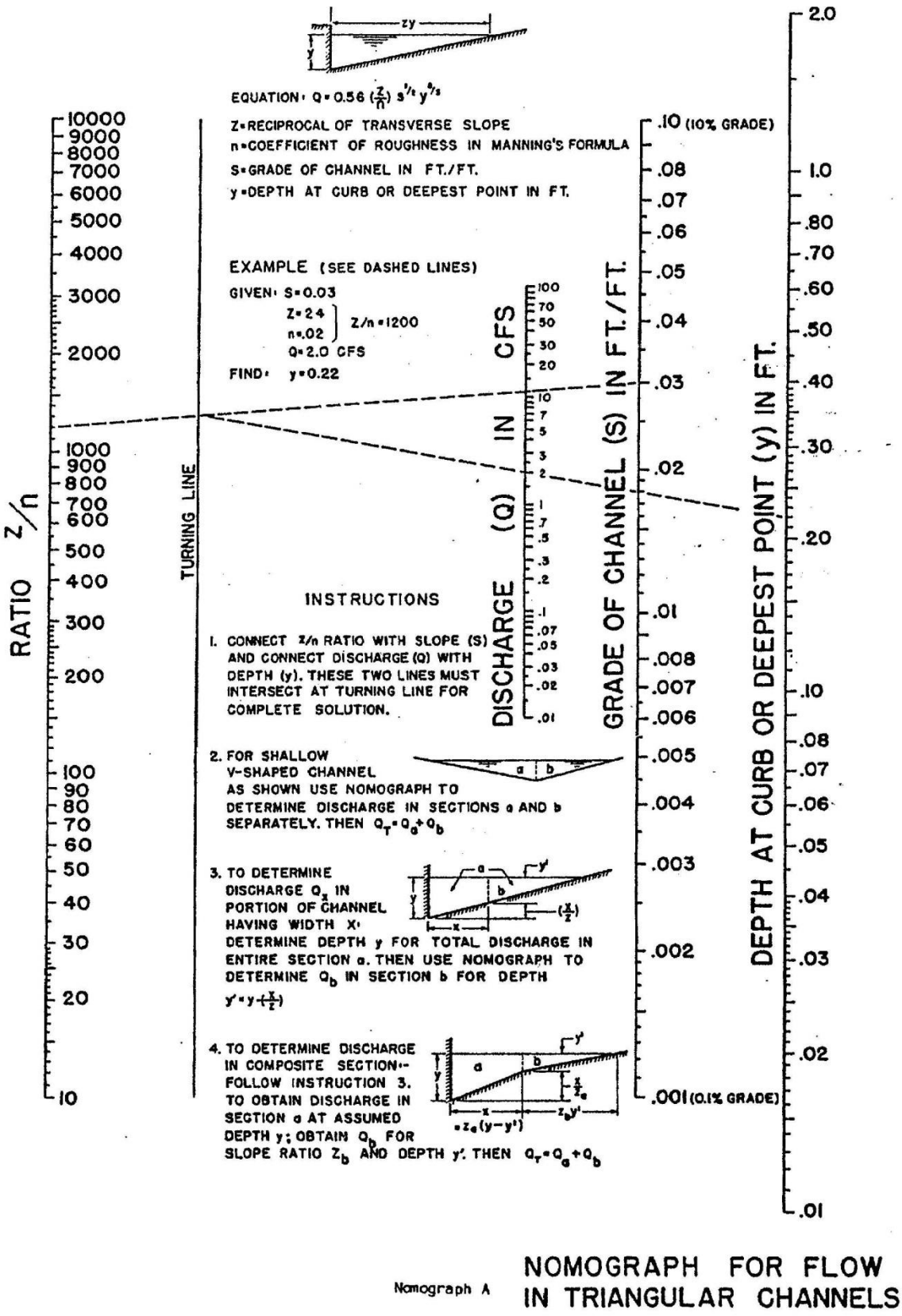
F. VALLEY GUTTERS

The use of valley gutters to convey storm water across a street intersection is subject to the following criteria:

1. A Class 1 street shall not be crossed with a valley gutter.

2. Wherever feasible, a Class 2 street shall not be crossed with a valley gutter.

3. At any intersection, perpendicular valley gutters will not be permitted and parallel valley gutters should cross only the lower classified street.



Nomograph A

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

BRIDGE DIVISION HYDRAULIC MANUAL
6 - 20

FIGURE 3-2 NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

G. SIZING AND LOCATION OF INLETS

For determining the size and locations of inlets, the following shall be used as a minimum:

TABLE 3-4 INLET OPENING REQUIREMENTS

Street Grade	Length of Inlet Opening for Each C.F.S. of Gutter Flow
Sags	0.6 Feet
Less than 2%	1.0 Feet
Greater than 3.5%	2.0 Feet

Inlets shall be spaced no closer than 300 feet apart without special permission from the City. The maximum length of an inlet at one location shall be 20 feet on each side of the street.

No more than 5 cfs can cross intersections in residential areas and no bypass of storm water across major intersections shall be allowed.

H. HYDRAULIC GRADIENT OF CONDUITS

After the computation of the quantity of storm runoff entering each inlet, the size and gradient of pipe required to carry off the design storm are to be determined. All hydraulic gradient calculations shall begin at the outfall of the system. The following are the criteria for the starting elevation of the hydraulic gradient:

1. The 100-year water surface elevation in a creek, stream or other open channel is to be calculated for the time of peak pipe discharge in the same storm and that elevation used for beginning the hydraulic gradient.

2. When a proposed storm sewer is to be connected to an existing storm sewer system that has a design flow less than the proposed, the hydraulic gradient for the proposed storm sewer should start at the elevation of the existing storm sewers hydraulics gradient based on the proposed design year of the upstream system.

I. HYDRAULIC DESIGN OF CLOSED CONDUITS

All closed conduits shall be hydraulically designed for full flow as shown in Chapter 6, STORM DRAINS, of the Texas Department of Transportation, “Hydraulic Manual.”

The crown of the pipe should be near the elevation of the hydraulic gradient, in most cases, to eliminate excessive excavation. The hydraulic gradient shall not be designed above the top of any inlet. The permissible difference between the hydraulic gradient and top of curb is normally 2 feet or 1.5 $V^2/2g$ where V is the velocity in feet per second and g is 32.2 feet per second. The hydraulic gradient in the inlet shall not be higher than 1 foot below the top of the inlet.

J. VELOCITY IN CLOSED CONDUITS

Pipe grade shall be set to produce a velocity of not less than 3 feet per second (fps) when flowing full. Grades producing velocities of less than 3 fps will not be allowed. All storm sewer pipe and driveway culverts shall be a minimum of 18 inches in diameter. Discharge velocity shall be calculated with a tailwater depth not greater than the lesser of the top of the pipe at the pipe outlet or the actual 100-year water surface elevation in the channel.

Table 3-5 shows the maximum allowable velocities in closed conduits:

TABLE 3-5 RECOMMENDED MAXIMUM VELOCITY

Type of Conduit	Maximum Velocity
Culverts	15.0 fps
Inlet Laterals	15.0 fps
Storm Sewers	12.5 fps

Discharge velocities cannot exceed the permitted velocity of the channel or conduit at the outfall.

K. ROUGHNESS COEFFICIENTS FOR CONDUITS

The recommended value for the roughness coefficient "n" for concrete conduits with smooth joints and good alignment is 0.013. Where engineering judgment indicates a value other than 0.013 be used, the appropriate adjustments should be made in the calculations and the variance noted.

L. HEAD LOSSES

The minimum head loss to be used at wyes, junctions, manholes and pipe size changes for storm drainage is 0.10 foot.

1. Head losses and gains for wyes and pipe size changes will be calculated by the formulas:

Where $V_1 < V_2$

$$H_1 = \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$$

Where $V_1 > V_2$

$$H_1 = \frac{V_2^2}{4g} - \frac{V_1^2}{4g}$$

Where:

H_1 = the head loss in feet measured at the point of wye or pipe size change.
V_1 = upstream velocity
V_2 = downstream velocity

2. Head losses and gains for manholes and junction boxes will be calculated by the formula:

$$H_1 = \frac{V_2^2}{2g} - \frac{KV_1^2}{2g}$$

Where:

H_1 = the head loss in feet measured from the downstream water surface elevation.
V_1 = upstream velocity or velocity in the lateral
V_2 = the downstream velocity

K = 0.35 for 90º Lateral
K = 0.43 for 60º Lateral
K = 0.50 for 45º Lateral
K = 0.25 for Thru Line

3. Head losses for pipe bends will be calculated by the formula:

$$H_1 = K\frac{V^2}{2g}$$

Where:

H_1 = the head loss in feet measured at the upstream end of the bend.
V = the pipe velocity
K = 0.50 for 90º Bend
K = 0.43 for 60º Bend
K = 0.35 for 45º Bend
K = 0.20 for 22.5º Bend

The use of pipe bends is discouraged and will be allowed only in special situations with the permission of the City Engineer.

4. In the case where the inlet is at the very beginning of a line, the equation becomes the following without any velocity of approach:

$$H_1 = K_1\frac{V^2}{2g}$$

Where: $K_1 = 1.25$

M. OPEN CHANNELS

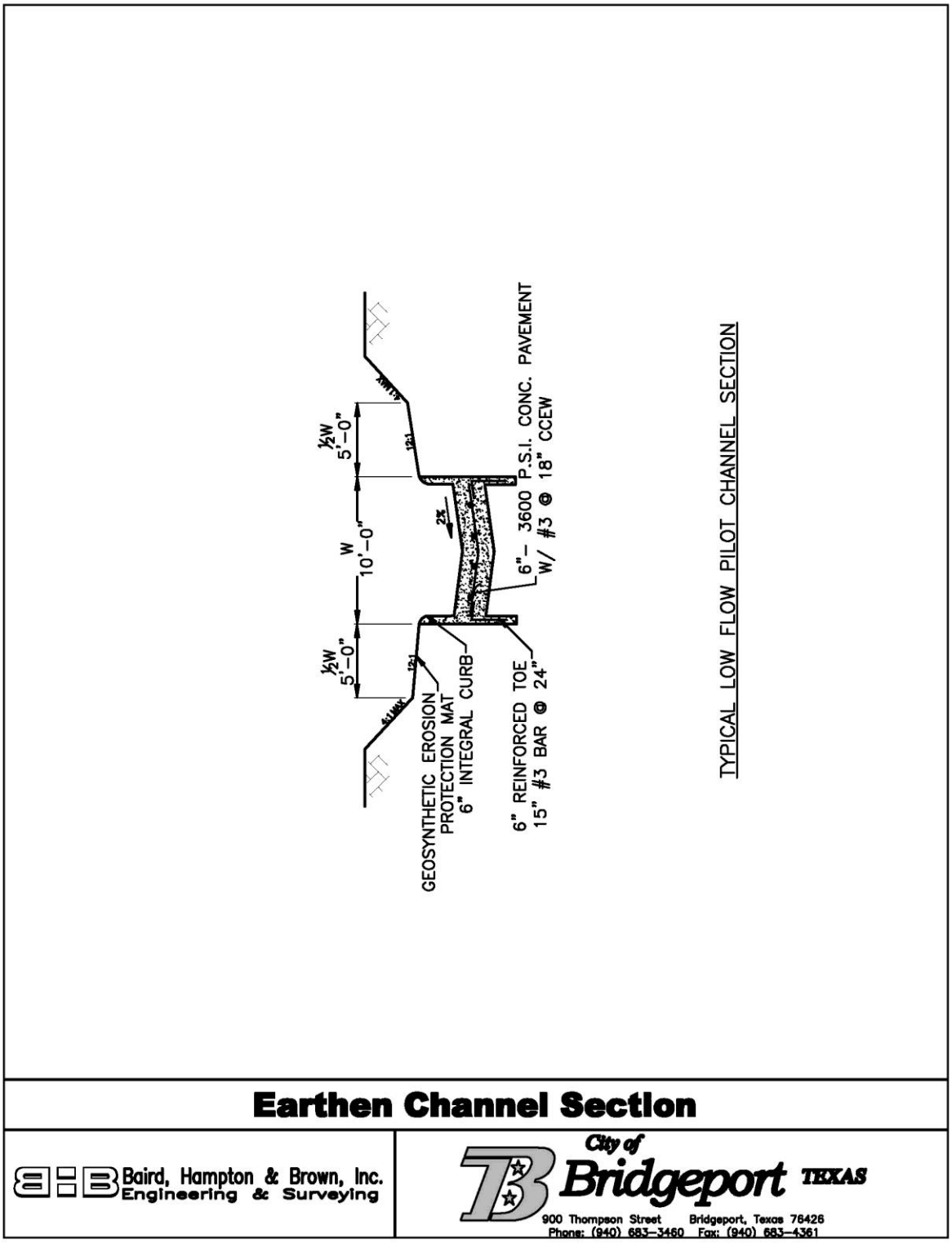
Open channels may be used to convey storm waters where closed conduits are not justified economically. In general, the use of existing channels in their natural condition is strongly encouraged. The use of lined channels should be avoided where possible. Where unavoidable, the design should consider the visual impact on the surrounding area. A wide variety of lined, partially lined or unlined channels are permitted except that lined channels may not be constructed in single family, or multi-family residential developments. Continuous adjacent landscaping of at least 4 feet in height must screen all lined channels. Low flow pilot channel lining of earthen channels will be required for any earthen channel carrying more than the capacity of an equivalent 84" diameter pipe. The design of the low flow pilot channel shall be as shown in Figure 3-3.

For residential developments, no more than two-barrel box culverts will be permitted for stream crossings, except in unusual conditions. For unlined channel sections, the maximum side slopes are 4:1 and the maximum permitted mean velocity in the channel is 6 feet per second. Channel side slopes that are steeper than 5:1 shall be hydro mulched in accordance with sections 2.15.3 and 3.10.7 of the NCTCOG Specifications and addenda. Temporary erosion control per Section 3.12 of the NCTCOG specifications is required for all channels.

For lined portions of channel sections, the sides may be vertical if the height of vertical wall does not exceed 3 feet. Paved and riprapped slopes shall have a maximum side slope of 2:1. Permitted velocities in totally lined channels are 15 feet per second for finished concrete and 10

feet per second for rock riprap. Discharge velocities from lined channels may not exceed 6 feet per second. The minimum velocity in any channel shall be greater the 2 fps, including roadway ditches.

FIGURE 3-3 TYPICAL LOW FLOW PILOT CHANNEL SECTION



N. HYDRAULIC DESIGN OF OPEN CHANNELS

The water surface as designed in an open channel is to be a minimum of 1 foot below the top of the channel section for concrete lined channels and 2 feet below the top of the channel section for rock rip-rap and earthen channels to provide a margin of safety for channel obstructions and for flows that exceed the design storm frequency.

Special care must be taken at entrances to closed conduits and culverts to provide for the headwater requirements.

On all channels the water surface elevation, which is coincident with the hydraulic gradient, shall be calculated and shown on the construction plans.

Maximum allowable velocities and roughness coefficients for open channels are shown in Table 3-6. When the normal available grade would cause velocities in excess of the maximums, it may be necessary to design special drops or channel retards.

O. HYDRAULIC DESIGN OF CULVERTS

In the design of culverts, the Engineer shall keep head losses and velocities within reasonable limits while selecting the most economical structure. This normally requires selecting a structure that creates a headwater condition and has a velocity of flow safely below the allowed maximum.

The vertical distance between the upstream design water surface and the roadway or bridge elevation is termed “freeboard.” The dimension is included as a safety factor to protect against unusual clogging of the culvert and to provide a margin for future modifications in surrounding physical conditions. Normally, a minimum of 2 feet shall be considered a reasonable freeboard when the structure is designed to pass a design storm frequency of 100 years. Unusual surrounding physical conditions may be cause for a change in this requirement. Hydraulic design of culverts shall be in accordance with Chapter 4, CULVERTS, of the Texas Department of Transportation, “Hydraulic Manual.”

P. HEADWALLS AND ENTRANCE CONDITIONS

Headwalls are to be used to protect the embankment from erosion and the culvert from displacement. Sloped headwalls conforming to the minimum slope specified in this Design Manual shall be constructed at the end of all pipe drainage facilities and vertical headwalls with wingwalls and aprons shall be constructed for all rectangular shaped hydraulic structures.

Special headwalls and wingwalls may be required at the entrance of all hydraulic structures where approach velocities are in excess of 8 feet per second. Culvert exit and headwall shall be designed such as the flow line of the culvert is coincident with the flow line of the stream or channel into which the culvert discharges.

The maximum exit velocity from the culvert is limited to the maximum velocity allowed in the stream or channel. Concrete riprap, rock riprap, gabions or other approved structural method shall be used to protect the streambed from scour and erosion. The riprap shall be reinforced and have toe walls to prevent undermining.

TABLE 3-6 ROUGHNESS COEFFICIENTS FOR OPEN CHANNEL

Description	Minimum Roughness Coefficient	Maximum Channel Velocity
NATURAL STREAMS		
Moderately Well-defined Channel		
Grass & Weeds, Little Brush	0.030	6
Dense Weeds, Little Brush	0.040	6
Weeds, Light Brush on Banks	0.045	6
Weeds, Heavy Brush on Banks	0.060	6
Weeds, Dense Willows on Banks	0.080	6
Irregular Channel With Pools and Meanders		
Grass & Weeds, Little Brush	0.045	6
Dense Weeds, Little Brush	0.050	6
Weeds, Light Brush on Banks	0.060	6
Weeds, Heavy Brush on Banks	0.070	6
Weeds, Dense Willows on Banks	0.100	6
Flood Plain, Pasture		
Short Grass, No Brush	0.035	6
Tall Grass, No Brush	0.050	6
Flood Plain, Cultivated		
No Grass	0.035	6
Mature Crops	0.050	6
Flood Plain, Uncleared		
Heavy Weeds, Light Brush	0.070	6
Medium to Dense Brush	0.160	6
Trees With Flood Stage Below Branches	0.120	6
UNLINED VEGETATED CHANNELS		
Mowed Grass, Clay Soil	0.030	6
LINED CHANNELS		
Smooth Finished Concrete	0.016	15
Rip-Rap, Rubble or Gabions	0.040	10

Q. Headwalls and Exit Conditions

Headwalls are used to protect the embankment from erosion and the culvert from displacement. The headwalls, with or without wing walls and aprons, shall be constructed in accordance with the standard drawings as required by the physical conditions of the particular installation.

Culvert exit and headwall shall be designed such that the flow line of the culvert is coincident with the flow line of the stream or channel into which the culvert discharges. The maximum exit velocity from the culvert is limited to the maximum velocity allowed in the stream or channel.

Due to the geometry of the culvert-stream intersection, turbulence or other conditions may tend to produce erosion. Concrete riprap will be used to protect the streambed from scour and erosion. The riprap shall be reinforced and have toe walls to prevent undermining.

R. Bridge Design Hydraulics

Once a design discharge and a downstream depth of flow have been determined, the size of the bridge opening can be determined. Determination of head losses through bridge structures shall be calculated.

The City of Bridgeport has the following policy with regard to the hydraulic design of bridge structures:

1. Minor head loss due to the structure is allowed. Normal losses due to channel cross sections are allowable.

2. Excavation of the natural channel is not normally allowed as compensation for loss of cross sectional area.

3. Channelization upstream or downstream of the proposed bridge will normally not be permitted.

4. Hydraulic design for bridges shall conform to the requirements of Chapter 5, BRIDGES, of the Texas Department of Transportation, “Hydraulic Manual.”

5. A 2 foot freeboard is required between the designed water surface and the bottom of the lowest beam.

6. Bridge design shall meet all FEMA requirements when a designated floodway is crossed.

S. Small Urban Area On-Site Detention Ponds

On-site detention facilities serve to control excess runoff from a particular site or subdivision. A detention facility’s use is particularly beneficial in situations where a site’s storm water runoff discharges into a system with limited flow capacity. Onsite detention is not typically required, and will be considered on a case by case basis. The following is a listing of general as well as some specific design criteria for on-site detention ponds.

1. General Criteria for On-Site Detention

a. The rate of outflow from the on-site detention facility shall be based on R-1 (Single-Family) developed peak flow. The 100 year return frequency storm is to be used to determine the volume of detention storage required. In addition, the outlet structure shall be designed such that peak discharges are not increased for 10-year and 100-year storm frequencies.

b. The rate of inflow to the detention facility must be calculated based on the assumption of full development of the site.

c. Outlet structures shall be capable of safely and properly passing the runoff flow for the entire drainage area both on and off site for the 100 year return frequency storm. The outflow structure shall discharge flows at a non-erosive rate.

d. No outlet structures from detention, filtration and/or sedimentation ponds, parking detention or other concentrating structures shall be designed to discharge concentrated flow directly onto arterial or collector streets. Such discharges shall be conveyed by a closed conduit to the nearest existing storm sewer. If there is no existing storm sewer within 300 feet, the outlet design shall revert the discharge back to street flow, following as nearly as possible the direction of the gutter. Any variances from this design will require approval by the City Engineer.

e. Storm runoff can be detained within parking lots; however, the engineer should be aware of the inconvenience to both pedestrians and traffic. The location of ponding areas in a parking lot should be planned so that this condition is minimized. Stormwater ponding in parking lots are limited to an average of eight (8) inches with a maximum of 12 inches for the 100 year return frequency storm.

f. When a site is situated such that off-site flows will be draining through the property and into the pond, provisions must be made in the overflow system for these flows. The engineer should understand that by mixing of on-site with off-site flows tend to produce inefficiencies in the pond. These criteria should not be confused with in-channel detention which is discussed below.

g. A detention pond that is placed within an existing channel that is accessed by more than one development shall be referred to as an in-channel detention pond. In this situation the engineer is required to perform a multi-hydrograph analysis which details the relationship of the existing site, the developed site with detention, and the channel. There shall be no increase at any point in the rising limb of the hydrographs when comparing the existing and developed detention hydrographs.

h. When designing ponds in series (i.e., when the discharge of one (1) becomes the inflow of another), the engineer shall submit a hydrologic analysis which demonstrates the system's adequacy. This analysis shall incorporate the construction of hydrographs for all inflow and outflow components.

i. Areas which do not discharge into a detention pond (un-detained flows) must be accounted for by a reduction in the allowable release rate from the detention pond equal to the discharge from the un-detained area.

j. All pipes discharging into a public storm sewer system shall have a minimum diameter of 12 inches and shall be constructed of reinforced concrete. An exception can be made for discharge pipes from a filtrations system.

2. Detention Pond Storage Determination

There are several methods for determining the runoff storage volume required for a detention pond. The design engineer shall review the design method to be used with the City engineer prior to beginning the design of the detention facility. An accepted method to be used for small drainage areas (less than 25 acres) is the modified Rational Method (MRM). For drainage areas 25 acres and greater, a hydrograph method shall be used.

a. Modified Rational Method (MRM)

The MRM was derived from the Rational Method. This methodology determines the duration which produces the total volume of runoff above the existing peak. The MRM design shall be limited to sites with contributing areas less than 25 acres.

The MRM is based on the same assumptions as the Rational Method. The most significant assumption is that the period of rainfall averaging is equal to the duration of the storm. This means that the rain and the corresponding runoff that occurs before and after the rainfall averaging period are not accounted for. Experience in comparing detention facility volumes obtained with the Modified Rational Method to those obtained with other methods, suggest that significant underestimates of required storage volumes may result for drainage areas larger than 25 acres.

The MRM method also assumes that an urban runoff hydrograph can be approximated as having either a triangular or trapezoidal shape. This assumption is equivalent to assuming that the contributing drainage area increases approximately linearly with time; that is, there is a linear area-time relationship for the drainage area.

The MRM is a graphical procedure to estimate the detention storage volume. The Modified Rational Method graphical procedure is only applicable for detention storage volume estimation for a single-storm event and shall not be used when a storage routing procedure is required.

3. Outlet Structure Design

There are two basic types of outlet control structures: those incorporating orifice flow and those incorporating weir flow. Weir flow is additionally broken down into two categories: rectangular and v-notch types. In each type, the bottom edge of the weir over which the water flows in called a crest. Two common types of rectangular weirs are the sharp-crested and broad crested weirs.

Generally, if the crest thickness is more than 60% of the nappe thickness, the weir should be considered broad-crested. The coefficients for sharp-crested and broad-crested weirs vary. The design engineer shall submit weir coefficients to the city engineer for approval prior to beginning the design of the weir.

a. Rectangular Weir Flow Equations

$$Q = C_d (L - 0.2H) H^{3/2}$$

Where

Q= Weir Flow, cubic feet per second
C_d= Coefficient of discharge
L= Wier Length, feet
H= Depth of Flow, feet

b. V-notch Weir Flow Equation

$$Q = C_d \frac{8}{15} \sqrt{2g} \tan(\theta/2) H^{5/2}$$

Where

Q= Weir Flow, cubic feet per second
C_d= Coefficient of discharge

θ= Angle of the Notch at the Apex (degrees)

c. Orifice Flow Equation

$$Q = C_d A_O \sqrt{2gH}$$ $Q= C_oA_o (2gH)^{0.5}$

Where

Q= Orifice Flow, cubic feet per second
C_d= Coefficient of discharge
A_o= Orifice Area, square feet
g= Gravitational Constant, 32.2 ft/sec^2
H = Head on Orifice measured from orifice centerline, feet

3.5 CONSTRUCTION PLANS PREPARATION

A. DRAINAGE AREA MAP

The drainage area map shall have a minimum scale of 1' = 200', and show the street right-of-way. For large drainage areas, a map having a minimum scale of 1' = 2000' is usually sufficient.

The following items/information shall be included:

1. Acres, coefficient, and intensity for each drainage sub-area;
2. Inlets, their size and location, the flow bypass for each, the direction of flow as indicated by flow arrows, the station for the centerline of the line;
3. A charge including data shown shall be submitted with the first review, and included on the map with the final review;
4. Existing and proposed storm sewers;
5. Sub-areas for alleys, streets, and off-site areas;
6. Points of concentration;
7. Runoff to all inlets, dead-end streets, and alleys or to adjacent additions and/or lots;
8. A table for runoff computations;
9. Flow arrows to indicate all crests, sags and street and alley intersections;
10. North arrow;
11. Any off-site drainage shall be included;
12. Street names shall be indicated;
13. 100-year floodplain shall be indicated on the drainage area map.

When calculating runoff, the drainage area map shall show the boundary of the drainage area contributing runoff into the proposed system. This boundary should be determined from a map

having a maximum contour interval of 2 feet. The area shall be further divided into sub-areas to determine flow concentration points or inlet locations. The centerline of all streets (except Residential of Local Streets) will normally be a boundary of a drainage area, to insure that inlets are sized and positioned to fill the need without depending on storm water crossing over the street crown for proper drainage.

In residential areas, the centerline of the street will only be used as a drainage area boundary if the flow in either gutter has not exceeded the street crown elevation.

Direction of flow within streets, alleys, natural and man-made drainage ways, and at all system intersections, shall be clearly shown on the drainage area map and/or paving plans. Existing and proposed drainage inlets, storm sewer pipe systems and drainage channels shall also be clearly shown and identified on the drainage area map. Storm sewers shall show and mark station tic marks at 100-foot intervals. Plan-profile storm sewer or drainage improvement sheet limits and match lines shall be shown with pipes and channels identified.

The drainage area map should show enough topography to easily determine its location within the City.

B. PLAN-PROFILE SHEETS

1. Inlets

Inlets shall be given the same number designation as the area or sub-area contributing runoff to the inlet. The inlet number designation shall be shown opposite the inlet. Inlets shall be located at or immediately downstream of drainage concentration points. At intersections, where possible, the end of the inlet shall be ten feet from the curb return P.T., and the inlet location shall also provide minimum interference with the use of adjacent property. Inlets in residential areas should be located in streets and alleys so the driveway access is not prohibited to the lots. Inlets located directly above storm sewer lines, as well as laterals passing through an inlet, shall be avoided. Drainage from abutting properties shall not be impaired, and shall be designed into the storm drainage system.

Data opposite each inlet shall include paving or storm sewer stationing at centerline of inlet, size and type of inlet number or designation, top of curb elevation and flow line of inlet as shown on construction plans.

2. Laterals

Inlet laterals leading to storm sewers, where possible, shall enter the inlet and the storm drain main at a 60-degree angle from the street side. Laterals shall be four feet from top of curb to flow line of inlet, unless utilities or storm sewer depth requires otherwise. Laterals shall not enter the corners or bottoms of inlets. Lateral profiles shall be drawn showing appropriate information including the hydraulic gradient and utility crossings. Short lateral (30 feet or less) crossings utility lines will be profiled.

3. Storm Sewer

In the plan view, the storm sewer designations, size of pipe, and length of each size pipe shall be shown adjacent to the storm sewer. The sewer plan shall be stationed at one hundred (100) foot intervals, and each sheet shall begin and end with even or fifty (50) foot stationing. All storm sewer components shall be stationed.

The profile portion of the storm sewer plan-profile sheet shall show the existing and proposed ground profile along the centerline of the proposed sewer, the hydraulic gradient

of the sewer, the proposed storm sewer, and utilities that intersect the alignment of the proposed storm sewer. Also, shown shall be the diameter of the proposed pipe in inches, and the physical grade in percent. Hydraulic data for each length of storm sewer between interception points shall be shown on the profile. This data shall consist of pipe diameter in inches, the 100-year design storm discharge in cubic feet per second, slope of hydraulic gradient in percent, Manning capacity of the pipe flowing full in cubic feet per second, velocity in feet per second, and $V^2/2g$. Also, the head loss at each interception point shall be shown.

Elevations of the flow line of the proposed storm sewer shall be shown at one hundred (100) foot intervals on the profile. Stationing and flow line elevations shall also be shown at all pipe grade changes, pipe size changes, lateral connections, manholes and wye connections. All soffits shall be connected.

4. Creek Cross-Sections

All plan sheets shall be drawn in ink on 24" x 36" material, to a standard engineering scale, and shall be clearly legible when sheets are reduced to half scale. After each review, all review comments shall be addressed, additional data incorporated, and drafting of plans completed. Each plan-profile sheet shall have a benchmark shown.

3.6 CHECK LIST FOR STORM DRAINAGE PLANS

A. DRAINAGE AREA MAP

1. Normally, use 1" = 200' scale for on-site, and 1" = 400" for off-site. Show match lines between any two (2) or more maps.
2. Show existing and proposed storm drains and inlets with designations.
3. Indicate sub-areas for alley, street, and off-site areas.
4. Indicate contours on map for on and off-site.
5. Use design criteria as shown in design manual.
6. Indicate zoning on drainage area map.
7. Show points of concentration and their designations.
8. Indicate runoff at all inlets, dead-end streets and alleys, or to and from adjacent additions or acreage.
9. Provide runoff calculations for all areas showing acreage, runoff coefficient, and inlet time. (Q = CIA table)
10. For cumulative runoff, show calculations.
11. Indicate all crests, sags, and street and alley intersections with flow arrows.
12. Identify direction of north to top page or to the left.
13. Show limits of 100-year fully developed flood plain on drainage area map.

B. STORM SEWERS

1. Diversion of flow from one natural drainage area to another will not be allowed.

2. Show plan and profile of all storm sewers.

3. Specify Class III pipe unless otherwise noted.

4. Use heavier than Class III pipes where crossing railroads, areas of deep fill and areas subjected to heavy loads.

5. Specify concrete strength for all structures. The minimum allowable is 3600 psi.

6. Provide inlets where street capacity is exceeded. Provide inlets where alley runoff exceeds intersecting street capacity.

7. Do not allow storm water flow from streets into alleys.

8. Do not use high velocities in storm sewer design. A maximum discharge velocity of six (6) fps. at the outfall is required. Velocity dissipation may be necessary to reduce erosion.

9. Flumes may not be allowed unless specifically designated, and will not be allowed on Class 1 & 2 thoroughfares.

10. Provide headwalls and aprons for all storm sewer outfalls. Provide rip-rap around headwalls where slopes exceed 4:1.

11. Discharge flow lines of storm sewers to be two (2) feet above the flow line or creeks and channels, unless channel lining is present. Energy dissipation shall be provided when specified by the City Engineer.

12. Where fill is proposed for trench cut in creeks or outfall ditches, compaction shall be 95% of the maximum density as determined by ASTM D 698.

13. Investigations shall be made by the engineer to validate the adequacy of the storm sewer outfall to a major stream.

14. Outfall area must have adequate capacity to carry the discharge. Provide erosion control facilities with hydraulic data.

15. Any off-site drainage work or discharge to downstream property will require an easement. Easements shall be sized such that the developed flows can be conveyed within the easement. Submit field notes for off-site easement that may be required (Private development only).

C. PLAN AND PROFILE

1. Indicate property lines and lot lines along storm sewers, and show easements with dimensions.

2. If necessary, provide separate plan and profile of storm sewers. The storm drain pipes should also be shown on paving plans with a dashed line, and on sanitary sewer profiles showing the full pipe section.

3. Tie storm sewer system stationing with paving stations.

4. Show pipe sizes in plan and profile.

5. Show hydraulics on each segment of pipe profile to include: Q_{10}, Q_{100}, C = Manning full flow capacity; S, V, $V^2/2g$.

6. Show curve data for all storm sewer system.

7. Show all existing utilities in plan and profile. On storm sewer profiles, as a minimum, the sanitary sewer profile will be shown.

8. Indicate existing and proposed ground line and improvements on all street, alley, and storm sewer profiles.

9. Show future streets and grades where applicable.

10. Where connections are made to existing storm sewer show computations on existing system when available. HGL will be calculated from the outfall to the connection point including the designed flows of the added on systems.

11. Indicate flow line elevations of storm sewers on profile, show pipe slope (percent grade). Match top inside of pipe where adjacent to other size pipe.

12. Intersect laterals at sixty (60) degrees with truck line.

13. Show details of all junction boxes, headwalls, storm sewers, flumes, ad manholes, when more than one pipe intersects the drainage facility or any other item is not a standard detail.

14. Pipe direction changes will be curves using radius pipe unless approved by the City Engineer.

15. Bends in pipe may be used in unusual circumstances with approval of the City Engineer. No bend at one location may exceed thirty (30) degrees.

16. Do not use 90-degree (90) turns on storm sewers or outfalls. Provide good alignment with junction structures or manholes (for small systems).

17. Profile outfall with typical flat bottom section.

18. Show all hydraulics, velocity head changes, gradients, and computations.

19. Show water surface at outfall or storm drain.

20. On all dead-end streets and alleys, show grade out to “daylight” for drainage on the profiles and provide erosion control. Show typical section and slope of “daylight” drainage. Side slopes shall not exceed 4:1.

21. At sags in pavement, provide a positive overflow (paved sidewalk in a swale) to act as a safety path for failure of the storm drain system. Minimum finished floor elevations will be shown on the plat to protect building against flooding should the positive overflow be used.

22. Where quantities of runoff are shown on plans or profiles, indicate storm frequency design.

23. Provide sections for road, railroad and other ditches with profiles and hydraulic computations. Show design water surface on profile.

24. For drainage ditches located in street right-of-way running parallel to street paving, show the size of each driveway culvert on the ditch profile. Assume the maximum number and width of driveways allowed for each lot. Show the hydraulic grade lines as required herein.

D. LATERALS

1. Show laterals on trunk profile with stations.

2. Provide lateral profiles for laterals exceeding thirty (30) feet in length.

3. Where laterals tie into trunk lines, place at sixty (60) degree angles with centerlines. Connect them so that the longitudinal centers intersect.

4. Calculate hydraulic grade line for laterals and inlets to insure collection of storm water. Check 1.5 $V^2/2g$, using trunk line velocity on laterals less than 80-feet long. Final the H.G. at the gutter or inlet lip by adding the 1.5 $V^2/2g$ to the hydraulic gradient of the trunk line at the lateral connection. For all inlets, provide HGL, and hydraulic data on profile for all profiled laterals. Laterals longer than eighty (80) feet require special analysis.

5. All inlets shall have a minimum eighteen in (18") laterals.

E. INLETS AND INTAKES

1. Provide inlets where street capacity is exceeded. Provide inlets where runoff from alley causes the capacity of the intersecting street to be exceeded.

2. Indicate runoff concentrating at all inlets and direction of flow. Show runoff for all stub outs, pipes and intakes.

3. On plan view, indicate size of inlet, lateral size, flow line, top-of-curb elevations, paving station, and inlet designation number.

4. Use standard curb inlets in streets. Use recessed inlets in divided streets. Use combination inlets in alleys when on a straight run. Do not use grate or combination inlet unless other solution not available (special situation).

5. Use type "Y" or special "Y" inlets in ditches or swales. No "Glory Holes" allowed as intake for a storm sewer or at a culvert. A three (3) foot concrete apron shall be constructed around "Y" inlets.

F. PAVING

1. Provide six (6) inch curb on alleys parallel to creek or channel on creek side of alley.

2. For a proposed driveway turnout, curb return P.T. must be 10 feet upstream from any existing or proposed inlet, or 5 feet downstream of a standard inlet.

3. Check the need for curbing at all alley turns and "T" intersections. Flatten grades ahead of turns and intersections.

4. Where inlets are placed in an alley, provide curbing for 10 feet on each side of combination inlets.

G. DETENTION BASINS (WHEN REQUIRED BY THE CITY ENGINEER)

1. Provide drainage area map and show all computations for runoff affecting the detention basin.

2. Provide a plot plan with existing and proposed contours for the detention basin and plan for structural measures.

3. Where earth embankment is proposed for impoundment, furnish a typical embankment section and specifications for fill include profile for the structural outflow structure and geotechnical report.

4. Provide structural details and calculations for any item not a standard detail.

5. Provide detention basin volume calculations and elevation versus storage curve.

6. Provide hydraulic calculations for outflow structure and elevation versus discharge curve.

7. Provide routings or modified rational determination of storage requirements, demonstrating that critical duration is used (permitted for areas of 600 acres or less).

8. Fencing may be required around detention area.

H. BRIDGES

1. Clear the lowest member of the bridge by 2 feet above the design water surface, unless otherwise directed by the City Engineer.

2. Show geotechnical soil boring information on plan.

3. Show bridge sections upstream and downstream.

4. Provide structural details and calculations with dead load deflection diagram.

5. Provide vertical and horizontal alignment.

6. Show soil erosion protection measures and concrete rip-rap.

PART 4 - WATER AND SEWER LINES

4.1 WATER MAINS

A. GENERAL

Water mains shall be looped and placed on the north and east sides of a street, at a distance of 4 feet 4 feet behind the curb or otherwise as directed by the City Engineer. Water lines shall be designed to designed to conform to the requirements of the Texas Administrative Code Title 30. Refer to the Utility the Utility Assignments detail sheets that accompany this manual for location of water and sewer lines sewer lines (See 0
Utility Assignments.)

1. Mains over 1200 feet in length or mains supplying more than one fire hydrant, shall be a minimum size of 8-inch diameter pipe in residential districts. For mains in commercial and manufacturing districts, a minimum of 12-inch diameter pipe will be required if the main is over 600 feet in length.

2. In residential districts and in those supplying only one fire hydrant, a 6-inch diameter pipe is required for mains less than 1200 feet in length. Dead end mains shall not exceed 600 feet in length, and at least one fire hydrant or blow-off valve will be required, usually at or near the end of the main.

3. In commercial and industrial districts, minimum 8-inch mains are required. In any event, water mains must be of adequate size to provide for the building total fire flow. Fire flow shall be Needed Fire Flow (NFF) as determined from the “Fire Suppression Rating Schedule” as published by the Insurance Services Office. Fire flow requirements shall be met at peak day demand.

4. Peak day domestic demand shall be as shown in Table 4-1:

TABLE 4-1 WATER CONSUMPTION RATES

Density	Peak Day Water Consumption (gallons per acre per day)
1.0 D.U./Acre	2600
2.0 D.U./Acre	3500
3.0 D.U./Acre	4700
3.8 D.U./Acre	5000

The density shall be determined by dividing the total number of dwelling units by the total platted area. The domestic water demand shall be calculated by multiplying the water consumption values in the above table by the total acreage in the platted area.

For densities other than those listed above, water consumption rates may be interpolated or extrapolated from the values given in the table.

Peak hourly rates may be considered to be two times the peak day consumption. Water lines shall be sized to meet the peak hourly domestic demand as well as the fire flow requirements as described previously.

B. WATER MAIN MATERIAL

1. All water mains shall be AWWA C900 or C905 PVC, DR 18, mechanical joint, or a bell and spigot joint. Double bell couplings may not be used for jointing pipe. Ductile iron fittings shall be used.

2. For water mains 24-inches in diameter and larger, Reinforced Concrete, Pretensioned Reinforced (Steel Cylinder Type), complying with AWWA C303, Class 150 may be considered on a case-by-case basis.

3. Profiles with elevations shall be provided for mains 10-inches in diameter and larger.

4. All water mains outside utility easements that supply fire sprinkler systems shall be minimum 200-PSI working pressure and U.L. listed.

5. All water line easements shall be a minimum of fifteen feet wide.

C. WATER VALVES

Valves 12-inches and smaller shall be placed on or near street property lines and shall be spaced at a minimum of 800 feet apart in residential, duplex and apartment districts and not over 500 feet apart in all other districts. They shall be placed in such a manner as to require preferably two, but not more than three valves to shut down each City block, or as may be required to prevent shutting off more than one fire hydrant. On cross-feed mains without services, a maximum of four valves shall be used to shut down each block. Also, valves shall be placed at or near the ends of mains in such a manner that a shut down can be made for a future main extension without causing loss of service on the existing main. The location of valves larger than 12-inches will be as approved by the City Engineer. Valves 12-inches and under will be Resilient Seat Gate Valves (RSGV). Sixteen and eighteen inch valves shall be non-rising stem double disc gate valves placed in the vertical position. Valves larger than 18 inches will be Butterfly Valves.

D. FIRE HYDRANTS

1. Number and Locations

A sufficient number of fire hydrants shall be installed to provide hose stream protection for every point on the exterior wall of the building. There shall be sufficient hydrants to concentrate the required fire flow, as recommended by the publication “Fire Suppression Rating Schedule” published by the Insurance Services Office, around any building with an adequate flow available from the water system to meet this required flow. In addition, the following guidelines shall be met or exceeded:

a. Single Family and General Residential

As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersection at a maximum spacing of 500 feet between fire hydrants as measured along the route that fire hose is laid by a fire vehicle.

b. Attached Housing

As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections at a maximum spacing of 400 feet as measured along the length of the center line of the roadway, and the front of any

structure at grade and shall be no further than 400 feet from a minimum of two fire hydrants as measured along the route that a fire hose is laid by a fire vehicle.

c. Other Districts

As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections at a maximum spacing of 300 feet as measured along the length of the center line of the roadway, and the front of any structure at grade and shall be no further than 400 feet from a minimum of two fire hydrants as measured along the route that a fire hose is lad by a fire vehicle.

d. Protected Properties

Fire hydrants are required to provide a supplemental water supply for automatic fire protection systems shall be within 100 feet of the fire department connection for such system.

e. Buildings Fire Sprinkled

An 8-inch fire line stub-out with valve shall be provided for all buildings to be sprinkles. A smaller stub-out can only be used with Fire Department approval.

f. Fire hydrants shall be installed along all fire lane areas as follows:

1) Attached Housing

Within 150 feet of the main entrance.

At maximum intermediate spacing of 400 feet as measured along the length of the fire lane.

2) Non-Residential Property or Use

Within 150 feet of the main entrance.

Within 100 feet of any fire department connection.

At a maximum intermediate spacing of 300 feet as measured along the length of the fire lane.

3) Generally, no fire hydrant shall be located closer than fifty (50') feet to a non-residential building or structure unless approved by the City Engineer.

4) In instances where access between the fire hydrant and the building that it is intended to serve may be blocked, extra fire hydrants shall be provided to improve the fire protection. Railroads, expressways, major thoroughfares and other man-made or natural obstacles are considered as barriers.

2. Restrictions

a. All required fire hydrants shall be as required by the North Central Texas Council of Governments Specifications and Addenda and shall be placed on water mains of no less than six (6") inches in size. Fire hydrants shall be as specified in the North Central Texas Council of Government Specifications and associated addenda.

b. Valves shall be placed on all fire hydrant leads.

c. Required fire hydrants shall be installed so the breakaway point will be no less than three (3") inches, and no greater than five (5") inches above the grade surface.

Fire hydrants shall be located as shown in 0

d. Utility Assignments. The fire hydrant shall not be in the sidewalk.

e. In non-residential developments an 8-inch lead will be required on all fire hydrants that are located on more than 50 feet from the looped main.

f. All required fire hydrants placed on private property shall be adequately protected by either curb stops or concrete filled steel posts or other methods as approved by the Engineer and shall be in easements. Such stops or posts to be the responsibility of the landowner on which the said fire hydrant is placed.

g. All required fire hydrants shall be installed so that the pumper nozzle connection will face the fire lane or street, or as directed by the Engineer.

h. Fire hydrants, when placed at intersections or access drives to parking lots, when practical, shall be placed so that no part of the fire truck will block the intersection or parking lot access when connections to the fire hydrant are made.

i. Fire hydrants, required by this article, and located on private property, shall be accessible to the Fire Department at all times.

j. Fire hydrants shall be located at street or fire lane intersections, when feasible.

k. Fire hydrant bonnet shall be painted according to North Central Texas Council of Governments and Addenda.

3. Main Size for Hydrant Supply

Four inch mains used for hydrant supply shall be replaced and dead ends eliminated where practical. Six-inch lines shall be connected so that not more than one hydrant will be between intersecting lines and not more than two hydrants on an 8-inch main between intersecting lines. The maximum length of a six-inch fire hydrant lead is 150'.

4. Fire Line Metering

Generally, the City of Bridgeport will own, operate and maintain all fire lines serving fire hydrants. Such fire lines shall be designed and constructed in accordance with the City's standards and shall be placed in an easement dedicated to the City for this purpose. Sprinkler service lines, fire line connections and other fire lines that are not maintained by the City shall be equipped with either a water meter or a detector check valve having a capacity equal to the required fire flow. Water meters and detector check valves shall be constructed in accordance with City standards.

E. MINIMUM COVER

The minimum Cover to the top of the pipe must vary with the valve stem. In general, the minimum cover below the street grade or finished grade (whichever is lower) should be as shown in table 4.2 below. Lines larger than 16-inch shall have a minimum of 6 feet of cover that is sufficient to allow water and sewer and other utilities to go over the large main. For water lines to be constructed along county type roads, which are commonly built with a high crown

about the surrounding property, increase the cover as required to allow for future paving grade changes.

TABLE 4-2 WATER MAIN MINIMUM COVER

Pipe Diameter (in)	Minimum Cover
≤8”	4.0’
≤12”	4.5’
≤16”	5.0’
>16”	6.0’

F. METER BOX AND SERVICE

A service with a meter box is constructed from the main to a point just behind the curb line, usually in advance of paving. The location of the meter box is as shown on the Utility Assignments detail sheets and as shown on the Construction Details. On multiple apartments and business properties, the owners usually specify the desired size and location. Minimum requirements for water service sizes are:

1. Three quarter-inch water services are required to serve all residential lots including City house lots, patio homes and duplexes. Separate meter connections shall be provided for each of the family units.

2. The size of apartment, condominium, multi-family services or commercial will depend on the number of units served with a minimum of one meter per building.

G. SERVICE CONNECTIONS - HYDRANTS

A service connection shall not be allowed on fire hydrant leads except as authorized by the City Engineer.

4.2 SANITARY SEWERS

A. GENERAL

All platted lots must be served by an approved means of wastewater collection and treatment. In most cases, lots will be served by a municipal sewer system. Where, in the opinion of the City Engineer, connection to the municipal system is not economically feasible, on site treatment of wastewater may be allowed.

B. LOCATION OF SEWER LINES

Sizes and grades for sanitary sewers shall be as required by the City Engineer. Sewers shall be be constructed with extensions to the development boundary to allow for direct connection by future future developments. Sewers are typically located 3’ behind curb. Each addition has its individual individual problems; therefore, no fixed rules will apply to all cases. Sanitary sewer lines shall be be designed to conform to the requirements of the Texas Administrative Code Title 30. Refer to the Utility the Utility Assignments detail sheets that accompany this manual for location of water and sewer lines sewer lines (See 0
Utility Assignments.)

C. EASEMENTS

Where easements are used, they shall be not less than fifteen feet wide. Sanitary sewer lines with a depth greater than 12' will require additional width as approved by the City Engineer.

D. MINIMUM COVER

Minimum cover shall be 3.5 feet; exceptions authorized by the City Engineer shall have concrete protection. For sanitary sewers in streets, the minimum cover shall be 5.0 feet. In general, the minimum depth required for the sewer to serve given property with a 4-inch lateral shall be 3 feet (4.5 feet if the water line is on the same side of the street as the lateral in question) plus 2% times the length of the house lateral (the distance from the sewer to the center of the house). Thus, for a house 135 feet from the sewer, the depth would be 3 feet plus 2% x 135 feet = 2.7 plus 3.0 = 5.7 feet. The depth of the flow line of the sewer should then be at least 5.7 feet below the elevation of the ground at the point where the service enters the house. Profiles of the ground line 20 feet past the building line will be required to verify that these criteria are met. A minimum of 3 feet of cover on sewer services is required at all points in Street R.O.W. where swales are constructed. On lines deeper than 12 feet, a parallel sewer line will be required when laterals are to be attached. This requirement should be discussed with the City Engineer.

E. SEWAGE FLOWS, SIZE AND GRADES

Sewage flow shall be computed in accordance with the following formula:

$$Q = \frac{C^{0.89}}{295}$$

Where:

Q = Peak wastewater flow (million gallons per day)
C = Equivalent single family connections

This equation is graphically displayed in Figure 4-1. Equivalent single-family connections are based on a density of 2.7 persons per dwelling unit. The City Engineer shall determine densities for other residential uses. The City Engineer shall determine sewage flow for non-residential uses.

Pipes should be placed on such a grade that the velocity when flowing full is not less than two feet or more than ten feet per second. Minimum grades shall be as follows:

TABLE 4-3 SANITARY SEWER MINIMUM GRADIENTS

Pipe Diameter (in)	Minimum Gradient
6"	0.60%
8"	0.40%
10"	0.26%
12"	0.20%
15"	0.14%
18"	0.12%
21"	0.10%
≥24"	0.08%

All grades shall be shown to the nearest 0.01 foot. Grades shall be evenly divisible by 4, and if practical, they should be even, such as: 0.20%, 0.40%, 0.60% and 1.00%, etc., in order to facilitate field computations. When the slope of a sewer changes, a manhole will be required. Vertical curves may be used only at manholes to eliminate drop manholes. The length of vertical curves in this instance shall not exceed 100 feet. No other vertical curves will be allowed. Horizontal curves to match change in street direction will be allowed as approved by the City Engineer.

F. MANHOLES, WYES, BENDS, TAPS, AND CLEANOUTS

The sizes and locations of manholes, wyes, bends, tap connections, cleanouts, etc., shall be as designated by the City Engineer. In general, manholes shall be placed at all four-way connections and three-way connections. The diameter of a manhole constructed over the center of a sewer should vary with the size of the sewer. For 6", 8", and 10" sewers, the manhole shall be 4.0 foot minimum diameter; for 12", 15", and 18" sewers - 4.5 foot minimum diameter; for 21", 24", and 27" - 5.0 foot minimum diameter; 30" - 5.5 foot minimum diameter; and 36" - 6 foot minimum diameter. In Flood Plains, sealed manholes "Type S" are used. Clean-outs shall be placed on the ends of all lines. Drop manholes shall be required when the inflow elevation exceeds the outflow elevation by more than 18 inches.

In order to provide access for sewer lines for cleaning, manholes and/or cleanouts shall be so located that 250 feet of sewer rod can reach any point in the line. This means that manhole spacing shall be a maximum of 500 feet; that spacing between a manhole and an upstream cleanout shall be limited to 400 feet. Cleanouts may be located at the end of the line only.

G. LATERALS

The sizes and locations of laterals shall be as designated by the City Engineer. In general, for single family dwellings, the lateral size shall be 4" minimum, for multiple units, apartments, local retail and commercial - 6" minimum; for manufacturing and industrial, the size should be 8" or larger as required. House laterals usually come out 10 feet downstream from the center of the lot, and shall have a 10-foot lateral separation from the water service. Manholes will be required on 8-inch and larger laterals where they connect to the main line. Laterals will not be attached to sewer mains that are deeper than 12 feet. A minimum of one lateral per building shall be required. Also, a minimum of one lateral per residential lot shall be required.

H. RAILROAD, HIGHWAY AND CREEK CROSSINGS

Railroad, State Highway and creek crossings, etc., shall be as approved by the City Engineer.

I. SEWER LINE MATERIALS

1. All sewer pipes shall be PVC or Reinforced Concrete sewer pipe. Reinforced Concrete Pipe is allowed only on lines larger than 24 inches in diameter.

2. Sewer pipe shall conform to the North Central Texas Council of Governments (NCTCOG) Specifications and associated addenda.

3. Sewer pipe joint materials shall have resilient properties, conforming to the NCTCOG Specifications and associated addenda.

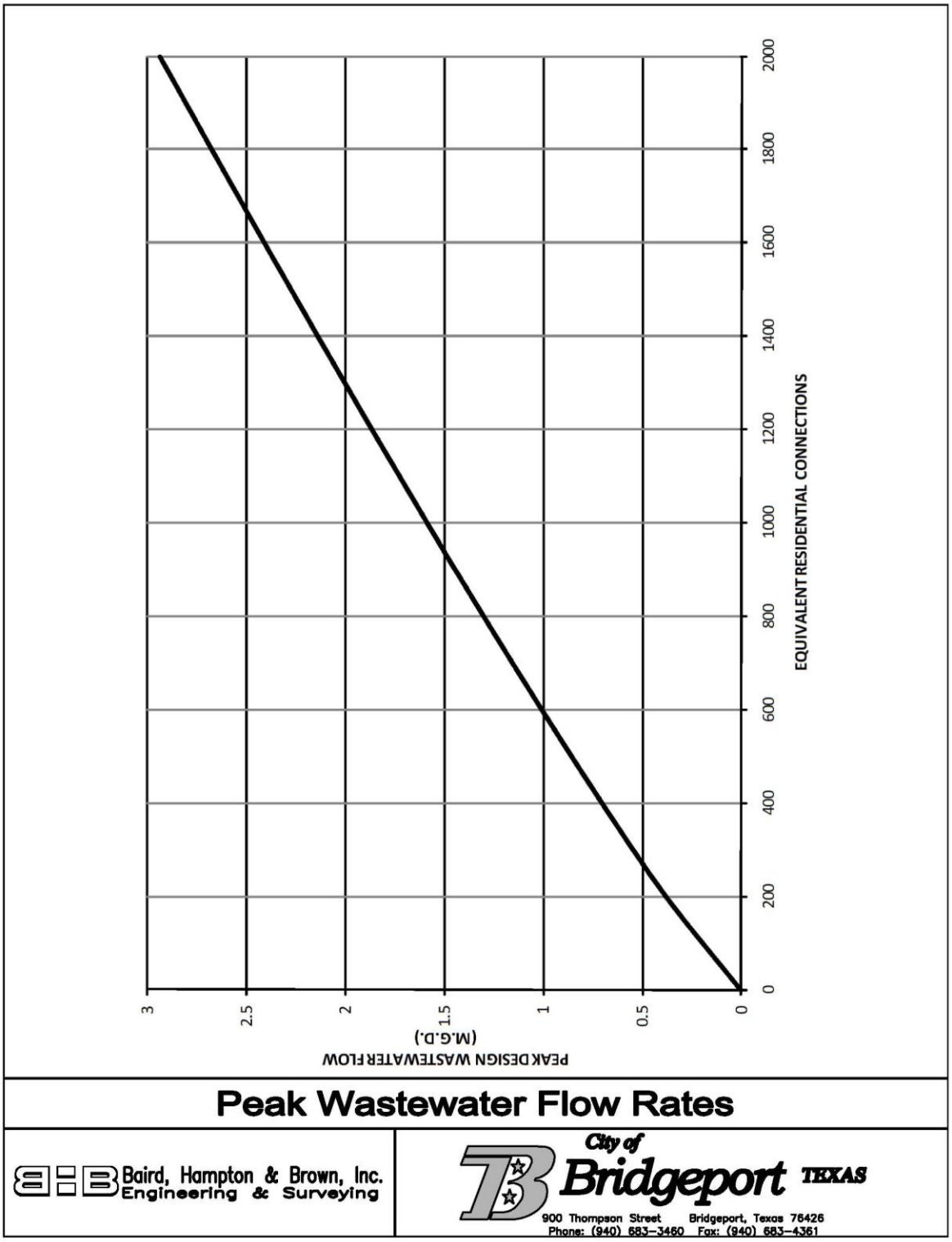


FIGURE 4-1 PEAK WASTEWATER FLOW RATES

4.3 PREPARATION OF WATER AND SEWER PLANS

A. FORM OF PLANS

1. Plans shall be clear, legible, and neatly drawn on bordered sheets, size 24' x 36". Each sheet shall clearly display the Texas Professional Engineer's seal of the Engineer under whose direction the plans were designed. A title block in the lower right-hand corner shall be filled in to include: (1) project name; (2) Engineer's name, address, and telephone number and (3) space for notation of revisions.

2. The plan sheet should be drawn so that the north arrow points to the top or to the left side of the sheet. It is important that the plan show sufficient surrounding streets, lots, and property lines so the existing water and sewer may be adequately shown and so that proper consideration may be given to future extensions. Proposed water and sewer lines shall be stubbed out to the addition extremities in order that future extensions may be made with a minimum of expense and inconvenience. Unless it would make the plan very difficult to read, both water and sewer lines should be shown on the same sheet. The lines on the profile sheet shall be drawn in the same direction as on the plan. Lettering shall be oriented to be read upward or to the left.

3. On large additions or layouts requiring the use of more than six sheets (total of plan & profile), key sheets may be required on a scale of 1' = 400' or 1" = 1000", as designated by the City Engineer. They shall show the overall layout with the specific project clearly indicated with reference to individual sheets.

4. The use of "off-standard" scales will not be permitted. A plan shall be drawn to scales of 1" = 100', or 1" = 40'. Plans for water and sewer that do not involve great detail should be drawn on a scale of 1" = 100'. These may be on plan-profile sheets or the "plan" may be drawn with the profiles on full ruled profile cloth. (If required for clarity, a separate sheet on 1" = 40' scale may be used to show details.) Plans in and along creeks, heavily wooded sections, streets with numerous utilities, or as may be required to produce a clean and legible drawing, shall be drawn on plan-profile sheets or separate plan and profile sheets on a scale 1" = 40'. If the plan is in an extremely congested area, a scale of 1" = 20' may be necessary and will be permitted. All profiles shall be drawn on a vertical scale as required for clarity, and the horizontal scale shall be the same as for the plan unless otherwise directed by the City Engineer.

B. DATA TO BE INCLUDED

1. Sewer Data to be Included on Plan Sheet

   The plan shall show the existing and proposed water and sewer lines and all appurtenances thereto. The plan should also have the storm sewer system dashed in. All lines shall be numbered, lettered or otherwise designated on both plan and profile sheets. All lines shall show sizes and direction of flow on both plans and profile sheets. Stationing shall be shown to the nearest 0.1 foot and each new line shall begin at 0+00 at the outlet and increase up the sewer. Station pluses at all junctions or sewers, horizontal P.C.'s and P.T.'s bends, angle points, wyes, cleanouts, manholes, the centerlines of all cross streets and railroads, and all crossing utilities, etc., shall be shown on both plan and profile. The degree of angles and horizontal curve data shall be shown on the plan only. Minimum Radius for sanitary sewer mains is 200 feet. Sewer laterals shall be shown at a location most convenient to serve the property. Sewer laterals will usually be near the center of the lot, either at the street or alley. If the lateral is to be adjacent to the water service, then show the lateral 10 feet downstream. The location shall be designated on the plans.

2. Sewer Data to be Included on the Profile Sheet

The data for the profile sheet shall be obtained by running a line of levels along the actual route and by taking any other necessary observations. Profiles shall show the elevations to the nearest 0.1 foot of the ground at the centerline of the sewer and to the right and left of the centerline of the sewer at the location of the approximate center of the proposed houses or buildings to be served, and the approved street or alley grade. Profiles shall also show the sewer pipe, manholes, cleanouts, etc. The size of the sewer, the direction of the flow, and the grade to the nearest 0.01 foot should be indicated just over the "pipe" and the total linear footage of line, size, kind of pipe, and type of embedment or encasement shown below the "pipe." All of the information pertaining to the horizontal data, station pluses, appurtenances to be built, etc., is usually shown just above the ground lie, whereas, the flow line (invert) elevations shall be shown to the nearest 0.01 foot. Invert elevations shall be recorded at all junctions (all lines-in and out), at grade breaks, the ends of lines, or other points as requested by the City Engineer. Benchmarks used shall also be clearly shown, giving the descriptive locations and elevations. Elevations must be from sea level datum, not assumed. Bench level circuits should begin at a USGS monument and benchmark of second order accuracy established at least every one-half mile through the project. All existing water, sewer, gas, storm crossing the proposed sewer or water line shall be adequately designated as to size, type, and location. Drainage area maps and capacity calculations for mains 10" and larger will be required.

3. Data to be Included for Water Plan and Profile

Indicate the location of any existing valves required for shutdown purposes and of any tees, ends, etc., to be tied into. Indicate clearly the sizes of the lines to be installed, and all proposed valves, fire hydrants, tees, crosses, bends, reducers, plugs, sleeves, wet connections, tap connections, creeks, railroad or highway crossings, tunnels, meter boxes, valve vaults, and other appurtenances at each intersection or as required. Where the pipe is a curve, the curve data on the plat is usually sufficient unless otherwise requested. The size and type of services and the material, type of joint, and class of pipe may be indicated by adequate notation in the lower left or right-hand corners of the plan sheet. Water services and meter boxes shall be indicated and shall be located at or near the center of the front of each lot. If a water line requires a profile, then follow the general procedures as outlined for sewers, except that the grades and elevations of the proposed water line usually need not be shown closer than the nearest 0.01 foot.

4.4 ON-SITE TREATMENT OF WASTEWATER

A. DESIGN CRITERIA

All applicable design criteria shall be used in the design and construction of on site wastewater treatment systems including the Texas Natural Resources Conservation Commission, North Texas Municipal Utility District and Dallas County. All on site treatment systems shall be approved by the City of Bridgeport. The minimum lot size for on site treatment systems is 43,560 square feet.

B. PLATTING REQUIREMENTS

Where on site wastewater treatment systems are allowed, the location of the proposed drain field shall be shown on the preliminary plat. The final plat shall indicate the minimum finished floor elevation if a gravity system is used. The minimum finished floor elevation shall not be less than 3.5 feet above the highest elevation of ground at the proposed drain field unless documentation is submitted and approved that demonstrates that a lower finished floor elevation will allow the on site treatment system to function properly.

APPENDIX A: RECOMMENDED PROCEDURE FOR SETTING STREET GRADES

[Intentionally left blank]

CITY OF BRIDGEPORT

ENGINEERING DESIGN MANUAL

APPENDIX – A

RECOMMENDED PROCEDURE FOR SETTING STREET GRADES

1. Plot profiles on each right-of-way line. Check for the following:

    a. Have drives, intersections, ditches, etc., been shown? Profile must give realistic picture of conditions grades must meet.

    b. If additional right-of-way is to be acquired, have profiles been plotted along proposed property line, not existing?

    c. If property line falls in a ditch, has second profile been shown to normal ground elevation?

    d. Check any sharp breaks in the profile which might identify plotting errors.

2. Spot critical points in the profile which will control top of curb elevation. Calculate maximum curb elevation permissible at these points.

3. Lay tentative grade for low side of street. Minimum grade = 0.5%.

4. Lay matching grade on high side of street. Watch the following:

    a. On divided streets slope of traffic lanes must not be less than 0.5 foot between curbs nor more than ½ inch per foot any place in the roadway.

    b. Avoid fill if at all possible. If absolutely necessary to fill, try to limit height so access to abutting property will not be restricted.

    c. In extreme cases the street may slope the same direction for the full width of the street. Special permission is required for this.

    d. Occasionally the centerline of the proposed pavement can be offset to aid in matching improvements on the high side.

    e. In flat areas of City, try to keep top of curb 0.5’ below ground at property line. This will assure good drainage from the abutting property.

5. If the street is in the flood plain, the minimum curb elevation must be determined after consultation between paving and drainage engineers and approved by competent authority.

6. Use standard design criteria for vertical curves. Safe sight distances must not be compromised.

7. Check safe speed of all curves. Superelevation may be necessary on short radius curves to maintain safe design speed.

8. Avoid changing shape of crown since this requires hand work by the contractor and increases construction costs.

9. Plot proposed tops of curbs on cross sections. Check for proper slope in parkway at every location. Look for places grade can be improved to serve property better. Numerous breaks in

grade to enhance value of street to abutting property are preferable to long straight grades which may be detrimental to property.

a. Check every intersection carefully give special attention to:

b. Drainage. Make sure ditches and gutters drain.

c. Riding quality. This is very important at the intersection of two thoroughfares. Severe grade breaks must be avoided in both directions.

10. Approach grades should not be over 4%. Steeper grades require special consideration. Vehicles should be able to see both directions clearly.

11. Check both ends of project as to drainage and riding quality. Avoid such solutions as “Grade to Drain.” If necessary to drain into existing ditches, show ditch profiles and proposed grades in profile. Show spot ditch elevations in plan view.

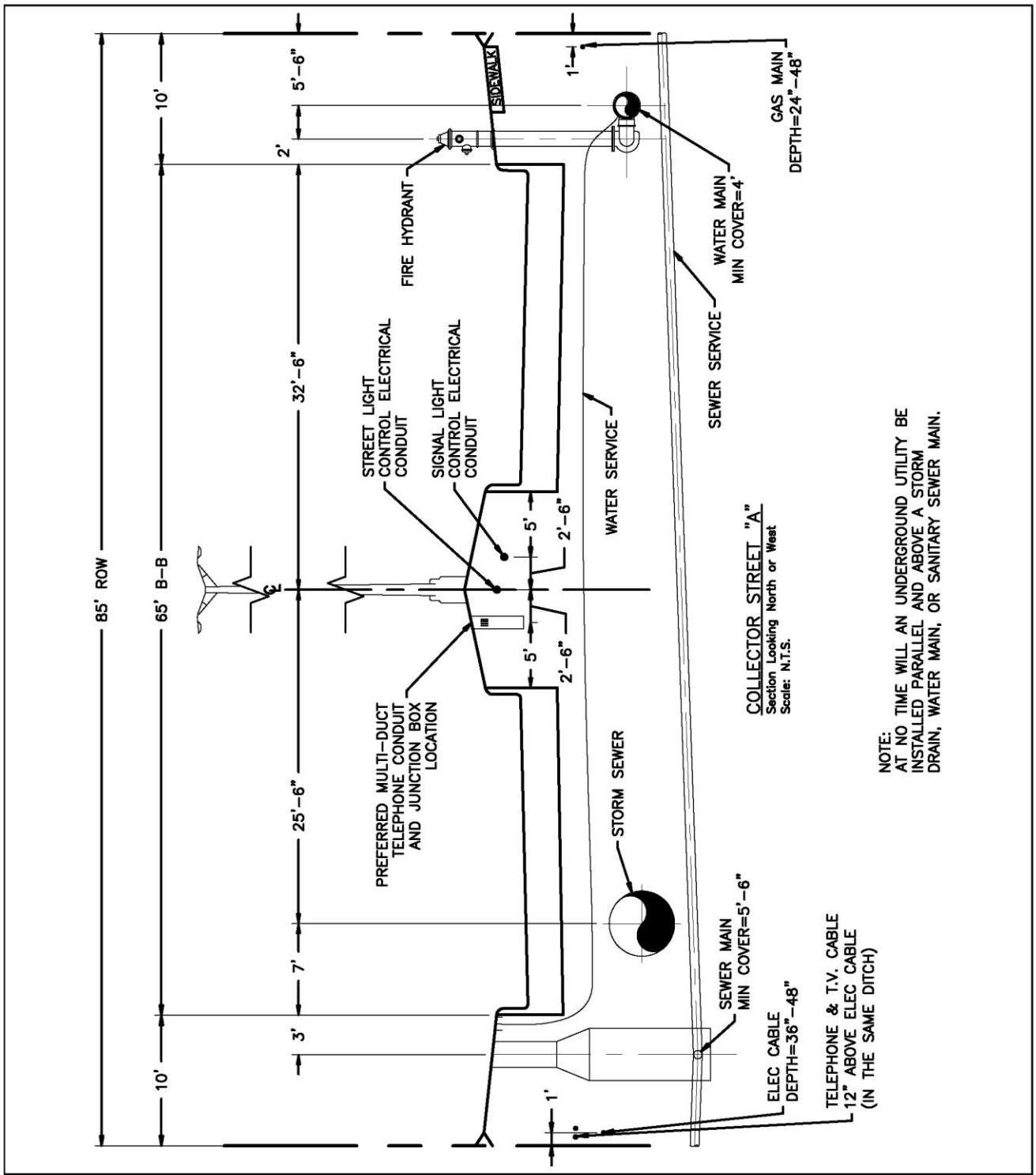
12. Sags in grade should fall at locations where inlets will cause least inconvenience to abutting property owners.

13. Median grade on divided thoroughfares follow the curb line of the traffic lane, usually 7 to 10 feet from centerline. Therefore, it is necessary to show top of curb elevations at critical points on left turn lanes. Show these in the plan view. Slope of left turn lane should match slope of adjacent through lanes if possible.

14. In general, street grades need to meet the needs and safety requirements of the traveling public, but must also serve the abutting property.

APPENDIX B: UTILITY ASSIGNMENTS

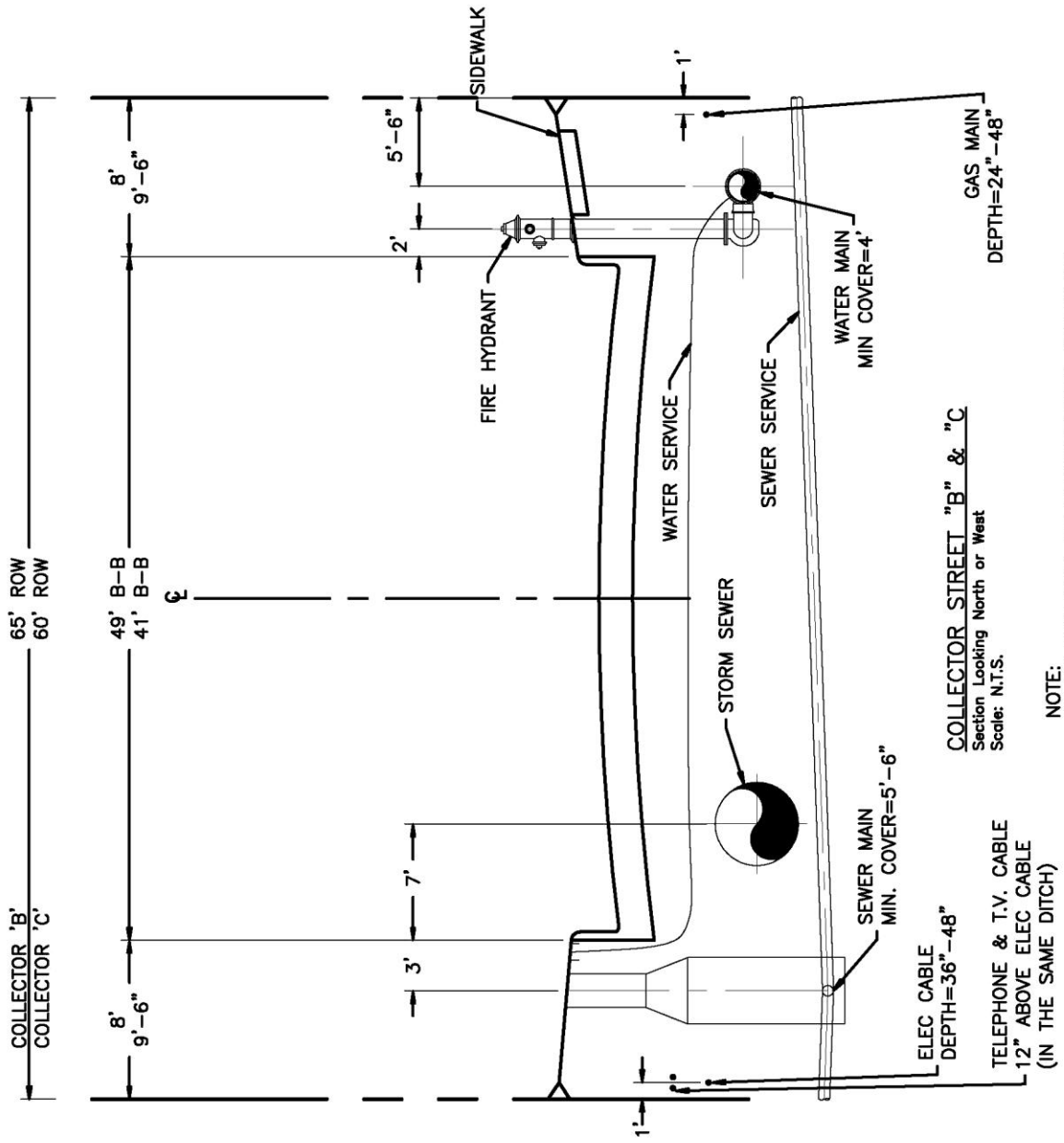
[Intentionally left blank]



Utility Assignment - Collector Street 'A'

Baird, Hampton & Brown, Inc.
Engineering & Surveying

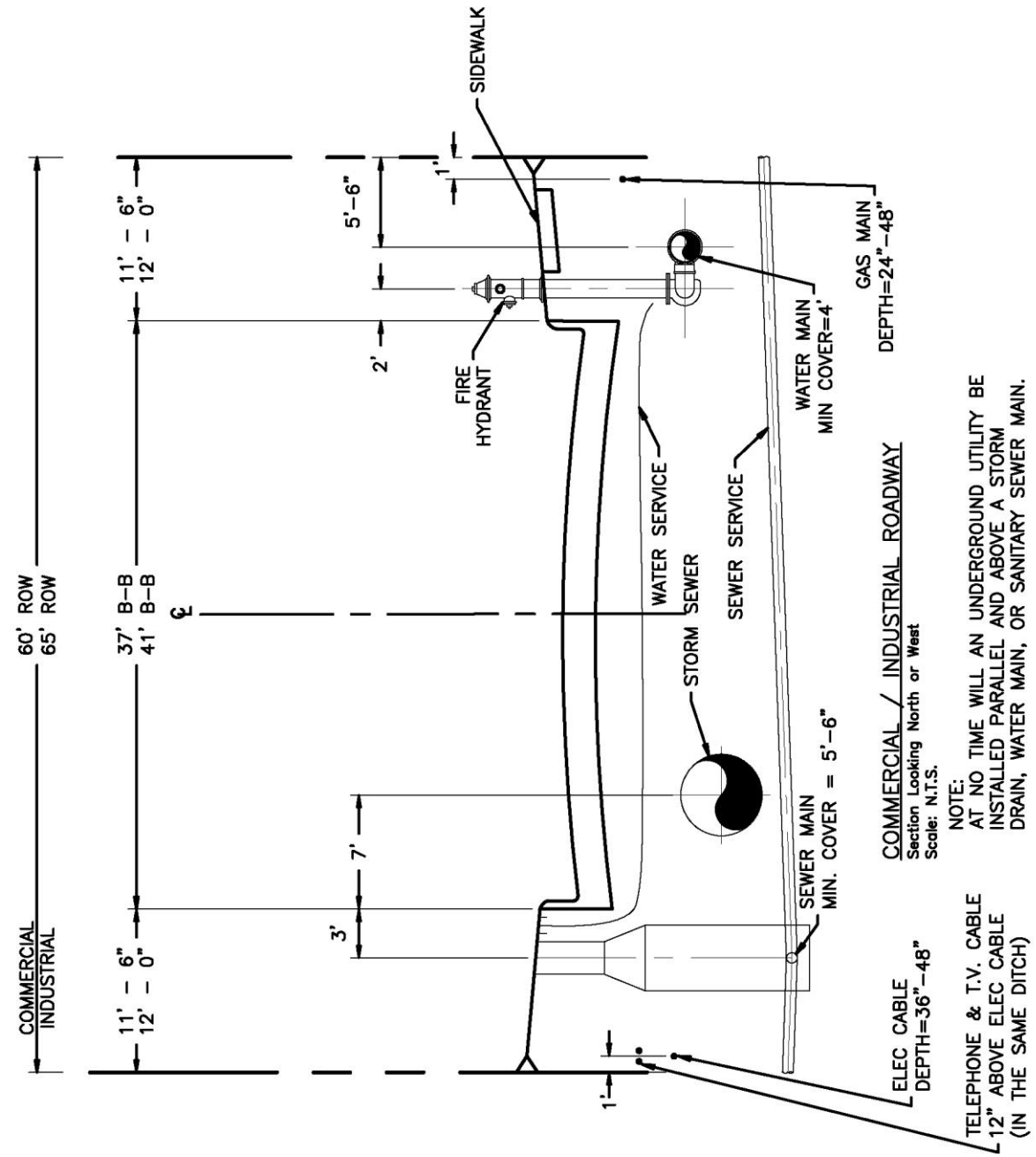
City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



Utility Assignment - Collector Street 'B' & 'C'

Baird, Hampton & Brown, Inc.
Engineering & Surveying

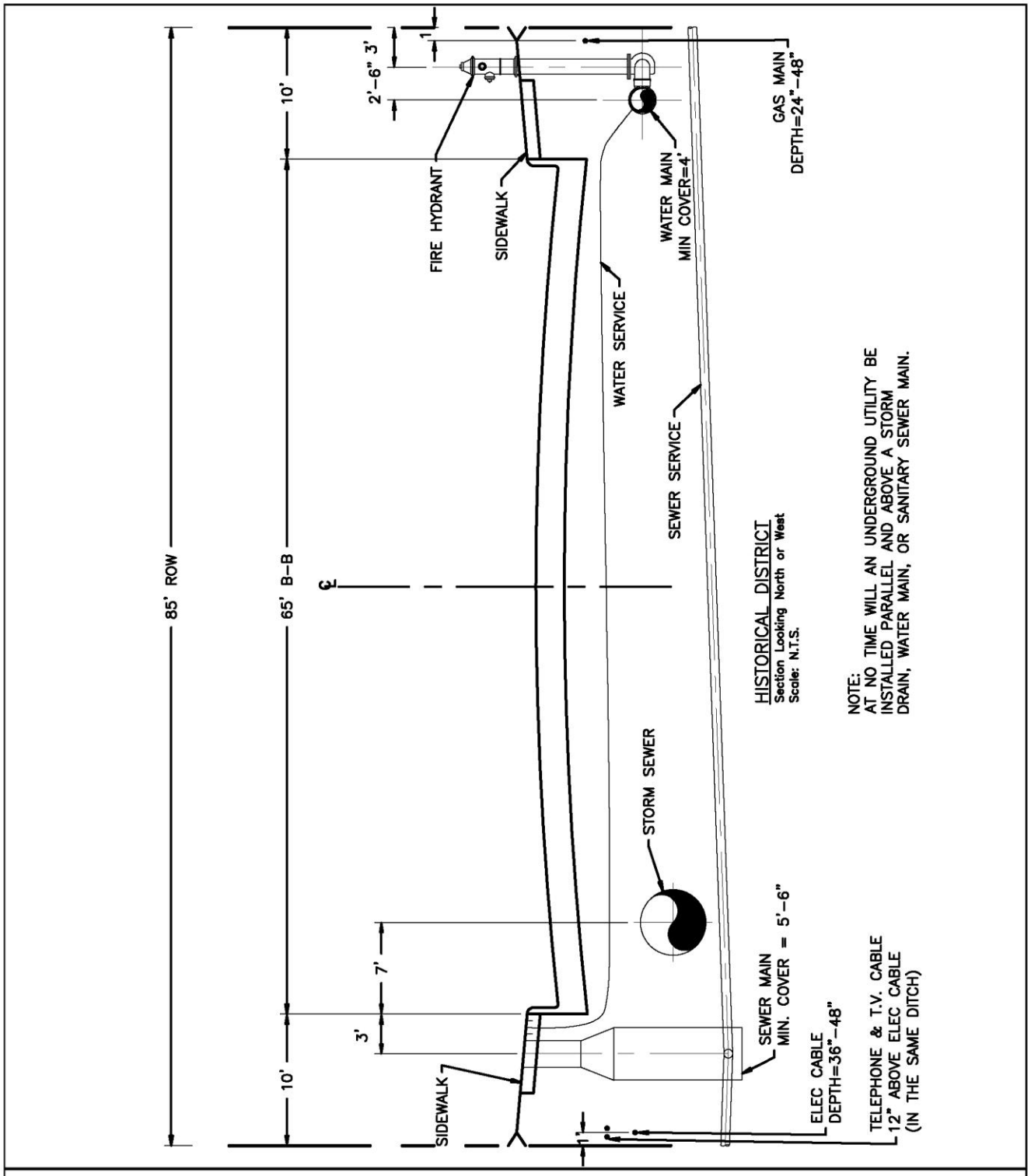
City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



Utility Assignment - Commercial/Industrial Roadway

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

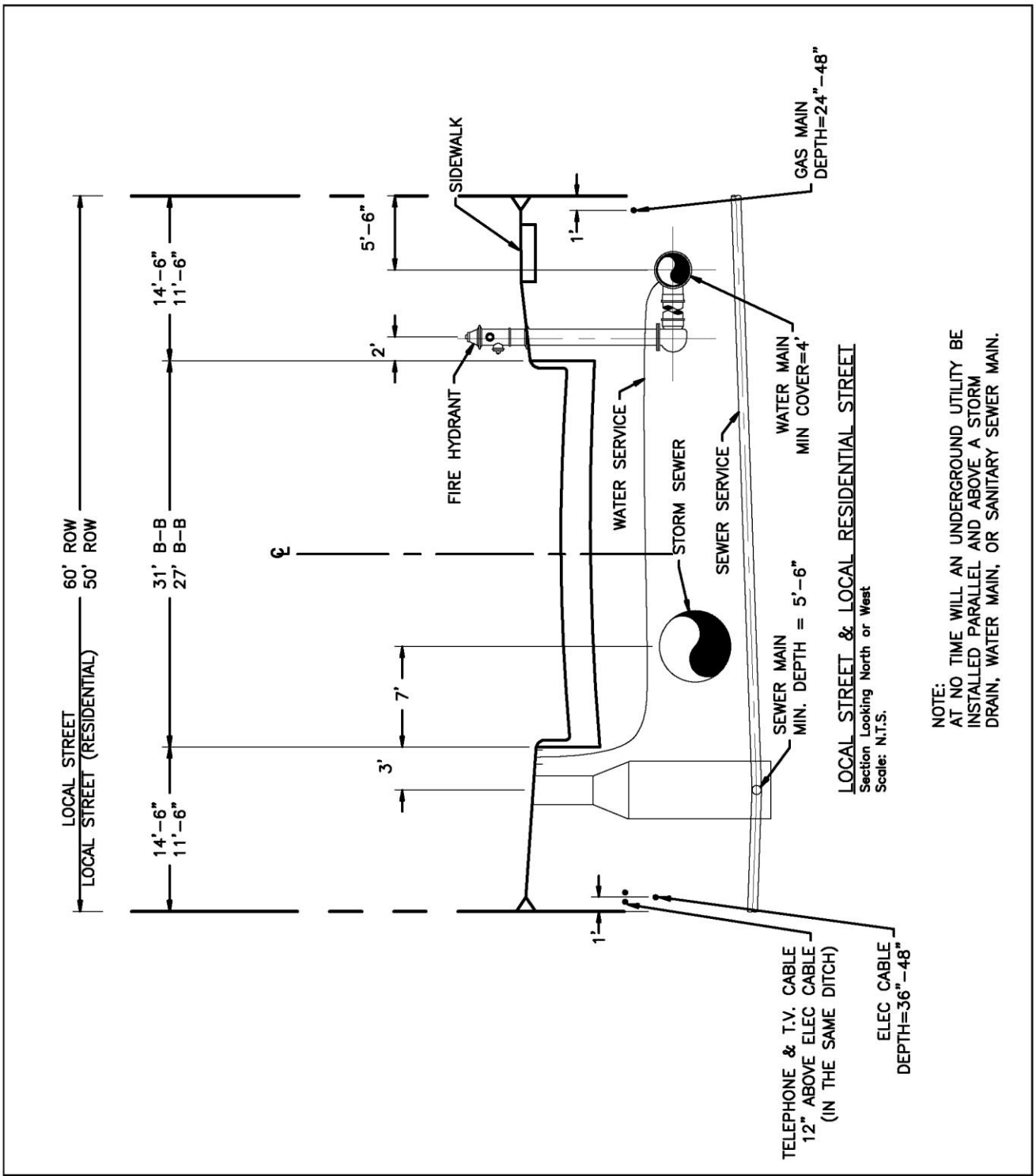


Utility Assignment - Historical District

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS

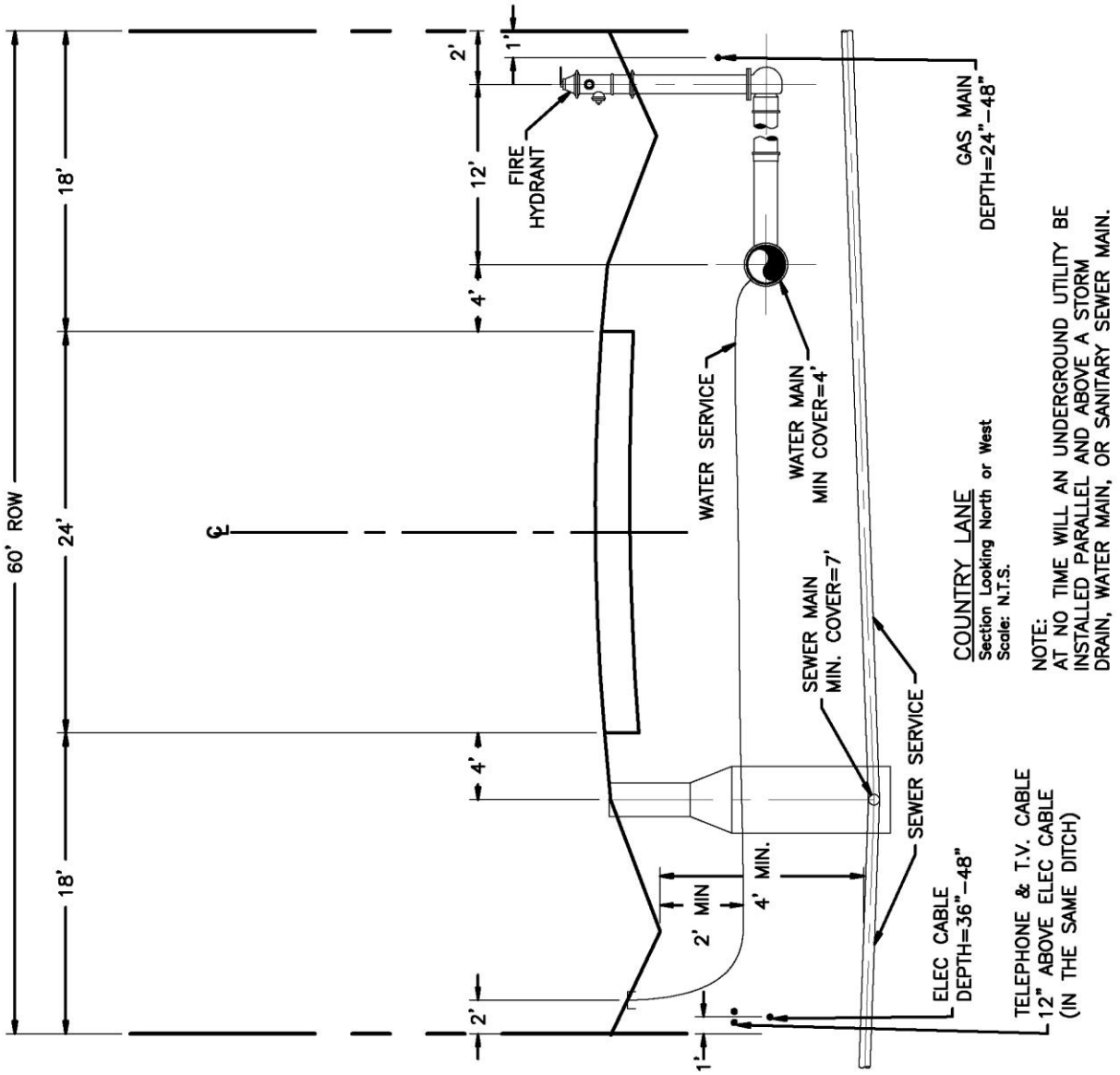
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



Utility Assignment - Local & Local Residential Street

Baird, Hampton & Brown, Inc.
Engineering & Surveying

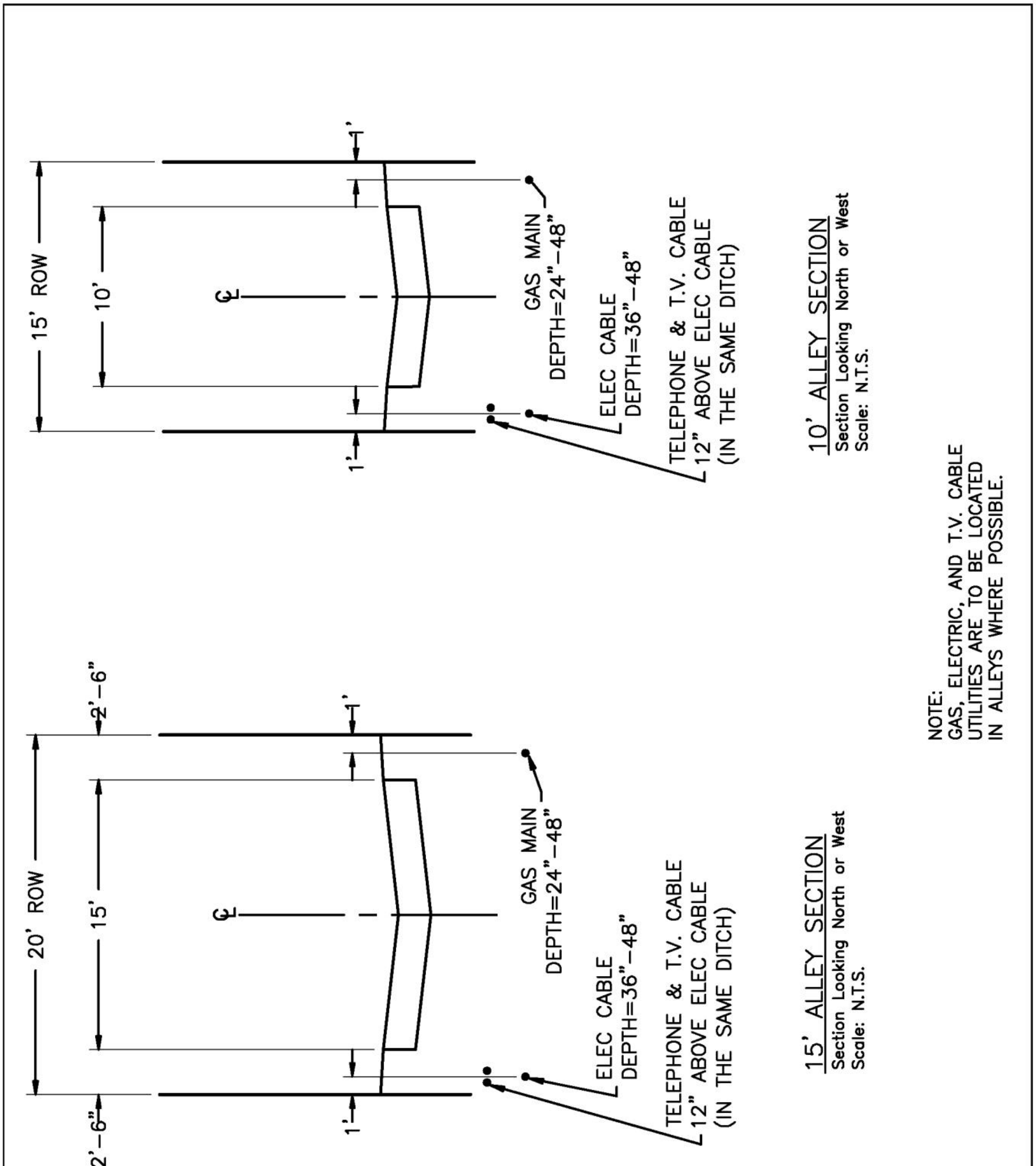
City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



Utility Assignment - Country Lane

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



Utility Assignment - Alley Sections

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

[Intentionally left blank]

APPENDIX C: GENERAL NOTES FOR CONSTRUCTION PLANS

[Intentionally left blank]

CITY OF BRIDGEPORT

ENGINEERING DESIGN MANUAL

APPENDIX "C"

GENERAL NOTES

GENERAL

1. All construction shall be in accordance with the North Central Texas Council of Governments "Standard Specifications for Public Works Construction" and the City of Bridgeport's addendum thereto.

2. Before beginning construction, the contractor shall prepare a construction sequence schedule. The construction schedule shall be such that there is minimum interference with traffic along or adjacent to the project.

3. Construction may not be begun earlier that 7:00 A.M. on weekdays nor continued after dark without permission from the City of Bridgeport. Construction on Saturday may not be begun before 8:00 A.M. and work on Sunday is prohibited without special permission.

4. Utilities shown on the plans were taken from field surveys and information provided by the utility companies. The completeness and the accuracy of this data is not guaranteed.

5. The contractor is responsible for verifying the location of all underground utilities and structures and protecting them from damage during construction.

6. Work may not be backfilled or covered until it has been inspected by the City.

7. Material testing shall be performed by an independent testing laboratory and paid for by the contractor.

8. All excavation on the project is unclassified.

9. Temporary erosion control shall be used to minimize the spread of silt and mud from the project onto existing streets, alleys, drainage ways, and public and private property. Temporary erosion controls may include straw bales, berms, dikes, swales, strips of undisturbed vegetation, check dams and other methods as required.

10. Finished slopes on the public rights-of-way and easements shall not be steeper than 4:1. All slopes steeper than 6:1 shall be hydro mulched and maintained by the contractor until 80% grass coverage of the slope is achieved.

11. The contractor shall maintain two-way traffic at all times along the project.

12. Remove, salvage, and replace all street and traffic control signs which may be damaged by the construction of the project.

13. All trenching and excavation shall be performed in accordance with OSHA standards.

PAVING

1. All embankments shall be compacted to 95% Standard Proctor density.

2. All streets and alleys shall be placed on lime or cement stabilized sub-grade as appropriate with a lime or cement content of not less than 6%.

3. The minimum 28 day compressive strength of concrete street paving shall not be less than 3600 P.S.I. and shall be air entrained. Water may not be applied to the surface of concrete paving to improve workability.

4. All curb and gutter shall be integral with the pavement.

5. Parabolic crowns are required on all street pavements except on major thoroughfares where straight sections are required.

6. Sidewalk ramps shall be constructed at intersections as indicated on the plans to meet Texas Accessibility Standards (TAS) requirements.

DRAINAGE

1. Storm sewer pipe shall be reinforced concrete, Class III unless otherwise noted.

2. All structural concrete shall be Class "C" (3600 P.S.I. compressive strength at 28 days), air entrained.

3. The contractor shall install plugs in storm sewer lines or otherwise prevent mud from entering the storm sewer system during construction. Accumulated sediment shall be removed by the contractor with no additional compensation.

WATER AND SANITARY SEWER

1. Water mains shall be AWWA C-900 PVC Class 150 unless otherwise noted. Minimum cover for waterlines is 48" or as required to clear existing utilities, whichever is greater.

2. Marking tape shall be installed over PVC water lines.

3. Fittings fro PVC water lines shall be ductile iron and be encased in polyethylene sheath.

4. Valves shall be resilient seat gate valves.

5. All direct burial valves shall be provided with cast iron valve boxes with OVC stacks. Valve stacks shall be vertical and concentric with the valve stem. Stainless steel valve extensions are required on all valves where the operating nut is greater than 4 feet below finished grade.

6. Fire hydrants shall be field painted per City of Bridgeport specifications.

7. All exposed bolting on any buried equipment or material shall be stainless steel. Included are:

    a. Bonnet and stuffing box bolts on valves.

    b. Shoe bolts on fire hydrants.

    c. Flange bolts.

    d. "Cor-ten" mechanical joint "T" bolts are acceptable for direct burial service.

8. Meter boxes shall be approved by the City of Bridgeport.

9. Sanitary sewer mains shall be SDR-35 PVC.

10. The contractor shall install and maintain watertight plugs in all connections to the City's sanitary sewer system until the project is accepted by the City.

11. All sanitary sewer lines and manholes shall be leak tested before the project is accepted. Deflection testing of PVC sewer lines is required.

[Intentionally left blank]

APPENDIX D: STANDARD OWNER'S CERTIFICATE

[Intentionally left blank]

APPENDIX “D”

CITY OF BRIDGEPORT

STANDARD OWNER’S CERTIFICATE

The following certificate shall be placed on all final plats:

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS:

THAT_____, acting herein, and through its duly authorized officers, does hereby adopt this plat designation the hereinabove described property as __ _____, an addition to the City of Bridgeport, Texas, and does hereby dedicate to the public use forever the streets and alleys, thereon; and does hereby dedicate the easements shown on the plat for mutual use and accommodation of all public utilities desiring to use, or using same. No buildings, fences, trees, shrubs, or other improvements shall be constructed or placed upon, over, or across the easements on said plat. The City of Bridgeport, and/or public utilities shall have the right to remove and keep removed all or part of any buildings, fences, trees, shrubs or other improvements, or growths, which in any way endanger or interfere with the construction, maintenance, or efficiency of its respective system on any of these easements.

Each property owner shall keep drainage channels and/or drainage and floodway easements traversing or adjacent to his property clean and free of debris, silt, and any other substance which may impede the flow of storm waters or result in unsanitary conditions. This includes all necessary establishments of ground cover, slope stabilization, mowing, weeding, litter pick-up, and other normal property owner responsibilities. The City of Bridgeport shall have the right of ingress and egress for the purposes of inspection and supervision of maintenance work by the property owner to alleviate any undesirable conditions which may occur. No obstruction to the natural flow of storm water runoff shall be permitted by filling or by construction of any type, including, but not limited to, construction of any dam, building, fence, bridge, walkway, or any other structure within the drainage channels or easements, unless approved by the City of Bridgeport, provided, however, it is understood that in the event it becomes necessary for the City of Bridgeport to erect any type of drainage structure in order to improve the storm drainage that may be occasioned by the streets and alleys in or adjacent to the subdivision, then in such event, the City of Bridgeport shall have the right to enter upon the drainage or floodway easements at any point or points to erect, construct, or maintain any drainage facility deemed necessary for drainage purposes.

The City of Bridgeport and/or public utilities shall at times have the full right of ingress or egress to and from and upon any of said easements for the purpose of constructing, reconstructing, inspecting, maintaining, reading meters and adding to or removing all or part of its respective system without the necessity at any time of procuring permission from anyone.

Witness my hand this ____ day of _____. 20__.

_____
Owner’s signature

All signatures shall be notarized.

[Intentionally left blank]

APPENDIX E: ADDENDUM TO NCTCOG STANDARD SPECIFICATIONS

[Intentionally left blank]

Appendix "E"

CITY OF BRIDGEPORT
ADDENDUM TO THE
NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS
STANDARD SPECIFICATIONS FOR
PUBLIC WORKS CONSTRUCTION

This addendum to the North Central Texas Council of Governments Standard Specifications for Public Works Construction, as amended, sets forth (by reference number) exceptions or requirements of the City of Bridgeport and thereby takes precedence over any conditions or requirements of the Standard Specifications with which it is in conflict.

101.1 The term "OWNER" shall refer to the City of Bridgeport. The term "OWNER'S Representative" shall refer to the City's Engineer or other duly authorized assistant, agent, engineer, inspector, or superintendent acting within the scope of the particular duties instructed to him.

103.3.1.5 MAINTENANCE BONDS

The Contractor shall furnish the City of Bridgeport with a Maintenance Bond from an approved surety company which protects the City against defective workmanship and materials for a period of two (2) years from the date of the final acceptance by the City. Where defective workmanship and/or materials are discovered requiring repairs to be made under this guarantee, all such repair work shall be done by the Contractor at his own expense within five (5) days after being notified; the City may make the necessary repairs and charge the Contractor with the actual cost of all labor and materials required.

The Maintenance Bond shall be in the amount of ten percent (10%) of the amount of the Contract but not less than $50,000.00. The Contractor shall execute the Maintenance Bond on the forms furnished by the City.

106.5 Add the following:

Testing of all materials shall be performed by an independent testing laboratory acceptable to the City. The Contractor shall pay the cost of all material testing including the retesting of all materials which fail the required tests. Test reports of all materials tested shall be sent to the City.

108.13 Add the following:

All necessary repairs and removal of any section of the work so put into use, due to defective materials or workmanship or due to operations of the Contractor, shall be performed by the Contractor at his own expense.

1.09 MEASUREMENT AND PAYMENT

Only those items in the Proposal will be measured and paid for. All other items of work required to complete the project shall be considered subsidiary to the pay items in the proposal and no claims whatsoever for extra work on such subsidiary items will be considered.

202.2.2 Removal and separation of topsoil is required unless otherwise noted. Finish grade shall be ± 0.1 feet of original grade unless otherwise noted. The Contractor is responsible for

removing and disposing of all excess excavated materials. Such materials may not be left on public right-of-way or adjacent property without written permission to do so.

301.3 Portland cement treatment of base and subgrade may be used only with special permission of the City.

301.4 Asphalt treatment of subbase may be used only with special permission of the City.

303.3.4.2 Unless otherwise noted in the plans and specifications, concrete shall be class 'C'.

303.5.4.2 Expansion joints shall be spaced at no greater than 600 foot centers. Expansion joints are required across the entire pavement width on all sides of an intersection.

303.5.6.1.3 Add the following:

A stamp or die shall be used to mark on the face of the curb or edge of pavement, the location of all of the following facilities:

Facility	Marking
Water Valve	V
Water Service	W
Sanitary Sewer Service	S

For water valves, the bottom of the "V" shall point in the direction of the valve. The stamp or die shall be approved by the City.

502.1.4.1.3 Fiberglass manholes may be used only with special permission of the City.

502.3 Fire hydrants shall be Mueller Centurion.

502.3.1.1 Add the following:

All hydrants shall be equipped with:

Two hose nozzles 2 1/2" in (6.4 cm) nominated I.D. National Standard Fire-hose Coupling Screw Thread. One Pumper Nozzle 4" nominal I.D. National Standard Thread.

The operation nozzle cap nuts shall be 1-½" in. point face at base and 1-¼" in. point to face at top. A weather cap or shield shall be furnished to protect the opening between the operating nut and the top of the bonnet.

Two (2) or more none corrosive outlets for drainage shall be provided in the base or barrel or between the base and the barrel of the hydrant. The outlet shall be an integral part of the drain valve. Drain rods independent of the main stem shall not be accepted.

Direction to open shall be counter-clockwise.

502.3.1.1.(2) Add the following:

a) Color of the urethane coating for the bonnet of the hydrant shall be based on the largest Size line within 75 feet horizontally from the hydrant according to the following table:

Line Size	Color
4”	Red
6”	ANSI 70 Grey
8”	Blue
10” & Larger	Yellow

b) All colors except grey shall be safety colors per ANSI Z53.1. Grey color shall be per ANSI Z55.1

502.3.2 A Blue Stimsonite, Fire-Lite reflector (or approved equal) shall be placed in the center of the street opposite fire hydrants

502.6.2.1 Valves shall be Mueller

502.10.3.1.7 Direct tapping of PVC pipe will not be permitted.

(1) All water service shall be marked on the end of services with a blue plastic tape with the word “Water” stamped thereon.

(2) After the completion of paving, all water deadheads shall have a meter box installed by the contractor. The type of meter box shall be approved by the City.

504.5.3.2 Add: The Contractor shall guarantee the backfilling of excavation and trenches against excessive (as determined by the Engineer) settlement for a period of one year after the final completion of the contract under which the work is performed. Make all repairs of replacements necessary by settlement including refilling and compacting the upper portion of the ditch and repairing broken or settled pavements within thirty (30) days after notice from the Engineer or City.

OTHER PROVISIONS:

1. Street Lights

Street light poles shall be Type RTAZB as manufactured by Trimble House, Pinckneyville, Georgia. Pole height shall be 20 feet nominal. Poles shall be furnished with ¾”x30” hot dipped galvanized steel anchor bolts.

2. Street Signs

All street signs and hardware shall be purchased from the City of Bridgeport. Signs shall be mounted on 2” nominal diameter Schedule 40 hot dipped galvanized steel pipe posts. Post lengths shall be 12’-0” for street identification signs and be 10’-0” long for traffic control signs.

3. Pavement Striping

Pavement markings and striping shall be hot applied thermo plastic road striping compound equal to Cata-Therm as manufactured by Cataphote, Inc., Jackson, Mississippi. Striping compound shall be placed on a clean substrate in strict accordance with the manufacture’s recommendations. Reflective glass beads shall be applied to the fluid compound. Glass beads shall meet TxDOT specifications regarding material and application.

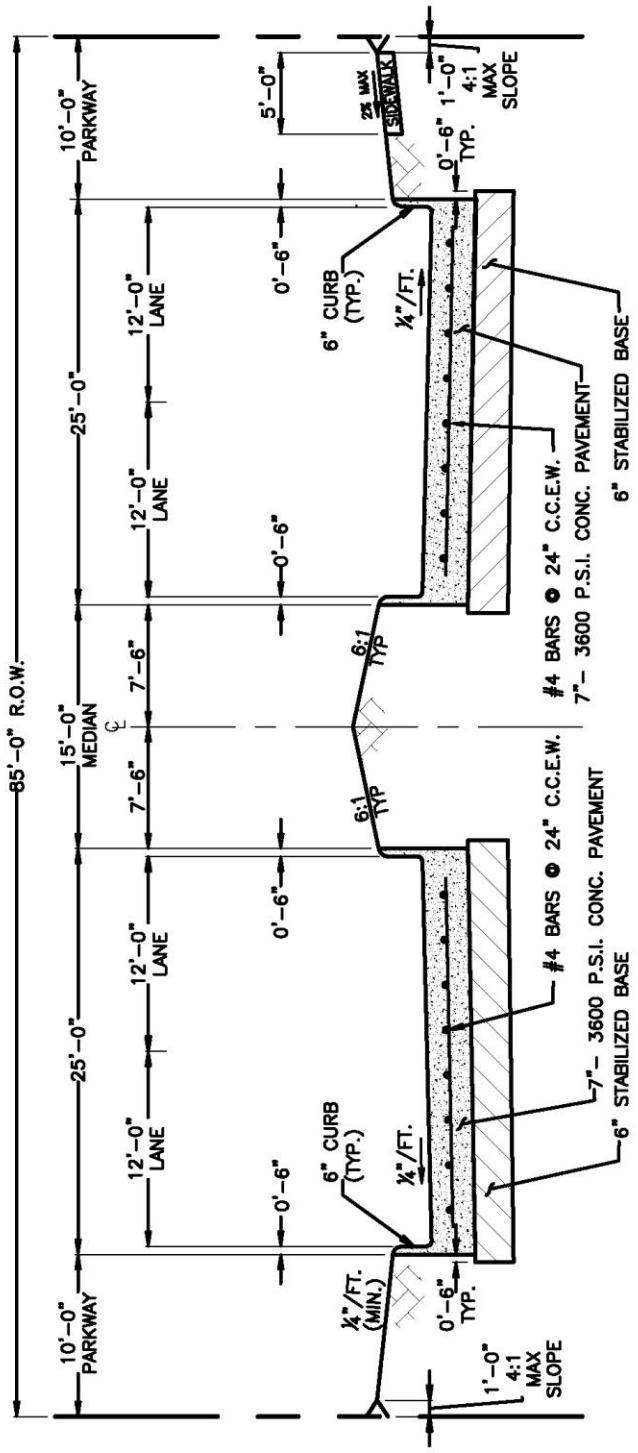
[Intentionally left blank]

APPENDIX F: CONSTRUCTION DETAILS

[Intentionally left blank]

PAVING SECTIONS

[Intentionally left blank]

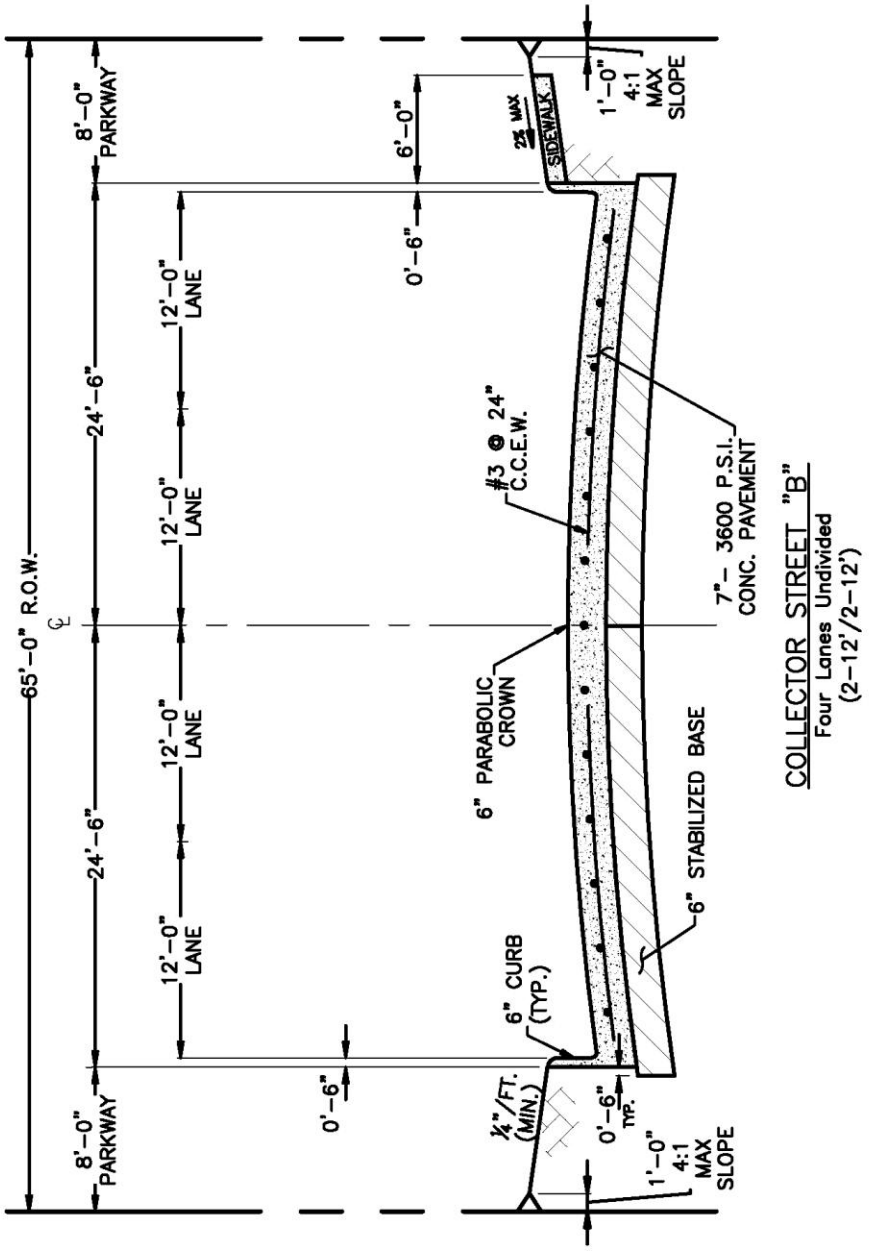


COLLECTOR STREET "A"
Four Lanes Divided
(2-12'/ 16' Median/ 2-12')

Collector Street "A"

Baird, Hampton & Brown, Inc.
Engineering & Surveying

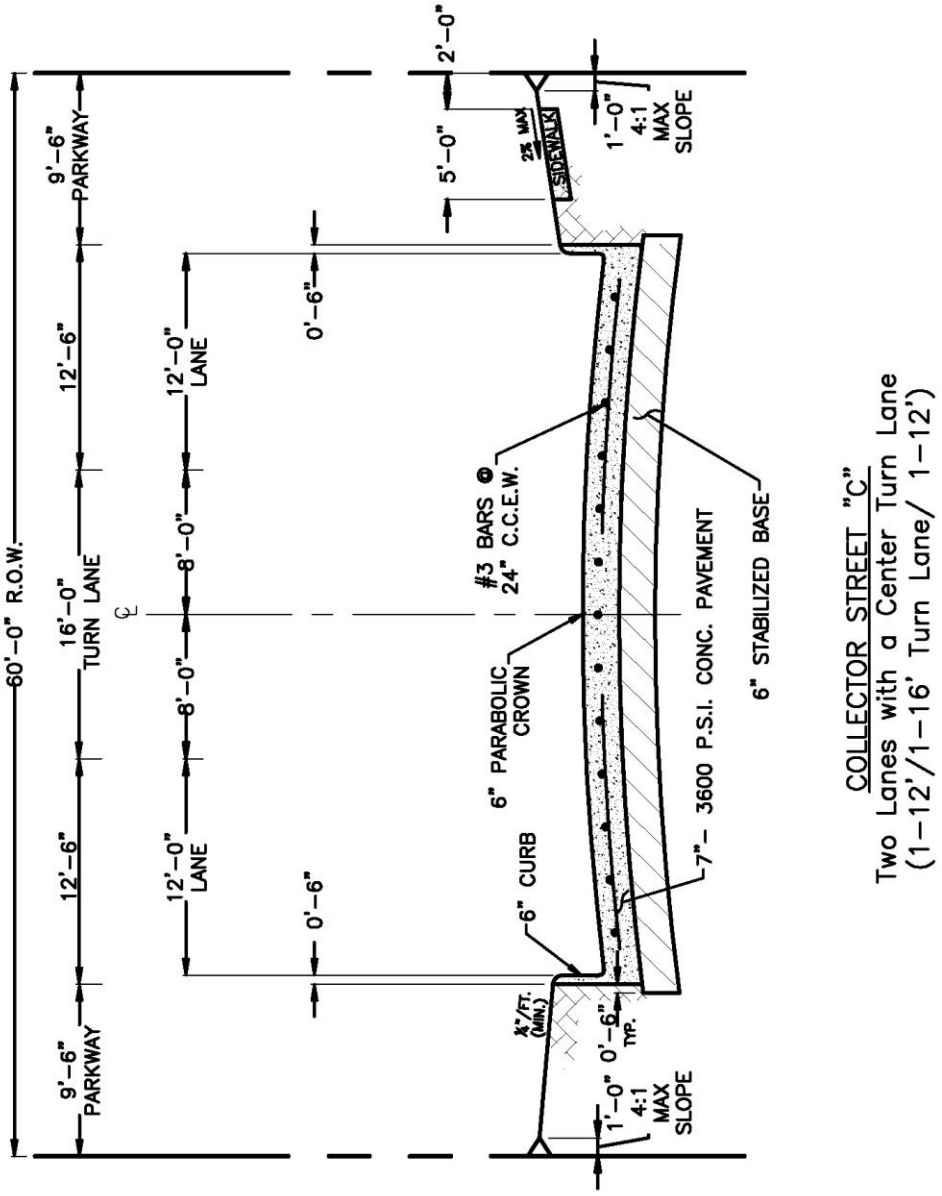
City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



Collector Street "B"

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

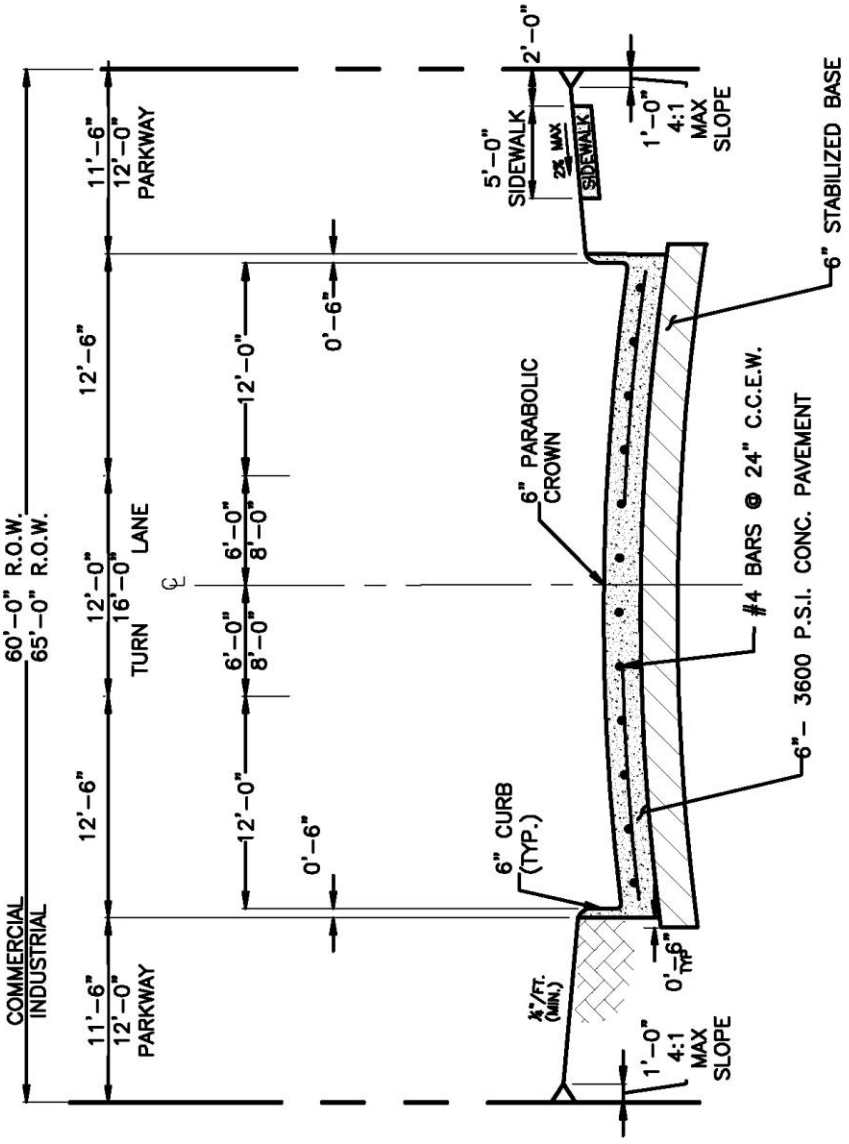


COLLECTOR STREET "C"
Two Lanes with a Center Turn Lane
(1-12'/1-16' Turn Lane/ 1-12')

Collector Street "C"

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

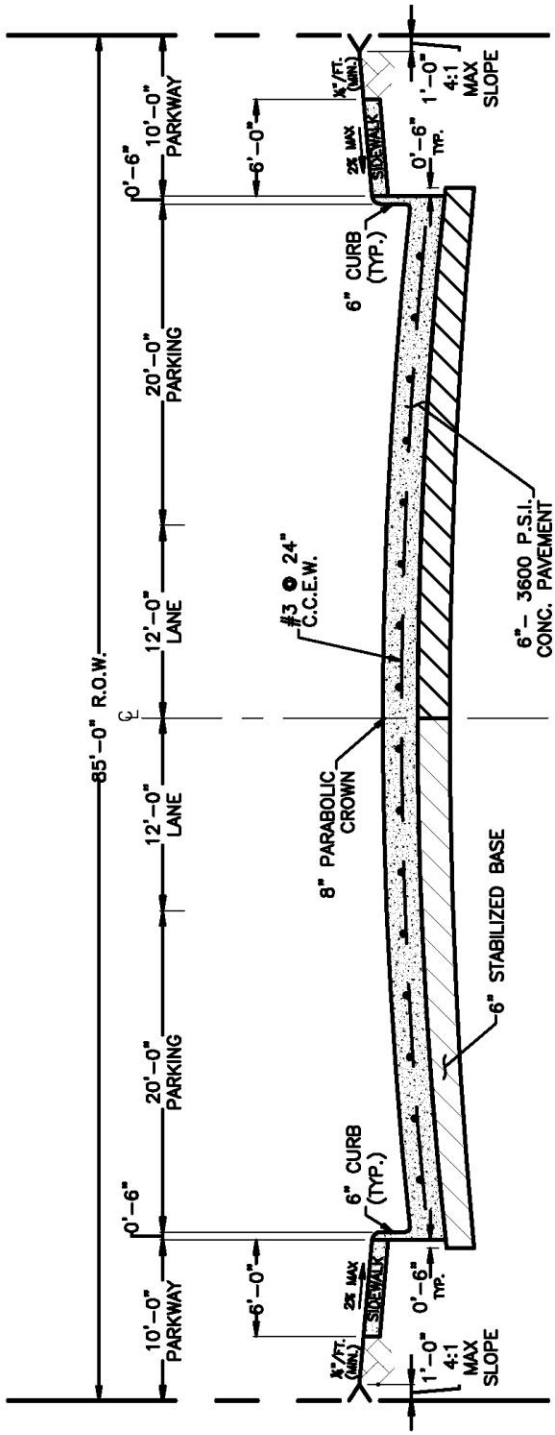


COMMERCIAL / INDUSTRIAL ROADWAY
Two Lanes with a Center Turn Lane
(1-12'/1-12' or 1-16' Turn Lane/ 1-12')

Commercial / Industrial Roadway

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



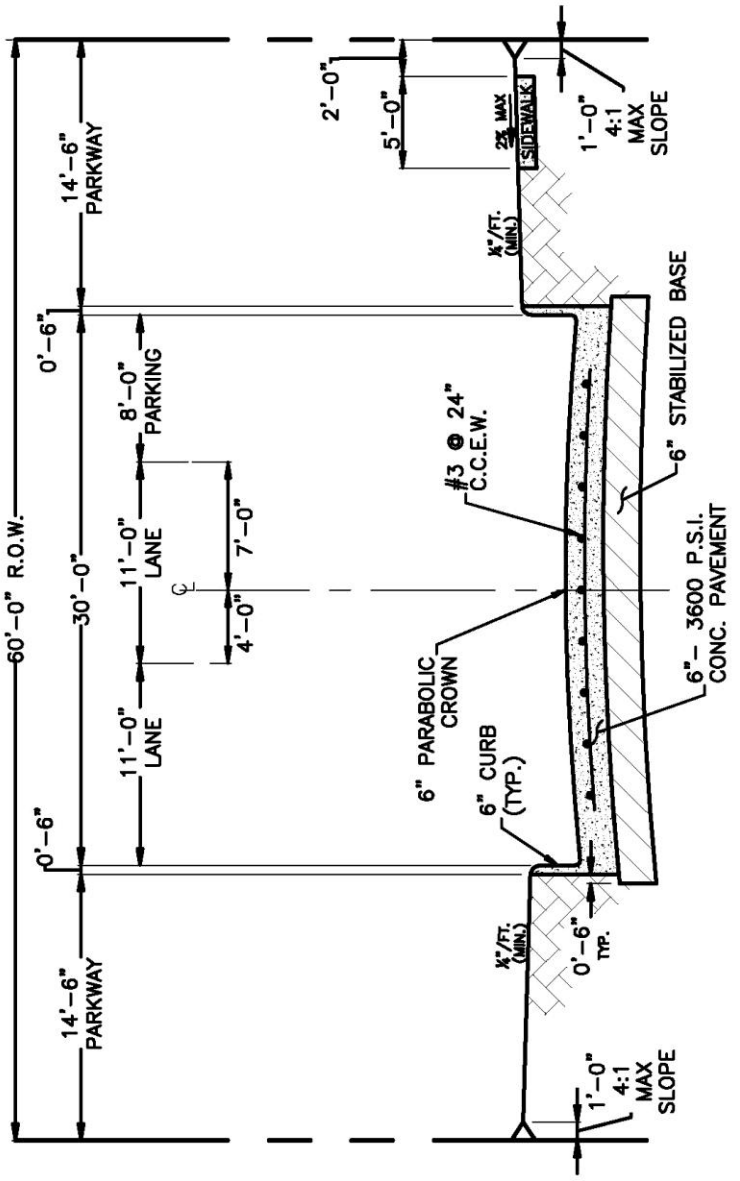
HISTORICAL DISTRICT
Two Lanes Undivided
(20' Parking/1-12'/1-12'/20' Parking)

Historical District

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS

900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

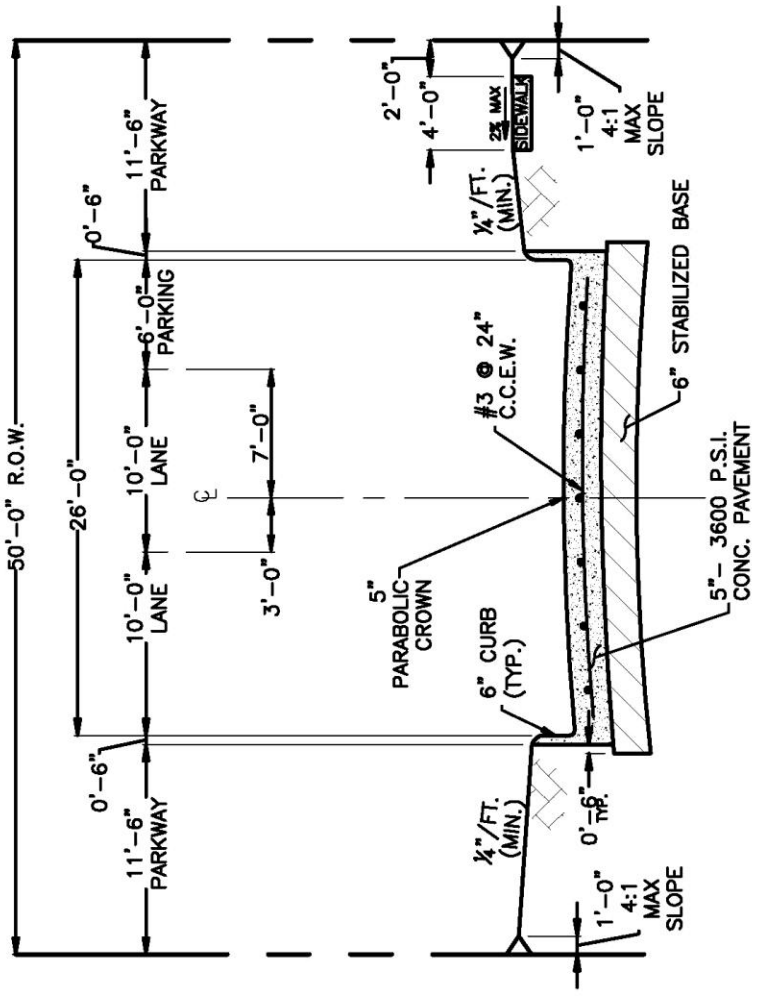


LOCAL STREET
Two Lanes Undivided
(1-11'/1-11'/1-8' PARKING) 60' R.O.W

Local Street

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

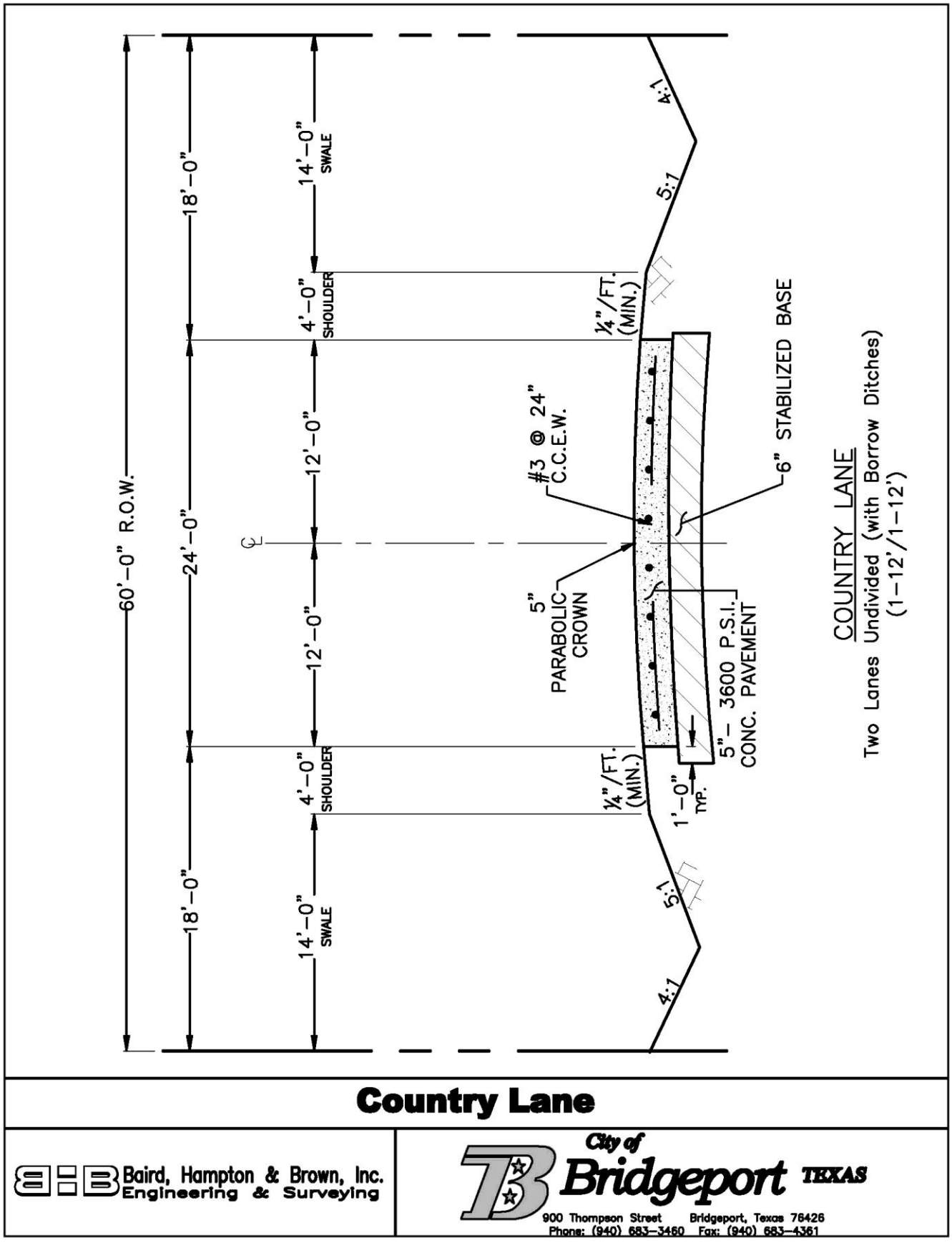


LOCAL STREET (RESIDENTIAL)
Two Lanes Undivided
(1-10'/1-10'/1-6' PARKING) 50' R.O.W.
(Residential Only)

Local Street (Residential)

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

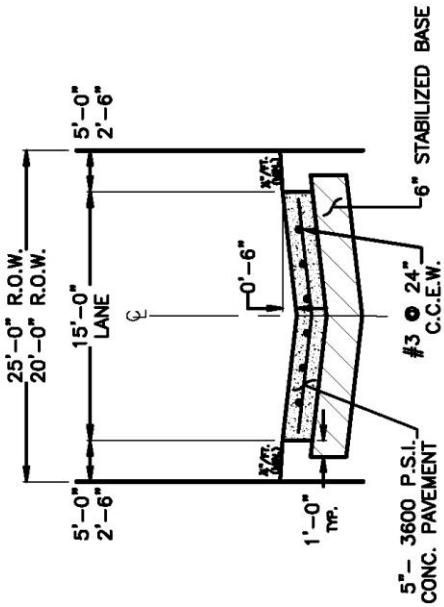


Country Lane

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS

900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



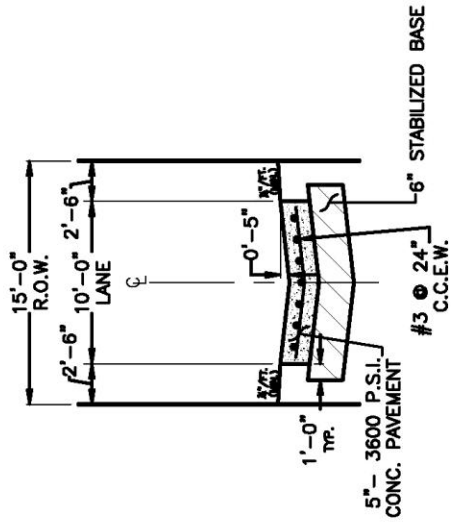
15' ALLEY SECTION

15' Alley

Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS

900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361



10' ALLEY SECTION

10' Alley

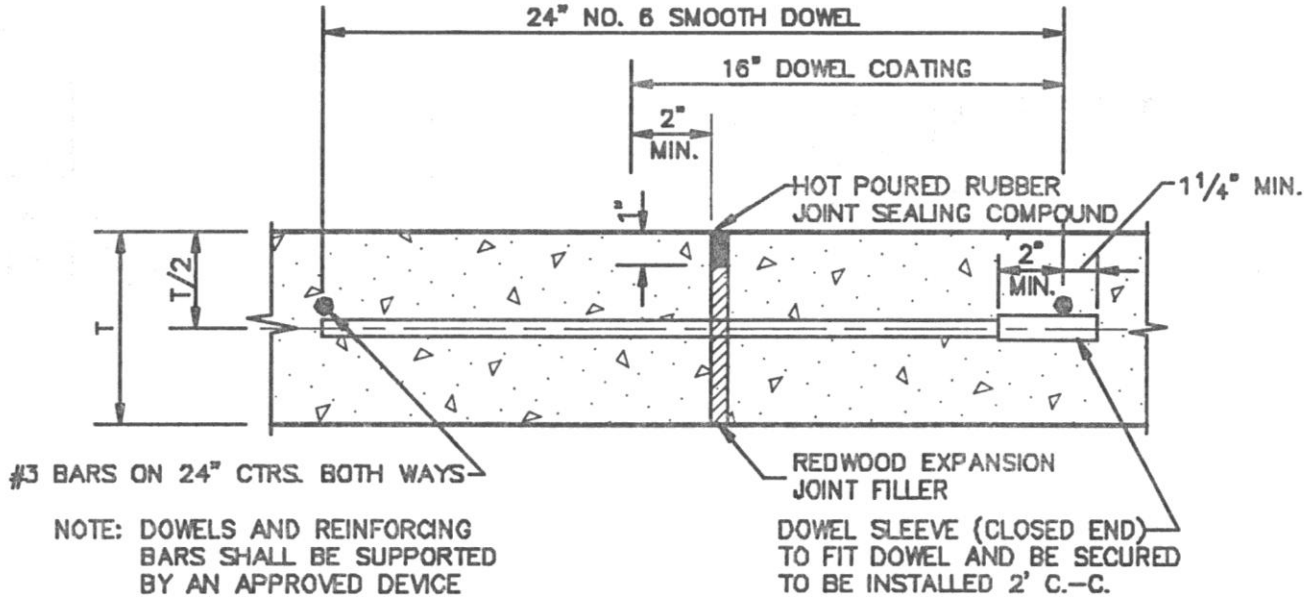
Baird, Hampton & Brown, Inc.
Engineering & Surveying

City of Bridgeport TEXAS
900 Thompson Street Bridgeport, Texas 76426
Phone: (940) 683-3460 Fax: (940) 683-4361

PAVING DETAILS

[Intentionally left blank]

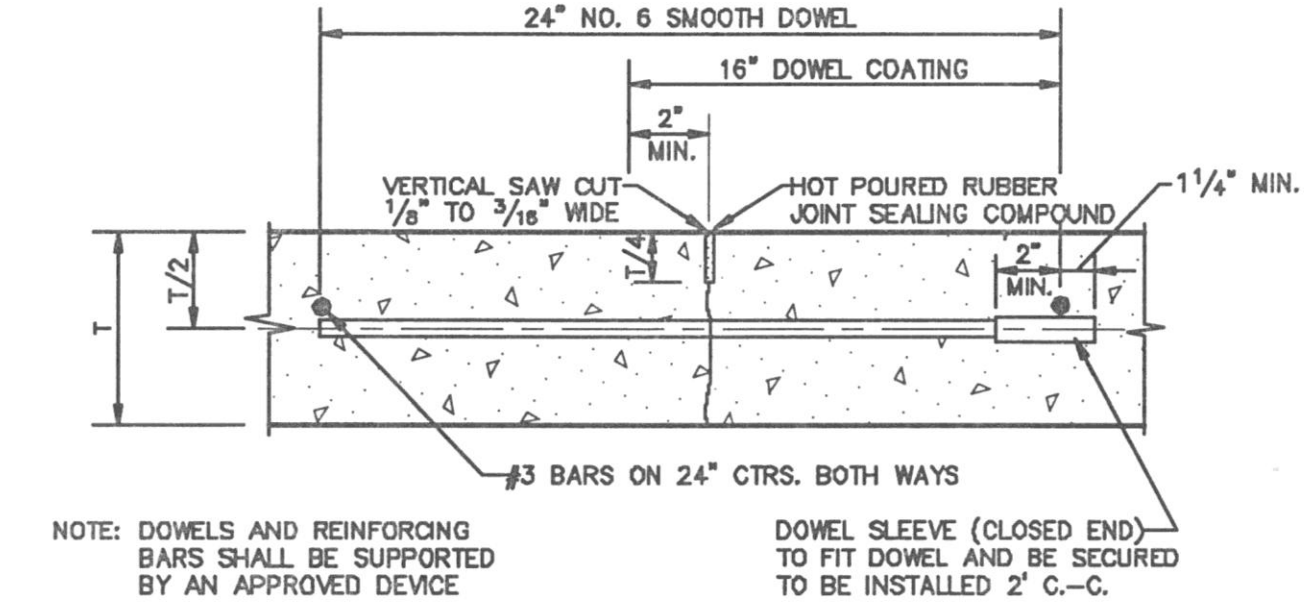
02610F



TRANSVERSE EXPANSION JOINT DETAIL

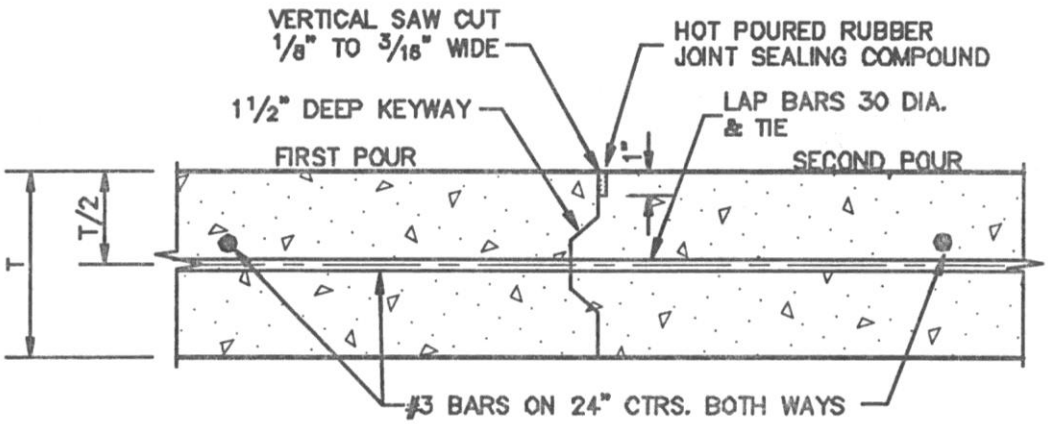
NO SCALE

NOTE: SPACE 600' O.C., LOCATE AT INTERSECTIONS



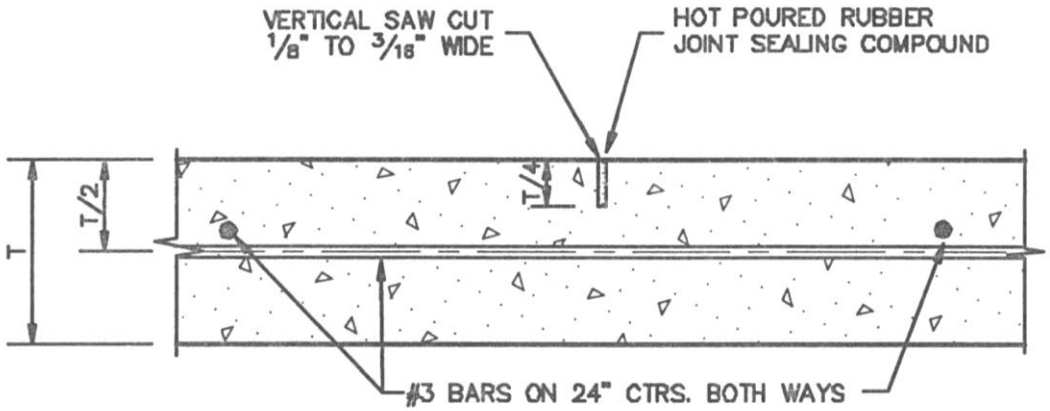
CONTRACTION JOINT DETAIL

NO SCALE



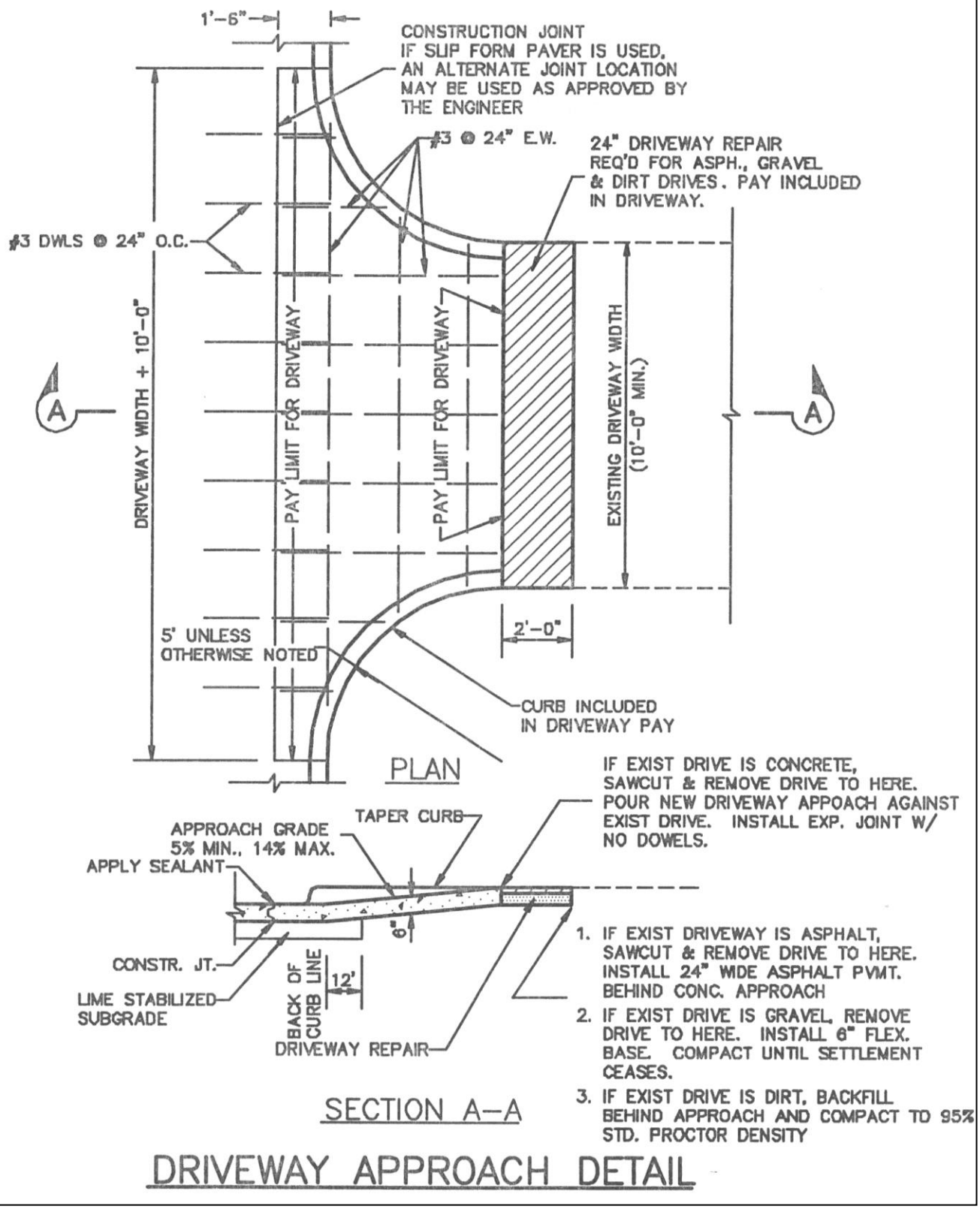
CONSTRUCTION JOINT DETAIL

NO SCALE

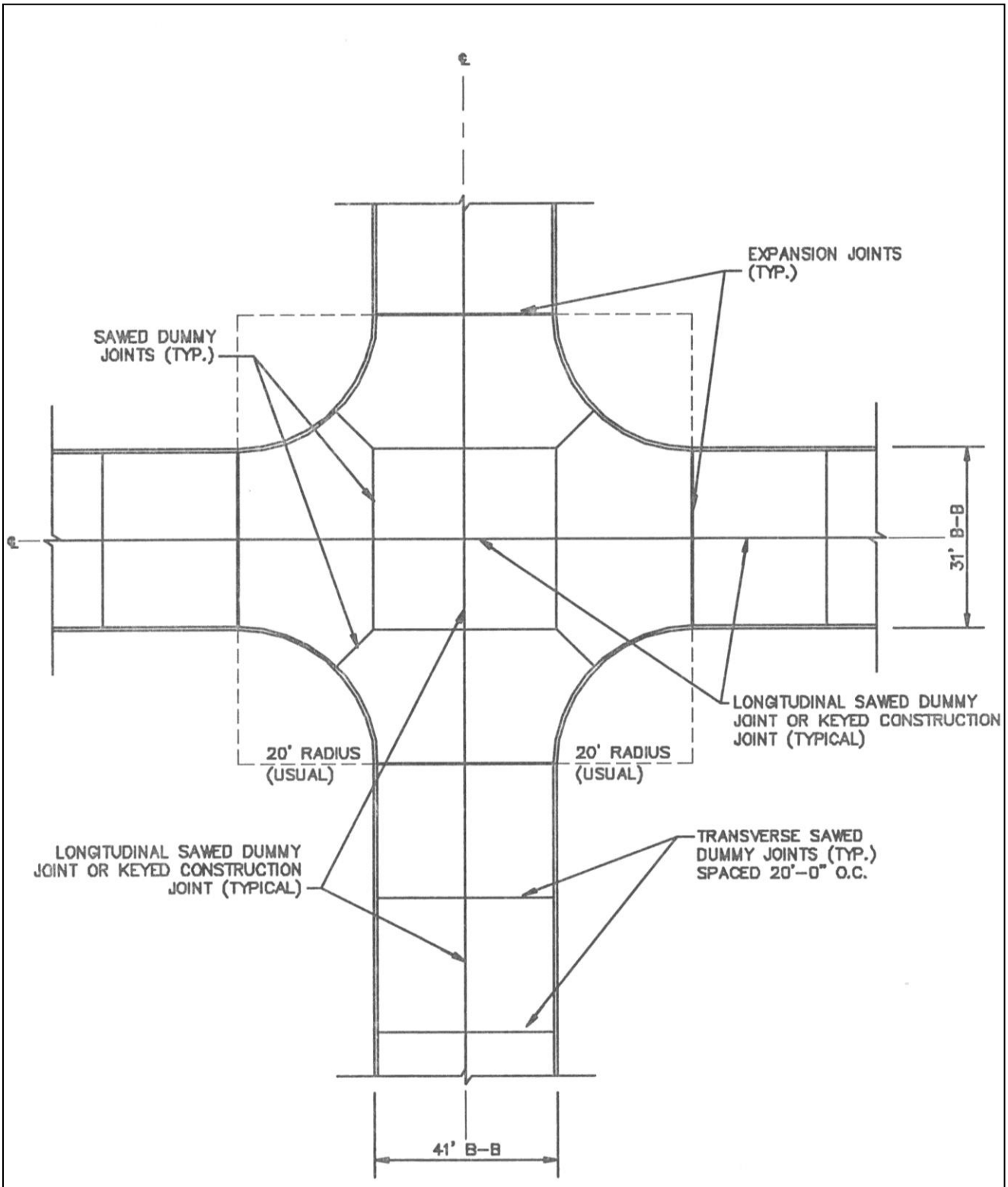


SAWED DUMMY JOINT DETAIL

NO SCALE

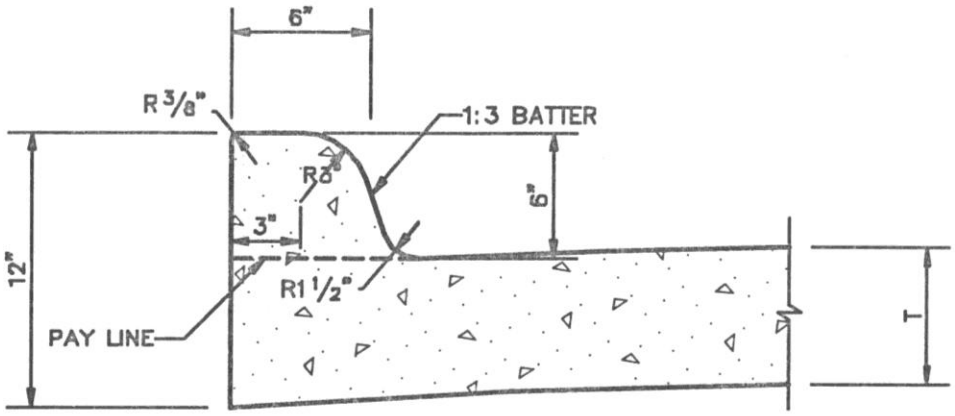


DRIVEWAY APPROACH DETAIL



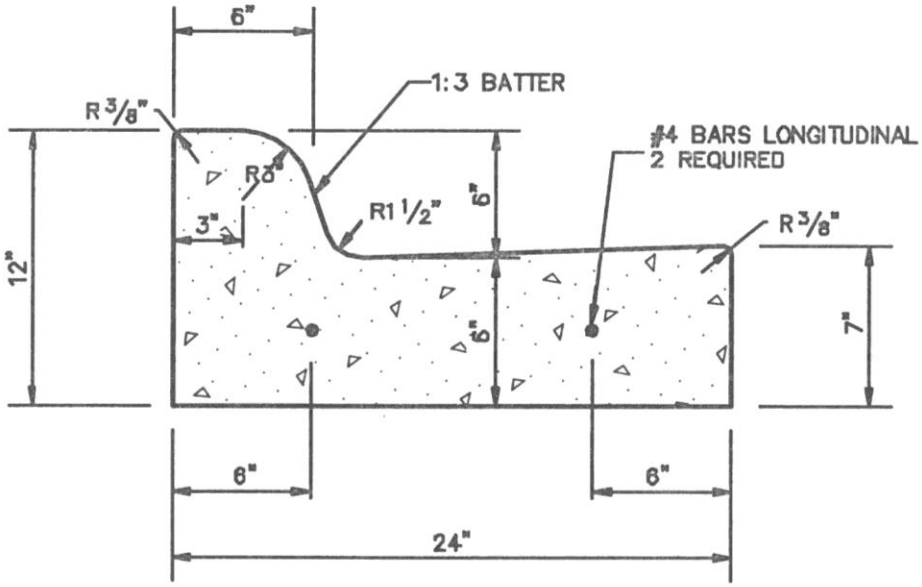
TYPICAL INTERSECTION JOINTING

NO SCALE



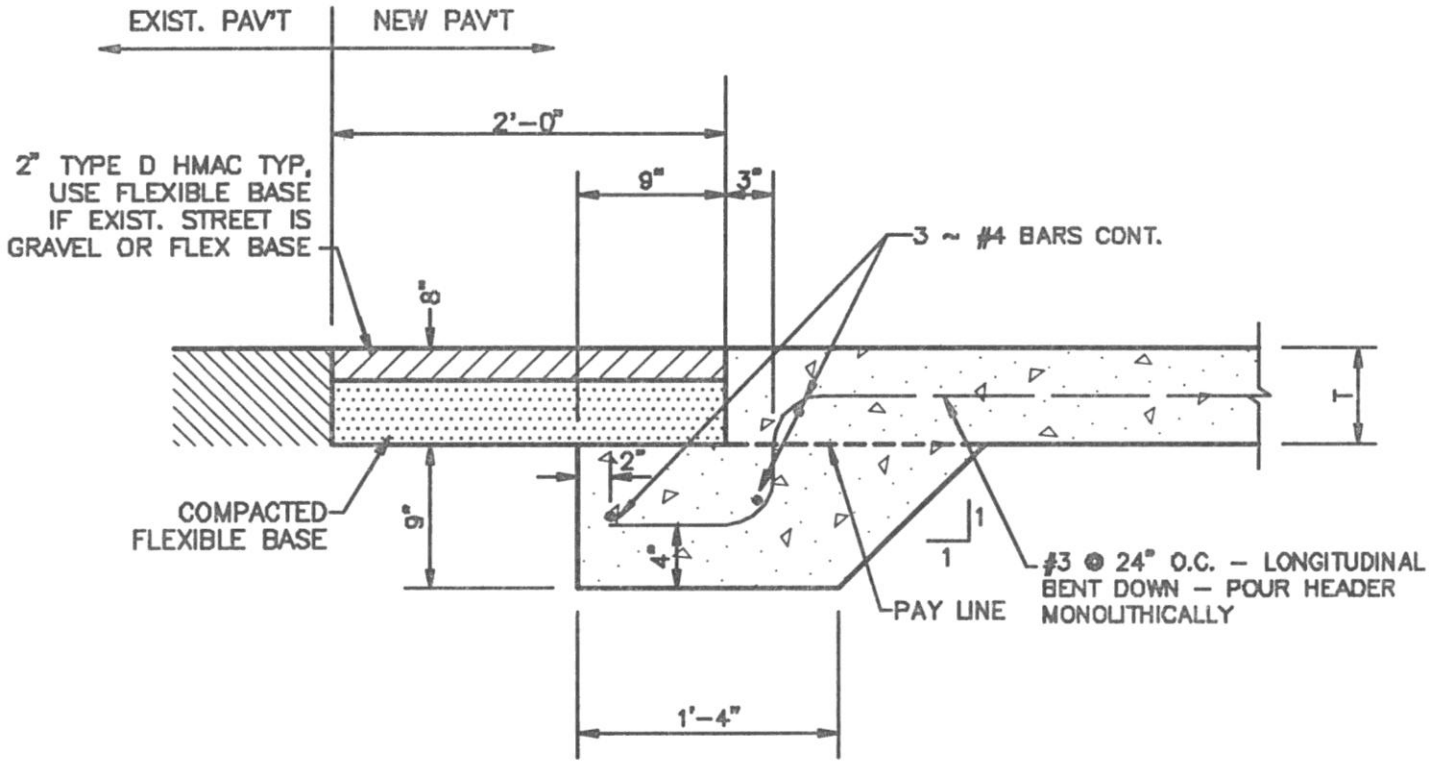
INTEGRAL CURB DETAIL

SCALE: 1 1/2"=1'-0"



24" SEPARATE CURB & GUTTER DETAIL

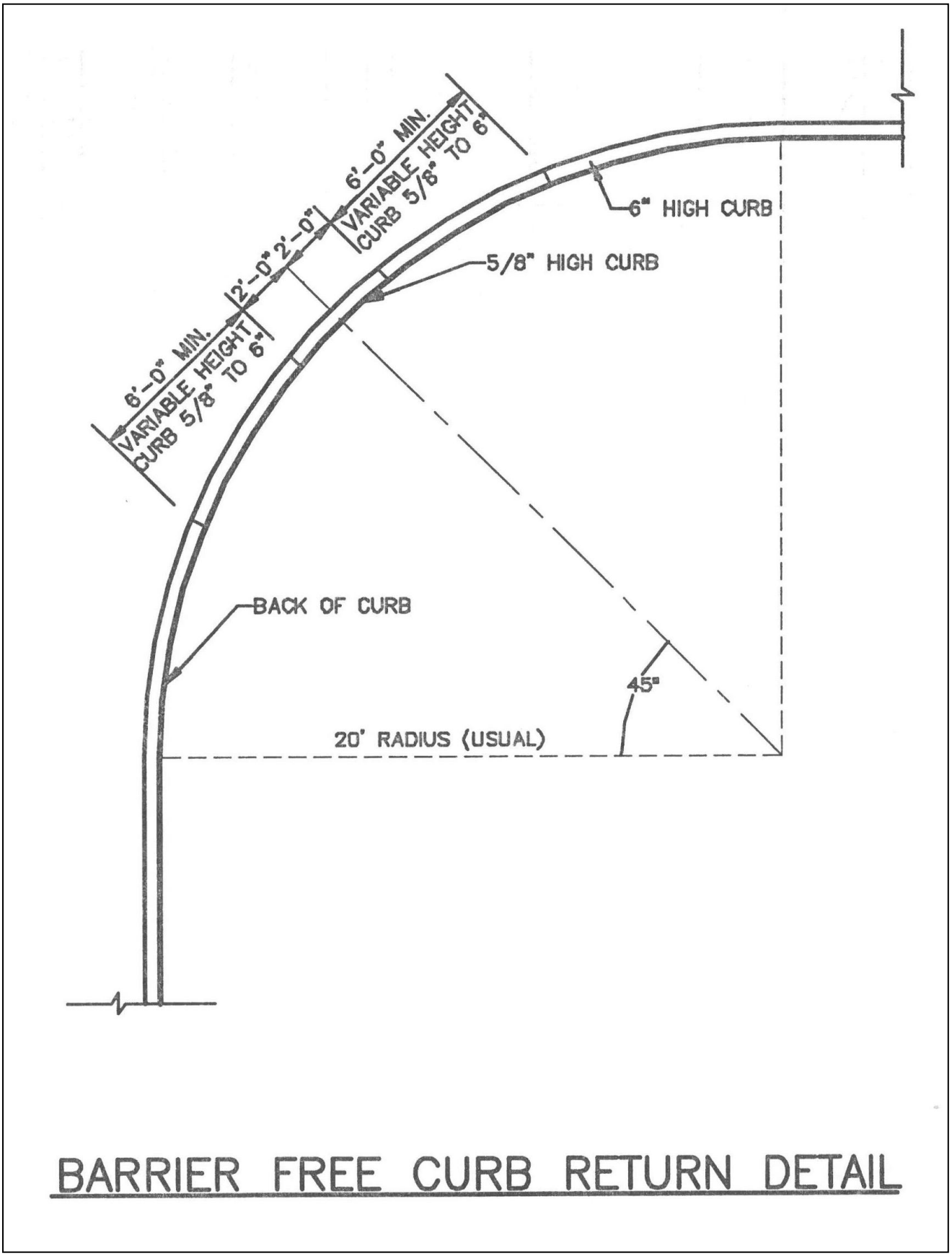
SCALE: 1 1/2"=1'-0"



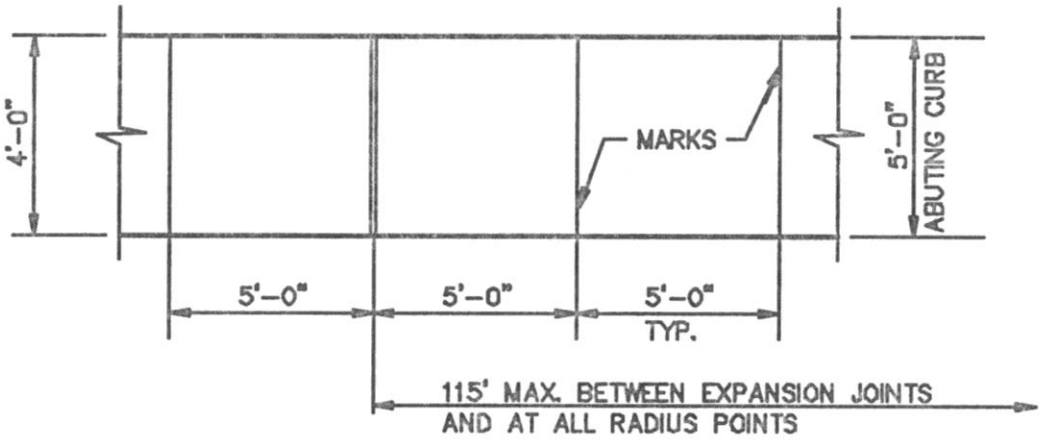
TYPICAL HEADER

CONCRETE HEADER DETAILS

NO SCALE

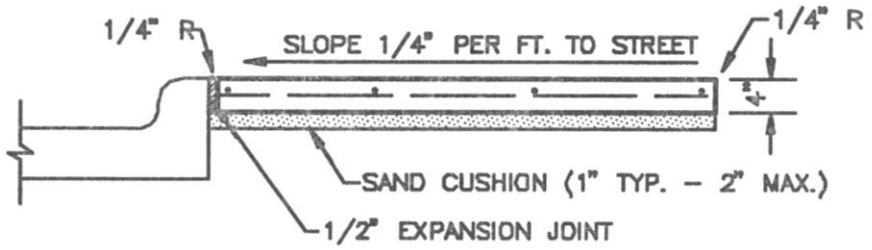


BARRIER FREE CURB RETURN DETAIL

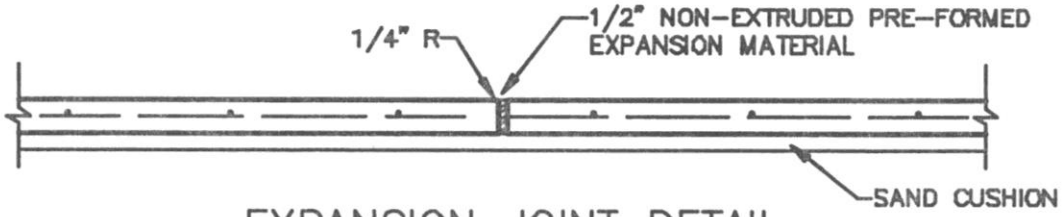


NOTE:
AT MARKINGS THE CONCRETE SHALL BE CUT 1" DEEP, FOLLOWED BY GROOVING TOOL. STRENGTH SHALL BE 2500 p.s.i. WITH #3 BARS @ 24" O.C.

PLAN

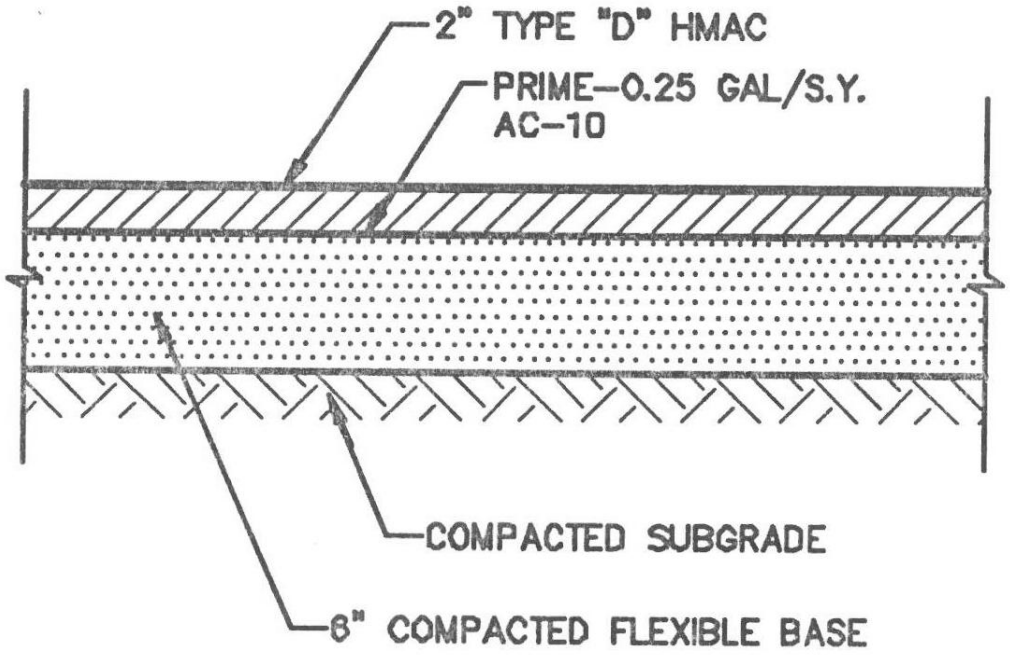


TYPICAL SECTION



EXPANSION JOINT DETAIL

TYPICAL SIDEWALK DETAIL



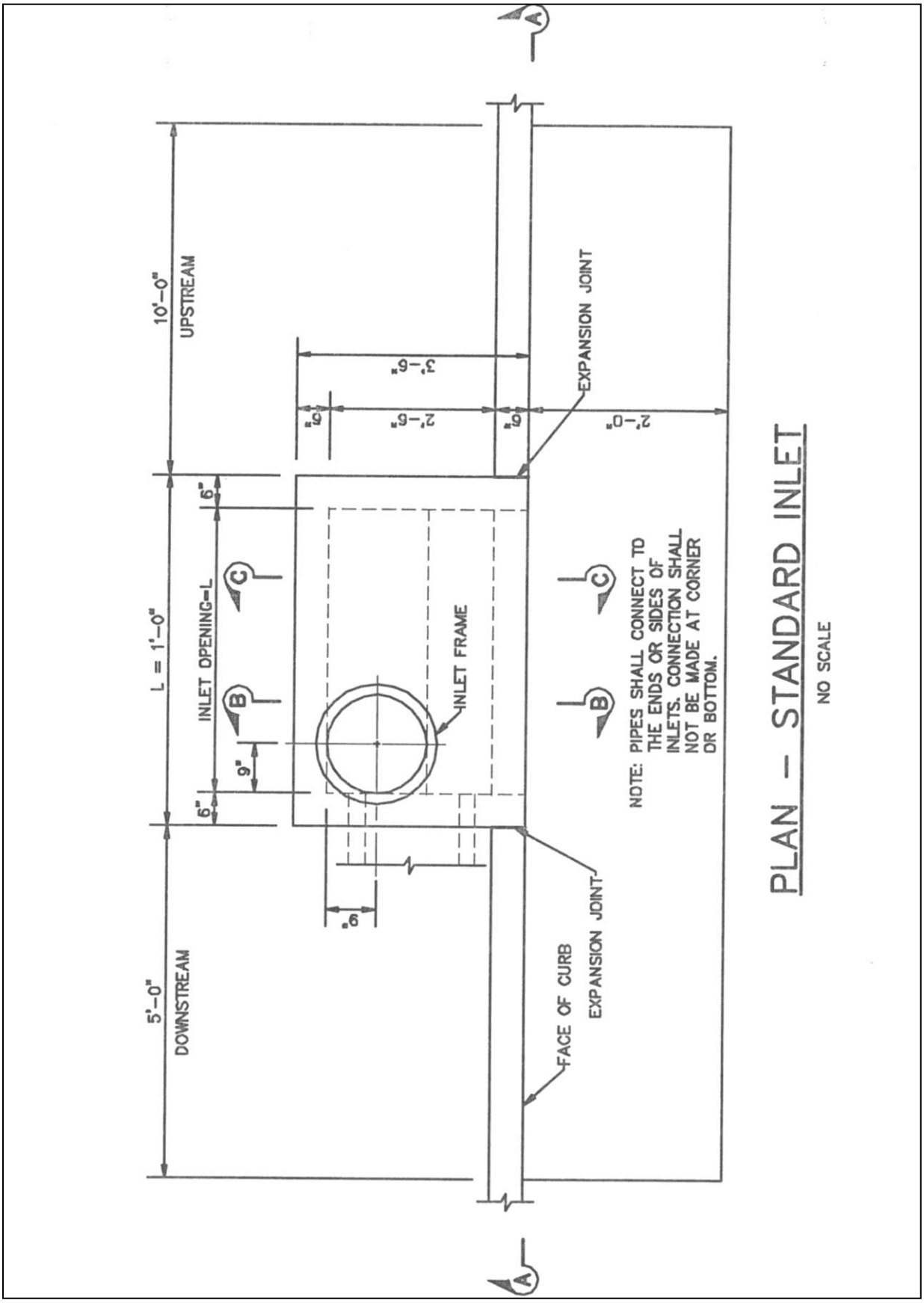
ASPHALT PAVEMENT DETAIL

NO SCALE

[Intentionally left blank]

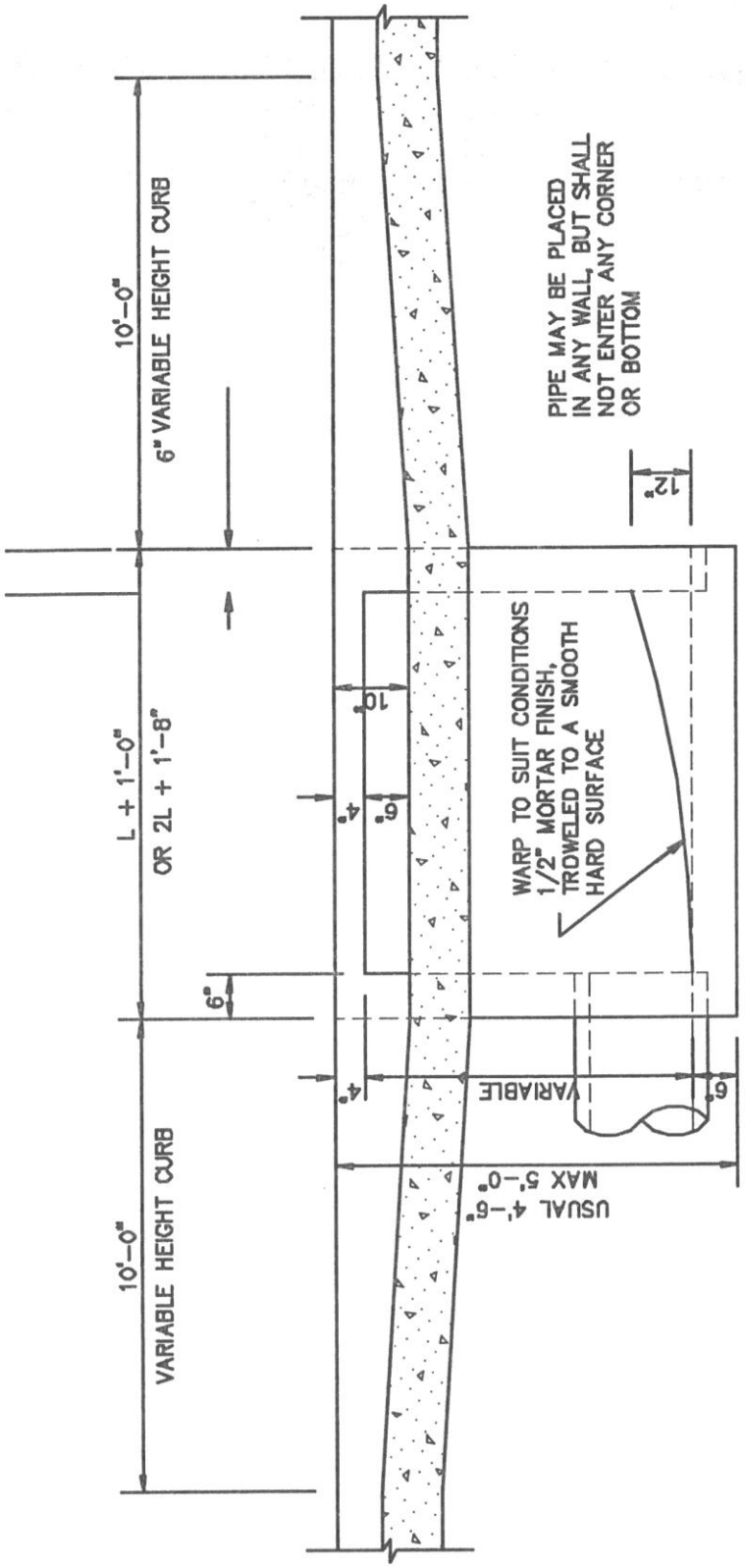
DRAINAGE DETAILS

[Intentionally left blank]



PLAN – STANDARD INLET

NO SCALE

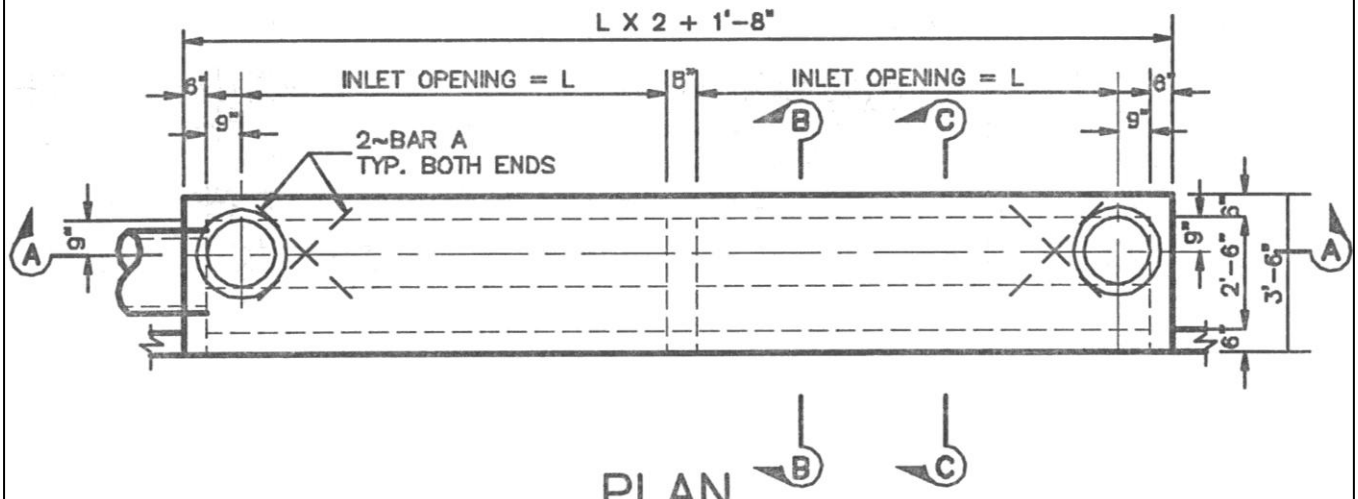


SECTION A-A

RECESSED AND STANDARD DETAILS

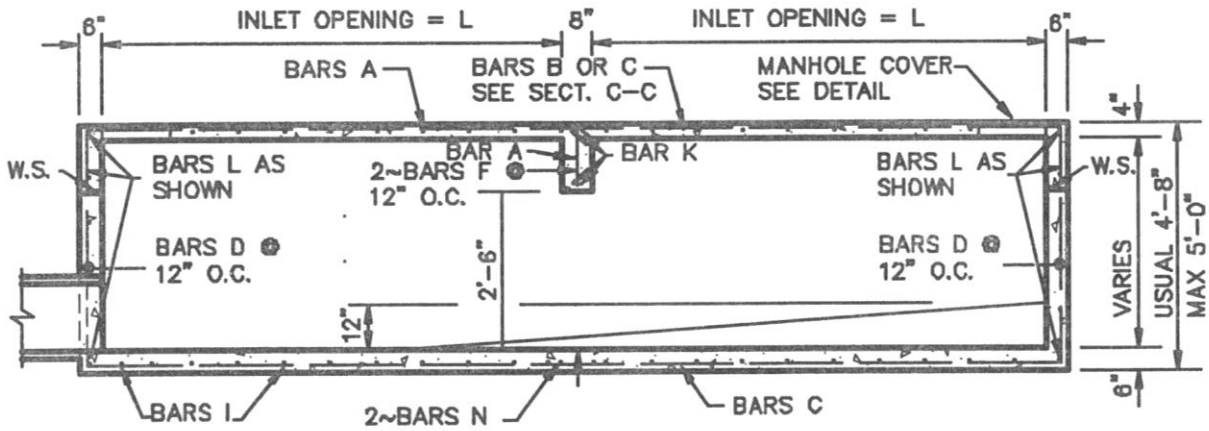
NO SCALE

025138



PLAN

SCALE: 1/4" = 1'-0"

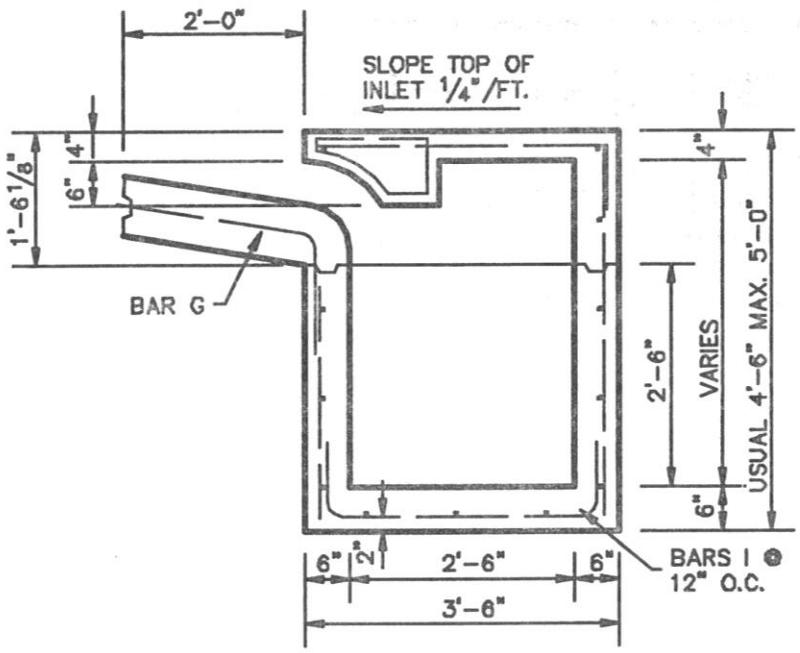


SECTION "A-A"

SCALE: 1/4" = 1'-0"

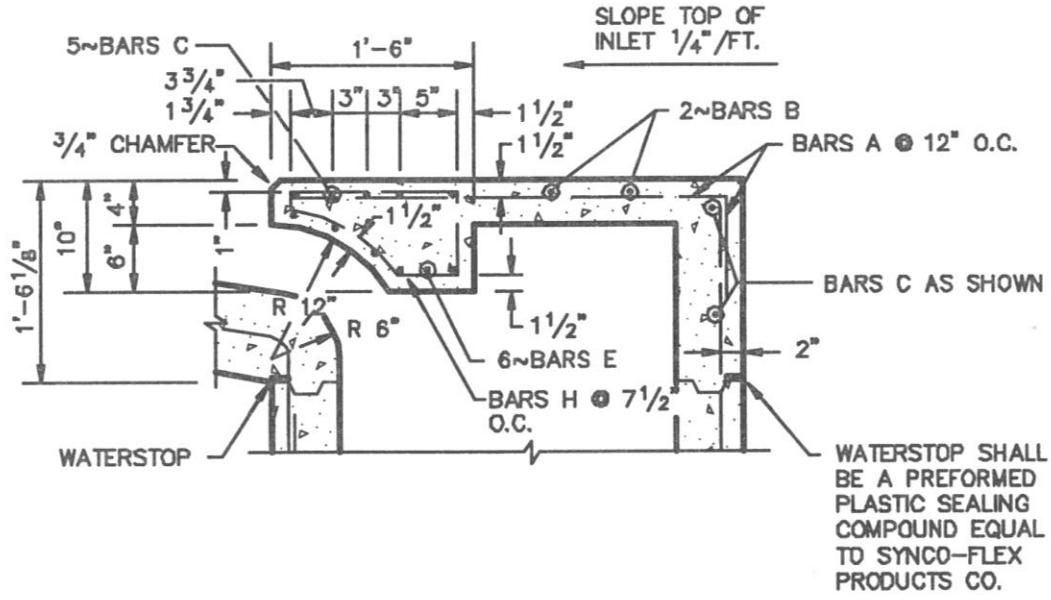
NOTE:

DETAIL SHOWN IS FOR INLETS LARGER THAN 10' IN WIDTH. FOR INLETS 10' IN WIDTH AND LESS, DELETE CENTER ROOF BEAM AND ONE MANHOLE COVER.



SECTION "B–B"

SCALE: 1/2" = 1'-0"



SECTION "C–C"

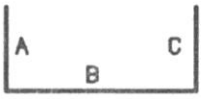
SCALE: 3/4" = 1'-0"

REINFORCING STEEL SCHEDULE

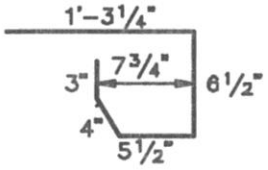
DIMENSIONS SHOWN ARE FOR MAX. SIZE INLETS

INLET LENGTH L	BAR TYPE	BAR DIA. (1/8")	NO. REQD.	BAR DIMENSIONS		
				A	B	C
6 FT.	A	3	9	3'-2"	0'-3"	---
	B	3	1	4'-10"	---	---
	C	4	15	6'-8"	0'-6"	---
	D	4	5	4'-8"	---	---
	F	4	1	3'-2"	---	---
	G	3	5	2'-0"	1'-3"	---
	H	3	3	*	*	*
	N	3	3	3'-2"	3'-2"	3'-2"
8 FT.	A	3	12	3'-2"	0'-3"	---
	B	3	1	6'-10"	---	---
	C	4	15	8'-8"	0'-6"	---
	D	4	5	4'-8"	---	---
	F	4	1	3'-2"	---	---
	G	3	5	2'-0"	1'-3"	---
	H	3	4	*	*	*
	N	3	3	3'-2"	3'-2"	3'-2"
10 FT.	A	3	10	3'-2"	0'-3"	---
	B	3	2	8'-10"	---	---
	C	4	16	10'-8"	0'-6"	---
	D	4	4	4'-8"	---	---
	E	5	6	10'-8"	---	---
	G	3	5	2'-0"	1'-3"	---
	H	3	15	*	*	*
	I	4	8	4'-8"	3'-2"	3'-2"
	L	4	5	4'-3"	---	---

* SEE DIAGRAM FOR DIMENSIONS



TYPICAL BAR BENDING



BAR H

REINFORCING DETAILS

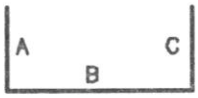
REINFORCING STEEL SCHEDULE

DOUBLE INLETS

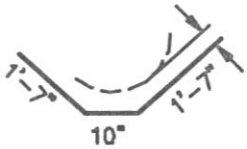
DIMENSIONS SHOWN ARE FOR MAX. SIZE INLETS

INLET LENGTH L	BAR TYPE	BAR DIA. (1/8")	NO. REQD.	BAR DIMENSIONS		
				A	B	C
8 FT.	A	3	19	3'-2"	0'-6"	---
	B	3	2	15'-6"	---	---
	C	4	16	17'-4"	0'-6"	---
	D	4	9	4'-8"	---	---
	E	5	8	17'-4"	---	---
	F	4	5	1'-2"	---	---
	G	3	12	2'-0"	1'-3"	---
	H	3	26	*	*	*
	I	4	16	4'-8"	3'-2"	3'-2"
	J	5	1	*	*	*
	K	5	6	3'-2"	0'-6"	---
	L	4	11	3'-2"	0'-6"	---
	M	4	2	3'-0"	---	---
	N	4	2	4'-8"	3'-2"	4'-8"
10 FT.	A	3	23	3'-2"	0'-6"	---
	B	3	2	19'-6"	---	---
	C	4	16	21'-4"	0'-6"	---
	D	4	9	4'-8"	---	---
	E	5	8	21'-4"	---	---
	F	4	5	1'-2"	---	---
	G	3	15	2'-0"	1'-3"	---
	H	3	32	*	*	*
	I	4	20	4'-8"	3'-2"	3'-2"
	J	5	1	*	*	*
	K	5	6	3'-2"	0'-6"	---
	L	4	11	3'-2"	0'-6"	---
	M	4	2	3'-0"	---	---
	N	4	2	4'-8"	3'-2"	4'-8"

* SEE DIAGRAM FOR DIMENSIONS

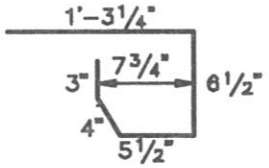


TYPICAL BAR BENDING



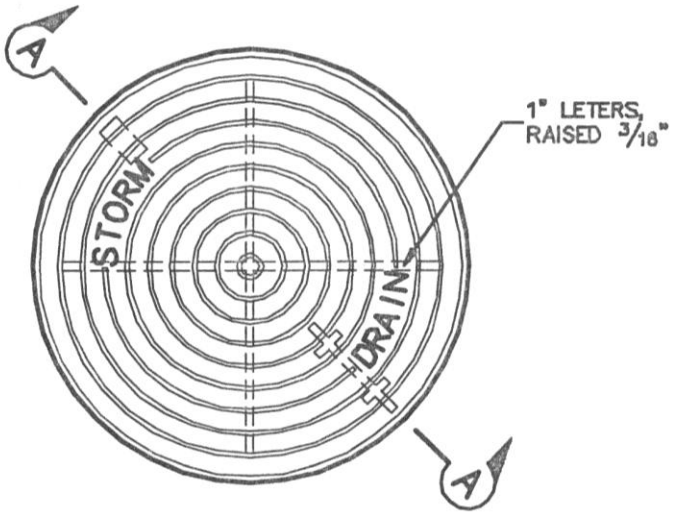
BEND TO ALLOW A MIN. 1 1/2" CLR. OF DRAIN PIPE.

BAR J

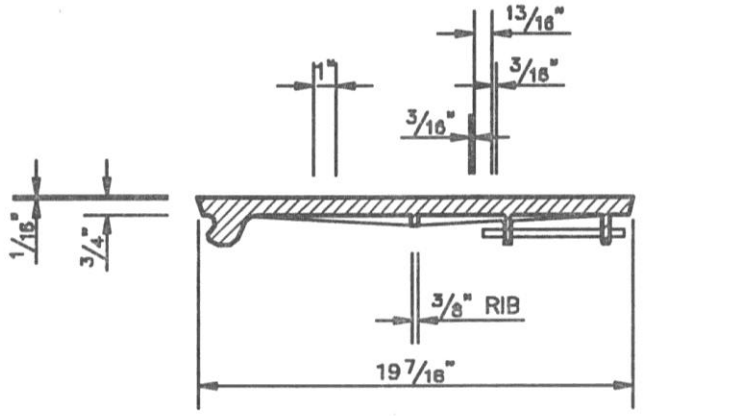


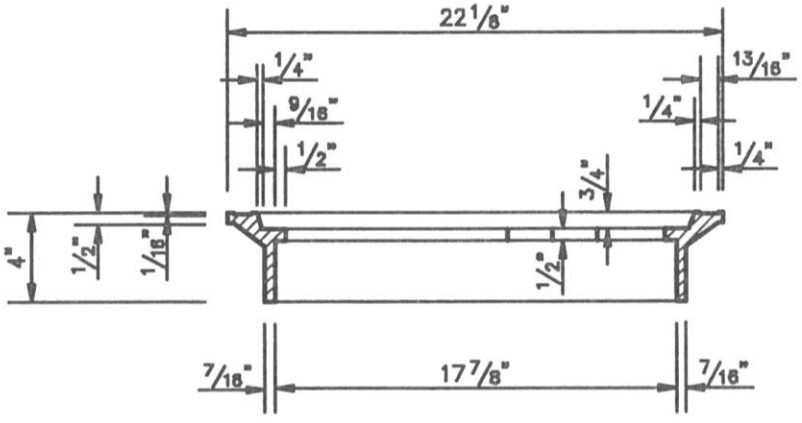
BAR H

REINFORCING DETAILS



PLAN OF COVER

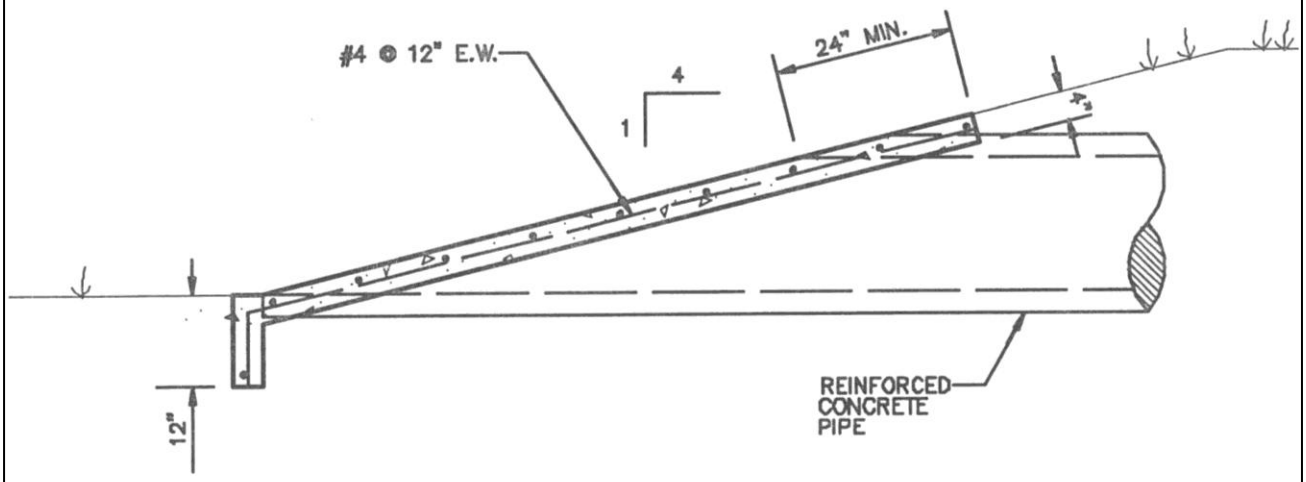




SECTION OF FRAME AND COVER

INLET FRAME AND COVER

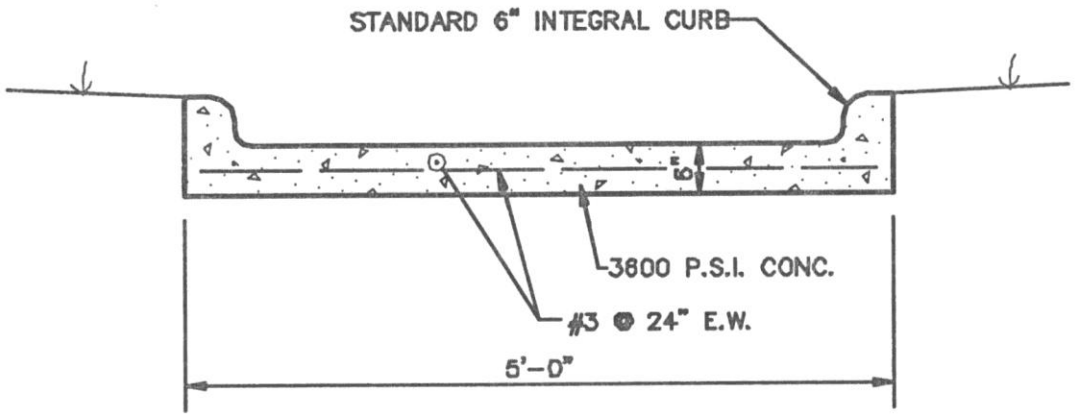
SCALE: 1 1/2" = 1'-0"



HEADWALL DETAIL

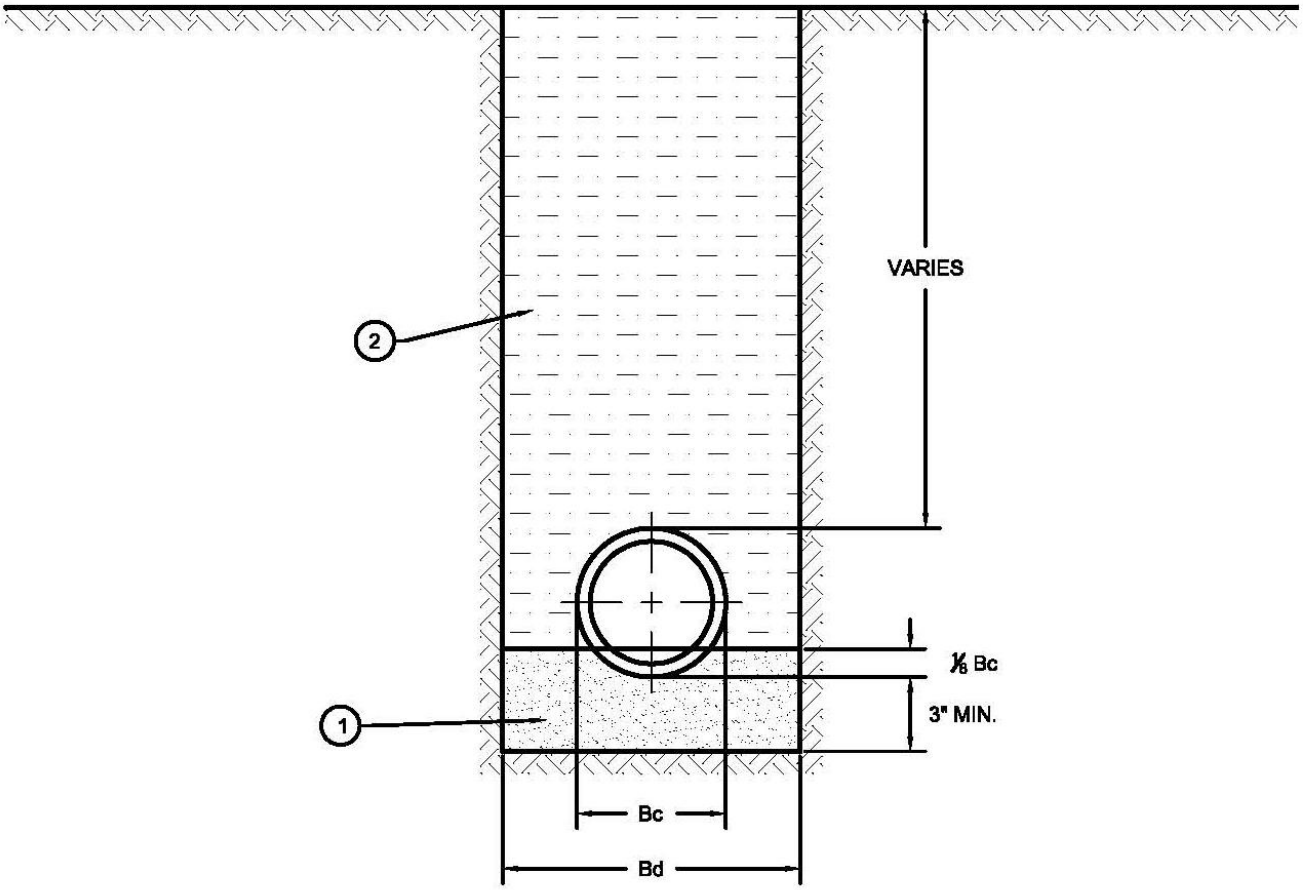
NOTES:

1. WIDTH OF HEADWALL IS EQUAL TO PIPE O.D. + 24".
2. SAWCUT 4:1 BEVEL ON PIPE.



FLUME DETAIL

NO SCALE



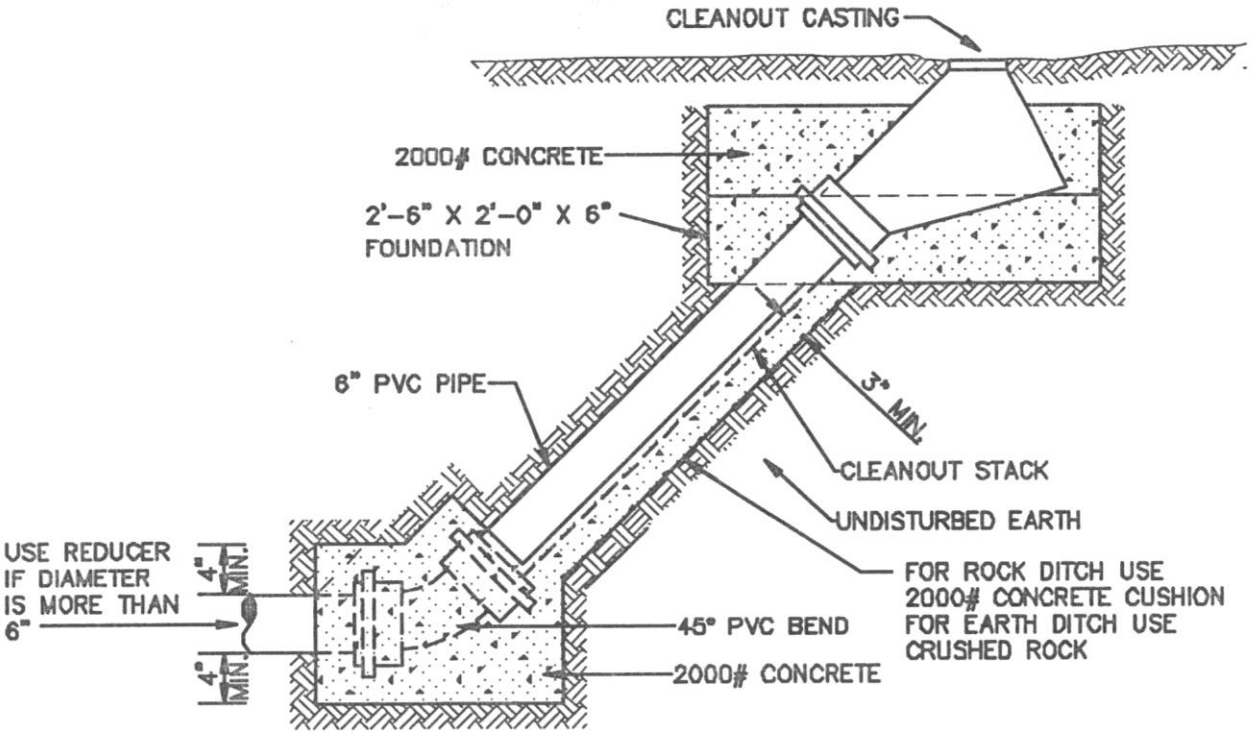
1. STANDARD GRADATION CRUSHED STONE - TOP LAYER IS TO BE PLACED TO GRADE TO PROVIDE UNIFORM SUPPORT OF PIPE BARREL. EXCAVATE BELL HOLES.

2. SELECT MATERIAL FREE OF ROCKS LARGER THAN 3", CLUMPS LARGER THAN 6" IN GREATEST DIMENSION. COMPACT TO 90% STANDARD PROCTOR DENSITY. UNDER STRUCTURES, ROADWAYS, AND PAVEMENT, COMPACT TO 95% STANDARD PROCTOR DENSITY.

CLASS "C" EMBEDMENT
(STORM SEWER)

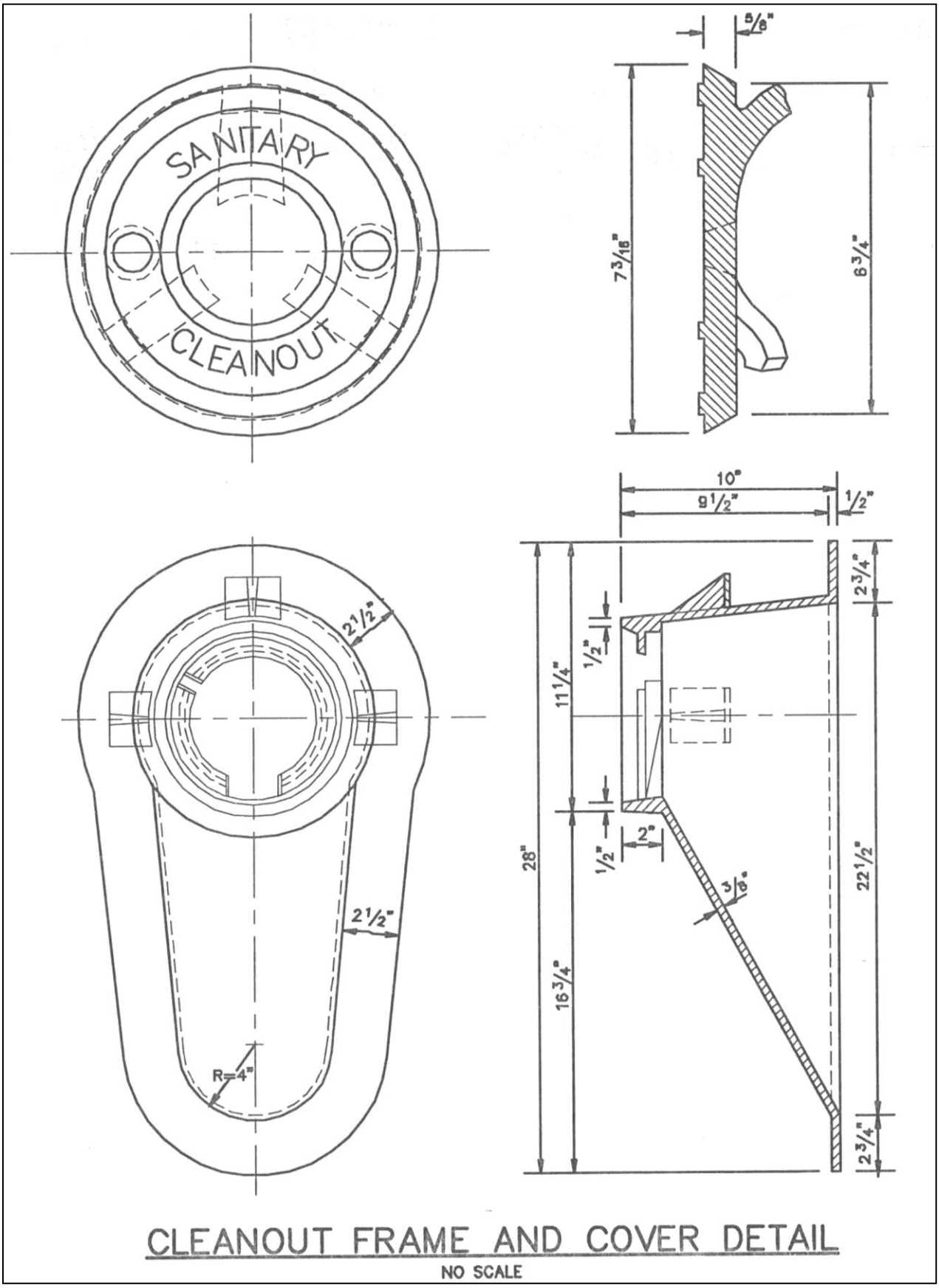
SANITARY SEWER DETAILS

[Intentionally left blank]



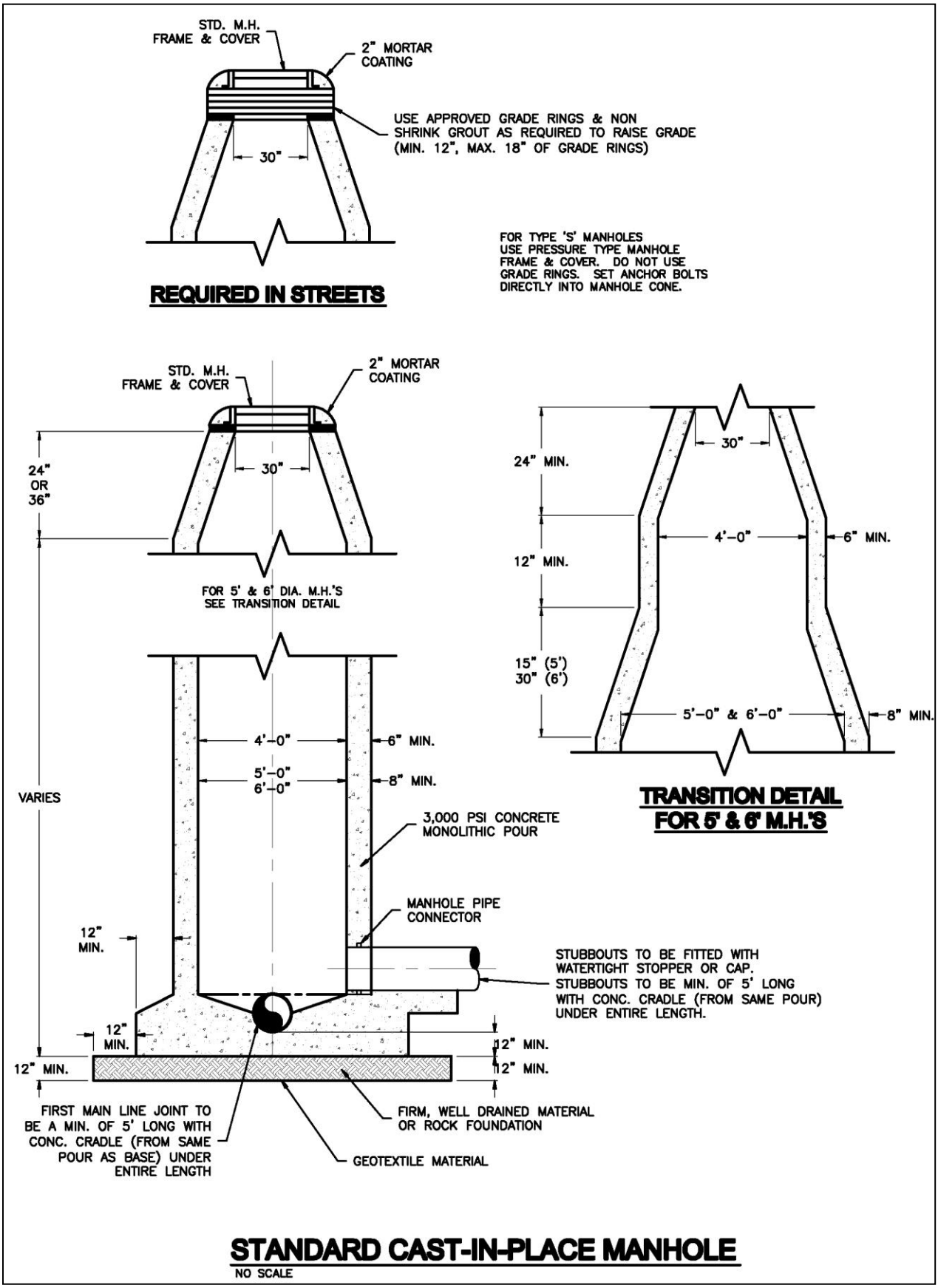
SANITARY SEWER CLEANOUT DETAIL

NO SCALE



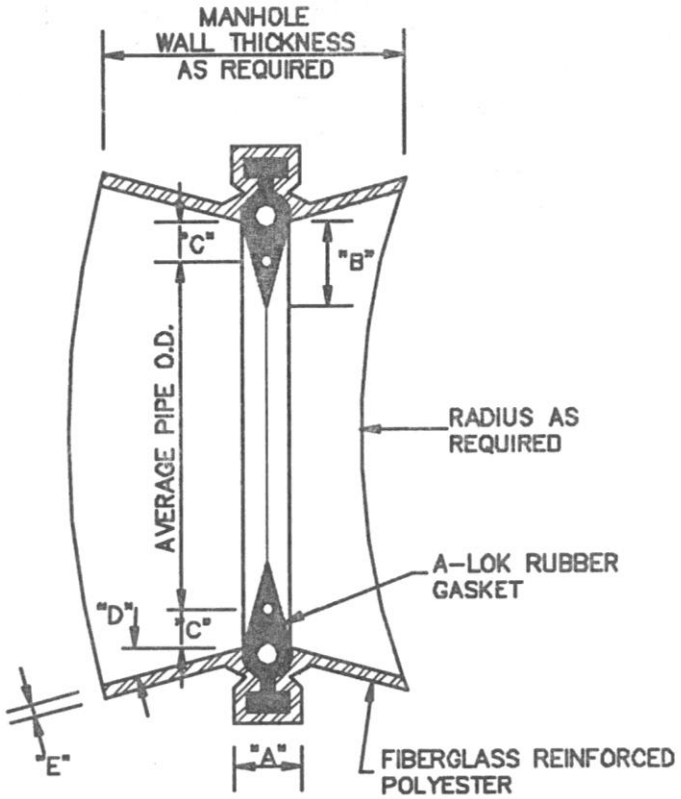
CLEANOUT FRAME AND COVER DETAIL

NO SCALE



STANDARD CAST-IN-PLACE MANHOLE

NO SCALE

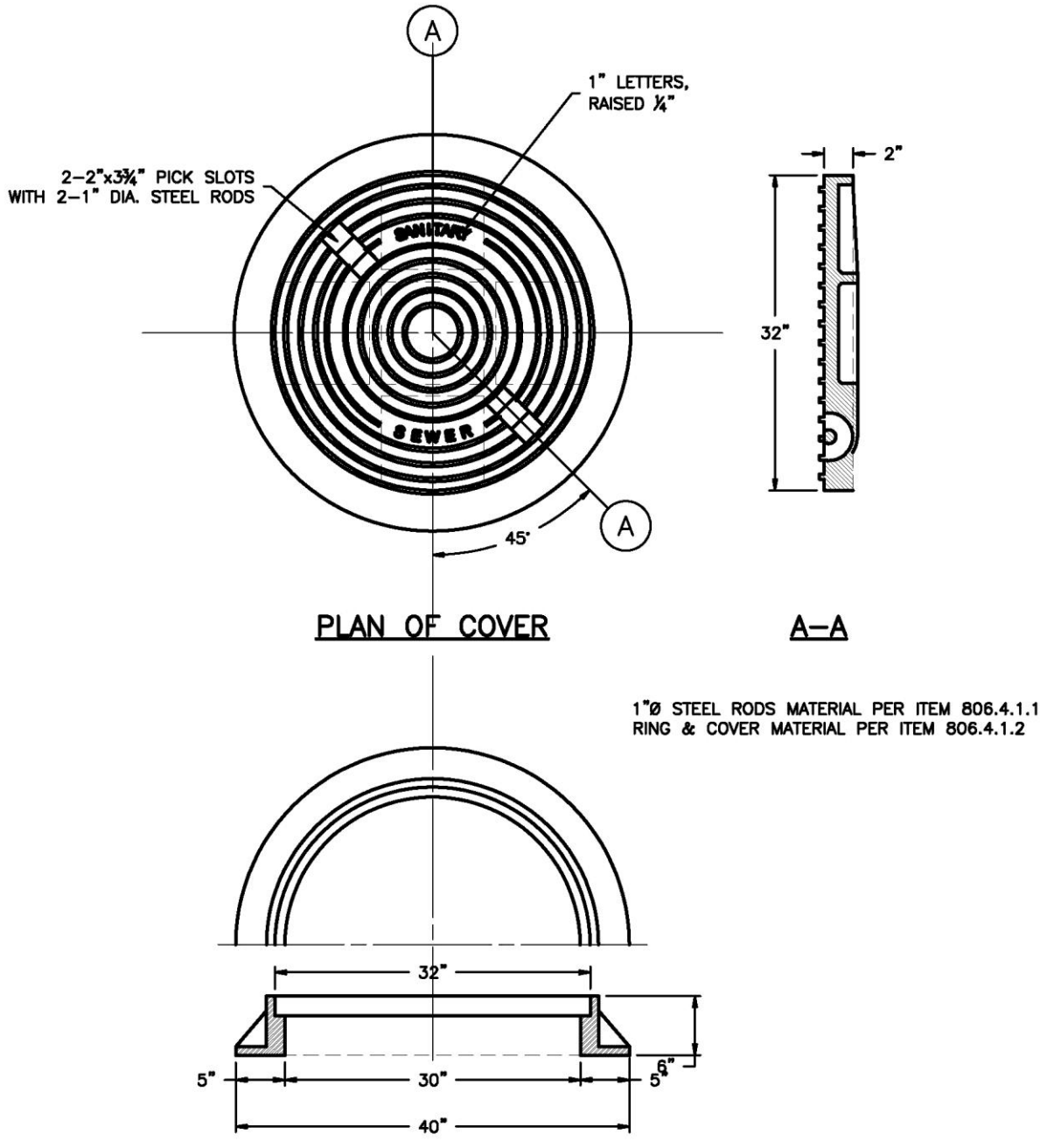


DIMENSIONS FOR MANHOLE PIPE CONNECTOR A.S.T.M. D-923

PIPE SIZE	A	B	C	D	E
4"-6"	1 1/2"	7/8"	3/8"	10°	0.10±
8"-24"	2 1/8"	1 3/8"	5/8"	10°	0.10±
24"-60"	2 3/8"	1 3/4"	3/4"	10°	0.25±

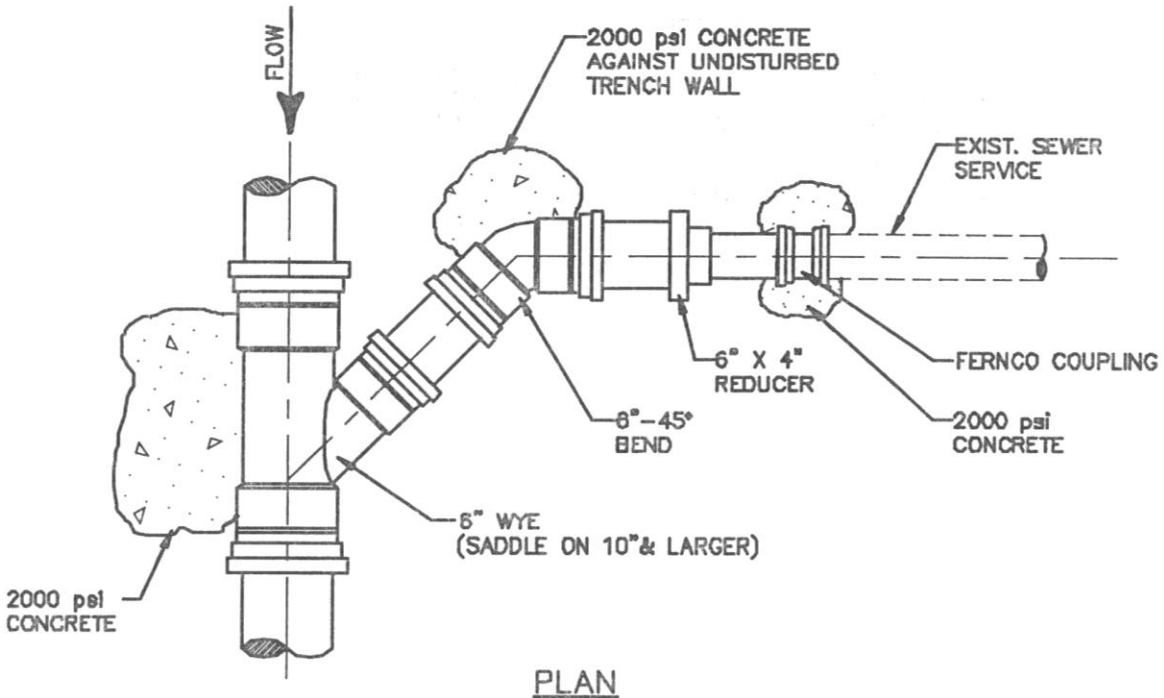
MANHOLE PIPE CONNECTOR
(FOR ALL CAST-IN-PLACE MANHOLES)

NO SCALE

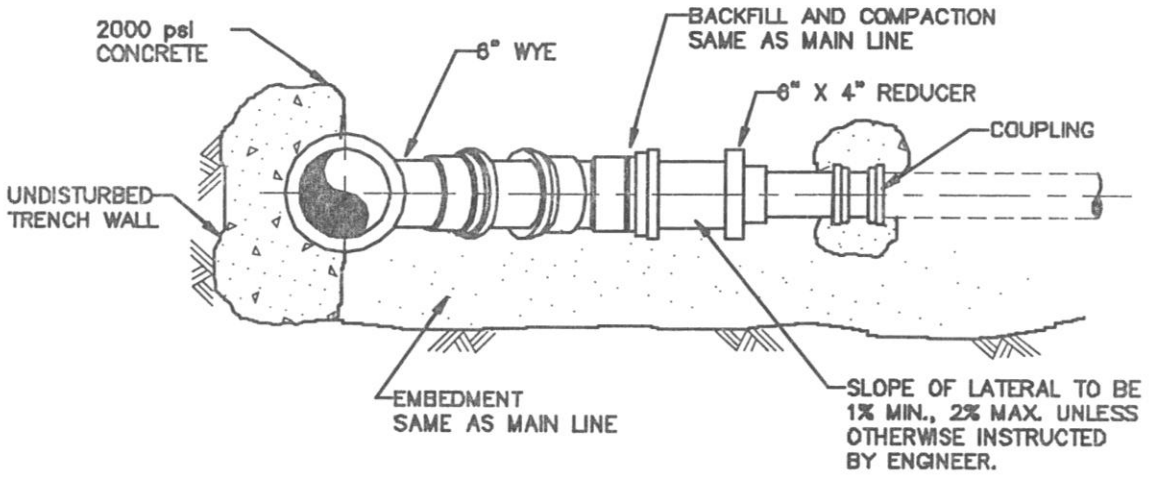


MANHOLE FRAME & COVER DETAIL

NO SCALE



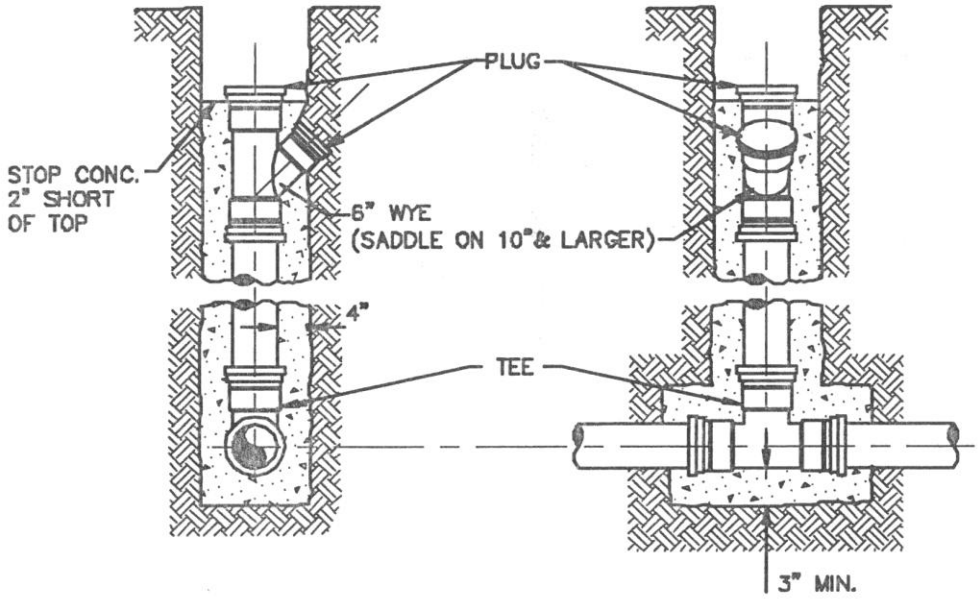
PLAN



SECTION

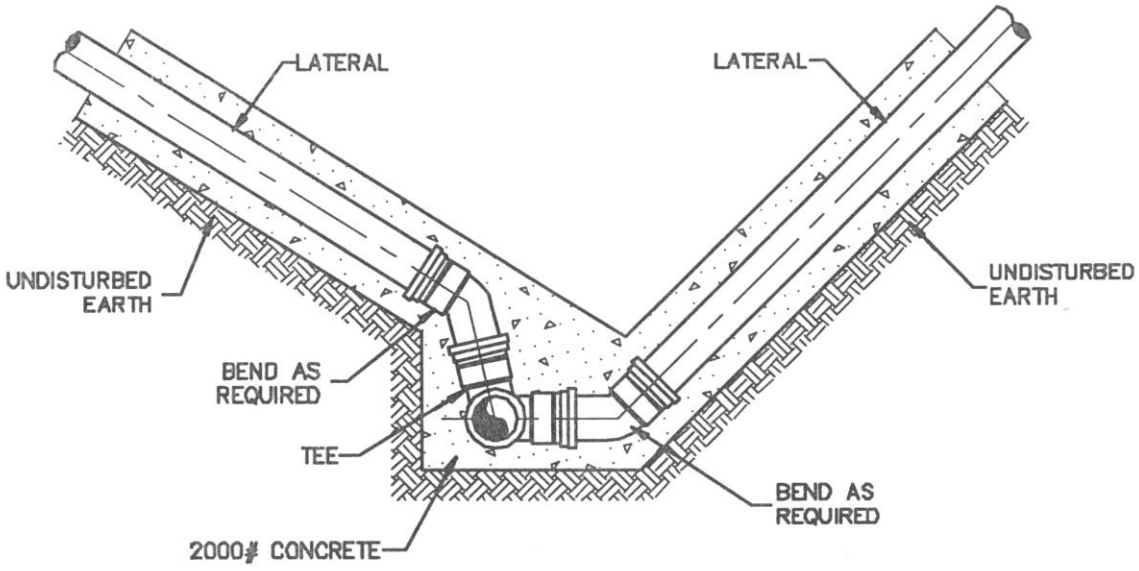
SANITARY SEWER SERVICE

SCALE: 3/4"=1'-0"



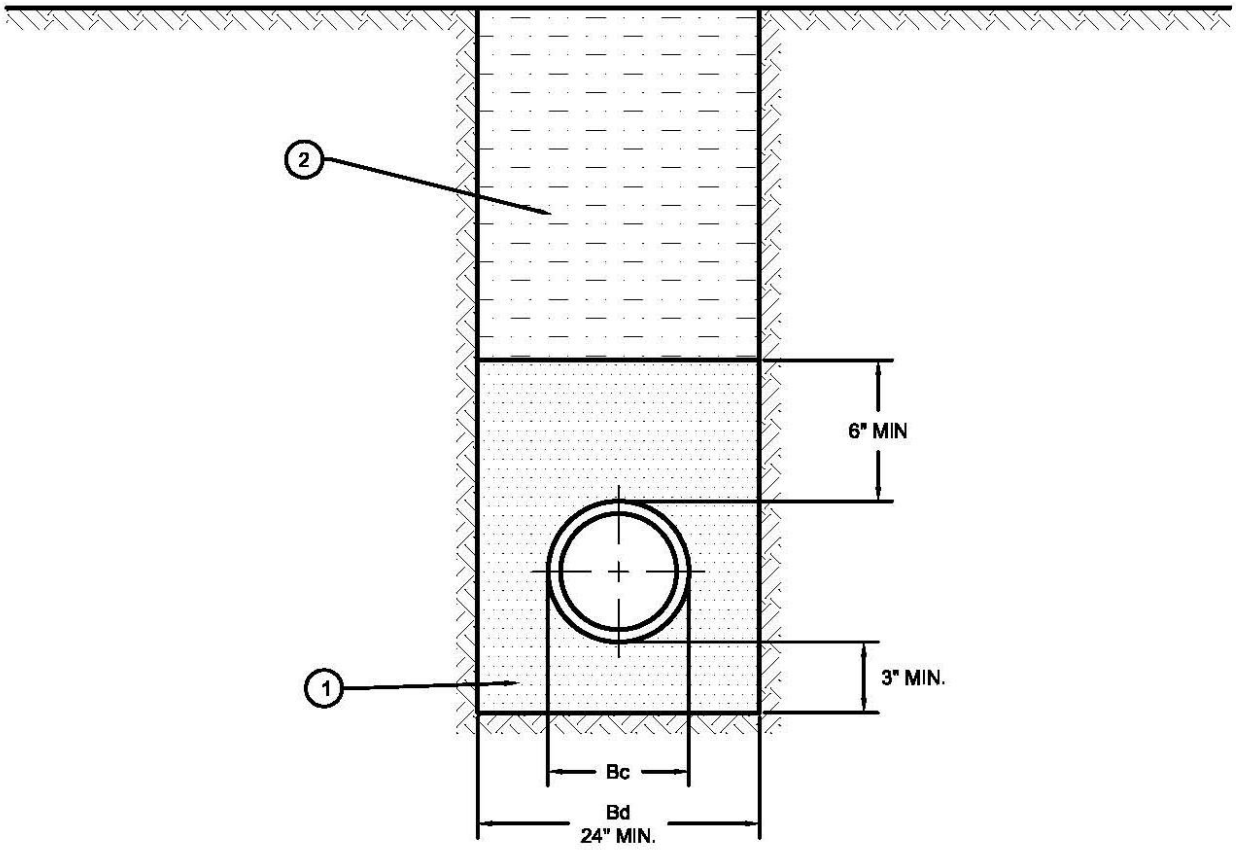
DEEP CUT CONNECTION USING P.V.C. PIPE

NO SCALE



LATERAL CONNECTION FOR DITCHES WITH SLOPING SIDES USING PVC PIPE

NO SCALE



① FINE GRADATION CRUSHED STONE

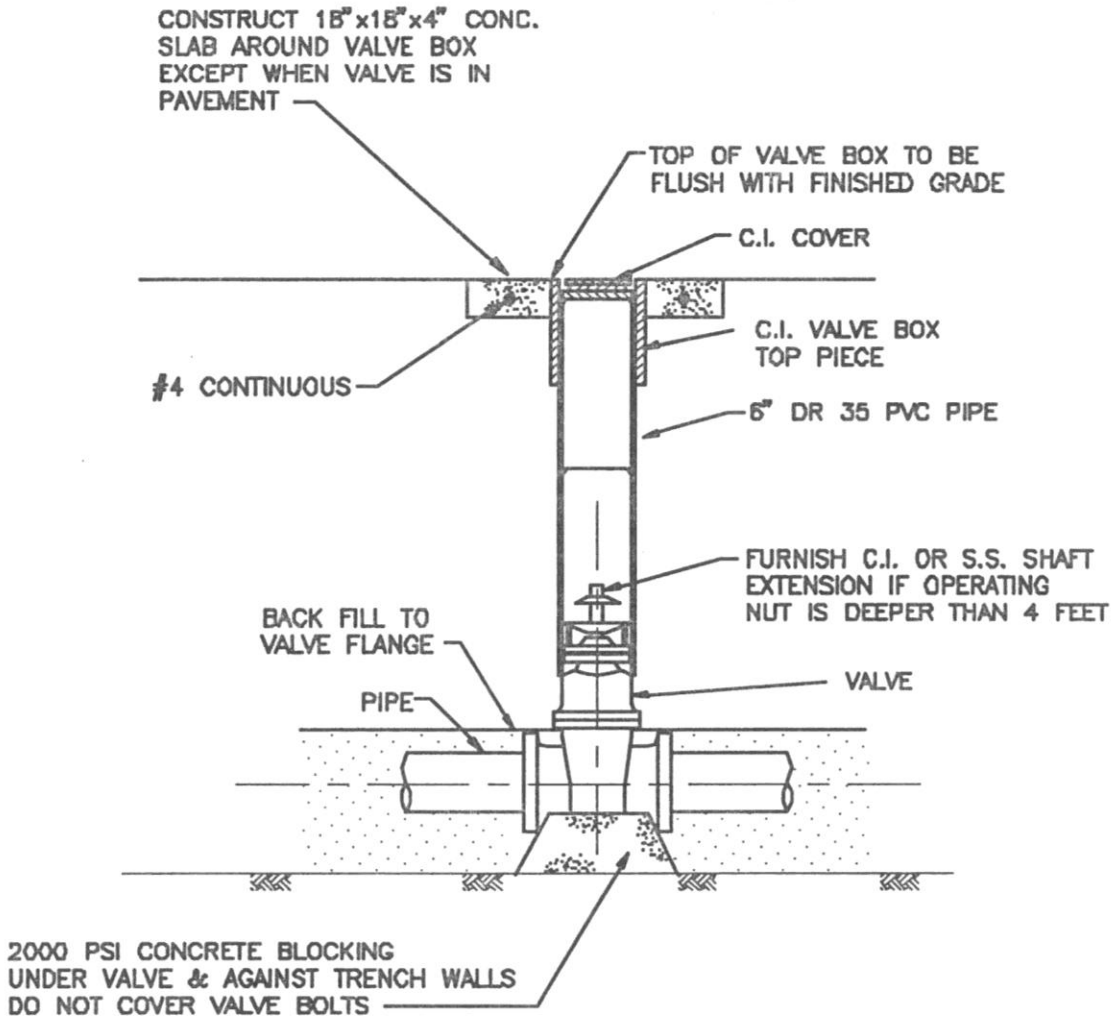
② SELECT MATERIAL FREE OF ROCKS LARGER THAN 3", CLUMPS LARGER THAN 6" IN GREATEST DIMENSION. COMPACT TO 90% STANDARD PROCTOR DENSITY. UNDER STRUCTURES, ROADWAYS, AND PAVEMENT, COMPACT TO 95% STANDARD PROCTOR DENSITY.

SIE OF PIPE IN INCHES DIA.	TYPE OF PIPE	EXTERNAL DIA. (Bc) IN INCHES	MINIMUM TRENCH WIDTH (Bd) IN INCHES	MAXIMUM TRENCH WIDTH (Bd) IN INCHES
6	PVC SEWER PIPE	6.28	24	6
8	PVC SEWER PIPE	8.4	24	36
10	PVC SEWER PIPE	10.2	26	38
12	PVC SEWER PIPE	13.2	29	41

CLASS "B-2" EMBEDMENT
(ALL GRAVITY LINES)

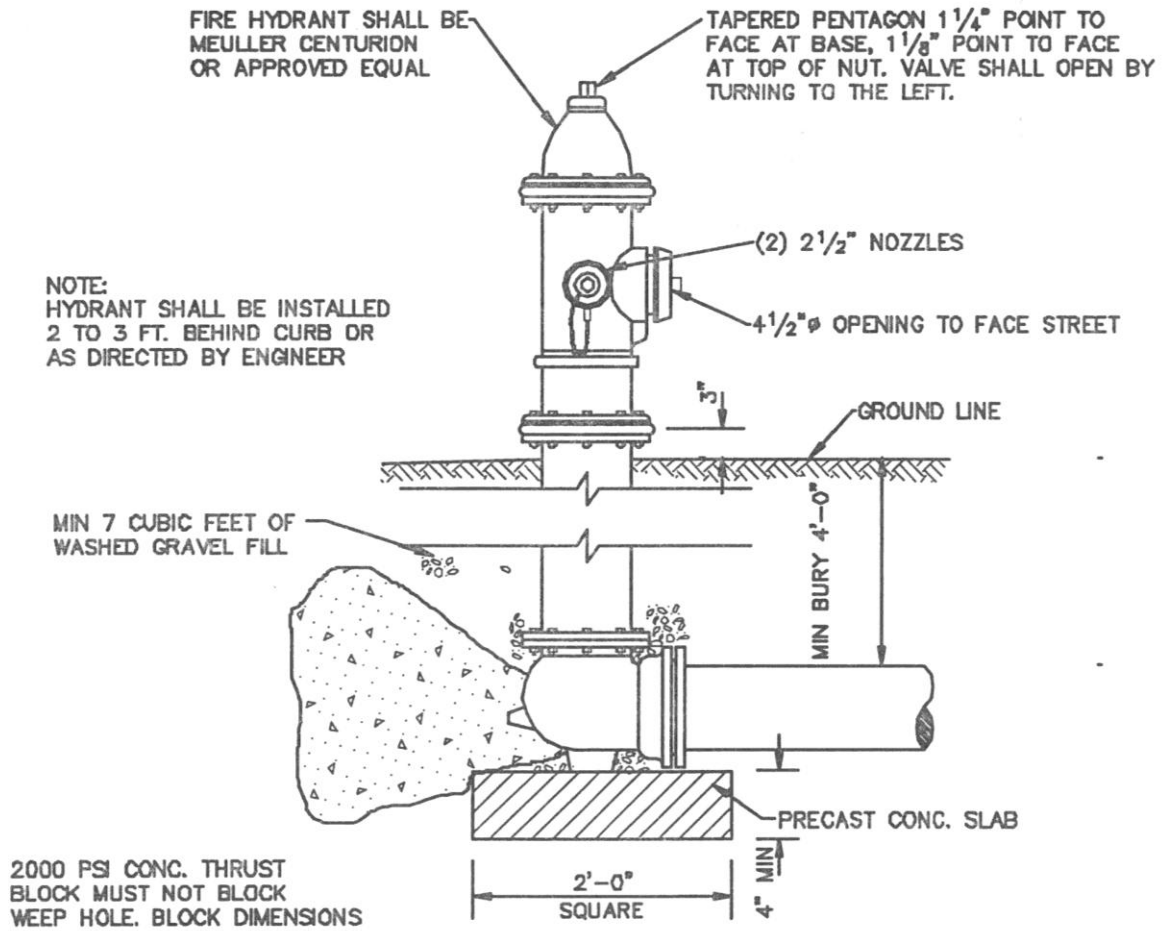
WATER SYSTEM DETAILS

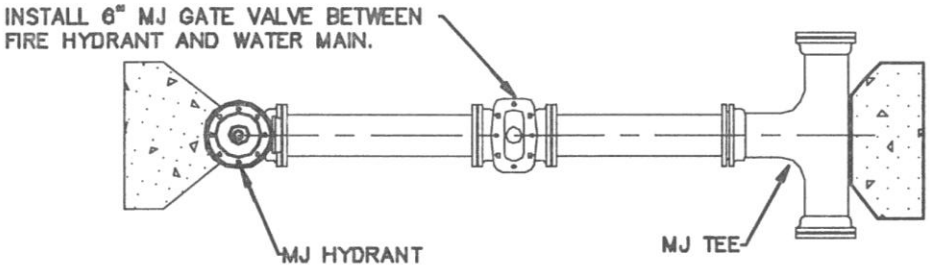
[Intentionally left blank]



VALVE INSTALLATION DETAIL

NO SCALE



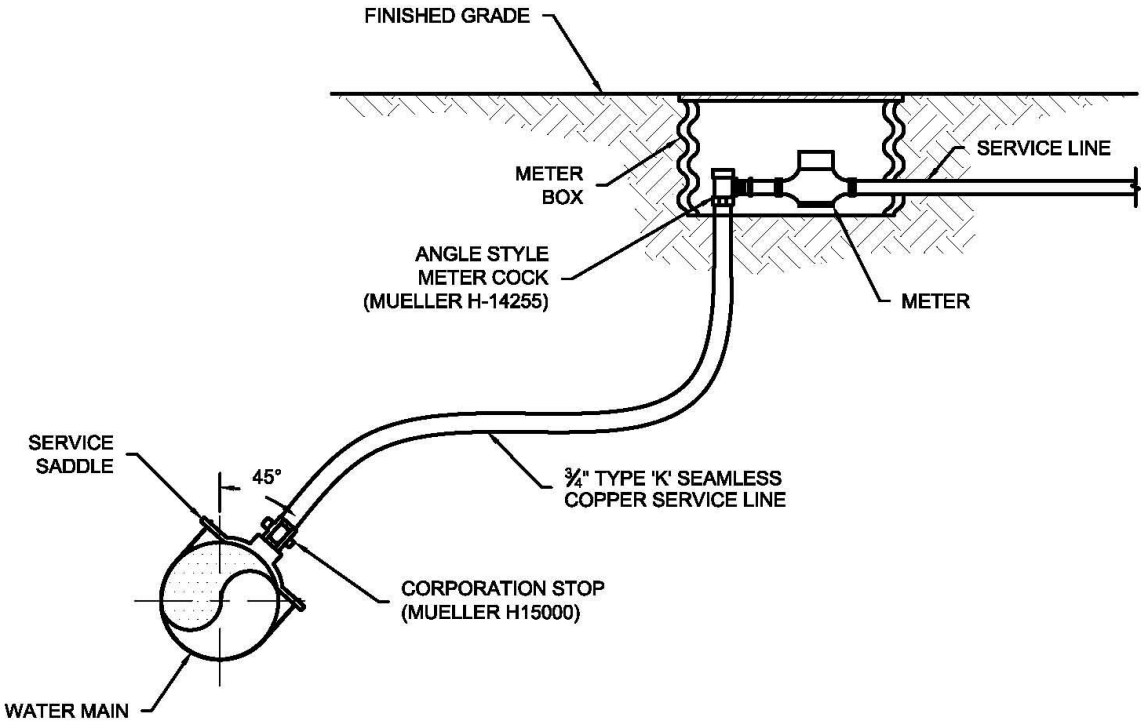


BLOCKED INSTALLATION

FIRE HYDRANT ASSEMBLY DETAIL

NO SCALE

NOTE: ALL MATERIALS SHOWN ON THIS DETAIL SHALL BE INCLUDED IN THE UNIT PRICE FOR A FIRE HYDRANT ASSEMBLY. NO SEPARATE PAYMENT WILL BE MADE FOR VALVES, PIPE, FITTINGS ETC.

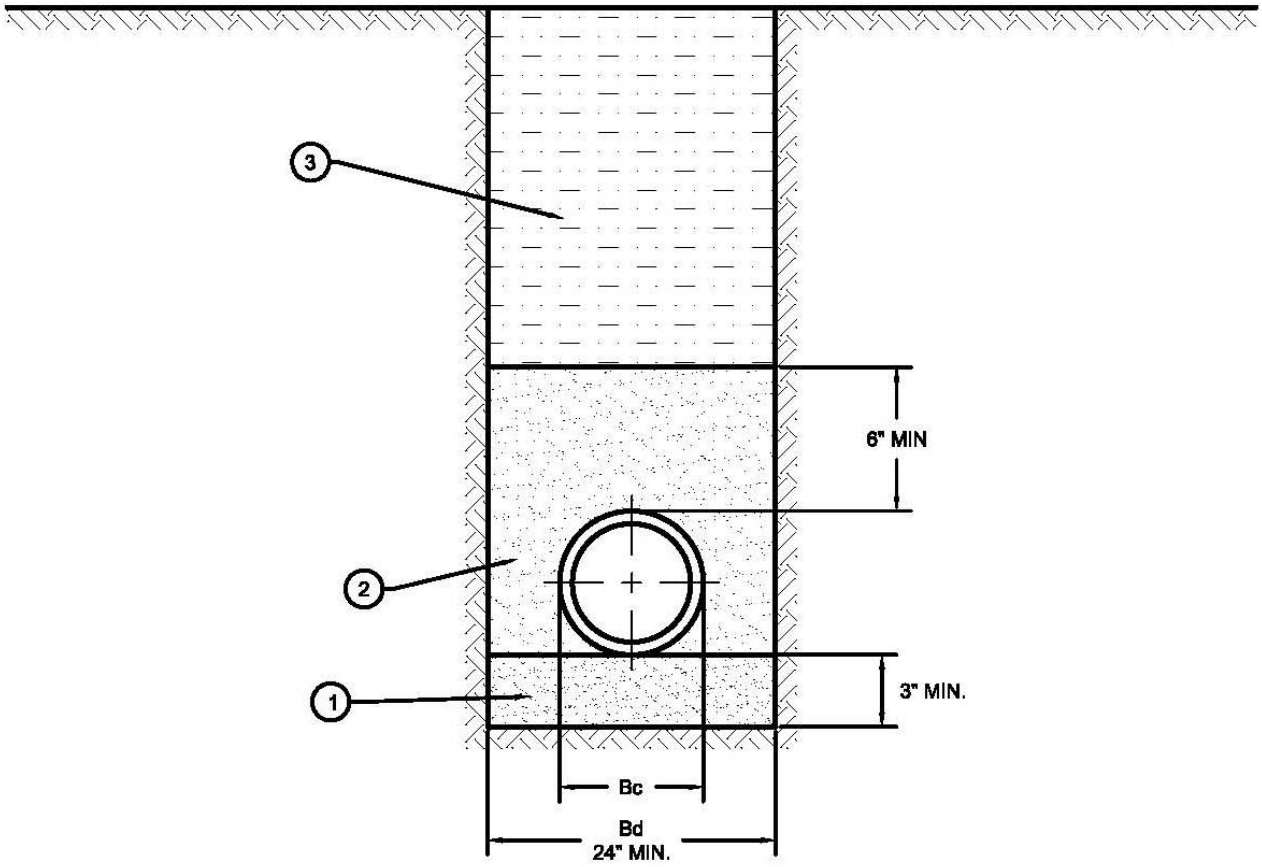


NOTES:

1. ALL COPPER FITTINGS SHALL BE COMPRESSION FITTINGS.
2. METERS SHALL NOT BE INSTALLED WITHIN EXISTING OR PROPOSED SIDEWALKS OR DRIVEWAYS.
3. COPPER SERVICES SHALL BE CONTINUOUS WITH NO JOINTS FROM CORP. STOP TO ANGLE STYLE METER COCK.

3/4" WATER SERVICE INSTALLATION

NO SCALE



1. GRANULAR MATERIAL (SAND) - TOP LAYER OS TO BE PLACED TO GRADE TO PROVIDE UNIFORM SUPPORT OF PIPE BARREL. EXCAVATE BELL HOLES. COMPACT TO 95% PROCTOR DENSITY.

2. GRANULAR MATERIAL (SAND) - COMPACT TO 90% STANDARD PROCTOR DENSITY EXCEPT UNDER STRUCTURES, ROADWAYS AND PAVEMENT WHERE 95% COMPACTION IS REQUIRED.

3. SELECT MATERIAL FREE OF ROCKS LARGER THAN 3", CLUMPS LARGER THAN 6" IN GREATEST DIMENSION. COMPACT TO 90% STANDARD PROCTOR DENSITY. UNDER STRUCTURES, ROADWAYS, AND PAVEMENT, COMPACT TO 95% STANDARD PROCTOR DENSITY.

CLASS "D+" EMBEDMENT
(WATER LINE)