

# CITY OF BAY CITY

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## STANDARD SPECIFICATIONS AND DETAILS

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JULY 1994

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# STANDARD SPECIFICATIONS and DETAILS

Prepared For:

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JULY 1994



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STANDARD SPECIFICATIONS AND DETAILS**

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## PREFACE

The purpose of these design standards is to provide Engineers, Designers, Draftsmen, Inspectors and others with a handy reference to the City's minimum Standards for the design and installation of the street system, storm drainage system, water distribution system, and sanitary sewer system. The form has been kept brief and no attempt has been made to cover all possible situations or to provide lengthy explanations of these standards.

The information provided is divided into three sections, each of which is divided into two parts. The three sections are:

1. Streets and Storm Drainage System
2. Water Distribution System
3. Sanitary Sewer System

The three areas for each section are:

1. Design Standards
2. Technical Specifications

Standard drawings for each section are provided at the end for reference and clarification purposes of minimum design considerations and technical specifications.

Alternate materials and methods will be considered for approval on an individual basis.

**STREET AND STORM DRAINAGE SYSTEM  
DESIGN STANDARDS**

**SECTION ONE  
INTRODUCTION**

**1.00 PURPOSE:**

The standards set forth below are intended to result in streets and storm drainage systems which will:

- a. Be of adequate size and grade to carry the expected traffic flow to serve the adjacent properties safely.
- b. Be of materials resistant to erosion and degradation.
- c. Be of proper configuration to provide safe intersection for users.
- d. Be economical and safe to build and to maintain.
- e. Be of adequate size to carry the expected drainage flow, within their design life, and at sufficient depth to serve adjacent drainage ways.
- f. Be strong enough to resist all external loads which may be imposed.

**1.01 REVISIONS TO THESE STANDARDS:**

It is anticipated that revisions to these standards and drawings will be made from time to time. The date appearing on the title page is the date of the latest revision. Users should determine the issue which applies to the work contemplated. The date appearing in the drawing title blocks are the dates of the latest revision.

**1.02 REFERENCES:**

Reference herein is made to the latest edition of the standards, test, methods and specifications of research as follows:

1. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, prepared by Oregon Chapter American Public Works Association.
2. STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, prepared by Oregon Department of Transportation, Highway Division.
3. HYDRAULICS MANUAL, prepared by Oregon Department of Transportation, Highway Division.

**1.03 APPROVAL OF ALTERNATE MATERIALS OR METHODS:**

Any alternative material or method not explicitly approved herein will be considered for approval on the basis of the objectives set forth in sub-section 1.00 above. Persons seeking such approvals should make application in writing. Approval of any major deviation from these Standards will normally be in written form. Approval of minor matters will be made in writing if requested.

## SECTION TWO PLANS AND SPECIFICATIONS

### 2.00 GENERAL:

All plans for streets and storm drainage systems shall be prepared by a registered Engineer and shall bear a suitable title showing the name of the Subdivision and Bay City, and shall show the scale in feet, the North point, date, and the name of the Engineer, his signature and imprint of his registration seal.

### 2.01 PLANS:

Three copies of the construction plans and specifications for the project shall be submitted for review and approval to the City of Bay City. The plans shall be submitted on standard size sheet of either 18"x24" or 24"x36". No construction shall commence on the project until approval is granted by the City. Upon completion of the project and prior to acceptance of the streets and storm drainage systems by Bay City, a set of "as-built" plans shall be submitted with the Engineer's certification that the project was constructed in accordance with the approved plans and specifications. The scale used shall be a standard Engineering scale, i.e. 1"=100', 1"=50', etc.

2.01.01 Profile - A profile of the centerline of all proposed streets shall be shown. Included on this profile shall be the profiles of the original ground at centerline and at each right-of-way line.

A profile of the centerline of existing streets for a distance of three hundred (300) feet each way of an intersection of a proposed street with the existing street shall be shown.

An extension of the profile of a proposed street that stops at the boundary of the project shall be provided for at least two hundred (200) feet to show either the tie into an existing street or to show the profile of a future street extension.

A profile of the top of curb shall be shown for all curb returns at intersections and around cul-de-sacs, etc. A profile of the storm sewers and ditches shall be provided.

2.01.02 North Arrow and Scale - A north arrow shall be shown with the scale of the drawing immediately below the arrow.

2.01.03 Street Names and Stationing shall be shown on all maps. Generally, stationing shall increase from the North to the South and from the West to the East.

2.01.04 Curve Radii shall be shown for all centerline curves and for all curb return radii at intersections, cul-de-sacs, etc.

2.01.05 Bench Marks - The location and elevation of a National Geodetic Survey, United States Geological Survey, State Highway, or Tillamook County bench mark shall be shown. Any other



datum proposed shall be submitted to and approved by Bay City prior to use and shall be used only if the United States Coast and Geodetic Survey, United States Geological Survey, State Highway, or Tillamook County bench mark is not within one-half mile of the boundaries of the project. All temporary bench marks shall be shown on the plans.

2.01.06 Street Barricades - The location of street barricades to be constructed shall be noted on the plans.

2.01.07 Typical Section shall be shown on the plans or reference made to applicable typical section in the standard drawings.

2.01.08 Drainage - Each storm sewer on the plans shall be stationed. Generally, stationing shall begin at the lower end of each drainage project and increase upgrade. The stationing shall continue on the main line.

Tributary storm sewer lines to the main line shall begin with 0 + 00 where the new line connects with the main storm sewer line and increase upgrade. Supplementary identification may be used on these lines if necessary.

The profile of the storm sewer shall show the rim elevation and invert elevation at the inlet and outlet of each run of pipe and shall also show the gradient of the pipe in percent. The type of backfill to be used shall be shown on the profile.

The location of drainage facilities (inlets, pipe, ditches, etc.) shall be shown on the plans. A typical section of any ditches to be constructed shall be provided.

A copy of the calculations and worksheets used to determine design compliance of the drainage system within the development and adequacy of the downstream facilities shall be submitted with the Drainage Plans for approval.

## 2.02 SPECIFICATIONS:

Three copies of the complete technical specifications for the construction of streets and storm drainage, and all appurtenances, shall accompany the plans. Reference to Bay City's Technical Specification is acceptable. Deviation from Bay City's Technical Specification must be submitted in detail and approved prior to construction of the project.

## 2.03 REVISION TO APPROVED PLANS:

Any deviations from approved plans or specifications affecting capacity, drainage, etc. shall be approved in writing before such changes are made. Plans or specifications so revised should, therefore, be submitted well in advance of any construction work which will be affected by such changes, to permit sufficient time for review and approval. Minor structural revisions or other minor changes not affecting capacities, drainage, or street design will be permitted during construction without approval. "As-built" plans clearly showing such alterations shall be submitted to the City at the completion of the work.

### SECTION THREE MINIMUM DESIGN CONSIDERATIONS

#### 3.00 GENERAL:

The information contained within these Standard Specifications are considered minimum standards for streets and storm sewer systems.

#### 3.01 ROADBED:

3.01.01 Horizontal and Vertical Alignment - The alignment of the centerline of improvement shall normally be parallel to and coincidental with the centerline of the right-of-way, except that offset centerlines may be approved by the City of Bay City under the circumstances, such as wide bicycle pathway along one side of the street, etc. The angle of intersection of streets shall be kept as nearly to ninety (90) degrees as possible and in no case shall it be less than sixty (60) degrees.

All streets shall, as far as practicable, be in alignment with existing streets by continuation of the centerlines thereof.

The minimum radius for the right-of-way returns at intersections shall be fifteen (15) feet, except returns at intersections with collector streets shall be twenty-five (25) feet. The minimum radius for curb returns at intersections and at returns at cul-de-sacs shall be twenty-five (25) feet. The minimum right-of-way radius for cul-de-sacs shall be forty-five (45) feet and the minimum curb or street radius shall be thirty-six (36) feet. A cul-de-sac shall be as short as possible and shall in no event be more than 600 feet long. The length of the cul-de-sac shall be measured along the centerline of the roadway from the near side of the intersecting street right-of-way to the farthest point of the cul-de-sac right-of-way.

The minimum street centerline gradient shall be four tenth (0.4) percent. The minimum width of right-of-way and street improvements, maximum gradients, minimum horizontal curve radii, and minimum stopping sight distance for the various classifications of streets are shown in **TABLE A**. Additional right-of-way or slope easements shall be provided when necessary to meet terrain or other conditions of design and construction.

TABLE A					
Street Classification	Minimum R/W Width	Minimum Improvement Width	Maximum Centerline Grade %	Minimum Horizontal Radius	Minimum Stop Sight Distance
Cul-de-sac (up to 300' length)	45'	24'	15	100'	160'
Cul-de-sac (300' to 600' length)	50'	30'	15	100'	160'
Minor Street	50'	30'	15	100'	160'
Collector	60'	40'	12	250'	240'
Commercial Industrial	60'	40'	10	250'	240'

**3.01.02 Type of Street** - Street serving lots greater than 1/2 acre and 100' of street frontage may use a rural street section to the width indicated in TABLE A. Streets serving 1/2 acre or smaller parcels or parcels with 100 feet or less street frontage shall have urban street section to the width indicated in TABLE A. Improvement width is measured from face of curb to face of curb.

**3.01.03 Structural Section**

**3.01.03A** - The acceptable structural sections for the various street classifications without obtaining soil tests are shown in the Standard Drawings.

**3.01.03B** - If the City of Bay City or its Engineer has reason to believe that the soils in a particular project may be unable to handle the Standard Structural Street Section, the City or authorized Engineer may require the Developer to have soil tests made to determine the soil's capability. The street section shall then be designed in accordance with the street classification shown in TABLE B and the soils capability.

TABLE B				
Street Classification	Design ADT	% Trucks	Truck weight	Design Traffic No.
Cul-de-sac	500	2	15,000	1
Minor Street	1,000	4	20,000	6
Collector	3,000	5	20,000	25
Commercial-Industrial	3,000	10	48,000	180

**3.01.04 Typical Section** - The typical section to be used for each street classification is shown in the standard drawings. All collector streets that lie within the commercial and industrial street classification shall include curb and sidewalk.

Where, due to terrain, it is not possible to construct a street section with the curbs on each side of the street at the same elevation, the offset crown typical section as shown in the Standard Drawings may be used.

**3.01.05 Barricades** - Street barricades, as detailed in the standard drawings, shall be provided at the end of streets "stub off" at the project boundary.

**3.01.06 Signs** - The Developer shall provide street name signs and posts necessary as required by the street construction specifications. The Developer shall reimburse the City of Bay City for the purchase and erection of the required signs.

### **3.02 WALKS, RAMPS, DRIVEWAYS AND CURB CUTS:**

All ramps, sidewalks, curbs, and driveways within the public right-of-way shall be constructed in accordance with guidelines outlined in the Americans with Disabilities Act, with the relating standard specifications included in the Street and Storm Drainage System section of this manual, and with the relating standard drawings found at the end of this manual.

Sidewalks shall consist of a minimum 4" of concrete over 2" of base. At driveways, the minimum thickness shall be 6". The standard minimum width of sidewalks shall be 48". Handicap ramps shall have a maximum slope of 1:12 and shall be textured to assure good traction. A minimum ramp slope of 1:8 may be used when modifying existing facilities with written permission from the City. Ramp construction shall also consist of 4" of concrete over 2" of base.

All driveway aprons within the public right-of-way shall be constructed in accordance with the following specifications.

Curb openings for driveways shall align with the driveway on private property and driveways shall approach at right angles to the centerline of the street. Driveway openings shall be at least five (5) feet from the side property line prolonged. No two residential driveway openings shall be less than twenty (20) feet apart when constructed on the same lot. Driveway openings on corner lots shall be located a minimum of five (5) feet from the ends of curb radius returns. All driveway aprons shall be paved a minimum of 20' from surface back into the driveway.

On roadways where driveway culverts are necessary the minimum size shall be 10" concrete tongue and groove culvert pipe. Alternate materials shall include double wall HDPE pipe and fitting. Metal pipe will not be allowed.

**3.03 DRAINAGE:**

**3.03.01 Rainfall Intensities** - Storm Sewers shall be designed according to the rainfall intensity chart for 5 year frequency periods for various duration of storms contained in the Oregon Department of Transportation "Hydraulic Manual", 1990. (see Standard Drawings)

**3.03.02 Runoff Coefficients** to be used in the design of drainage facilities shall be based on the expected future development of the drainage shed area. A list of the values for the various areas are contained in the Standard Drawings.

**3.03.03 Inlet or Time of Concentration** - The inlet time or concentration time varies considerably and should be calculated in order to determine the intensity from the rainfall chart.

**3.03.04 Areas** to be considered in designing or checking the adequacy of storm sewers shall include all areas that will be tributary to the storm being designed.

**3.03.05 Size and Life of Storm Sewers** - The design and construction of all drainage facilities within a project shall be of sufficient size and quality to receive and transport, at a 5 year storm frequency standard, all surface drainage and natural drainage course waters coming to and passing through the project from the watershed or watersheds to which it is servient, when the lands located in such are at full planned development, according to the Comprehensive Land Use Plan. The minimum diameter pipe to be used shall be 10 inches.

In those areas located in the 100 year flood plain, the design and construction of all drainage facilities shall be of sufficient size and quality to receive and transport the 100 year storm without raising the flood plain elevation. The drainage facilities may be designed to pass less than a 100 year storm provided retention or detention of the runoff is designed and that such retention or detention does not raise the flood plain upstream.

The minimum design service life for storm sewer materials under pavement sections shall be 100 years and not under pavement sections shall be 50 years.

**3.03.06 Coefficient of Roughness (N)** - The values of the coefficient of roughness for the various types of pipes shall be in accordance with the manufacturer's specifications.

**3.03.07 Location of Storm Sewers** - All storm sewers shall be located within a public right-of-way or within a utility easement granted to the City of Bay City.

**3.03.08 Manholes** shall be placed at the following locations:

1. Change in grade or alignment of sewers
2. Point of change in size or elevation of sewer
3. Intersection or junction of sewer
4. Upper end of lateral sewers
5. Maximum spacing of 500 feet.

Catch basins or curb inlets, either standard or oversized may be used in lieu of manholes at locations approved by the City of Bay City.

At all locations where there is more than 30° angle in the sewer at the manhole locations, the invert grade shall be dropped an additional 0.20 feet in addition to the normal grade crossing the manhole. If there is a difference in gradients on each side of the manhole, this difference shall be 0.20 in addition to the greater percentage.

**3.03.09 Inlets** - Connections from the inlets to the storm sewers may be made by installing a standard "T" connection in the storm sewer pipe, or may be made into a manhole. The "T" connection may be used if the length of pipe from the "T" to the inlet is less than fifty (50) feet.

Catch basins as shown in the Standard Drawings for catch basins shall have a maximum height from grate to flowline of pipe of 3' - 6" and shall be used with a maximum pipe size of 18 inches in diameter. Catch basins shall be used on street gradients up to 6%.

Curb inlets as shown in the Standard Drawings for curb inlet shall have the same restrictions as catch basin above except that curb inlet shall be used on street gradients over 6%.

Oversize catch basins, as shown in the Standard Drawing for oversized catch basin, shall have a maximum height from grate to flowline of pipe of 6 feet and shall be used with a maximum pipe diameter of 18 inches in end wall and 30 inches in side wall. Oversize catch basin shall be used on street gradients up to 6%.

Oversize curb inlets, as shown in the Standard Drawing for oversized curb inlet, shall have the same restrictions as oversize catch basins above except that oversize curb inlets shall be used on street gradients over 6%.

**3.03.10 Ditches** - If a natural drainage course is altered as a result of the development of the project, the drainage shall be enclosed in a storm sewer system, except that in the case of a development having common areas that are owned and maintained by a Homeowners Association or a like Organization, the drainage may be carried through the common area in a ditch. The ditches shall be constructed such that they have sufficient size and slope to carry the runoff as set forth in these specifications. The ditch side slope shall be 2 to 1 or flatter.

**3.03.11 Drainage Easements** - When, due to topographical or other reasons, all or any portion of the water collected in the project must be discharged at the boundary of the project, such that it is concentrated and must run across other private property before reaching a natural or existing drainage course, the developer shall make all necessary arrangements to obtain all required easements with the affected property owner or owners.

If it is necessary to carry water across portions of the land being developed, which are not to become public, and a satisfactory easement has not been provided in the official plat of the area, the developer shall prepare and cause to be executed a proper easement to the public for such purpose.

3.03.12 Connections to Roadside Ditches - Where drainage is to be connected to an existing roadside ditch, the ditch shall not be deepened so as to produce a finished ditch more than two (2) feet below the shoulder of the adjacent road. Should it be necessary to deepen beyond the maximum two (2) foot depth, the developer shall cause to be constructed a proper size storm sewer line and said roadside ditch.

All steps necessary shall be taken to prevent erosion of the existing ditch and shoulder of road i.e., rip-rap, splash walls, pipe elbow, etc.

**STREET AND STORM DRAINAGE SYSTEM  
TECHNICAL SPECIFICATIONS**

**201 CLEARING, GRUBBING, AND ROUGH GRADING**

**201.1 DESCRIPTION:**

This item includes all work necessary to clear, remove and dispose of all debris and vegetation such as stumps, trees, logs, roots and brush within the designated limits, and to rough grade the areas so as to leave the areas that have been disturbed with a neat and finished appearance free from vegetative debris. Interfering utilities will be moved by the developer according to the approval of the City.

201.1.01 Clearing is defined as the cutting and removal of trees, snags, high stumps, brush and branches, and the removal of down trees, logs and loose brush and debris at or above the surface of the ground.

201.1.02 Grubbing is defined as the removal of wood items remaining at or below the ground surface following the clearing operation to a depth of one foot below the existing grade. All stumps and roots thereof shall be completely removed.

201.1.03 Rough grading is defined as the excavation and grading of all clearing limit areas to conform with the lines, grades and dimensions shown on the approved plans, and to leave such areas with a neat and finished appearance.

**201.2 CONSTRUCTION:**

201.2.01 Areas to be Cleared and Grubbed - The areas on which clearing and grubbing is to be performed shall be the areas indicated by the clearing limit areas shown on the approved plans.

201.2.02 Ownership and Disposal of Materials - Clearing and grubbing material shall become the property of the Contractor and shall be disposed of by the Contractor in compliance with all federal, state, and local laws, regulations, rules, and ordinances.

201.2.03 Material Burning - Burnable material may be burned within the clearing limit areas in street right-of-ways on the project where the burning will not injure or endanger adjacent properties or trees. Burning shall be in compliance with all Federal, State and local laws regarding fire permits.

201.2.04 Rough Grading - After the completion of clearing and grubbing operations, the Contractor shall rough grade all clearing limit areas so as to provide a suitable grade and work area for construction. The Contractor shall fill all stump holes with suitable material from adjacent street right-of-way areas. In those areas designated on the plans as rough grading embankment and rough grading excavation, the Contractor shall move material from the excavation areas to the embankment areas. Any movement of material, irrespective of nature, character or conditions encountered, shall be considered rough grading.



**202 EARTHWORK****202.1 DESCRIPTION:**

This item includes all work necessary for excavating and grading all roadways, curb, sidewalk, driveway areas, parking areas planting areas, cuts, embankments, slopes, roadway ditches, lot grading and all other earth-moving work required in construction including disposal of all surplus material.

**202.2 MATERIALS:**

202.2.01 Disposal of unsuitable and excess material - The Developer shall arrange disposal of all unsuitable and excess material not required elsewhere on the project. Disposal of unsuitable and excess material shall be off the construction site.

**202.3 CONSTRUCTION:**

202.3.01 Embankments and fills shall be placed in approximately horizontal layers of a maximum of 8 inches in thickness, each layer being separately and thoroughly compacted.

202.3.02 Excavation and grading shall be to the lines and grades as shown on the approved plans. The Contractor shall trim all roadbeds, parking areas ditches and other excavations and embankments to the established lines and grades. All surfaces shall be left in a neat and well-finished condition prior to the time the project is completed and accepted.

202.3.03 Roadway subgrade shall be excavated and shaped to line, grade, and cross-section as shown on the approved plans. The Developer shall remove all soft or otherwise unsuitable material as directed by the city and replaced with thoroughly compacted crushed rock base.

202.3.04 Compaction - The Contractor shall proof-roll or mechanically compact the subgrade within 6 inches of established subgrade elevation to a minimum density of 95 percent of the maximum density. Compacted subgrade shall finish to true grade and cross-section with a tolerance of plus or minus one inch.

**203 STREET BARRICADE****203.1 DESCRIPTION:**

This item includes all work necessary to furnish, and install permanent street barricade.

**203.2 MATERIALS:**

203.2.01 Barricade Rails and Posts shall consist of pressure treated lumber of specified sizes (See Standard Drawing).

203.2.2 Reflectors shall be red and be a minimum diameter as specified in Standard Drawings.

203.2.3 Bolts shall be 5/8" galvanized square head machine bolts with equivalent sized washers.

203.3 CONSTRUCTION:

203.3.01 Barricade Construction - Barricades shall be constructed as specified in the Standard Drawing.

**204 AGGREGATE BASES**

204.1 DESCRIPTION:

This item includes all work necessary to furnish, place and compact one or more courses of aggregate base, sub-base, or leveling courses on a prepared subgrade within the designated limits. This item also includes crushed rock surfacing used for shoulder work and driveways and placement of construction fabric.

204.2 MATERIALS:

204.2.01 Base course aggregate shall be of a minimum of 8" and of the designated size 1 1/2 inch - 0 inch and shall meet the requirements of OSHD Standard Specifications subsection 703.07.

204.2.02 Leveling course aggregate shall be of a minimum of 2 inch and of the designated size 3/4 inch - 0 inch and shall meet the requirements of OSHD Standard Specifications subsection 703.07.

204.3.03 Construction fabric shall be ground stabilization fabric woven from monofilaments of isotactic polypropylene, Mirafi 500X, or approved equal. Fabric shall have the following properties:

Weight . . . . .	4 oz./sq.yd.
Thickness . . . . .	25 mils
Grab Strength . . . . .	200 lbs.
Rapid Tear Strength . . . . .	25 lbs.
Burst Strength . . . . .	325 psi

204.3 CONSTRUCTION:

204.3.01 Preparation of Foundation - All surfaces on which a base is to be constructed shall be firm at the time aggregate is placed thereon. No materials shall be placed on a soft, muddy or frozen subgrade.

204.3.02 No Standing Water shall be present at the excavated subgrade when fabric is placed. Roll fabric onto the subgrade, keeping it as taut and free of wrinkles as possible. Some stretching stakes may be required. Overlap joints a minimum of 24 inches between sections of fabric.

204.3.03 Aggregate base and fill should be placed on the fabric without any construction equipment operating on the uncovered fabric. Proofroll the base or fill to tension the fabric and identify soft spots in the subgrade. If a soft spot is encountered, mound base rock into the subgrade at the soft area.

204.3.04 Thickness of Base Course - If the required compacted depth of the base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches. Each layer shall be placed in spreads as wide as practicable and to the full width of the course before a succeeding layer is placed.

204.3.05 Placing - The Contractor shall haul, deposit, and blade mix the material so as to provide a homogeneous mixture of unsegregated and uniformly dispersed materials as placed in position for compacting. The Contractor shall spread and strike off the material to the designated line, grade and transverse slope with surface texture of uniform appearance without segregation or fracture of material.

204.3.06 Density Requirements - No specific density requirements will be specified herein. The intent of this specification is to have a non-yielding base for the subsequent surfaces. The Contractor shall be held responsible for any settlement and shall bring all surfaces to the required grade at his own expense should settling occur within the one-year warranty period following acceptance of the project.

## 205 ASPHALT CONCRETE PAVEMENT

### 205.1 DESCRIPTION:

This item includes all work necessary for the construction of hot mix asphalt concrete pavements upon prepared foundations or base surfaces. This item includes, but not limited to tack coat, furnishing, placing, and compacting asphaltic concrete on the street surface, driveways, and other areas designated to be paved including paved drainage ways.

### 205.2 MATERIALS:

205.2.01 Asphalt cement shall be either PBA 5 or PBA 2. The use of silicones as an additive to asphalt cement will not be permitted.

205.2.02 Aggregates shall meet the requirements of subsection 703.08, Standard Specifications for Highway Construction, OSHD.

205.2.03 Mineral filler shall conform to the requirements of AASHTO M17. Collector dust may be used as mineral filler, in whole or in part, provided the dust or the resultant mineral filler mixture conforms to the above requirements.

**205.2.04 Additives and admixtures** may be used to prevent stripping or separation of bituminous coatings from aggregates, and to aid in the mixing or use of bituminous mixes or for experimental purposes. Admixtures and additives shall be standard recognized products of known value for the intended purpose and shall be approved by the Engineer on the basis of laboratory tests prior to their use in the work. They shall have no deleterious effect on the bituminous material and shall be completely miscible.

**205.2.05 Classes of Concrete and Proportions of Materials** The asphalt concrete mixture shall be of the class as shown on the plans and shall conform to the following requirements:

Sieve Size	Class "B" Percentages of Total Aggregate (by weight)	Class "C"
1"		
3/4"	95-100	100
1/2"		95-100
3/8"		
1/4"	52-72	65-85
No. 10	21-41	30-45
No. 40	8-24	8-26
No. 200	3-7	3-7
Asphalt Cement*	4-8	4-8

- \* The asphalt cement content (percent of total mix, by weight) shall conform to the current approved mix design on file with OSHD for the source to be used, within a tolerance of plus or minus 0.5 percent. The Contractor shall furnish the City with a copy of this mix design. If there is no current mix design, the asphalt cement content for the mixture shall be not less than 6.0 percent. The mixture shall be accepted by such testing as the City deems necessary to assure that the mixture is suitable for the purpose intended.

**205.2.06 Prime Coat Asphalt** shall be emulsified asphalt and shall be RS-1 grade.

**205.2.07 Tack Coat Asphalt** shall be emulsified asphalt and shall be RS-1 grade.

**205.3 CONSTRUCTION:**

**205.3.01 Asphalt Concrete Driveways and Gutters** - Driveways shall generally be paved to the right-of-way line or as specifically directed by the City. All driveways shall be properly sloped to provide drainage. Valley gutters shall be formed at the location designated and as directed by the City. Construction of asphalt concrete structures shall use following guidelines.

**205.3.02 Foundation Preparation** - All bases and foundations shall be constructed to the condition prescribed under the applicable specification. Broken or ragged edges of existing Portland cement concrete or bituminous surfaces underlying or abutting the new pavement shall be trimmed back to firm material. Contact surfaces of structures in the paving area shall be treated with an asphalt tack coat prior to placing the asphalt concrete. Underlying surfaces of Portland cement concrete and designated areas of asphalt-deficient, fine-cracked or spalled bituminous material shall be treated with an asphalt tack coat prior to placing the asphalt concrete.

**205.3.03 Existing Pavement Surfaces** - Existing pavement surfaces shall be cleaned of all loose material, dirt and dust by brooming, by flushing with water or by other approved methods. All vegetation on existing asphalt surfaces shall be removed by first burning with a torch followed by careful removal of the burned vegetation by scraping and brooming.

**205.3.04 Weather Limitations** - Asphalt concrete mixtures shall be placed on dry prepared surfaces when the air temperature in the shade and the surface temperature is 50° F and warmer. However, paving work may begin if the temperature is 45° F or above and rising, and in the judgement of the City will be 50° F in a reasonable period of time. Placing any mixture during rain or other adverse weather conditions will not be permitted, except that mix in transit at the time these adverse conditions occur may be laid if the following conditions are met:

- a. Mix is at proper temperature.
- b. Mix is covered during transit.
- c. Mix is placed on a foundation free of standing or flowing water.

**205.3.05 Prime coat asphalt** shall be applied to cleaned potholes and to aggregate base pavement edges which have been shaped and compacted prior to paving. Prime coat asphalt shall be applied at a rate of 0.3 to 0.4 gallons per square yard of surface. Distributor spraying temperature shall be a minimum of 120° F and a maximum of 160° F. Asphalt shall not be applied on wet surfaces or when the air temperature is below 50° F.

**205.3.06 Tack coat asphalt** shall be applied to existing bituminous and Portland cement concrete surfaces prior to placing asphalt concrete. The application rate shall normally be within a range of 0.06 to 0.10 gallons per square yard of surface. Asphalt shall not be applied to any wet surfaces or when the air temperature is less than 50° F. The asphalt shall be applied by pressure-spray equipment capable of providing a uniform application at the prescribed rate. It shall be applied only so far in advance of the asphalt concrete paving operations as is necessary in order to provide a tacky surface upon which to place the asphalt concrete.

**205.3.07 Placing** - Asphalt concrete shall be at a temperature of between 250° and 300° F at the time it is placed. Asphalt Concrete shall be placed in panels of such width as to hold to a practical minimum the number of longitudinal joints required. The longitudinal joints in any panel shall offset those joints in underneath panels by not less than six inches. Special care shall be taken at longitudinal joints to provide the required bond and density. The placing of asphalt concrete shall be a continuous operation as nearly as practicable. If the capacity of the paving machine exceeds the capacity of the hauling vehicles, the paving machine shall be operated at a reduced uniform speed so as to maintain a continuous operation. Overlay paving shall be applied in a minimum of two lifts. The first lift shall be a leveling course, followed by a cover course.

**205.3.08 Compaction** - Longitudinal joints shall be rolled directly behind the paving machine. The first panel shall have vertical edges, and the abutting panel shall be tightly crowded against its edge. Material from the second panel shall be pushed over the surface of the first panel so as to develop an overlap of from three to six inches. Breakdown rolling shall immediately follow the rolling of the longitudinal joints and edges. Rollers shall be operated as close to the paving machine as necessary to obtain adequate density without causing undue displacement. The breakdown roller shall be operated with the drive roll or wheels nearest the paving machine. Exceptions may be made when working on steep slopes or superelevated curves. Breakdown rolling and the rolling of longitudinal joints shall be performed with steel wheeled rollers having a minimum weight of 10 tons. Compaction rolling, consisting of at least 6 coverages with a steel wheel roller, having a minimum weight of 10 tons, or of at least 4 coverages with a vibratory roller, capable of imparting a dynamic force of at least 21,000 pounds, shall follow the breakdown rolling as closely as possible and while the material is at a temperature that will result in good compaction being achieved. This rolling shall continue until roller wheel marks are no longer discernible. Roller wheels shall be kept moist with only enough water to avoid picking up the material. Rollers shall move at a uniform speed not to exceed 3 mph for steel wheeled rollers or 5 mph for pneumatic tired rollers. Rollers shall be in good condition and capable of being reversed without backlash. The line of rolling shall not be suddenly changed nor the direction of rolling suddenly reversed. Any pronounced change in direction of the roller shall be made on stable material. If rolling causes displacement of the material, the affected areas shall be loosened and restored to the original grade with loose material before being rerolled. Heavy equipment, including rollers, shall not be permitted to stand on finished surface before it has thoroughly cooled or set. The finished surface shall be true to line and grade, free of irregularities and roller wheel tracks.

## **206 CAST-IN-PLACE CONCRETE**

### **206.1 DESCRIPTION:**

This item includes the furnishing of all labor, materials and tools necessary to do all the plain and reinforced concrete work, including finishing as shown on the plans.

**206.2 MATERIALS:**

**206.2.01 Concrete** shall be 6-sack transit-mixed concrete in accordance with ASTM C94. In no case will the use of concrete be permitted which has been mixed with water for more than 90 minutes prior to placing. Water content shall be controlled such that maximum slump by standard slump cone test, ASTM C143, shall not exceed 3 1/2".

**206.3 CONSTRUCTION:**

**206.3.01 Placing** - Concrete shall be placed in such a manner as to prevent segregation. Concrete shall be consolidated to the maximum practicable density, free from pockets of coarse aggregate and entrapped air, and closed snugly against all surfaces of forms and embedded materials. Consolidation of concrete in structures shall be by electric or pneumatic drive, immersion-type vibrators. Consolidation of all other concrete shall be by vibration, hand spading, rodding, or tamping.

**206.3.02 Finishing of Slabs**- After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. All high and low spots shall be levelled during this operation to produce a true plane surface within 1/4 inch in 10 feet, as determined by a 10-foot straightedge placed anywhere on the surface. Immediately after the concrete has received a float finish, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

**206.3.03 Curing**- Concrete shall be protected from premature drying, freezing, wash by drainage rains, snow, and from traffic and mechanical injury. Formed concrete surfaces shall be cured by leaving the forms in place for at least 7 days after placing. Flat concrete surfaces shall be water cured by spraying lightly with water as soon as the concrete has hardened enough to prevent damage from spraying, then covered completely with a plastic waterproof membrane. A curing compound approved by the engineer and applied in accordance with manufacturer's instructions may be used in lieu of water curing. Precast concrete slabs shall not be moved for at least 28 days after casting.

**207 CONCRETE CURBS AND GUTTERS****207.1 DESCRIPTION:**

This item includes all work necessary for the construction of concrete curbs, gutters, and combination curbs and gutters.

**207.2 MATERIALS:**

**207.2.01 Concrete** shall conform to the requirements of ASTM C94 and of Section 206. Compressive field strength of Portland Cement Concrete shall be not less than 3,000 p.s.i. at 28 days.

207.2.02 Preformed expansion joint fillers for concrete shall conform to the requirements of AASHTO M153 or AASHTO M213 except that those furnished under AASHTO M213 shall be tested in conformance to ASTM D1751. Fillers conforming to AASHTO M213, except the binder if other than bituminous material, may also be used provided that they otherwise meet this specification and provided further that they have been demonstrated to be rot and vermin proof for a period of at least 5 years.

207.2.03 Curing materials shall be liquid membrane-forming compounds for curing concrete conforming to the requirements of AASHTO M148.

### 207.3 CONSTRUCTION:

207.3.01 Aggregate Foundation and Bedding - All bases upon which new concrete curbs are to be constructed shall be firm and free of all extraneous matter. Foundation courses and beddings shall be constructed in conformance with the applicable requirements of section 204. The Contractor shall thoroughly dampen surfaces upon which new concrete is to be placed prior to placement of the concrete.

207.3.02 Line and Grade - The top and face of finished curb shall be true and straight and the top surface of curbs shall be of uniform width, free from humps, sags, honeycombs, or other irregularities. The Contractor shall construct all curb and gutter within 0.02 foot of true line, within 0.02 foot of established surface grade, cross section and slope, and within 0.02 foot of specified thickness.

207.3.03 Placing - Concrete curbs may be placed either by mechanical extrusion methods or between suitable forms, as specified by the City.

207.3.03A Extrusion Method - If concrete is to be placed by mechanical extrusion methods, the slump shall be between one and two inches. Concrete shall be fed into the extruding machine at a uniform rate and the machine shall be operated under sufficient restraint to forward motion to produce a well compacted mass of concrete. Maximum size of aggregate shall be 1/2 inch.

207.3.03B Forms - If forms are used, the concrete slump shall be between two and four inches. Maximum size of aggregate shall be 3/4 inch. Placing of concrete shall conform to the requirements of subsection 206.3.01. Forms shall be removed from formed structures after the concrete has taken its initial set and while the concrete is still green. Forming of depressed curb section shall occur as directed by the City.

207.3.04 Finishing - Minor defects shall be repaired with mortar containing one part portland cement and two parts sand. Plastering will not be permitted on exposed surfaces. Honeycombed and other structurally defective concrete shall be removed and replaced at no expense to the City. While the concrete is still green, the exposed surfaces shall be finished as required to provide a uniform texture and smooth surface. Where necessary, blockouts shall be provided in gutter portion for installation of catch basins.



207.3.05 Transverse expansion joints shall be constructed opposite abutting expansion joints, at each point of tangency, and at connections to existing curbs, driveways and walks. Additional transverse expansion joints shall be provided at other evenly spaced locations as required to confine the expansion joint spacing to a maximum distance of 15 feet. The width of joints and thickness of filler shall match those of the joints in abutting concrete; elsewhere the filler thickness shall be not less than 1/2 inch. Each expansion joint shall be at right angles to the alignment, vertical to the top surface, and shall provide complete separation of the concrete. The joint in the old concrete which abuts the new concrete shall be made with a saw cut.

207.3.06 Curing - After the concrete has been placed and finished, it shall be cured by application of a white pigmented liquid membrane-forming compound applied uniformly to the damp concrete by pressure spray methods, or by keeping the concrete protected and moist, by approved methods, for at least 72 hours. The concrete shall be protected from contact, strain, and vehicular traffic for at least seven days.

207.3.07 Backfill - Any necessary backfill behind curbs shall occur after a minimum of 3 days cure and shall be lightly compacted and shaped to drain. Backfill shall be placed prior to additional base course placement.

## 208 CONCRETE DRIVEWAYS, RAMPS & WALKS

### 208.1 DESCRIPTION:

This item includes all work necessary for the construction of concrete driveways, walks, ramps, and miscellaneous surfacings.

### 208.2 MATERIALS:

208.2.01 Concrete shall conform to the requirements of ASTM C94 and of section 206. Compressive field strength of portland cement concrete shall be not less than 3,000 p.s.i. at 28 days. Maximum size of aggregate shall be 3/4 inch. Concrete slump shall be between 2 and 4 inches.

208.2.02 Reinforcing bars shall be deformed as defined in ASTM specifications. All reinforcing bars shall be Grade 40, ASTM A615. Metal reinforcement at the time concrete is placed shall be free from mud, oil, loose mill scale, loose rust, or other coatings that adversely affect bonding capacity in the opinion of the Engineer.

208.2.03 Preformed expansion joint fillers shall conform to the requirements of subsection 207.2.02.

208.2.04 Curing materials shall be liquid membrane-forming compounds for curing concrete conforming to the requirements of AASHTO M148.

208.2.05 Welded Wire Reinforcement shall conform to specifications outlines in the Standard Drawings.

208.3 CONSTRUCTION:

208.3.01 Aggregate Foundation and Bedding - All bases upon which new concrete surfacings are to be constructed shall be firm and free of all extraneous matter. Foundation courses and beddings shall be constructed in conformance with the applicable requirements of section 204. The Contractor shall thoroughly dampen surfaces upon which new concrete is to be placed prior to placement of the concrete.

208.3.02 Surface Line and Grade - Construct slabs and similar surfaces to drain with true, uniform slopes. Finished surfaces shall be free from humps, sags, or other irregularities. All work shall be within 0.02 foot of true line, within 0.02 foot of established surface grade, cross section and slope, and within 0.02 foot of specified thickness.

208.3.03 Reinforcement - All requirements of concrete reinforcement not covered in these specifications or on the plans shall be in accordance with "Manual of Standard Practice," as published by the Concrete Reinforcing Steel Institute (CRSI). All hooks shall conform to bend dimensions defined as "Standard Hooks" in "Manual of Standard Practice," as published by CRSI. Reinforcing bars shall not be bent or straightened in a manner that will injure the material.

208.3.04 Placing of concrete shall conform to the requirements of subsection 206.

208.3.05 Finishing - Concrete surfaces shall have a broomed surface unless otherwise specified. Brooming shall be transverse to the direction of traffic. The surface shall be lightly grooved or marked into squares or other shapes to match other such markings on similar existing surfacings in the vicinity, or as designated by the City. Edges shall be tooled with 1/4 inch radius edger.

208.3.06 Transverse expansion joints - shall conform to the requirements of subsection 207. Joint filler shall also be installed where new walks contact poles, hydrants, and other protruding objects.

208.3.07 Transverse contraction joints of the weakened plane or dummy type shall be constructed at such locations as are required to confine the contraction joint spacing to a maximum of 15 feet. The joints shall be formed to a depth of 1/3 of the thickness of concrete and to a width of about 1/8 inch. Joint edges shall be tooled.

208.3.08 Curing shall conform to the requirements of subsection 207.

**209 WORK ON NEW & EXISTING UTILITY STRUCTURES****209.1 DESCRIPTION:**

This item includes all work necessary for joining new drainage work to existing, for the adjustment of existing storm drainage structures, and for the installation of new monument boxes for street centerline monuments.

**209.2 MATERIALS:**

209.2.01 Concrete shall conform to the requirements of ASTM C94. Compressive field strength shall be not less than 3,000 p.s.i. at 28 days. Maximum size of aggregate shall be 3/4 inch. Slump shall be between 2 and 4 inches.

209.2.02 Mortar shall conform to the requirements of ASTM C387, or be proportioned 1 part Portland cement to 2 parts clean, well graded sand which will pass a 1/8 inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the precast concrete. Mortar mixed longer than 30 minutes shall not be used.

209.2.03 Precast concrete grade rings shall conform to the requirements of ASTM C478.

209.2.04 Monument boxes shall be cast iron frames and covers. Frames shall provide for a minimum 9 inch diameter clear opening as manufactured by Neenah Foundry Company, Type R-1975-A, or approved equal.

**209.3 CONSTRUCTION:**

209.3.01 Excavation, bedding and backfill shall be done in the intent to restore the surface so that it may mate with the original surface and minimize ravelling and maintenance problems.

209.3.02 Pipe connections to existing structures shall be made according to manufacturer's recommendations. All connections shall be completely watertight. All pipes entering or leaving the structure shall be placed on firmly compacted bedding material.

209.3.03 Manhole Adjustment-Manholes shall be raised or lowered by removing the existing frames, grates or covers and adjusting the height as necessary to correspond to grade. Manholes may be raised or lowered by any of the following or combination of methods when no particular method is specified.

209.3.03A Manhole necks are defined as that upper portion of a manhole having vertical walls and a uniform diameter or dimensions sufficient to receive and support the metal frame. The manhole neck may be extended by the use of precast extension rings and mortar or by reconstructing the neck except that the total distance from the top of the metal frame at its new adjusted grade to the bottom of the neck shall not exceed 24 inches.

209.3.03B Manhole cones may be cut down and rebuilt provided the batter or slope of the cone does not exceed 6 inches horizontal per 12 inches vertical.

209.3.03C Manhole barrels of brick, block or concrete shall be extended in kind with like materials.

209.3.03D Existing frames, grates or covers shall be reset in fresh mortar and brought to proper grade following manhole adjustment.

209.3.04 Monument boxes shall be installed by the Contractor after the installation of the base course rock at locations designed by the City. Monuments will be referenced and set or reset by an approved Engineer. Monument boxes shall be installed flush with the final surface grade.

## 210 STORM DRAINAGE PIPE & FITTINGS

### 210.1 DESCRIPTION:

This item includes all work necessary for the construction of surface and subsurface storm drainage piping and facilities including but not limited to, storm drainage piping and culverts, drywells, subsurface trench drains, and the trenching, furnishing and installing pipe, backfilling, and placing of necessary rip-rap as required.

### 210.2 MATERIALS:

210.2.01 General - Storm drainage pipe and fittings shall be as hereinafter specified for the particular kind of pipe and fittings required, as designated on the approved plans. Joints for all fittings shall be the same as the joints used on the pipe. No pipe and fittings that are not hereinafter specified will be allowed on the project, and no substitution of approved pipe materials will be allowed other than the pipe materials shown on the approved plans.

#### 210.2.02 Storm Drainage Pipe -

210.2.02A Corrugated High Density Polyethylene smooth interior (HDPE) pipe and fittings shall conform to the requirements of ASTM D1248, Type III, Category 4 or 5, Grade P33 or P34, Class C. Stiffness of HDPE pipe and fittings shall conform to the requirements of ASTM D-2412.

210.2.02B Single-Wall Corrugated Polyethylene (CPE) pipe and fittings shall conform to the requirements of AASHTO M-2523. Couplings and fittings shall be split or snap-on type for pipe 3" to 15" in diameter.

210.2.02C Perforated Single-Wall Corrugated Polyethylene (Perforated CPE) pipe and fittings shall conform to the requirements of AASHTO M-2523. Perforated pipe shall be furnished with factory made slots and wrapped at the factory with a geotextile fabric. Fabric wrapping shall have the following properties:

Fabric Pore Size . . . . .	50 Sieve
Grab Tensile Strength . . . . .	20 lbs.
Trapezoid Tear Strength . . . . .	11 lbs.
Mullen Burst Strength . . . . .	25 psi

210.2.02D Polyvinyl Chloride (PVC) pipe shall conform to the requirements of ASTM D3034 and D2729.

210.2.02E Nonreinforced Concrete Pipe shall conform to the requirements of ASTM C14, Class 3.

210.2.03 Jointing Materials -

210.2.03A Corrugated PE Joints shall be made with standard polyethylene fittings designed for use with corrugated PE tubing.

210.2.03B PVC Pipe Gaskets shall conform to the requirements of ASTM D3212.

210.2.04 Fittings -

210.2.04A Corrugated PE Pipe Fittings shall conform to the applicable portions of ASTM F405 and ASTM F667.

210.2.04B PVC Pipe Fittings shall conform to the applicable portions of the following specifications: ASTM D1785, ASTM D2729, ASTM D2466, ASTM D2467, and ASTM D3034.

210.2.04C Concrete Pipe Fittings on 18 inch and smaller concrete pipe shall be shop fabricated. Fittings on pipe 21 inches and larger may be field or shop fabricated. Fittings fabricated by inserting a stub into a hole cut in the pipe shall be grouted with a nonshrinking grout. Surfaces to receive grout shall be coated with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside the sewer pipe.

210.2.05 Drainage Fabric shall be nonwoven fabric made from bicomponent fibers of polypropylene and polyethylene. The fabric shall be non-biodegradable and inert to most soil chemicals, acids and alkalies over a PH range of 3 to 12. Drainage fabric shall be Mirafi 140S or approved equal. Fabric shall have the following properties:

Water permeability Coefficient	....	0.1 cm/sec
Fabric Pore Size	.....	70-100 Sieve
Grab Tensile Strength	.....	125 lbs.
Trapezoid Tear Strength	.....	65 lbs.
Mullen Burst Strength	.....	125 psi

210.2.06 Drain Rock shall be railroad ballast rock which shall consist of uniformly graded 2 to 3 inch, rough edged aggregate. At the option of the Contractor, rounded river rock, washed to remove all fines, with a maximum size of 3 inches, may be substituted for railroad ballast rock.

210.2.07 Native Pipe Bedding and Trench Backfill material shall consist of native material being earth, sand, gravel, rock or combination thereof, free of humus, organic matter, vegetative matter, frozen material, clods, sticks and debris and containing no stone having a dimension greater than 1 1/2 inches. The materials shall predominate in the fine sizes and in place, shall present no isolated points or areas or larger stones which would cause fracture or denting of the structure of subject it to undue stress. When, in the opinion of the City, the native material is unsuitable for pipe bedding and trench backfill, select material shall be used. All pipe bedding and trench backfill materials shall be submitted for the City's approval prior to utilization.

210.2.08 Select Pipe Bedding material shall be clean crushed rock with a maximum size of either 1 1/2 inches or 3/4 inch, uniformly graded from coarse to fine. The maximum size of select pipe bedding material used shall be as directed by the City for the particular conditions encountered in the culvert trench. The select pipe bedding depth shall be as specified on the approved plans.

210.2.09 Select Initial Backfill material shall be pit run rock, maximum aggregate size 3 inches, with sufficient fine material to act as binder but no excess earth. The contractor shall obtain the approval of the City for both the pit selected to supply the material and the material as delivered to the job site. The City may reject any material which, in the opinion of the City, is unsuitable.

**210.3 CONSTRUCTION:**

**210.3.01 Trench Excavation -**

210.3.01A Trench Width - It is the intent of these specifications that the trench width at the surface of the ground be kept to a minimum necessary to install the pipe in a safe manner. In all cases, trenches must be of sufficient width to allow for shoring, as required, and permit proper joining of the pipe and backfilling of material along the sides of the pipe. The minimum trench width, in the pipe zone, shall be 12 inches larger than the outside diameter of the pipe, or as specified on the plans.

210.3.01B Grade - The contractor shall excavate the trench to the lines and grade shown or established by the City, with proper allowance for pipe diameter and pipe bedding depth.

210.3.01C Disposal of Excavated Material - Excavated material shall be disposed of by the contractor by smoothly grading the material onto the street right-of-way as specified by the City.

**210.3.02 Pipe Bedding** consists of leveling the bottom of the trench and placing bedding material to the depth as specified on the plans. Bedding material shall be as specified hereinbefore. The contractor shall spread the bedding smoothly to proper grade so that the pipe is uniformly supported along the barrel. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length. The contractor shall place subsequent lifts of not more than six inches in thickness up to the required depth, bring lifts up together on both sides of the pipe and carefully work under the pipe haunches by slicing with a shovel, tamping or other approved procedure. Particular attention must be given to the area from the flow line to the horizontal centerline of the pipe or top of bedding to insure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone. Pipe bedding shall be placed the full width of the trench.

**210.3.03 Initial Backfill** - The contractor shall place the specified initial backfill material carefully around the pipe in six inch layers and thoroughly hand tamp with approved tamping sticks supplemented by "Walking In" and slicing with a shovel. The contractor shall prevent pipe from movement either horizontally or vertically during placement and compaction of pipe zone material. Mechanical compactors shall not be utilized in placement of the material. The material shall be placed to a depth of 12 inches above the top of the pipe.

**210.3.04 Trench Backfill** - If the native backfill is found to be compactible and within the tolerance range of the moisture content, the contractor will be allowed to use it for trench backfill. The contractor shall take reasonable precautions to prevent excavated material from becoming saturated beyond the critical moisture limits and replace any saturated native material with other approved native material at no expense to the owner. When, the excavated material is unsuitable for trench backfill by reason of pre-existing moisture content or other undesirable physical characteristics, the contractor shall use select trench backfill material at the direction of the City. The contractor shall backfill and compact the trench above the pipe zone in lifts not to exceed eight inch loose depth. Any subsequent settlement of the trench during the one-year warranty period shall be considered to be the result of improper compaction and shall be promptly corrected.

**210.3.05 HDPE and CPE Joint Construction** - Joints shall be made with split couplings corrugated to engage the pipe corrugations and shall engage a minimum of four corrugations, two on each side of the pipe joint. Installation shall be in accordance with ASTM Recommended Practice D2321.

**210.3.06 Drainage Fabric Placement** - No standing water shall be present in the trench or at the excavated subgrade when fabric is placed. Place fabric in trench, drywell or on the prepared subgrade, keeping it as taut and free of wrinkles as possible. Stretching stakes may be required in order to secure the fabric in place during the rock placing operations which follow placement of the fabric. Overlap fabric joints a minimum of 24 inches between sections of fabric.

**211 CATCH BASINS AND CURB INLETS****211.1 DESCRIPTION:**

This item includes all work necessary for the construction of catch basins of the types and sizes shown on the Standard Drawings.

**211.2 MATERIALS:**

211.2.01 Concrete shall conform to the requirements of ASTM C94. Compressive strength for poured in place concrete shall be not less than 3,000 p.s.i. at 28 days. Maximum size of aggregate shall be 3/4 inch. Slump shall be between 2 and 4 inches.

211.2.02 Formwork shall conform to the requirements of ACI 347-68 unless otherwise noted. The Contractor shall be responsible for adequate strength and safety of all falsework, bracing, and shoring.

211.2.03 Welded frames and grates shall be fabricated of steel meeting or exceeding the requirements for "Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality", ASTM A283. Welding shall conform to the standard requirements of the American Welding Society.

211.2.04 Precast concrete units may be substituted for cast-in-place units, at the option of the City. Precast units shall conform to the requirements of ASTM C478.

211.2.05 Precast concrete and cast iron frames and grates may be substituted for welded frames and grates, at the option of the Contractor. Cast iron frames and grates shall conform to the requirements of AASHTO M105, Class 30B.

**211.3 CONSTRUCTION:**

211.3.01 Excavation and backfill shall be in accordance with applicable portions of Section 210.

211.3.02 Cast-in-place units shall be constructed according to the plans. Forms shall be tight and well braced. The concrete shall be consolidated by mechanical vibration, hand spading, rodding, or tamping. Screed the top surface of exposed surfaces to a smooth even surface. Finish exposed edges with a steel edging tool followed by broom finish. All details of concrete work shall conform with applicable portions of Section 206.

211.3.03 Precast concrete units may be used, at the option of the Contractor, provided that all details of construction are approved by the City prior to construction.

211.3.04 Pipe connections shall be smoothly finished with the inside surface of the catch basin wall, and shall not project into the catch basin opening.



**212 MANHOLES AND CLEANOUTS****212.1 DESCRIPTION:**

This item includes all work necessary for the construction of manholes for storm drainage purposes.

**212.1.01 Related technical Specifications:** The APWA Standard Specifications for Public Works Construction, 1990 Edition, is incorporated into this specification by reference. It shall be understood that in any matter addressed by both the text of this technical specification and the referenced specification, be it in construction method, material, or quality control, the more stringent specification is intended and shall be enforced.

**212.2 MATERIALS:****212.2.01 Cast-in-Place Manholes**

**212.2.01A Aggregates** shall conform to the requirements of APWA Standard Specifications for Public Works Construction, Section 212. Clean 3/4-inch minus gravel or crushed rock uniformly graded from coarse to fine may generally be used with permission of the City.

**212.2.01B Portland Cement and Portland Cement Concrete (PCC)** shall conform to the requirements of APWA Standard Specifications for Public Works Construction, Section 212, and shall be Class 3000-1 1/2. Slump shall be between 2" and 4".

**212.2.01C Metal Reinforcement** shall conform to the requirements of ASTM A 615, Grade 60, deformed bars.

**212.2.01D Forms** Exterior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material. Trench walls, rock, or earth will not be acceptable form material.

**212.2.02 Metal castings**

**212.2.02A General** Manhole covers shall be designed so they may be secured to the frames. Matching surfaces of covers and frames shall be flat to prevent any movement of covers within frames. Covers and frames shall be interchangeable.

**212.2.02B Cast Iron** materials shall conform to the requirements of ASTM A 48. Class 30B. The foundry shall certify as to the tensile and transverse properties and Brinell Hardness. The City reserves the right to require a rough transverse bar ( size of bar 1.2 inches in diameter by 20 inches long) and/ or a tensile bar as per ASTM A 48 for each 20 castings or heat when less than 20 castings are made.

**212.2.02C Manhole frames and covers** shall be of heavy duty design with minimum weight of 295 lbs. Frames and covers shall be machine finished or ground on seating surfaces to assure a non-rocking fit in any position and interchangeability. Covers shall be marked with "SEWER" or "S" in minimum 2-inch raised or indented letters.

212.2.03 Cap screws and washers for watertight manhole covers shall be stainless steel with 60,000 p.s.i. minimum tensile strength conforming to the requirements of ASTM A453.

212.2.04 Precast Concrete Manholes

212.2.04A Precast concrete manhole sections and appurtenances shall conform to the requirements of ASTM C478. Minimum wall thickness shall be 4 inches. Cones shall have the same wall thickness and reinforcement as riser sections. Cones shall be eccentric. Joints shall be tongue-and-groove or keylock type. Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material which is to be supplied to the project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 14. Precast manhole sections shall consist of circular sections in standard nominal inside diameters of 42, 48, 54, 60, 72, 84, or 96 inches. Heights of sections shall be multiples of 12 inches. Heights of manhole sections 72 inches through 96 inches in diameter shall be as required to fit site conditions. Other sections shall be 24-inch riser and flattop sections.

212.2.04B Precast concrete manhole bases may be used provided all the details of construction are approved prior to construction. Inlet and outlet pipe holes shall be core-drilled at the plant location or in the field. Conical-type flexible neoprene boots shall be installed in the factory core-drilled hole to create a water-tight connection between manhole and sewer pipe. Where a flexible boot is not practical, and plastic pipe is used, an approved manhole water stop or collar shall be installed on the pipe at the manhole.

212.2.05 Joint Materials

212.2.05A Mortar shall conform to the requirements of ASTM C387, or be proportioned 1 part Portland cement to 2 parts clean, well-graded sand which will pass a 1/8 inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the Precast concrete if using the standard tongue-and-groove type joint. If the keylock type joint is used, the consistency shall be such that excess mortar will be forced out of the groove and support is not provided for the next Precast manhole section to be placed. Mortar mixed for longer than 30 minutes shall not be used. Standard premixed mortar conforming to ASTM C387 may also be used.

212.2.05B Non-Shrink Grout shall be Sika 212, Euco N-S, Five-Star, or approved equal non-metallic cementitious commercial grout exhibiting zero shrinkage per ASTM C-827 and CRD-C-621. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Unused grout shall be discarded after 20 minutes and shall not be used. Non-shrink grouts shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. The bonding agent shall be compatible with the brand of grout being used. Water shall not be used as a substitute for the commercial bonding agent.

212.2.05C Preformed plastic gaskets shall be used in addition to mortaring all joints. Preformed plastic gaskets shall meet all the requirements of federal specification SS-S-00210.

212.2.05D Rubber Gaskets shall conform to ASTM C 443.

212.2.06 Manhole Steps shall conform to the requirements as listed below:

Plastic with Reinforcing Steel . . . . . ASTM C 478 and A 615

212.2.07 Pipe Fittings

212.2.07A General - Pipe and fittings shall conform to the applicable portions of APWA Standard Specifications, Sections 303 and 305. Tees, ells and other fittings for drop manholes shall be of the same material as the pipe in the adjacent trench.

212.2.07B PVC pipe shall be joined to the manhole with an approved conical-type flexible boot or an approved short stub section of a factory bonded fiberglass pipe with sand coating.

212.2.08 Flexible Manhole Boots shall be required in all connections where practical between PVC sewer pipe and manhole. The conical-type flexible boot shall be made of a NEOPRENE-EPDM blended compound that meets ASTM C 443 with a 3/8 inch minimum wall thickness. The internal expanding band shall be made of non-magnetic, corrosion-resistant stainless steel. The flexibility shall allow for 22 degree angular deflection in any direction and 2 inch vertical displacement. PVC pipe adapters shall be Fernco CMA, Romac LCT, Tylox Manhole Adapter, Vassally Series 32850, Kor-N-Seal, Sealtite, Z-Lok-XP, or approved equal commercial product.

212.2.09 Pipe stubouts for future drainage connections shall be the same type as approved for use in the lateral, main or trunk sewer construction. Strength classifications shall be the same as in the adjacent trench. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Rubber-gasketed water-tight plugs, adequately braced against hydrostatic or air test pressures, shall be furnished with each stubout.

### 212.3 CONSTRUCTION:

212.3.01 General -

212.3.01A - Manhole excavation, foundation stabilization, bedding and backfill shall be in accordance with applicable portions of section 301.

212.3.01B Pipe connections at manholes shall be made according to manufacturer's recommendations. Special care shall be taken by the Contractor to see that the pipe connections at manholes are completely watertight. All pipes entering or leaving the manhole shall be provided with flexible joints within 1 foot of the exterior surface of the manhole and shall be placed on firmly compacted bedding material.

212.3.01C Pipe connections to existing manholes shall be constructed such that connections are watertight and will provide a smooth flow into and through the manhole. Existing pipe stubouts may be used for new pipe connections provided that the existing pipe stubout is not damaged and is in proper alignment with the new pipe. When existing pipe stubouts are damaged or not in proper alignment with the new pipe, the existing stubout shall be removed and the new pipe installed in the manhole base as described in subsection 212.3.01B. The Contractor shall provide all diversion equipment and facilities and perform all work necessary to maintain flow in existing lines and manholes during work on any manhole.

212.3.02 Bases shall be placed on a prepared bedding of 8 inches compacted thickness of 3/4" minus crushed rock.

212.3.02A Cast-in-place bases shall be constructed according to the plans. The concrete shall be consolidated by mechanical vibration, hand spading, rodding, or tamping. The concrete shall be screeded off such that the manhole riser section has a level uniform bearing for the full circumference.

212.3.02B Precast bases shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, making sure that all entering pipes can be inserted on proper grade. Concrete pipe connections to sanitary manholes shall be grouted watertight with non-shrink grout conforming with subsection 212.2.05B. PVC pipe shall be connected to sanitary manholes using an approved adapter specifically manufactured for the intended service, and conforming to subsections 212.2.07 and 212.2.08. Field-fabricated waterstops or improvised adapters shall not be used. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming with subsection 212.2.05B.

The invert shall be constructed to a section identical with that of the sewer pipe. Where the size of the pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, the top shall be broken out to the spring line of the pipe for the full width of the manhole, and the exposed edge of the pipe completely covered over with mortar. During construction, the Contractor shall divert existing flows of water or sewage from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

212.3.02C Manhole inverts shall be carefully formed, the curves of tributary sewers made as smooth and easy as possible. The base shall be constructed to an elevation of at least 1 inch above the top of the largest pipe.

212.3.03 Precast concrete manhole risers - All lift holes shall be thoroughly wetted, then completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness. Preformed plastic or rubber gaskets shall be used on all sanitary manholes. Mortar shall be used on 24-inch extension rings above the cones. All mortar joints between precast elements shall be thoroughly wetted, then completely filled mortar. On proposed street grades, a minimum of one 24-inch precast riser will be required between the cone and the

manhole cover frame. Watertight seals between the precast concrete manhole section(s) and the precast bases and eccentric cones shall be effected by placing a preformed plastic or rubber gasket between the precast sections, then filling the remaining voids in the joint seam, both inside and outside, with mortar.

212.3.04 Manhole, grates, frames and covers shall be installed in such a manner as to prevent infiltration of surface or ground water between the frame and the concrete of the manhole section. All mortared sanitary sewer manhole necks and all riser ring joints made with mortar shall be constructed using an approved commercial concrete bonding agent applied to all cured concrete surfaces being mortared. No joints, necks, or frames on sanitary manholes shall be mortared without an approved bonding agent. Rim elevations shall be adjusted with approved precast concrete grade rings.

212.3.05 Cleanouts shall be constructed as shown on the approved plans. The riser pipe shall be supported at the bends by encasement in concrete.

#### 212.4 TESTING:

212.4.01 General The Contractor shall be responsible for quality control testing of manholes and shall conduct such tests as necessary during the construction process. The results of the tests will not indemnify the Contractor of responsibility for defects in the construction. The first three sanitary sewer manholes built by each construction crew on the project shall be immediately proof tested. No additional manholes shall be constructed until three successful proof tests have demonstrated satisfactory workmanship and materials. Except as directed by an authorized Engineer, acceptance tests shall be conducted on a random sample of 15% of the manholes constructed. The manholes to be tested will be selected by the City and will be tested after completion of backfilling, compaction, and surface restoration, including paving. For each manhole that fails the acceptance testing, the City will select three more manholes to be tested, in addition to the original sample, up to the total project manholes.

212.4.02 Infiltration Testing - When the ground water is within 18 inches of the top of the manhole, the manhole shall be tested for infiltration by the following procedure:

1. Plug all openings into manhole.
2. Completely dry manhole.
3. Provide the Engineer with means to measure ground water elevation.
4. Request the authorized Engineer to inspect manhole, measure and record ground water elevation, record time, and re-check manhole and ground water elevation at the end of 24 hours. The manhole shall remain dry for 24 hours.

**212.4.03 Exfiltration or Hydrostatic Testing** - When the ground water is more than 18 inches below the top of the manhole, the manhole shall be tested for exfiltration by the following procedure:

1. Plug all openings into manhole.
2. Fill the manhole with water to a point on the manhole frame. (A manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into concrete walls.)
3. Request the authorized Engineer to measure and record the water surface elevation from a point on the manhole rim.
4. After one hour, the authorized Engineer will re-measure the water surface elevation and calculate the amount of leakage. The leakage in each manhole shall not exceed 0.2 gallon per hour per foot of head above the invert. Comparably stringent vacuum testing procedures may be substituted for hydrostatic testing with the approval of the Engineer.

## WATER DISTRIBUTION SYSTEM DESIGN STANDARDS

### SECTION ONE INTRODUCTION

#### 1.00 GENERAL:

The design standards set forth below are intended to result in a water distribution system which will:

- a. Provide sufficient capacity to maintain minimum pressure during periods of maximum use and to provide sufficient volumes of water at adequate pressures to provide the expected average daily consumption plus fire flow.
- b. Be of material strong enough to resist all expected loads, both internal and external, and able to preserve the purity and potability of the water supply.
- c. Be economical and safe to build and to maintain.

#### 1.01 REVISIONS TO THESE STANDARDS:

It is anticipated that revisions to these standards will be made from time to time. The date appearing on the title page is the date of the latest revision. Users should determine the issue which applies to the work contemplated.

#### 1.02 REFERENCES:

Reference herein is made to the latest edition of the standards, test, methods and specifications of research as follows:

1. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, prepared by Oregon Chapter American Public Works Association.
2. STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, prepared by Oregon Department of Transportation, Highway Division.
3. HYDRAULICS MANUAL, prepared by Oregon Department of Transportation, Highway Division.
4. AWWA STANDARDS, prepared by American Water Works Association.

#### 1.03 APPROVAL OF ALTERNATE MATERIAL OR METHODS:

Any alternate material or method not explicitly approved herein will be considered for approval on the basis of the objectives set forth in sub-section 1.00 above. Person seeking such approvals should make application in writing. Approval of any major deviation from these standards will normally be in written form. Approval of minor matters will be made in writing if requested.

## SECTION TWO PLANS AND SPECIFICATIONS

### 2.00 GENERAL:

All plans for extended water systems shall be prepared by a registered Engineer and shall bear a suitable title showing the name of the Subdivision and Bay City, and shall show the scale in feet, the North Point, data, date, and the name of the Engineer, his signature and imprint of his registration seal.

### 2.01 PLANS:

Three copies of the construction plans and specifications for the project shall be submitted for review and approval to the City of Bay City. The plans shall be submitted on standard size sheet of either 18"x24" or 24"x36". No construction shall commence on the project until approval is granted by the City. Upon completion of the project and prior to acceptance of the water systems by Bay City, a set of "as-built" plans shall be submitted with the Engineer's certification that the project was constructed in accordance with the approved plans and specifications. The scale used shall be a standard Engineering scale, i.e. 1"=100', 1"=50', etc.

2.01.01 Profile and Layout - A profile of the centerline of the water system shall be shown including the elevation of proposed and/or existing streets, original ground surface, all sanitary sewer crossings, and type of backfill to be used.

The layout or plan view should contain at least, but not limited to, the following:

- a. Adjacent street and property lines, utility easements and references thereto.
- b. Location of water main and appurtenances. Each fitting and branch line shall be stationed to facilitate coordination in locating appurtenances.
- c. Size, material and length of main between fittings.
- d. Location of adjacent sanitary sewers (invert elevations, above mean sea level, indicated as necessary), all stream and railroad crossings, gas mains, culverts and underground power or telephone, wherever possible.
- e. Appurtenances - detailed drawings should be included for all appurtenances, including hydrants, valves, thrust blocking, etc.

2.01.02 North Arrow and Scale - A north arrow shall be shown with the scale of the drawing immediately below the arrow.

2.01.03 Stationing shall be shown on all maps. Generally, stationing shall increase from the point of connection to the existing supply source.

2.01.05 Bench Marks - The location and elevation of a National Geodetic Survey, United States Geological Survey, State Highway, or Tillamook County bench mark shall be shown. Any other datum proposed shall be submitted to and approved by Bay City prior to use and shall be used only if the United States Coast and Geodetic Survey, United States Geological Survey, State Highway, or Tillamook County bench mark is not within one-half mile of the boundaries of the project. All temporary bench marks shall be shown on the plans.



**2.02 SPECIFICATIONS:**

Three copies of the complete technical specifications for the construction of water systems, and all appurtenances, shall accompany the plans. Reference to Bay City's Technical Specification is acceptable. Deviation from Bay City's Technical Specification must be submitted in detail and approved prior to construction of the project.

**2.03 REVISION TO APPROVED PLANS:**

Any deviations from approved plans or specifications affecting capacity, drainage, etc. shall be approved in writing before such changes are made. Plans or specifications so revised should, therefore, be submitted well in advance of any construction work which will be affected by such changes, to permit sufficient time for review and approval. "As-built" plans clearly showing such alterations shall be submitted to the City at the completion of the work.

### SECTION THREE MINIMUM DESIGN CONSIDERATIONS

#### 3.00 GENERAL:

The information contained within these Standard Specifications are considered minimum Standards for Water Distribution Systems. In general water distribution system should be designed to care for maximum development of the service area.

#### 3.01 CAPACITY (sizes):

Design capacities shall be determined by consideration of the following factors and assumptions:

1. Area to be served, both immediate and adjacent.
2. Current and projected population within the areas to be served.
3. Current and projected land use within the areas to be served.
4. Commercial, industrial, or institutional users to be served.
5. Changes in any of the above factors which are likely to occur within a foreseeable time period.

In the absence of consumption data or other reliable information, the following factors may be assumed:

1. Average demand for single family dwelling is 2 gpm (for design purposes).
2. Average demand for typical commercial user to be as for single family dwelling.
3. Demand for unique commercial installations, industrial users, and institutional concerns will be calculated on an individual basis.
4. Absolute minimum fire flow in hydrants shall be 500 gpm at 20 psi residual pressure.

The latest Water Distribution Master Plan completed for the City of Bay City shall also be consulted as a guideline for the determination of design capacities. These factors may be used to estimate the minimum, average, and peak demands. Submission of design calculations will not ordinarily be required, but designers should be prepared to substantiate pipe size, layout, population estimates, land uses, or other design assumptions.

Main Sizes:	
4"	Not to be used as part of the distribution system.
6"	May be used for unsupported mains not forming a part of the fire protection grid and not to exceed 400 feet in unsupported length nor for service to more than twenty (20) residences.*
8"	Standard sized lateral water main for grid iron (looped) system, not to exceed an unsupported length of 800 feet. Wherever possible, looping of the distribution grid to be every 600 ± feet.
10"	Minimum size for permanently dead-ended mains supplying fire hydrants and for minor trunk mains.
12"	And larger - As required for trunk (feeder) mains.

\* No fire hydrants will be supplied by this size main nor will it be used to close a loop in the distribution grid.

All dead-end mains shall terminate with a blow-off assembly. Permanent dead-ends may have a blow-off assembly as per the Standard Drawings which can conceivably be extended at some later date shall have a blow-off assembly as per the Standard Drawing.

**3.03 LOCATION AND GRIDIRON:**

**3.03.01 Location** - The standard location for water mains shall be within the public streets and roads and shall be seven (7) feet from the property line of such streets and roads and preferably on the South and West sides of street center-lines. Exceptions to these requirements may be made in order to avoid cutting and replacing pavement, to avoid conflicts with other existing underground facilities, and to permit sanitary sewers to be installed on the low sides of streets. As nearly as practical, mains shall be installed on a particular street with the distance from the property-line of the street varied as little as possible. Wherever possible, mains shall be installed a minimum clear distance of ten (10) feet horizontally from sanitary sewers and shall preferably go over the top of such sewers with 18 inches of clearance at intersections of these pipes. The minimum spacing between water mains and storm sewers, gas lines and other underground utilities, excepting sanitary sewers, shall be three (3) feet horizontally. The standard minimum cover over buried water mains shall be 30 inches. Mains shall not be installed in alleys and the installation of mains with easements across privately owned property is to be done only when absolutely necessary, such as the avoidance of dead-end conditions. Such easements, when required, shall be a minimum of twenty (20) feet in width and the conditions of the easement shall not be used for any purpose which would interfere with the unrestricted use for water main purposes. All easements must be furnished to the City after recording.

**3.03.02 Gridiron** - The distributions system mains shall be looped wherever possible. The installation of permanent dead-end mains and dependence of relatively large areas on single mains is to be avoided.

**3.04 VALVES:**

**3.04.01 Sizes** - In general, the valve sizes shall be the same as the mains in which they are installed. Special valves such as plug or ball valves may be a size smaller than the main depending upon the special conditions involved.

**3.04.02 Location** - Wherever possible, distribution system valves shall be located at the intersection of the main with a property line. There shall be a sufficient number of valves so located that not more than four and preferably three valves must be operated to effect any one particular shut-down and the spacing of valves shall be such that the length of any one shut-down in high value areas shall not exceed 800 feet nor 1,200 feet in other areas.

In general, a tee-intersection shall be valved in three branches and a cross-intersection shall be valved in four branches. Major trunk water mains shall have valves at not more than 2,000 foot spacings and preferable 1,300 foot spacings. Hazardous crossings, such as a creek, railroad, and freeway crossings, shall be valved on each side.

**3.05 FIRE HYDRANTS:**

Distribution of hydrants shall be based upon the required fire flow, the average area served not to exceed that given in **TABLE 1** as reproduced herein from the Insurance Services Offices, 160 Water Street, New York, NY 10038. Preferred coverage will normally result in hydrant spacing of 500 feet in residential areas and 300 feet in high-value districts. Hydrants stubs may be approved for installation in areas of currently minimum development.

**TABLE 1 – STANDARD HYDRANT DISTRIBUTION**

Fire Flow Required, gpm	Average Area per Hydrant, square feet
1,000 or less	160,000
1,500	150,000
2,000	140,000
2,500	130,000
3,000	120,000
3,500	110,000
4,000	100,000
4,500	95,000
5,000	90,000
5,500	85,000
6,000	80,000
6,500	75,000
7,000	70,000
7,500	65,000
8,000	60,000
8,500	57,500
9,000	55,000
10,000	50,000
11,000	45,000
12,000	40,000

Hydrants shall be located as nearly as possible at street intersections.

### 3.06 SERVICE LINES:

The term "service line" is meant to be used only for the water line extending from the distribution main to the using meter, hydrant, or sprinkler system.

All service lines must be installed in accordance with AWWA C 800. Uniform Plumbing Code (Ch. 10), or requirement of Water Authority.

3.06.01 Sizes - The sizes of service lines which may be used are 3/4", 1", 2", 4", 6", 8", 10", and 12".

3.06.02 Materials and Layout - Service lines shall have a corporation stop at the main. A Customer valve, which shall be a full opening bronze gate valve with hand wheel or lever handled ball valve, shall be provided on the customer's side of the meter and in the meter box.

Two service lines may be installed in the same trench with a minimum clear distance of eight (8) inches between lines. Two or more meters may not be served by a common service line. An Oregon State Health Division approved double check valve assembly or reduced pressure backflow preventor shall be installed at each service on the customer side of meters.

Service connections with meters three (3) inch and larger shall have a by-pass with normally closed gate valve so that the meter may be removed for servicing without discontinuance of service to the customer. If the service is used all or in part for fire protection, the by-pass shall be full size, otherwise it can be one size smaller than the meter size. By pass valves four (4) inch and larger shall be equipped with a position indicator post which will permit locking the valve position in place.

3.06.03 Location - The service lines shall normally extend from the main to the property line behind the curb and sidewalk with the curb stop, meter and meter box being located at the termination of the service connection. As nearly as possible, the service line shall terminate at edge of the public right-of-way. In general, service connections shall terminate in front of the property to be served. All meters shall be set 1' inside the property line.

3.06.04 Installation - Unless otherwise approved, installation of service lines shall comply with all respects to requirements set forth in these standards.

**WATER DISTRIBUTION SYSTEM  
TECHNICAL SPECIFICATIONS****301 TRENCH EXCAVATION, BEDDING  
AND BACKFILL****301.1 DESCRIPTION:**

This item includes all work necessary for trench excavation, trench foundation, pipe bedding, pipe zone, trench backfill, and surface removal and replacement as described below.

301.1.01 Trench excavation is defined as the removal of all material encountered in the trench to the depths as shown or as directed.

301.1.02 Trench foundation is defined as the bottom of the trench on which the pipe bedding is to lay and is responsible for the support of the pipe.

301.1.03 Pipe bedding is defined as the furnishing and placing of specified materials on the trench foundation so as to uniformly support the barrel of the pipe. The total bedding depth shall extend from a point 4 inches below the barrel of the pipe to the horizontal centerline of the pipe.

301.1.04 The initial backfill is defined as the full width of the trench from the top of the bedding to a point 10 inches above the top outside surface of the barrel of the pipe.

301.1.05 Trench backfill is defined as the furnishing, placing and compacting of material in the trench between the top of the initial backfill material and the bottom of the pavement base rock, ground surface, or surface material as directed.

301.1.06 Surface removal and replacement is defined as the removal and/or replacement of surface material such as topsoil, sod, pavement, sidewalks, gravel, etc. which requires special consideration in order to accomplish and restore the trench excavation area as specified.

**301.2 MATERIAL:**

301.2.01 The trench foundation shall be undisturbed native material in all areas except where ground water or other conditions exist and the native material is such that it cannot support the pipe. In those conditions, excavation shall be included to additional depths as required and backfilled with select trench foundation material which shall be 1 1/2 inch- minus crushed rock.

301.2.02 Pipe bedding material shall be required in all instances and shall consist of clean pea gravel or crushed rock with a maximum size of 3/4 inch, uniformly graded from coarse to fine. All pipe bedding materials shall be subject to approval by the City.

301.2.03 The initial backfill material shall be clean pea gravel or crushed rock with a maximum size of 3/4" inch, uniformly graded from coarse to fine. Initial backfill material shall be subject to the City's approval.

301.2.04 Trench backfill in rights-of-way shall be clean pea gravel or crushed rock with a maximum size of 3/4" inch, uniformly graded from coarse to fine. Trench backfill in other areas shall be native or common material which, in the opinion of the City, meets the desired characteristic required for the specific surface loading or other criteria of the backfill zone. When the native material is deemed unsuitable for trench backfill, select trench backfill material shall be used which shall be pit-run or river-run rock, maximum aggregate size 4 inches, with sufficient fine material to act as binder but no excess earth.

301.2.05 Surface removal and replacement shall consist of any and all material encountered in the excavation which is deemed suitable for use in the restoration and replacement of the original surface. All surface removal and replacement materials shall be subject to the City's approval.

### 301.3 CONSTRUCTION:

#### 301.3.01 Trench Excavation

301.3.01A General - All trench excavation and backfill shall conform to any and all specifications of any controlling regulatory agency under which the work is being performed. Pipelines shall be constructed in continuous open trench, unless noted otherwise.

301.3.01B Clearing the Right of Way - Where clearing of the right of way is necessary, it shall be completed prior to the start of the trenching. Trees and brush shall be cut as near to the surface of the ground as practicable and removed to a disposal site approved by the City. Do not remove existing trees or tree limbs over 2 inches in diameter without permission from the City, unless within 4 feet of trench center line. All stumps within this 8 foot area shall be removed. The Contractor shall observe all federal and state laws relating to fire permits and local regulations related to burning materials. Under no conditions shall excavated materials be permitted to cover brush prior to clearing and disposal of same.

301.3.01C Open Trench Limit - The length of open trench excavated shall always be kept to a minimum. In normal cases, the open trench length shall not exceed 100 feet. Related trench construction such as pavement, road gravel, concrete restoration, etc. shall normally be completed within 500 feet of the open trench limit unless otherwise specified by the City.

301.3.01D Trench Width - It is the intent of these specifications that the trench width at the surface of the ground be kept to a minimum necessary to install the pipe in a safe manner. In all cases, trenches must be 18 inches greater than the inside diameter of the pipe to be laid, except by permission of the City. Generally, the minimum trench width in the pipe zone shall be 24 inches. No maximum width of trench at the top of the pipe will be specified herein. When required by design, it will be shown on the plans. If the maximum width shown is exceeded by the Contractor without written authorization, the Contractor will be required, at no expense to the owner, to provide pipe of a higher strength designation, a higher class of bedding, or both, as approved. Excavation for manholes and other structures shall be wide enough to provide a minimum 12 inches



between the structure surface and the sides of the excavation. The Contractor shall confine the top width of the trench to right of ways or easements. Special written agreements to extend the width may be made with the affected property owner, provided such agreement is first approved by the City. The Contractor shall take all necessary precautions to avoid damage to properties, structures and utilities adjacent to the trench.

301.3.01E Grade - No definite grades will be specified herein, although attention shall be directed to minimum cover requirements set forth in the approved plans.

301.3.01F Disposal of Excess Material - The Contractor shall dispose of all excess material not required elsewhere on the project, make arrangements for disposal and bear all cost related thereto. All unimproved street rights-of-way within the limits of this project may be used as disposal areas for excess material provided that the material is graded smoothly over the ground surface and permission is granted from the City.

301.3.01G Shoring - Unless otherwise provided in the special provisions, the Contractor shall provide all materials, labor and equipment necessary to adequately shore trenches to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. The method of shoring shall be according to the Contractor's design. The Contractor may elect to use a combination of shoring and overbreak, tunneling, boring, sliding trench shields or other methods of accomplishing the work, provided the method conforms with all applicable local, state and federal safety codes. Removal of any cribbing and sheeting from the trench shall be accomplished in such a manner as to fulfill the above requirements. Damages resulting from improper cribbing or from failure to crib shall be the sole responsibility of the Contractor. That portion of cribbing or sheeting extending below the springline of rigid pipe or below the crown elevation of flexible pipe shall be left in place unless satisfactory means of reconsolidating bedding or side support, disturbed by cribbing or sheeting removal, can be demonstrated. If a moveable box is used in lieu of cribbing or sheeting and the bottom cannot be kept above the springline of rigid pipe or the crown elevation of flexible pipe, the bedding or side support shall be carefully reconsolidated behind the movable box prior to placing backfill. The use of horizontal strutting below the barrel of pipe or the use of the pipe as support for trench bracing will not be permitted.

301.3.01H Location of Excavated Material - Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic, nor interfere with the function of existing drainage facilities. Generally, excavated material shall be located within the construction easement of right-of-way. Pile material so top of slope is at least 2 feet from the edge of the trench.

301.3.01I Existing Drainage Culvert - The Contractor shall remove and replace existing drainage culverts to complete trench excavation. Where pipe has been damaged or deemed in poor condition, it shall be replaced as directed by the City. In general, all culverts shall be protected from damage or restored to equivalent condition.

301.3.02 Dewatering - The Contractor shall provide and maintain ample means and devices with which to promptly remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe and until the backfill at the pipe zone has been completed. The Contractor shall dispose of the water in a suitable manner without damage to adjacent property. Groundwater shall be controlled such that softening of the bottom of excavations or formation of "quick" conditions or "boils" during excavation shall be prevented. Where the native trench material is sand, the Contractor shall use appropriate trench dewatering methods, to include vacuum dewatering, such that running sand, moving sand and "quick" sand conditions are prevented at the bottom of the excavation. Dewatering systems shall be designed and operated so as to prevent removal of the natural soils and so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

301.3.03 Trench Foundation - When the existing material in the bottom of the trench is unsuitable for supporting the pipe, the Contractor shall excavate below the pipe, as directed by the City. The Contractor shall backfill the trench to subgrade of the pipe bedding, with select trench foundation material over the full width of the trench and compact in layers not exceeding six inches deep to the required grade. Where the native trench material is sand, no trench foundation materials will be authorized on account of water entering the trench excavation. In such case, the Contractor shall stabilize the native sand trench foundation with adequately designed dewatering systems in accordance with subsection 301.3.02.

301.3.04 Pipe Bedding - Pipe bedding consists of leveling the bottom of the trench or the top of the foundation material and placing bedding material to the horizontal centerline of the pipe. Bedding material shall be as specified hereinbefore and placed in at least two lifts. Place the first lift to provide the minimum six inch depth of bedding material as shown on the plan before the pipe is installed. The Contractor shall spread the bedding smoothly to proper grade so that the pipe is uniformly supported along the barrel and excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length. The Contractor shall place subsequent lifts of not more than six inches in thickness up to the horizontal centerline of the pipe, bring lifts up together on both sides of the pipe and carefully work under the pipe haunches by slicing with a shovel, tamping or other approved procedure. Particular attention must be given to the area from the flow line to the horizontal centerline of the pipe or top of bedding to insure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone. Pipe bedding shall be placed the full width of the trench.

301.3.05 Initial Backfill - The Contractor shall place the specified initial backfill material carefully around the pipe in six inch layers and thoroughly hand tamp with approved tamping sticks supplemented by "Walking In" and from movement either horizontally or vertically during placement and compaction of initial backfill material. Mechanical compactors shall not be utilized in placement of the initial backfill material. Under no circumstances should backfill material be dropped in a manner that may damage the pipe.

**301.3.06 Trench Backfill** - In areas where native backfill material is allowed and found to be compactible and within the tolerance range of the moisture content, the Contractor may use it for trench backfill. The Contractor shall take reasonable precautions to prevent excavated material from becoming saturated beyond the critical moisture limits and replace any saturated native material with other approved native material at no expense to the City. When the excavated material is deemed unsuitable for trench backfill by reason of pre-existing moisture content or other undesirable physical characteristics, the Contractor shall use suitable excess excavated material at the direction of an authorized Engineer. The Contractor shall backfill the trench above the pipe zone to within eight inches of the final surface grade, or as shown on the plans, in lifts not to exceed eight inch loose depth. The Contractor shall compact each lift to a minimum of 95 percent of the maximum density as determined by AASHTO T99, Method D. The Contractor shall then place the proper surface replacement as required. Any subsequent settlement of the trench during the warranty period shall be considered to be the result of improper compaction and shall be promptly corrected. The Contractor shall compact and rake the soil to match the ground surface adjacent to the trench and maintain the surface of the backfilled trench level with the existing grade until the entire project is accepted by the City. In rights-of-way areas, the Contractor shall maintain the surface of the backfill trench level with the existing grade with 3/4 inch minus crushed aggregate material as directed, until final pavement replacement is completed on the entire project, and is accepted by the owner. In paved or graveled areas, this maintenance shall include, but not be limited to, the addition of asphalt concrete or crushed aggregate material to keep the surface of the backfilled trenches reasonably smooth, free from ruts and potholes, and suitable for normal traffic flow. Clay cut-off walls, installed in the pipe bedding, initial backfill, and trench backfill, shall be provided at maximum 100 foot intervals in areas where trench bedding and backfill consists of crushed rock.

**301.3.07 Surface Removal and Restoration**

**301.3.07A General** - The intent of surface restoration is not to replace what was actually removed in kind, but rather, it is to effect a restoration which will mate with the original surface and minimize ravelling and maintenance problems.

**301.3.07B Removal of Topsoil** - In all cases, where trenches cross lawns, garden areas, pasturelands, cultivated fields, or other areas on which reasonable topsoil conditions exist, first remove the topsoil for a depth of 12 inches for the full width of the trench to be excavated. Stockpile this topsoil to one side of the right-of-way and do not mix with the remaining excavated material. Replace the topsoil in the top 12 inches of the backfill trench. Minimum finished depth of topsoil over all trenches shall be 10 inches. Maintain the finished grade of the topsoil over the center line of the trench level with the immediate area bordering the trench until final acceptance by the City. Correct all damage to adjacent topsoil caused by trenching or pip-laying operations by regrading, removal of all rock, gravel, clay, and any other foreign materials from the surface, and by the addition of topsoil when required.

**301.3.07C Paved Surfaces** - All bituminous pavement or oiled surface, regardless of thickness, shall be cut by an approved method prior to excavation of trenches. Width of cut shall be the minimum width necessary for the excavation and shall follow lines parallel to the pipe centerline. The use of any machine or device that, during the course

of operation, results in damage to adjacent pavement, existing utilities, adjacent structures or improvements shall not be permitted. When the trench has been backfilled to within eight inches of the final surface grade, the Contractor shall place a four inch compacted lift of 2 inch minus granular material consisting of gravel or crushed rock. After the four inch lift has been compacted, a 2-inch levelling course of 3/4 inch minus crushed rock shall be placed and compacted followed by 2 inches of asphaltic concrete. Any pavement or roadway surfacing not immediately over or adjacent to the trench which is disturbed or damaged as a result of the operations of the Contractor shall be similarly repaired or replaced to the satisfaction of the City.

301.3.07D Gravel Surfaces - The restoration shall be the same as for paved surfaces except that after the compaction of the 2 inch minus material, a 4 inch lift of 3/4 inch minus crushed rock shall be placed and compacted to the final surface grade.

301.3.07E Other Surfaces - The ground surface shall be left in a neatly dressed and finished condition wherever it has been disturbed by the operations of the Contractor. Previously planted areas shall be replanted with the same type vegetation. Portland cement concrete pavement, curbs and sidewalks shall be cut with a pavement saw. Portland cement concrete surfaces shall be replaced and finished to match the depth and finish surface of the removed surface.

## 302 WATER PIPE AND FITTINGS

### 302.1 DESCRIPTION:

This item includes all work necessary for the installation of water pipe and fittings as shown on the plans for use in water distribution systems.

### 302.2 MATERIALS:

302.2.01 General - Materials and strength specifications shall be as hereinafter specified for the particular kind of pipe and fittings as shown on the plans. No pipe and fittings that are not hereinafter specified will be allowed on the project.

#### 302.2.02 Water Main Pipe

302.2.02A Ductile Iron Pipe shall conform to the requirements of ANSI A21.51 (AWWA C151), with push-on joints, mechanical joints or restrained joints as shown on the plans. All pipe shall be cement lined and seal coated according to ANSI A21.4 (AWWA C104). The minimum thickness class shall be class 50.

302.2.02B Polyvinyl Chloride (PVC) Pipe shall conform to ASTM D2241 for SDR 26, 200 psi pressure rating. Pipe shall have integral bell and spigot joints with elastomeric gaskets conforming to the requirements of ASTM D1869 and F477. Cast iron fittings shall be used with PVC pipe.

302.2.03 Water Main Pipe Fittings shall be of a class and rating at least equal to the adjacent pipe unless specified otherwise. Joint materials shall be compatible with the adjacent pipe. All fittings shall be cast or ductile iron. Mechanical joint and push-on joint type coupling shall conform to ANSI A21.10 and A21.11 (AWWA C110 and C111), cement lined and seal coated according to ANSI A21.4 (AWWA C104). Other types of joints shall conform with FS WWP-421 b, Type II for push-on joints. Flanged couplings shall be drilled and faced in accordance with ANSI B-16.1 or B-16.2. Rubber gasket type shall be U.S. Pipe, Tyton or approved equal. Cast iron fittings for use with FS Type II and Type III cast iron water pipe shall conform to the same specifications except that joints shall be mechanical type and include cast iron glands, plain rubber gaskets and T-head cast iron bolts and nuts per ANSI A21.11 or an approved compression type with rubber gasket.

302.2.04 Flanged Coupling Adaptors shall be Dresser Style 127, or approved equal.

302.2.05 Uniflange Adaptors shall be by Uniflange Corp., Series 900-C, or approved equal.

302.2.06 Thrust Blocks shall be constructed of Portland Cement Concrete conforming to the requirements of ASTM C94. Compressive field strength shall be not less than 2000 psi at 28 days. Maximum size of aggregate shall be 1 1/2 inches.

302.2.07 Water Service Assemblies for up to 1 inch Pipe

302.2.07A Pipe shall be Polyethylene type II IPS water service pipe conforming to ASTM D2239, 160 psi, SDR7. All compression joints shall use stainless steel insert stiffeners.

302.2.07B Service saddles on PVC water lines shall be all bronze fittings, Mueller H-13443 or approved equal.

302.2.07C Corporation stops for ductile iron water lines shall be Mueller type H-15026 or approved equal, for services up to 2 inches, with AWWA I.P. thread inlet and pack joint for IPS PE water service pipe outlet.

302.2.07D Angle meter stops shall be Mueller H-14266 or approved equal, with pack joint for IPS PE water service tubing inlet and meter spud thread outlet.

302.2.07E Quarter turn check valves shall be Mueller H-14351 or approved equal, meter spud thread inlet and FIPS outlet.

302.2.07F Meter Boxes shall be Brooks No. 36 concrete body with No. 36T cast iron cover or approved equal.

302.0.07G Backflow Prevention devices shall be Clayton D-2 double check valve assembly, Clayton RP-1 reduced pressure assembly, or approved equal.

302.2.08 Water Service Assemblies for 2 inch

302.2.08A Pipe shall be Schedule 40 PVC conforming to ASTM 1785 with solvent weld joints.

302.2.08B Fittings shall be Schedule 80 PVC conforming to ASTM 1785, solvent weld.

302.2.08C Service Saddles on PVC water lines shall be all bronze fittings, Mueller H-13443 or approved equal.

302.2.08D Corporation Stops on PVC water lines shall be Mueller type H-20046 ball valve, or approved equal, with AWWA I.P. thread x FIP with Schedule 80 PVC solvent weld male adapter.

302.2.08E Meter Stops shall be Mueller H-14286 DIP x meter flange or approved equal.

302.2.08F Meter Boxes shall be Brooks No. 65 concrete body with No. 65-S cover and lid or approved equal.

302.2.08G Backflow Prevention devices shall be Clayton D double check valve assembly, Clayton RP-2 reduced pressure assembly, or approved equal.

302.2.09 Air Release Assembly shall include all of the appropriate fittings for a standard water service assembly and shall include the following:

302.2.09A Air Release Valve shall be APCO No. 65 or approved equal.

302.2.09B Valve Box shall be Brooks No. 65 concrete body with a 6" extension and No. 65-S cover and lid.

302.2.10 Tracer Wire shall be #12 multi-stranded copper wire with blue colored insulation.

302.2.11 Sampling Station shall include all of the appropriate fittings for a standard water service assembly and shall include an ECLIPSE No. 88 Sampling Station or approved equal.

302.3 CONSTRUCTION:

302.3.01 Alignment and Grade - All pipe shall be laid to the required lines and grades. Fittings and valves shall be at the required locations with joints centered, spigots home, and valve and hydrant stems plumb. Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, or other obstructions encountered in the process of the work shall be furnished by the contractor at no expense to the Owner. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections, the obstructions shall be permanently supported, relocated, removed or reconstructed by the contractor in full cooperation with the owners of such utility structures, or the new water pipe shall be laid to an alignment and/or grade to miss the obstruction. No deviation shall be made from the required line or grade except with the written consent of the engineer.

**302.3.02 Depth of Trench** - Watermains shall have a minimum cover of 2-6" from finish grade to top of pipe. Water service lines shall be 24 inches below finish grade.

**302.3.03 Curvature** - PVC pipe may be laid on horizontal and vertical curves so long as the radius is no less than the following values:

- 8" pipe - 400 ft. radius (6" offset per 20' length)
- 6" pipe - 300 ft. radius (8" offset per 20' length)
- 4" pipe - 200 ft. radius (12" offset per 20' length)

Where the design alignment and grade call for greater curvature, appropriate angle fittings shall be used. Water service tubing may be laid on horizontal and vertical curves with a minimum radius of one foot.

**302.3.04 Installation** - Trench excavation, bedding and backfill shall be in accordance with section 301.

**302.3.04A Push-on Joints** - After a section of pipe has been lowered into the prepared trench, wipe clean the gasket and gasket seat inside the bell with a cloth. Place the gasket in the bell with the large round side of the gasket first. Apply a thin film of lubricant to the inside surface of the gasket. Using a cloth, wipe clean the plain end of the next pipe and insert into the bell just far enough to make contact with the gasket. Force "home" the plain end into the bell end by the use of a bar, fork tool or jack assembly. Align pipe for position and tamp into place.

**302.3.04B Mechanical Joints** - Before laying all pipe, valves, or fittings, remove all lumps, blisters, and excess coal-tar coating from the bell ends. Wire brush and wipe clean the inside of the bell and the outside of the spigot to remove all loose rust and foreign material just prior to assembly. Swab the cleaned surfaces with soapy water just prior to slipping the gasket over the spigot end. Accurately center the spigot end in the bell before inserting the gasket. After the gasket is in place, assembly the gland and bell end with bolts by alternately tightening the bolts around the bell end maintaining approximately equal tension until the final tension is reached.

**302.3.05 Pipe Restraint** - The contractor shall provide restrained joints at all tees, caps, plugs, and bends for the lengths shown on the plans adjoining such fittings. Joint restraint shall be mechanical joint with retainer glands, or push-on with approved locking gasket, U.S. Pipe Typ-Lok, or approved equal. All joint restraint method shall be submitted to the engineer for review prior to such use.

**302.3.06 Thrust Blocks** - All tees, plugs, caps, bends, fire hydrants and offsets, as well as all other appurtenances which are subject to unbalanced thrust, shall be properly braced with lateral thrust blocks of concrete. The concrete shall be formed and placed so that the bolts and glands can be removed. The concrete shall bear against solid undisturbed earth at side and bottom of trench excavation. Lateral Thrust Block bearing areas shall be of the size as specified in the Standard Drawings.

Fittings with restrained joints may be installed in lieu of thrust blocks under circumstances where standard thrust blocks are not feasible, subject to the approval of the Engineer.

302.3.07 Pipe Cutting shall be accomplished using proper pipe cutting tools designed specifically for that purpose. Cuts shall be made in accordance with the pipe manufacturer's recommendations.

302.3.08 Reconnecting Existing Water Services - The Contractor shall disconnect, replace, and reconnect existing water services over the length shown on the plans or as designated by the engineer. Connections between new and existing water services shall be made with approved compression type fittings. All connections shall be inspected by the inspector prior to covering.

The Contractor shall coordinate all service interruptions with the occupants of the affected property. Service interruptions shall be for as short a time period as possible and the contractor shall be responsible for arranging for alternative service of the affected property as required.

302.3.09 Tracer Wire shall be installed adjacent to PVC pipe in continuous lengths. Joints or splices in wire shall be waterproof. Ends of wire shall be accessible in all valve boxes with enough length so wire may be extended through valve cover.

#### 302.4 TESTING:

302.4.01 General - A pressure test and a leakage test shall be made by the contractor of every section of water main after the completion of the final trench backfill. All connections to existing mains shall be left uncovered for a period of 4 hours after normal operating pressure is applied, after which time the inspector shall inspect all such connections and joints, and any leaks which appear shall be repaired.

#### 302.4.02 Pressure Test -

302.4.02A Pre-test - After each valved section of pipe has been laid and partially backfilled, the contractor shall perform a hydrostatic pressure test as outlined below. The results shall be given to the engineer prior to complete backfill of the pipe. If the test indicates materials or workmanship that does not meet design requirements, defective material and/or workmanship shall be corrected and the test re-run until specifications are fulfilled.

302.4.02B Pressure Test of Completed Waterline - All mains, hydrants and fittings shall be subjected to a pressure test in the presence of the inspector after all pre-testing has been completed. A separate test shall be made on each section of the project whenever any section of the work is installed in such a manner as to permit its segregation as a unit. Each section of pipe shall be completely filled with water and care shall be taken to insure that all air is expelled from the pipe line. The specified test pressure shall be applied by means of a pump connected to the main through a corporation stop and service tubing. The test pressure, measured at the point of lowest elevation, shall be 150 p.s.i. for mains to be subjected to a working pressure of 100 p.s.i. or less, and 250 p.s.i. for mains to be subjected to a working pressure of over 100 p.s.i. The test pressure shall be



held for one hour during which time, all exposed pipe, fittings, valves and couplings will be carefully examined for leaks. The portion of main being tested shall be considered "acceptable" for the purposes of this test if the pressure does not decrease more than 10 p.s.i. in one hour. All leaks shall be repaired. The test shall be repeated until satisfactory.

**302.4.03 Leakage Test** - A leakage test shall be conducted after the pressure test has been satisfactorily completed and shall consist of an examination of all exposed joints for leakage as well as overall leakage test of the completed section of pipe. The pressure to be maintained during the test shall be the same as for the pressure test and shall be measured at the low point of the system. The same procedure for filling the line and expelling air shall be used as for the pressure test. The duration of each leakage test shall be one hour. Any joint found where accumulated leakage of the joint exceeds the rate of leakage specified by the manufacturer of the pipe shall be rejected. The overall permissible leakage for the section of pipe tested shall not be greater than the number of gallons per hour as determined by the formula in which:

$$L = \frac{ND \times (p)^{1\frac{1}{2}}}{14800}$$

L = allowable leakage in gph  
 N = Number joints in length of pipe tested  
 D = Nominal diameter of pipe in inches  
 p = average test pressure during test, in pounds per square inch

Should any test of a section of pipe line disclose joint leakage greater than that permitted, the contractor shall, at no expense to the owner, locate and repair the defective joints until the leakage is within the permitted allowance.

**302.4.04 Testing of Service Lines** - Corporation stops, service lines, and curb stops shall be installed prior to the above described tests. Water service reconnections shall be tested up to the curb stop. Reconnected portions of water services beyond the last valve will not be subject to testing, but shall be approved by the inspector prior to covering, and any leaks which appear shall be repaired. Water service connections for future use shall be tested up to the last valve.

**302.4.05 Disinfection and Flushing** - Upon completion of the testing, water mains shall be disinfected in accordance with AWWA C601 and the latest Oregon State Health Division regulations. After disinfection, the chlorinated water shall be flushed from the water main until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. The chlorinated water shall be disposed of in a manner approved by the Oregon State Health Division and the Oregon State DEQ. The chlorinated water shall be discharged into a sanitary sewer system only after the written permission of the system owner is obtained.

### 303 VALVES AND VALVE BOXES

#### 303.1 DESCRIPTION:

This item includes all work necessary for the installation of valves and valve boxes as shown on the approved plans for use in the water distribution system.

#### 303.2 MATERIALS:

##### 303.2.01 Valves

303.2.01A General - All water main valves and hydrant valves shall be gate valves.

303.2.01B Gate Valves, 2 inches and larger in diameter shall conform to the requirements of AWWA C500 as to composition and quality of material and workmanship. Valves shall be iron body, bronze mounted, double disc parallel seat type, with double O-ring seals, non-rising stem, and 2-inch square operating nut. Gate valves shall be Clow, Dresser M and H, Mueller, or approved equal. valve ends shall be mechanical joint, flanged joint, or push-on joint, or a combination of the foregoing as called for in the approved plans.

303.2.02 Valve Boxes - Cast iron valve boxes shall be furnished with all valves 2" and larger, and shall conform to the requirements of ASTM A48. Valve box shall consist of a top section, cover, and extension section.

#### 303.3 CONSTRUCTION:

303.3.01 Valve Installation - Valves shall be set and joined to the pipe in accordance with the manufacturer's recommendations. Valves shall be provided with special support such as crushed rock or concrete pads so that the pipe will not support the weight of the valve. Adjacent pipe shall be supported so as to prevent stress on the valve. Valves shall not be used to bring misaligned pipe into alignment during installation. Valves shall be installed in a vertical position.

303.3.02 Valve Box Installation - Valve boxes shall be installed so as not to transmit shock or stress to the valve. The box cover shall be flush with the surface of the area in which installed. The valve operating nut shall be readily accessible for operation through the opening in the box or vault. Backfill around valve box shall be thoroughly tamped to preclude subsegment settlement.

### 304 FIRE HYDRANTS

#### 304.1 DESCRIPTION:

This item includes all work necessary for the installation of fire hydrant assemblies as shown on the plans. This assembly consists of the flanged gate valves, flanged fire hydrants, and connecting spool between valve and hydrant.

**304.2 MATERIALS:**

**304.2.01 General** - Materials and strength specifications shall be as hereinafter specified for the particular kind of pipe and fittings as shown on the plans. Pipe and fittings that are not hereinafter specified will be allowed with prior permission from the City.

**304.2.02 Hydrant Pipe**

**304.2.02A Ductile Iron Pipe** shall conform to the requirements of ANSI A21.51 (AWWA C151), with mechanical joints or restrained joints as shown on the plans. All pipe shall be cement lined and seal coated according to ANSI A21.4 (AWWA C104). The minimum thickness class shall be class 50.

**304.2.03 Hydrant Fittings** shall be of a class and rating at least equal to the adjacent pipe unless specified otherwise. Joint materials shall be compatible with the adjacent pipe. All fittings shall be cast or ductile iron. Mechanical joint type coupling shall conform to ANSI A21.10 and A21.11 (AWWA C110 and C111), cement lined and seal coated according to ANSI A21.4 (AWWA C104). Flanged couplings shall be drilled and faced in accordance with ANSI B-16.1 or B-16.2. Rubber gasket type shall be U.S. Pipe, Tyton or approved equal. Cast iron fittings for use with FS Type II and Type III cast iron water pipe shall conform to the same specifications except that joints shall be mechanical type and include cast iron glands, plain rubber gaskets and T-head cast iron bolts and nuts per ANSI A21.11 or an approved compression type with rubber gasket.

**304.2.04 Valves**

**304.2.04A Hydrant Valves**, 3 inches and larger in diameter shall conform to the requirements of AWWA C500 as to composition and quality of material and workmanship. Valves shall be iron body, bronze mounted, double disc parallel seat type, with double O-ring seals, non-rising stem, and 2-inch square operating nut. Gate valves shall be Clow, Dresser M and H, Mueller, or approved equal. Valve ends shall be mechanical joint or flanged joint, or a combination of the foregoing as called for in the plans.

**304.2.05 Valve Boxes** - Cast iron valve boxes shall be furnished with all valves 3" and larger, and shall conform to the requirements of ASTM A48. Valve boxes shall be 2-piece sliding type with 5 1/4" diameter shaft. Extensions shall be used as required for varying installation conditions and shall be cast iron. Valve box covers shall be marked "WATER".

**304.2.06 Fire Hydrants** shall be of the dry barrel type conforming to the requirements of AWWA C502. Each hydrant shall be equipped with two 2-1/2 inch hose nozzles and one 4-1/2 inch threaded pumper nozzle. Main valve shall be 4-1/2 inch compression type with a 6-inch inlet and counter clockwise opening. Hydrants shall be furnished with factory lubricated, O-ring sealed bonnet, safety flange construction, allowing for 360 degree rotation of nozzle section on stem. Hydrant assemblies shall include connecting pieces with integrally cast joint restraint, Tyler mechanical joint swivel fittings, or approved equal. Hydrants shall be Mueller Centurion.

**304.3 CONSTRUCTION:**

**304.3.01 Alignment and Grade** shall be specified in subsection 302.3.01.

**304.3.02 Pipe distribution and handling** shall be as specified in subsection 302.3.04.

**304.3.03 Installation** - Trench excavation, bedding and backfill shall be in accordance with section 301.

**304.3.03A Mechanical Joints** - Before laying all pipe, valves, or fittings, remove all lumps, blisters, and excess coal-tar coating from the bell ends. Wire brush and wipe clean the inside of the bell and the outside of the spigot to remove all loose rust and foreign material just prior to assembly. Swab the cleaned surfaces with soapy water just prior to slipping the gasket over the spigot end. Accurately center the spigot end in the bell before inserting the gasket. After the gasket is in place, assembly the gland and bell end with bolts by alternately tightening the bolts around the bell end maintaining approximately equal tension until the final tension is reached.

**304.3.04 Pipe Cutting** shall be accomplished using proper pipe cutting tools designed specifically for that purpose. Cuts shall be made in accordance with the pipe manufacturer's recommendations.

**304.3.05 Fire hydrants** shall be installed as shown on the approved plans and in accordance with the hydrant manufacturer's recommendations. Install hydrant with proper depth of bury or use extension for height adjustment such that hydrant traffic flange shall be located above grade as shown on the plans. Hydrants shall be set true and plumb. Hydrants shall be repainted to the color specifications of the City with two coats of paint.

**305 BLOWOFF ASSEMBLY****305.1 DESCRIPTION:**

This item includes all work necessary for the blowoff assembly including, but not limited to reducer, adapting fittings, valve, valve box and cover, and all piping necessary for installation.

**305.2 MATERIALS:**

**305.2.01 Pipe** from main to the valve shall be of the same material as the main. Pipe from valve to end of the blowoff shall be as specified in approved plans.

**305.2.02 Valve and Box** shall conform to applicable portions of section 303.2 and details outlined in approved plans.

**305.3 CONSTRUCTION:**

**305.3.01 Installation** of blowoff assembly shall conform to the applicable portions of section 303.3 and approved plans. Area around blowoff shall be graded for appropriate drainage.

**SANITARY SEWER SYSTEM  
DESIGN STANDARDS****SECTION ONE  
INTRODUCTION****1.00 PURPOSE:**

The design standards set forth below are intended to result in sewers which will:

- a. Be of adequate size to carry the expected flow, within their design life, and at sufficient depth to serve adjacent properties.
- b. Have sufficient grade to maintain a minimum velocity of two (2) feet per second when flowing half full.
- c. Be strong enough to resist all external loads which may be imposed.
- d. Be of materials resistant to both corrosion and erosion.
- e. Be economical and safe to build and to maintain.
- f. Prevent infiltration or inflow of ground and surface waters.

**1.01 REVISIONS TO THESE STANDARDS:**

It is anticipated that revisions to these standards will be made from time to time. The date appearing on the title page is the date of the latest revision. Users should determine the issue which applies to the work contemplated.

**1.02 REFERENCES:**

Reference herein is made to the latest edition of the standards, test, methods and specifications of research as follows:

1. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, prepared by Oregon Chapter American Public Works Association.
2. STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, prepared by Oregon Department of Transportation, Highway Division.
3. UNIFORM PLUMBING CODE, I.A.P.M.O.

**1.03 APPROVAL OF ALTERNATE MATERIALS OR METHODS**

Any alternate material or method not explicitly approved herein will be considered for approval on the basis of the objectives set forth in sub-section 1.00 above. Persons seeking such approvals should make application in writing. Approval of any major deviation from these standards will normally be in written form. Approval of any major deviation from these standards will normally be in written form. Approval of minor matters will be made in writing if requested.

**1.04 SPECIAL PROBLEMS**

The design of the following are considered special problems and are not covered in detail in these standards:

1. Pump or Lift Stations
2. Force Mains
3. Inverted Siphons
4. Relining of Existing Sewers
5. Internal Sealing of Existing Sewers
6. Energy Dissipators
7. Regulating Devices
8. Flow Measurement Devices

## SECTION TWO PLANS AND SPECIFICATIONS

### 2.00 GENERAL:

All plans for sanitary sewer extensions shall be prepared by a registered Engineer and shall bear a suitable title showing the name of the Subdivision and Bay City, and shall show the scale in feet, the North Point, data, date, and the name of the Engineer, his signature and imprint of his registration seal.

### 2.01 PLANS:

Three copies of the construction plans and specifications for the project shall be submitted for review and approval to the City of Bay City. The plans shall be submitted on standard size sheet of either 18"x24" or 24"x36". No construction shall commence on the project until approval is granted by the City. Upon completion of the project and prior to acceptance of the sewers by Bay City, a set of "as-built" plans shall be submitted with the Engineer's certification that the project was constructed in accordance with the approved plans and specifications. The scale used shall be a standard Engineering scale, i.e. 1"=100', 1"=50', etc.

2.01.01 Sewer Layout or Plans - Plans for sewer lines should contain at least the following information:

1. Adjacent street and property lines, utility easements and references thereto.
2. Location of sewer and appurtenances. Each manhole shall be numbered or stationed to facilitate checking the plans with the profiles.
3. Location of adjacent water course, wells, stream and railroad crossings, water mains, gas mains, culverts and underground power, or other utilities wherever possible.

2.01.02 Sewer Profiles - Profiles for the individual sewer lines should contain at least the following information:

1. Location of manholes and other appurtenances with each manhole numbered or stationed as in item (2.01.02) above.
2. Profile of ground surface and sewer invert.
3. Size, slope, and length of sewer between consecutive manholes.
4. Elevation of original ground, finished grade and sewer inverts at each manhole. (Mean Sea Level Datum).

2.01.03 Appurtenances - Detailed drawings should be included for all sewer appurtenances, including manholes, pumping stations, inverted siphons, outfall bulkheads, storm water diversion, etc. Appropriate references to the Bay City's Standard Drawings may be used in lieu of details actually shown on the plans.

2.01.04 North Arrow and Scale - A north arrow shall be shown with the scale of the drawing immediately below the arrow.

2.01.05 Bench Marks - The location and elevation of a National Geodetic Survey, United States Geological Survey, State Highway, or Tillamook County bench mark shall be shown. Any other datum proposed shall be submitted to and approved by Bay City prior to use and shall be used only if the United States Coast and Geodetic Survey, United States Geological Survey, State Highway, or Tillamook County bench mark is not within one-half mile of the boundaries of the project. All temporary bench marks shall be shown on the plans.

2.01.06 Stationing shall be shown on all maps. Generally, stationing shall start at the point of connection to the existing sanitary sewer lines and/or the lowest elevation.

## 2.02 SPECIFICATIONS:

Three copies of the complete technical specifications for the construction of sewer systems, and all appurtenances, shall accompany the plans. Reference to Bay City's Technical Specification is acceptable. Deviation from Bay City's Material's and Installation Specification must be submitted in detail and approved prior to construction of the project.

Because of high ground water which is prevalent in many areas, excessive infiltration will occur unless extreme care is taken in the laying and lifting of sewer lines. Excessive infiltration results in increased construction and operation costs of sewage treatment plants and interferes with the efficiency of operation. It is necessary, therefore, that the amount of infiltration be kept as low as possible. For this purpose, the specifications should cover in detail the method of laying pipe and constructing joints. Strict supervision shall be provided during construction to make certain that the specifications are complied with.

In general, the sewer specifications shall cover pipe material, excavation, laying of sewer pipe, jointing, backfilling, testing, etc.

## 2.03 REVISION TO APPROVED PLANS:

Any deviations from approved plans or specifications affecting capacity, drainage, etc. shall be approved in writing before such changes are made. Plans or specifications so revised should, therefore, be submitted well in advance of any construction work which will be affected by such changes, to permit sufficient time for review and approval. "As-built" plans clearly showing such alterations shall be submitted to the City at the completion of the work.



**SECTION THREE  
MINIMUM DESIGN CONSIDERATIONS**

**3.00 GENERAL:**

Sanitary sewers should be designed to remove the domestic sewage and basement drainage from houses, business buildings and other public and private establishments, but not the street or roof drainage. Basement drainage shall be provided wherever practicable. Storm water, including street, roof, or footing drainage, shall be removed by a system of storm sewers or by some other method separate from the sanitary sewer system. Unpolluted cooling waters and swimming pool drains should be kept out of sanitary sewers wherever possible.

In general, sewer systems should be designed to care for future loads which may reasonably be expected within a period of 30 to 50 years, and for ultimate development of the specific drainage area concerned.

Specific approval of lift or Pump Stations shall be required.

**3.01 CAPACITY:**

Design flows shall be determined by consideration of the following factors:

1. Drainage basin area to be served.
2. Population within the areas to be served.
3. Land use within the areas to be served.
4. Per capita sewage flow.
5. Commercial, industrial, or institutional users to be served.
6. Infiltration allowance.
7. Changes in any of the above factors which might reasonably be expected to occur during the design life of the sewer.

In the absence of consumption data or other reliable information, the following factors may be assumed:

- Per Capita Daily Flow . . . . . 300 to 350 gpcd (lateral sewers)\*
- Per Capita Daily Flow . . . . . 250 gpcd (trunk sewers)\*

It is recommended that design calculations include estimates of average maximum and minimum daily flows. The submission of design calculations will not ordinarily be required but designers should be prepared to substantiate pipe sizes, layout, population estimates, land uses or other design assumptions. Aids to designers may be found in the reference Section 1.02.

\* These factors may be used to estimate the peak daily flow and include an allowance for infiltration.

**3.02 SIZE:**

Main line sewers shall be at least eight (8) inches inside diameter except that the upstream section of a lateral sewer which will not be extended may be of six (6) inch inside diameter. The length of such six (6) inch line may not exceed 250 feet, than shall begin at a manhole and shall terminate at its upper end at an appropriate cleanout or manhole.

**3.03 MINIMUM GRADE:**

All sanitary sewer shall be laid on a grade which will produce a mean velocity, when flowing full or half full of at least two (2) feet per second, based upon Kutter's "n", the coefficient of roughness, values at not less than 0.013, depending upon the type of pipe used. The minimum grades for various sizes of pipe with an "n" value of 0.013 are listed below:

MINIMUM GRADES FOR PIPE	
Inside Pipe Diameter (Inches)	Grade (Feet per 100 feet)
6	0.60
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

In general, slopes greater than those shown above are desirable and are particularly recommended on the upper ends of lateral sewers.

Slopes slightly less than those shown above may be considered if substantial justification can be demonstrated. In cases where flatter slopes are considered and sewers are less than 15 inches inside diameter, there must be enough live sewer interceptions to ensure that the average depth of sewage flow will be 30% of the pipe inside diameter. Engineers are cautioned not to specify sewers of sizes which are obviously larger than are necessary for satisfactory carrying capacity but which are specified in order to meet grade requirements.

**3.04 ANCHOR WALLS:**

Sewers on slopes of twenty (20) percent or more shall be secured by anchor walls in accordance with the following: (see the Standard Drawings)

1. Not over 36 feet center to center on grades 20 percent and up to 35 percent.
2. Not over 24 feet center to center on grades 35 percent and up to 50 percent.
3. Not over 16 feet center to center on grades 50 percent and over.

**3.05 MINIMUM DEPTH:**

All sewers shall be laid at depth sufficient to drain basements and to be protected against damage by frost and traffic. Sewers laid in areas subject to wheel load shall have a minimum cover of three (3) feet measured from top of pipe to finished grade or be otherwise protected from damage by traffic.

Under normal conditions, mainline sewers in residential areas without basements should be laid at a depth of six (6) feet. Services to adjacent properties from such sewers should normally be laid so that the depth of the service line at property line is at least four (4) feet. Depths are measured to the sewer or service line invert from finished grade.

**3.06 LOCATION:**

**3.06.01 Relation to Water Lines and Wells** - No sanitary sewers should be less than ten (10) feet from any well, spring, or other source of domestic water supply. All sanitary sewers or parts thereof which are located within fifty feet from any such source of domestic water supply shall be constructed of cast iron water pipe with watertight joints. Sanitary sewers and domestic water lines shall not be laid in the same trench. Parallel water and sewer lines wherever possible should be located at least ten (10) feet apart horizontally when there is less than 18 inches of vertical clearance between water and sewer. When physical conditions render this spacing impossible or impractical, then cast iron water pipe with watertight joints or concrete encasement is required for the sewer line. Wherever it is necessary for sewer and water lines to cross each other, the crossing should be at an angle of approximately 90° and the sewer shall either be located 18 inches or more below the water line or be constructed of cast iron water pipe with watertight joints for a distance of nine (9) feet on both sides of the water line.

**3.06.02 Sewers in Streets or Easements** - Under normal conditions sewers should be located in street right of way within five (5) feet of the street centerline. When it is necessary to locate sewers in easements such easement shall be at least as wide as twice the maximum depth of the sewer or a minimum of ten (20) feet in width. Sewers 24 inch in diameter or larger may require wider easements. Easements shall be provided to the City prior to final acceptance of project.

**3.07 ALIGNMENT:**

Sewer lines should be laid on straight alignment and uniform grade between consecutive manholes. Horizontal and vertical curves in sewers are not recommended. However, in cases where justification can be shown, limited use of such designs will be considered. Radii of curvature must be of sufficient length to minimize joint opening and positively maintain watertightness. This should be considered early in the system design. Complete and accurate records must be kept of the exact location of such curved sewers for future reference.

**3.08 INCREASING SIZE:**

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

**3.09 HIGH VELOCITY PROTECTION:**

Where velocities greater than 15 feet per second are attained, special provision shall be made to protect against displacement by erosion and shock.

**3.10 MANHOLES AND CLEANOUTS:**

**3.10.01 Details** - See Standard Drawings.

**3.10.02 Manhole Construction** - Construction shall be watertight. If ground water or surface drainage can be expected to flood the top of the manhole, watertight covers shall be used. For non-reinforced rigid pipe, there shall be a standard joint or flexible coupling installed at the inlets and outlets of each manhole. These should be at a distance of no more than one pipe diameter from the outside surface of the manhole wall for pipes over 12 inches inside diameter, and no less than 12 inches from the wall. Tracer wire placed along all mains and laterals shall penetrate at manhole mortar stubout and loop up with enough length to be extended through manhole lid. Tracer wire shall be tied onto manhole steps for easy access.

**3.10.03 Manhole Location** - Manholes shall be located as follows:

1. Every change in grade or alignment of sewer.
2. Every point of change in size or elevation of sewer.
3. Each intersection or junction of sewer.
4. Upper end of all lateral sewers, except as provided in section 2.03.
5. At intervals of 500 feet or less.\*

\* Spacing may be increased for sewers in excess of 36 inches diameter.

**3.10.04 Flow Channel** - The flow channel through manholes should be made to conform in shape and slope to that of the sewers.

3.10.05 Cleanouts will not be approved as substitutes for manholes, except at the upper end of lateral sewers 250 feet or less in length which cannot be extended.

3.10.06 Drop Manholes - Outside drop assemblies shall be provided for pipes 12 inches in diameter and smaller when entering a manhole at a distance of more than 24 inches above the invert of the manhole. Larger pipe should be introduced into the manhole at the manhole invert.

3.11 SEWER JOINTS AND INFILTRATION:

The method of making joints and the materials used should be included in the specifications. Sewer joints shall be designed to minimize infiltration and to prevent the entrance of roots.

Leakage test shall be required as specified in the Materials and Installation Specifications. House or building sewers shall also be tested. The use of television camera or other visual methods for inspection prior to placing the sewer in service is recommended.

3.12 BUILDING SEWERS:

As a minimum criterion, construction of the house or building sewers shall be of the same quality and meet the same requirements as the public sewer with regard to materials, water tightness and location. In addition, these sewers shall conform to the state and local plumbing codes and restrictions. No road, surface, foundation, or other storm water drain lines shall be connected to the public sewers. See Standard Drawings.

**SANITARY SEWER SYSTEM  
TECHNICAL SPECIFICATIONS****401 SURFACE REMOVAL AND REPLACEMENT****401.1 DESCRIPTION:**

This item includes all work necessary for the removal and/or replacement of surface material such as topsoil, sod, pavement, sidewalks, gravel, etc., which requires special consideration in order to accomplish and restore excavated areas as specified. This item includes the replacement of hot mix asphalt concrete pavements upon prepared foundations or base surfaces.

**401.2 MATERIAL:**

401.2.01 Surface removal and replacement shall consist of any and all material encountered in the excavation which, in the opinion of the City, is suitable for use in the restoration and replacement of the original surface. All surface removal and replacement materials shall be subject to the City's approval.

401.2.02 Asphalt concrete pavement shall conform to the requirements of Section 212, Standard Specifications for Highway Construction, Oregon State Highway Division, for Class "C" asphalt concrete.

401.2.03 Asphalt tack coat shall conform to the requirements of Section 407, Standard Specifications for Highway Construction, Oregon State Highway Division.

**401.3 CONSTRUCTION:**

401.3.01 Surface Removal and Restoration General - The intent of surface restoration is not to replace what was actually removed in kind, but rather, it is to effect a restoration which will mate with the original surface and minimize ravelling and maintenance problems.

401.3.02 Paved Surfaces - All bituminous pavement or oiled surface, regardless of thickness, shall be cut by an approved method prior to excavation of trenches. Width of cut shall be the minimum width necessary for the excavation and shall follow lines parallel to the pipe centerline. The use of any machine or device that, during the course of operation, results in damage to adjacent pavement, existing utilities, adjacent structures or improvements shall not be permitted. When the trench has been backfilled to within eight inches of the final surface grade, the Contractor shall place a four inch compacted lift of 2 inch minus granular material consisting of gravel or crushed rock. After the four inch lift has been compacted, a 2 inch levelling course of 3/4 inch minus crushed rock shall be placed and compacted followed by 2 inches of asphaltic concrete. Any pavement or roadway surfacing not immediately over or adjacent to the trench which is disturbed or damaged as a result of the operations of the Contractor shall be similarly repaired or replaced to the satisfaction of the Engineer.

401.3.02A General - Bituminous base, asphalt concrete pavement and asphalt tack coat shall be constructed according to the above referred to sections of the Standard Specifications for Highway Construction, Oregon State Highway Division, supplemented and modified as set forth in the specifications which follow.

401.3.02B Weather Limitations - Bituminous plant mix shall be placed normally on dry prepared surfaces and when the air temperature in the shade is 50° F and warmer.

401.3.02C Compaction - Bituminous base and asphalt concrete pavement shall be compacted to a minimum of 92% chance of relative maximum density, as determined by AASHTO T 180.

401.3.03 Gravel Surfaces - The restoration shall be the same as for paved surfaces except that after the compaction of the 2 inch minus material, a 4 inch lift of 3/4 inch minus crushed rock shall be placed and compacted to the final surface grade. Aggregate shall comply with requirements set forth in Section 204.

401.3.04 Other Surfaces - The ground surface shall be left in a neatly dressed and finished condition wherever it has been disturbed by the operations of the Contractor. Previously planted areas shall be replanted with the same type vegetation.

## 402 GRAVITY SEWER PIPE & FITTINGS

### 402.1 DESCRIPTION:

This item includes all work necessary for the installation of sanitary sewer gravity pipe and fittings.

### 402.2 MATERIALS:

402.2.01 General - Sanitary sewer gravity pipe shall have solvent welded or flexible elastomeric gasket joints. Materials and strength specifications shall be as hereinafter specified for the particular kind of pipe and fittings required. Joints on all fittings shall be the same as the joints used on the pipe. Caps or plugs shall be furnished with each fitting, outlet, or stub as required with the same type gasket and/or joint as the pipe. Pipe and fittings that are not hereinafter specified may be used with permission from the City.

402.2.02 Service Connection Markers shall be new, one piece Douglas Fir or cedar, 2 x 4s, utility grade or better, painted white. Attachment to service line stopper shall be by means of 9 gauge minimum galvanized wire or 1/4 inch minimum polypropylene rope.

### 402.2.03 Pipe

402.2.03A Polyvinyl Chloride (PVC) pipe shall conform to the requirements of ASTM D3034 and D2729.

402.2.03B Material Certification - The manufacturer or fabricator shall furnish appropriate certification based on manufacturer's routine quality control tests, that the materials in the pipe meet the requirements specified herein.

402.2.04 Jointing Materials -

402.2.04A PVC Pipe Gaskets shall conform to the requirements of ASTM D3212.

402.2.05 Fittings -

402.2.05A General - Tee or wye fittings shall be provided in the sewer main for side sewer or inlet connections. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. All fittings shall be of the same materials as the pipe. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. All fittings shall be capped or plugged and gasketed with the same gasket material as the pipe joint, fitted with an approved mechanical stopper, or have an integrally cast knockout plug. The plug shall be able to withstand all test pressures without leaking, and when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

402.2.05B PVC Pipe - Fittings shall conform to the applicable portions of the following specifications: ASTM D1785, ASTM D2729, ASTM D2466, ASTM 2467, ASTM D3033 and ASTM D3034. Fitting joints shall be the same as the pipe joints.

402.2.05C Flexible couplings and donuts shall be as manufactured by Calder, Fernco, or approved equal, properly sized to fit.

402.2.06 Tracer Wire shall be #12 multi-stranded copper wire with green colored insulation.

402.3 CONSTRUCTION:

402.3.01 Line and Grade - Survey line and grade control hubs will be provided on an offset line at intervals not greater than 100 feet when the Contractor uses a laser beam for pipe alignment, and at intervals not greater than 40 feet for other methods of pipe alignment. The Contractor will be furnished with the elevation of the hubs and the corresponding sewer invert elevation at such hubs. Should the Contractor's operations cause or allow removal of stakes or hubs, their replacement shall be at the expense of the Contractor. Variance from established line and grade shall not be greater than 1/2 inch for line and 1/4 inch for grade, provided that such variation does not result in a level or reverse sloping invert. The Contractor shall establish line and grade for pipe by the use of lasers or by transferring the cut from the offset hubs to the trench at whatever intervals necessary to maintain the line and grade. The method of transferring the cut from the offset hubs to the trench shall be subject to the approval of the City. A transfer method not approved shall not be used. The Contractor shall constantly check both line and grade for each length of pipe laid and in the event they do not meet the limits described, the work shall be immediately stopped, the City notified, and the cause remedied before proceeding with the work. When using laser alignment the Contractor shall check beam alignment at 100 foot intervals.



**402.3.02 Pipe Distribution and Handling** - The Contractor shall not distribute material on the job faster than it can be used to good advantage. The Contractor shall unload pipe only by approved means. Pipe will not be unloaded by dropping to the ground. The Contractor shall inspect all pipe and fittings prior to lowering into trench to insure no cracked, broken, or otherwise defective materials are used. The Contractor shall clean ends of pipe thoroughly and remove foreign matter and dirt from inside of pipe and keep it clean during laying and joining. The Contractor shall use approved implements, tools, and facilities for the safe and proper protection of the work. The Contractor shall lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. The Contractor shall remove all damaged pipe from the jobsite. Pipe shall not be dropped or dumped into trenches.

**402.3.03 Laying Pipe on Curves** - The Contractor shall lay pipe on horizontal or vertical curves only when approved and at the direction of an authorized Engineer.

**402.3.04 Installation of Service Tees and Wyes** - Fittings shall be placed where indicated on the plans or as staked, or as required by existing services. The Contractor shall provide ends of all inactive service laterals and fittings with approved watertight plugs, caps, or stopper, suitably braced to prevent blowoff during internal hydrostatic or air testing. Such plugs or caps shall be removable and their removal shall provide a socket suitable for making a flexible joint lateral connection or extension. The Contractor shall place a stake at the location of fittings and see that it is maintained to mark the location of such fitting until the City has recorded the location of the fitting.

**402.3.05 Pipe Placing and Laying** - Trench excavation, bedding and backfill shall be in accordance with section 401.

**402.3.05A PVC Pipe** shall be laid upgrade with spigot ends in the direction of flow. After a section of pipe has been lowered into the prepared trench, the end of the pipe to be joined will be cleaned as will the inside of the joint and the rubber ring, immediately before joining the pipe. The joint will be assembled in accordance with the recommendations of the manufacturer of the type of joint used. All special tools and appurtenances required for the jointing assembly will be provided by the Contractor. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints. Sufficient pressure will be applied in making the joint to assure that the joint is "home", as defined in the standard installation instructions provided by the pipe manufacturer. Sufficient bedding material will be placed to secure the pipe from movement before the next joint is installed to assure proper pipe alignment and joint make-up. After the joint has been made, the pipe will be checked for alignment and grade. When in correct alignment and grade, the pipe shall be supported by placing the specified initial backfill material as described in section 301.

When the pipe is laid within a movable trench shield, all necessary precautions will be taken to prevent pipe joints from pulling apart when the shield is moved ahead. The Contractor shall take the necessary precautions required to prevent excavated or other foreign material from getting into the pipe during the laying operation. At all times, when laying operations are not in progress, at the close of the day's work, or whenever the workers are absent from the job, the open end of the last laid section of pipe will be closed and blocked to prevent

entry of foreign material or creep of the gasketed joints.

The Contractor shall plug or close off pipes which are stubbed off for manhole construction or for connection by others, with temporary plugs as specified in subsection 212.12.09. The Contractor shall take all precautions necessary to prevent the uplift or floating of the line prior to the completion of the backfilling operation. Where pipe is connected to manholes or concrete structures, the connection will be constructed so that the standard pipe joint is located not more than 1.5 feet from the outside edge of the structure. When cutting and/or machining of the pipe is necessary, the Contractor shall use only the tools and methods recommended by the pipe manufacturer. The Contractor shall join the pipe in conformance with the manufacturer's recommendations. Joints or pipe will not be deflected more than recommended by the manufacturer.

**402.3.05B Cased Pipe** - Where timber cradles are required, the Contractor shall provide a strapped timber cradle under the barrel of the pipe, join pipe and slide into casing. Pipe barrel shall bear continuously on cradles. Pipe installation shall conform to the applicable requirements of hydrostatic or air testing and line and grade.

**402.3.06 New Service Laterals** - Pipe and fittings for service lines shall be of PVC material throughout. Residential services shall normally be 6 inches, extending from the main to the property line. Larger service laterals shall be as shown or specified. An authorized Engineer will stake the location of the terminus of the service line. No one-eighth bends or other bends are required on service laterals. Bends may be installed, at the Contractor's option, to reduce the depth of service laterals. The depth of new service lines at the property line shall be a minimum of 4' deep unless otherwise approved by the City. The Contractor shall install the sewer main tee or wye so as to locate the service connection pipe within a horizontal distance of one foot either side of the stake location. The Contractor shall install the pipe on a uniform grade between the tee or wye and the stake at a minimum slope of 1/4 inch per foot unless otherwise permitted by the City. The terminus of the new service lateral shall be sealed with stopper in a manner similar to that required for the tee or wye. The Contractor shall install service connection markers at the terminus of new service laterals so as to extend from the end of the service line to 12 inches above ground. The Contractor shall determine the distance in feet and inches from the ground surface to the top of the service lateral and paint it on the marker. The service connection marker shall be firmly attached to the service lateral stopper by means of a 9 gauge minimum galvanized wire or 1/4 inch minimum polypropylene rope.

**402.3.08 Existing Service Laterals** - The Contractor shall disconnect existing service laterals from sewers to be abandoned and reconnect them to the new sewers. It shall be the Contractor's responsibility to locate the existing service laterals prior to installing the tee or wye in the new sewer line. Existing service laterals to be replaced shall be removed and replaced over the length shown on the approved plans or as designated by the City. Installation shall be as specified for new service laterals, except that the depth of the service laterals at the property line shall be as required by the existing service, and except that stopper and service connection markers will not be required. Connections between new and existing service laterals shall be made with approved flexible couplings or donuts. Concrete or mortar connections will not be permitted. All

connections shall be inspected by the inspector prior to covering. The Contractor shall coordinate all service interruptions with the occupants of the affected property. Service interruptions shall be for as short a time period as possible and the Contractor shall be responsible for arranging for alternative service of the affected property as required.

402.3.09 Tracer Wire shall be installed on the top of the initial backfill on all mains and laterals. Tracer wire shall penetrate manhole mortar stubout and have enough length to extend above the manhole lid. Tracer wire shall be tied to manhole steps for easy access. Tracer wire shall be attached to connection marker with continuous loop extending from main to connection marker and back to main.

#### 402.4 TESTING:

402.4.01 General - An internal or air pressure test, if required, shall be made by the Contractor of every section of sewer, including service connections, after the completion of the final trench backfill as follows:

#### 402.4.02 Air Test - 402.4.02A General

1. Leakage allowance: The portion of line being tested shall be considered "acceptable" if the time required for the pressure to decrease 1.0 psig is not less than the time shown for the given diameters in the following table:

<u>Pipe Diameter In Inches</u>	<u>Minutes</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5

If the section of line being tested includes more than one size of pipe (e.g. sewer main and building connections) the time used for the test, from the above table, shall be that for the largest size pipe.

**402.4.02B Procedure**

1. Clean reach of pipe to be tested including building connections.
2. Furnish plugs, air compressors, gauges, etc.
3. Plug all openings including building connections.
4. Measure the average back pressure in pounds per square inch ground water by one of the following methods:
  - a. Dig test holes to the top of the pipe; measure ground water depth in feet and tenths of feet; divide the water depth by 2.31.
  - b. Insert a pipe probe by boring or jetting into the backfill material adjacent to the center of the pipe; read the pressure in the probe in pounds per square inch, when air passes slowly through it.
5. Introduce air into the sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of ground water over the pipe.
6. Allow at least two minutes for air pressure to stabilize.
7. After the stabilization period, read the pressure gauge; 3.5 psig greater than the average back pressure of ground water over the pipe is the minimum pressure in the pipe under which the test can be started. (For example, if the height of water is 11 1/2 feet, the probe gauge pressure will be 5 psig. This increases the minimum 3.5 psig starting test pressure to 8.5 psig, and, in such case, the 2.5 psig minimum final pressure to 7.5 psig. The allowable drop of one pound and the timing remain the same.)
8. Disconnect the air hose from the control panel to the air supply.
9. Wait four (4) minutes and read and record the gauge pressure.

**402.4.03 Deflection Test for PVC Pipe** In addition to air testing and when required by the City, sanitary sewer mains constructed of PVC pipe shall be deflection tested after the trench backfill and compaction has been completed. The test shall be conducted by pulling an approved solid pointed mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the pipe diameter unless otherwise specified. Testing shall be conducted on a manhole to manhole basis and shall be done after the line has been completely flushed out with water. The Contractor will be required, at the Contractor's expense, to locate and repair any sections failing to pass the test and to retest the section.

**402.4.04 Cleaning Prior to Test** - Prior to the internal pressure testing and inspection of the system by an authorized Engineer, the Contractor shall flush and clean all parts of the system. The Contractor shall remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the system at or near the closest downstream manhole. If necessary, the Contractor shall use mechanical rodding or bucketing equipment. Upon inspection of the system, if any foreign matter is still present, the sections and portions of the system shall be reflushed and cleaned as required.

**402.4.05 Requirements Prior to Tests**

**402.4.05A General** - All gravity systems and appurtenances shall successfully pass an air test prior to acceptance and shall be free of visible leakage, using either method of testing. Manholes shall be tested as specified in subsection 212.4.

402.4.05B Plugging of Tees, Wyes, Stubs and Service Connections - The Contractor shall plug all wyes, tees, stubs and service connections with gasketed caps or plugs securely fastened or blocked to withstand the internal test pressure. Such plugs or caps shall be removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension

402.4.05C Testing Equipment and Procedure - The Contractor shall furnish all necessary testing equipment and perform the tests in a manner satisfactory to the City. Any arrangement of testing equipment which will provide observable and accurate measurements of either air or water leakage under the specified conditions will be permitted. Gauges for air testing shall be calibrated with a standardized test gauge provided by an authorized Engineer at the start of each testing day. The calibration shall be witnessed by the authorized Engineer.

402.4.05D Time of Test - The Contractor shall test the system during the normal work day, scheduling the plugging, capping and other preparatory work so as to conduct the test during daylight hours.

### 403 MANHOLES AND CLEANOUTS

#### 403.1 DESCRIPTION:

This item includes all work necessary for the construction of manholes for storm drainage purposes.

403.1.01 Related technical Specifications: The APWA Standard Specifications for Public Works Construction, 1990 Edition, is incorporated into this specification by reference. It shall be understood that in any matter addressed by both the text of this technical specification and the referenced specification, be it in construction method, material, or quality control, the more stringent specification is intended and shall be enforced.

#### 403.2 MATERIALS:

##### 403.2.01 Cast-in-Place Manholes

403.2.01A Aggregates shall conform to the requirements of APWA Standard Specifications for Public Works Construction, Section 403. Clean 3/4-inch minus gravel or crushed rock uniformly graded from coarse to fine may generally be used with permission of the City.

403.2.01B Portland Cement and Portland Cement Concrete (PCC) shall conform to the requirements of APWA Standard Specifications for Public Works Construction, Section 403, and shall be Class 3000-1 1/2. Slump shall be between 2" and 4".

403.2.01C Metal Reinforcement shall conform to the requirements of ASTM A 615, Grade 60, deformed bars.

403.2.01D Forms Exterior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material. Trench walls, rock, or earth will not be acceptable form material.

403.2.02 Metal castings

403.2.02A General Manhole covers shall be designed so they may be secured to the frames. Matching surfaces of covers and frames shall be flat to prevent any movement of covers within frames. Covers and frames shall be interchangeable.

403.2.02B Cast Iron materials shall conform to the requirements of ASTM A 48, Class 30B. The foundry shall certify as to the tensile and transverse properties and Brinell Hardness. The City reserves the right to require a rough transverse bar (size of bar 1.2 inches in diameter by 20 inches long) and/ or a tensile bar as per ASTM A 48 for each 20 castings or heat when less than 20 castings are made.

403.2.02C Manhole frames and covers shall be of heavy duty design with minimum weight of 295 lbs. Frames and covers shall be machine finished or ground on seating surfaces to assure a non-rocking fit in any position and interchangeability. Covers shall be marked with "SEWER" or "S" in minimum 2-inch raised or indented letters.

403.2.03 Cap screws and washers for watertight manhole covers shall be stainless steel with 60,000 p.s.i. minimum tensile strength conforming to the requirements of ASTM A453.

403.2.04 Precast Concrete Manholes

403.2.04A Precast concrete manhole sections and appurtenances shall conform to the requirements of ASTM C478. Minimum wall thickness shall be 4 inches. Cones shall have the same wall thickness and reinforcement as riser sections. Cones shall be eccentric. Joints shall be tongue-and-groove or keylock type. Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material which is to be supplied to the project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 14. Precast manhole sections shall consist of circular sections in standard nominal inside diameters of 42, 48, 54, 60, 72, 84, or 96 inches. Heights of sections shall be multiples of 12 inches. Heights of manhole sections 72 inches through 96 inches in diameter shall be as required to fit site conditions. Other sections shall be 24-inch riser and flattop sections.

403.2.04B Precast concrete manhole bases may be used provided all the details of construction are approved prior to construction. Inlet and outlet pipe holes shall be core-drilled at the plant location or in the field. Conical-type flexible neoprene boots shall be installed in the factory core-drilled hole to create a water-tight connection between manhole and sewer pipe. Where a flexible boot is not practical, and plastic pipe is used, an approved manhole water stop or collar shall be installed on the pipe at the manhole.

403.2.05 Joint Materials

403.2.05A Mortar shall conform to the requirements of ASTM C387, or be proportioned 1 part Portland cement to 2 parts clean, well-graded sand which will pass a 1/8 inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the precast concrete if using the standard

tongue-and-groove type joint. If the keylock type joint is used, the consistency shall be such that excess mortar will be forced out of the groove and support is not provided for the next precast manhole section to be placed. Mortar mixed for longer than 30 minutes shall not be used. Standard premixed mortar conforming to ASTM C387 may also be used.

403.2.05B Non-Shrink Grout shall be Sika 403, Euco N-S, Five-Star, or approved equal non-metallic cementitious commercial grout exhibiting zero shrinkage per ASTM C-827 and CRD-C-621. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Unused grout shall be discarded after 20 minutes and shall not be used. Non-shrink grouts shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. The bonding agent shall be compatible with the brand of grout being used. Water shall not be used as a substitute for the commercial bonding agent.

403.2.05C Preformed plastic gaskets shall be used in addition to mortaring all joints. Preformed plastic gaskets shall meet all the requirements of federal specification SS-S-00210.

403.2.05D Rubber Gaskets shall conform to ASTM C 443.

403.2.06 Manhole Steps shall conform to the requirements as listed below:

Plastic with Reinforcing Steel . . . . . ASTM C 478 and A 615

403.2.07 Pipe Fittings

403.2.07A General - Pipe and fittings shall conform to the applicable portions of APWA Standard Specifications, Sections 303 and 305. Tees, ells and other fittings for drop manholes shall be of the same material as the pipe in the adjacent trench.

403.2.07B PVC pipe shall be joined to the manhole with an approved conical-type flexible boot, where practical, or an approved asbestos-cement manhole collar, or an approved short stub section of a factory bonded fiberglass pipe with sand coating.

403.2.08 Flexible Manhole Boots shall be required in all connections where practical between PVC sewer pipe and manhole. The conical-type flexible boot shall be made of a NEOPRENE-EPDM blended compound that meets ASTM C 443 with a 3/8 inch minimum wall thickness. The internal expanding band shall be made of non-magnetic, corrosion-resistant stainless steel. The flexibility shall allow for 22 degree angular deflection in any direction and 2 inch vertical displacement. PVC pipe adapters shall be Femco CMA, Romac LCT, Tylox Manhole Adapter, Vassally Series 32850, Kor-N-Seal, Sealtite, Z-Lok-XP, or approved equal commercial product.

403.2.09 Pipe stubouts for future drainage connections shall be the same type as approved for use in the lateral, main or trunk sewer construction. Strength classifications shall be the same as in the adjacent trench. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Rubber-gasketed water-tight plugs, adequately braced against hydrostatic or air test pressures, shall be furnished with each stubout.

403.2.10 Tracer Wire shall be #12 multi-stranded copper wire with green colored insulation.

### 403.3 CONSTRUCTION:

#### 403.3.01 General -

403.3.01A - Manhole excavation, foundation stabilization, bedding and backfill shall be in accordance with applicable portions of section 301.

403.3.01B Pipe connections at manholes shall be made according to manufacturer's recommendations. Special care shall be taken by the Contractor to see that the pipe connections at manholes are completely watertight. All pipes entering or leaving the manhole shall be provided with flexible joints within 1 foot of the exterior surface of the manhole and shall be placed on firmly compacted bedding material.

403.3.01C Pipe connections to existing manholes shall be constructed such that connections are watertight and will provide a smooth flow into and through the manhole. Existing pipe stubouts may be used for new pipe connections provided that the existing pipe stubout is not damaged and is in proper alignment with the new pipe. When existing pipe stubouts are damaged or not in proper alignment with the new pipe, the existing stubout shall be removed and the new pipe installed in the manhole base as described in subsection 403.3.01B. The Contractor shall provide all diversion equipment and facilities and perform all work necessary to maintain flow in existing lines and manholes during work on any manhole.

403.3.02 Bases shall be placed on a prepared bedding of 8 inches compacted thickness of 3/4" minus crushed rock.

403.3.02A Cast-in-place bases shall be constructed according to the plans. The concrete shall be consolidated by mechanical vibration, hand spading, rodding, or tamping. The concrete shall be screeded off such that the manhole riser section has a level uniform bearing for the full circumference.

403.3.02B Precast bases shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, making sure that all entering pipes can be inserted on proper grade. Concrete pipe connections to sanitary manholes shall be grouted watertight with non-shrink grout conforming with subsection 403.2.05B. PVC pipe shall be connected to sanitary manholes using an approved adapter specifically manufactured for the intended service, and conforming to subsections 403.2.07 and 403.2.08. Field-fabricated waterstops or improvised adapters shall not be used. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming with subsection 403.2.05B.

The invert shall be constructed to a section identical with that of the sewer pipe. Where the size of the pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, the top shall be broken out to the spring line of the pipe for the full width of the manhole, and the exposed edge



of the pipe completely covered over with mortar. During construction, the Contractor shall divert existing flows of water or sewage from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

403.3.02C Manhole inverts shall be carefully formed, the curves of tributary sewers made as smooth and easy as possible. The base shall be constructed to an elevation of at least 1 inch above the top of the largest pipe.

403.3.03 Precast concrete manhole risers - All lift holes shall be thoroughly wetted, then completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness. Preformed plastic or rubber gaskets shall be used on all sanitary manholes. Mortar shall be used on 24-inch extension rings above the cones. All mortar joints between precast elements shall be thoroughly wetted, then completely filled mortar. On proposed street grades, a minimum of one 24-inch precast riser will be required between the cone and the manhole cover frame. Watertight seals between the precast concrete manhole section(s) and the precast bases and eccentric cones shall be effected by placing a preformed plastic or rubber gasket between the precast sections, then filling the remaining voids in the joint seam, both inside and outside, with mortar.

403.3.04 Manhole, grates, frames and covers shall be installed in such a manner as to prevent infiltration of surface or ground water between the frame and the concrete of the manhole section. All mortared sanitary sewer manhole necks and all riser ring joints made with mortar shall be constructed using an approved commercial concrete bonding agent applied to all cured concrete surfaces being mortared. No joints, necks, or frames on sanitary manholes shall be mortared without an approved bonding agent. Rim elevations shall be adjusted with approved precast concrete grade rings.

403.3.05 Tracer Wire shall be installed on the top of the initial backfill on all mains and laterals. Tracer wire shall penetrate manhole mortar stubout and have enough length to extend above the manhole lid. Tracer wire shall be tied to manhole steps for easy access. Tracer wire shall be attached to connection marker with continuous loop extending from main to connection marker and back to main.

403.3.06 Cleanouts shall be constructed as shown on the approved plans. The riser pipe shall be supported at the bends by encasement in concrete.

#### 403.4 TESTING:

403.4.01 General The Contractor shall be responsible for quality control testing of manholes and shall conduct such tests as necessary during the construction process. The results of the tests will not indemnify the Contractor of responsibility for defects in the construction. The first three sanitary sewer manholes built by each construction crew on the project shall be immediately proof tested. No additional manholes shall be constructed until three successful proof tests have demonstrated satisfactory workmanship and materials. Except as directed by an authorized Engineer, acceptance tests shall be conducted on a random sample of 15% of the manholes constructed. The manholes to be tested will be selected by the City and will be tested after

completion of backfilling, compaction, and surface restoration, including paving. For each manhole that fails the acceptance testing, the City will select three more manholes to be tested, in addition to the original sample, up to the total project manholes.

**403.4.02 Infiltration Testing** - When the ground water is within 18 inches of the top of the manhole, the manhole shall be tested for infiltration by the following procedure:

1. Plug all openings into manhole.
2. Completely dry manhole.
3. Provide the Engineer with means to measure ground water elevation.
4. Request the authorized Engineer to inspect manhole, measure and record ground water elevation, record time, and re-check manhole and ground water elevation at the end of 24 hours. The manhole shall remain dry for 24 hours.

**403.4.03 Exfiltration or Hydrostatic Testing** - When the ground water is more than 18 inches below the top of the manhole, the manhole shall be tested for exfiltration by the following procedure:

1. Plug all openings into manhole.
2. Fill the manhole with water to a point on the manhole frame. (A manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into concrete walls.)
3. Request the authorized Engineer to measure and record the water surface elevation from a point on the manhole rim.
4. After one hour, the authorized Engineer will re-measure the water surface elevation and calculate the amount of leakage. The leakage in each manhole shall not exceed 0.2 gallon per hour per foot of head above the invert. Comparably stringent vacuum testing procedures may be substituted for hydrostatic testing with the approval of the Engineer.

## 404 WORK ON EXISTING SEWERS AND STRUCTURES

### 404.1 DESCRIPTION:

This item includes all work necessary for joining new sewer work to existing, and for the adjustment of existing sewer structures.

### 404.2 MATERIALS:

**404.2.01 Concrete** shall conform to the requirements of ASTM C94. Compressive field strength shall be not less than 3,000 p.s.i. at 28 days. Maximum size of aggregate shall be 3/4 inch. Slump shall be between 2 and 4 inches.

**404.2.02 Mortar** shall conform to the requirements of ASTM C387, or be proportioned 1 part Portland cement to 2 parts clean, well graded sand which will pass a 1/8 inch screen. Admixtures may be used not exceeding the following percentages of weight of cement:

hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the precast concrete. Mortar mixed longer than 30 minutes shall not be used.

404.2.03 Precast concrete grade rings shall conform to the requirements of ASTM C478.

404.2.04 Pipe fittings

404.2.04A - PVC Pipe shall be jointed to the manhole with an approved asbestos-cement manhole collar.

404.2.04B - Flexible couplings shall be as manufactured by Calder, Fernco, or approved equal, and properly sized for a watertight joint.

404.3 CONSTRUCTION:

404.3.01 Excavation, bedding and backfill shall be in accordance with applicable portions of section 301.

404.3.02 Pipe connections to existing structures shall be made according to manufacturer's recommendations. All connections shall be completely watertight. All pipes entering or leaving the structure shall be provided with flexible joints within 12 inches of the exterior surface of the structure and shall be placed on firmly compacted bedding material.

404.3.03 Pipe connections to existing manholes shall be constructed such that connections are watertight and will provide smooth flow into and through the manhole. Existing pipe stubouts may be used for new pipe connections provided that the existing pipe stubout is not damaged and is in proper alignment with the new pipe. Connections to existing pipe stubouts shall be made with approved flexible couplings. When existing pipe stubouts are damaged or not in proper alignment with the new pipe, the existing stubout shall be removed and the new pipe installed in the manhole base as described in subsection 212.3.02. Where there are no existing pipe stubouts, the Contractor shall construct openings in the existing manhole base or barrel as required and shall construct connections that are watertight and will provide a smooth flow into and through the manhole, in accordance with subsection 403.3.02. The Contractor shall provide all diversion equipment and facilities and perform all work necessary to maintain flow in existing lines and manholes during work on any manhole.

404.3.04 Manhole Adjustment - Manholes shall be raised or lowered by removing the existing frames, grates or covers and adjusting the height as necessary to correspond to grade. Manholes may be raised or lowered by any of the following or combination of methods when no particular method is specified.

404.3.04A Manhole necks are defined as that upper portion of a manhole having vertical walls and a uniform diameter or dimensions sufficient to receive and support the metal frame. The manhole neck may be extended by the use of precast extension rings and mortar or by reconstructing the neck except that the total distance from the top of the metal frame at its new adjusted grade to the bottom of the neck shall not exceed 24 inches.

404.3.04B Manhole cones may be cut down and rebuilt provided the batter or slope of the cone does not exceed 6 inches horizontal per 12 inches vertical.

404.3.04C Manhole barrels of brick, block or concrete shall be extended in kind with like materials.

404.3.04D Existing frames, grates or covers shall be reset in fresh mortar and brought to proper grade following manhole adjustment.

#### 405 BORING AND JACKING

##### 405.1 DESCRIPTION:

This item includes all work necessary for the furnishing and installing of conduit casing by boring or jacking methods.

405.1.01 Boring shall include all methods by which a conduit is pushed or pulled into place and by which the excavation method precludes the stationing of a worker within the conduit without stopping or removing the excavation equipment.

405.1.02 Jacking shall include all methods by which a conduit is pushed or pulled into place with one or more workers inside to excavate and assist in keeping the conduit on the required grade and alignment.

##### 405.2 MATERIALS:

405.2.01 Casing of the size specified shall be provided by the Contractor. The minimum gauge or wall thickness shall correspond to the size of casing selected from the following table. However, the Contractor shall be responsible for selecting the gauge consistent with his operation and the requirements of the permitter.

<u>Diameter/Inches</u>	<u>Smooth Steel Pipe Minimum Thickness</u>
4-10	1/8" ASTM A53
12	3/16" ASTM A53
15-24	1/4" ASTM A53
30-36	5/16" AWWA C201

The casing shall be galvanized or shall be asphalt coated inside and outside.

**405.3 CONSTRUCTION:**

**405.3.01 General** - The work shall conform to all federal, state and local laws and regulations pertaining to tunneling and specifically to the standards set forth in the Oregon Safety Code for Places of Employment, Chapter 24, Safety Code for Mining, Tunneling and Quarrying, published by the Oregon Industrial Accident Commission, latest revision. Excavation shall be classified and shall include whatever materials are encountered to the depths as shown or as required. The Contractor shall make an estimate of the kind and extent of the various materials which will be encountered in the excavation. The work shall conform to all requirements of the permitter.

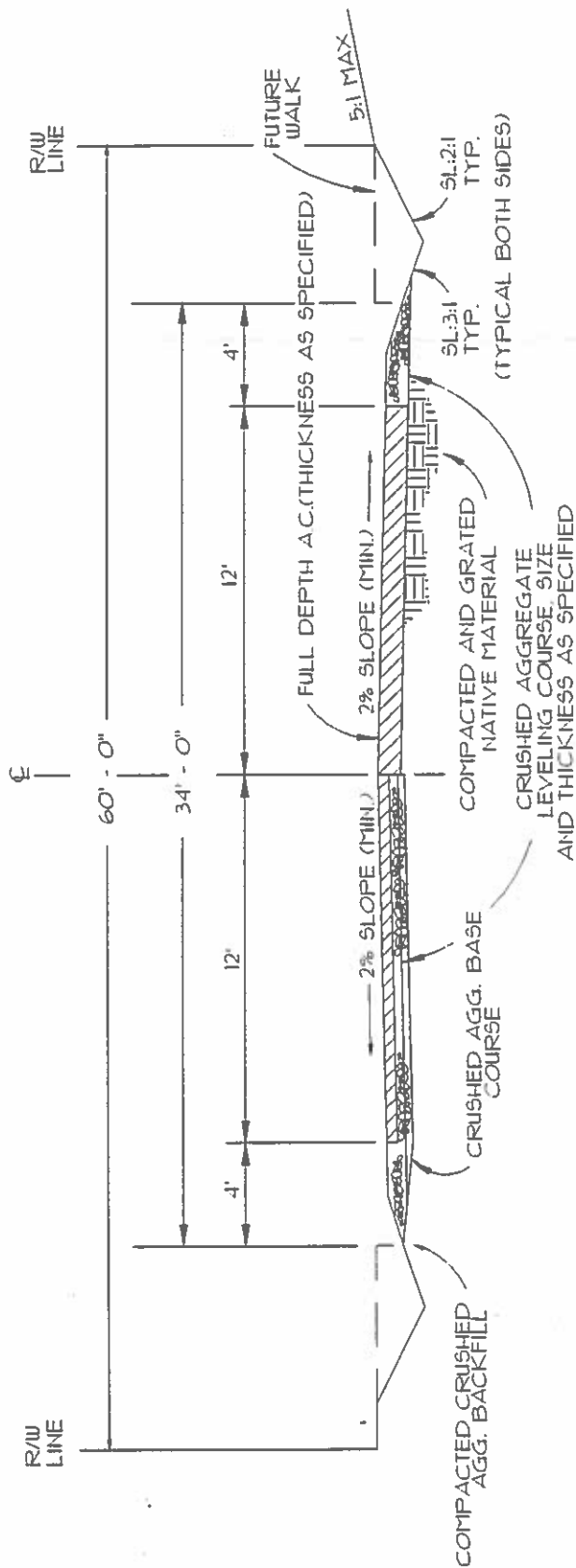
**405.3.02 Jacking and Boring** - The leading section of conduit shall be equipped with a jacking head securely anchored thereto to prevent any wobble or alignment variation during the jacking or boring operation. For jacking, all excavation shall be carried out entirely within the jacking head, and no excavation in advance thereof shall be permitted. For jacking, every effort shall be made to avoid any loss of earth outside the jacking head. Excavated material shall be removed from the conduit as excavation progresses and no accumulation of such material within the conduit will be permitted.

All conduit shall be jacked or bored to the required line and grade. The method shall be modified to correct any deviation therefrom. Should any deviation from line and grade be considered excessive in the City's judgment, that portion of the conduit shall be taken up and repositioned at no expense to the owner. Should appreciable loss of surrounding material occur during the jacking or boring operation, the voids shall be backpacted or grouted promptly before the completion of the shift. On completion, all voids shall be filled. Filling or backpacting shall be with grout or granular material as approved. It shall be understood that where any pipe is to be placed by jacking or boring in a tunnel or open trench, the design of such pipe is based upon the superimposed loads and not upon the loads resulting from the jacking or boring operations. Any increase in pipe strength to withstand jacking or boring loads shall be the responsibility of the Contractor.

**405.3.03 Smooth steel casing** to be jacked or bored shall be joined by welding the joints with a continuous weld for full circumference or by other approved means. The Contractor shall provide joints which are capable of resisting the jacking or boring forces.

**405.3.04 Railroad Crossings** - All work to be performed by the Contractor in construction on railroad right-of-way shall conform to all requirements of the railway company permit. The Contractor shall use all care and precaution in order to avoid accidents, damage or unnecessary delay or interference with the railway company's equipment or other property.

**405.3.05 Public Highway Crossings** - All work to be performed by the Contractor in construction on public highway right-of-way shall conform to all requirements of the operations permit issued by the governing authority. The Contractor shall use all care and precaution in order to avoid accidents, damage or unnecessary delay or interference with traffic or other property, both public and private.



**ASPHALT PAVING ON NATIVE MATERIAL**

- 1 1/2" CLASS "C" A.C.
- 5 1/2" CLASS "B" A.C.

**ASPHALT PAVING ON ROCK BASE**

- 3" CLASS "C" A.C.
- 2" 3/4"-0"
- 8" 1-1/2"-0"

**NOTE:**

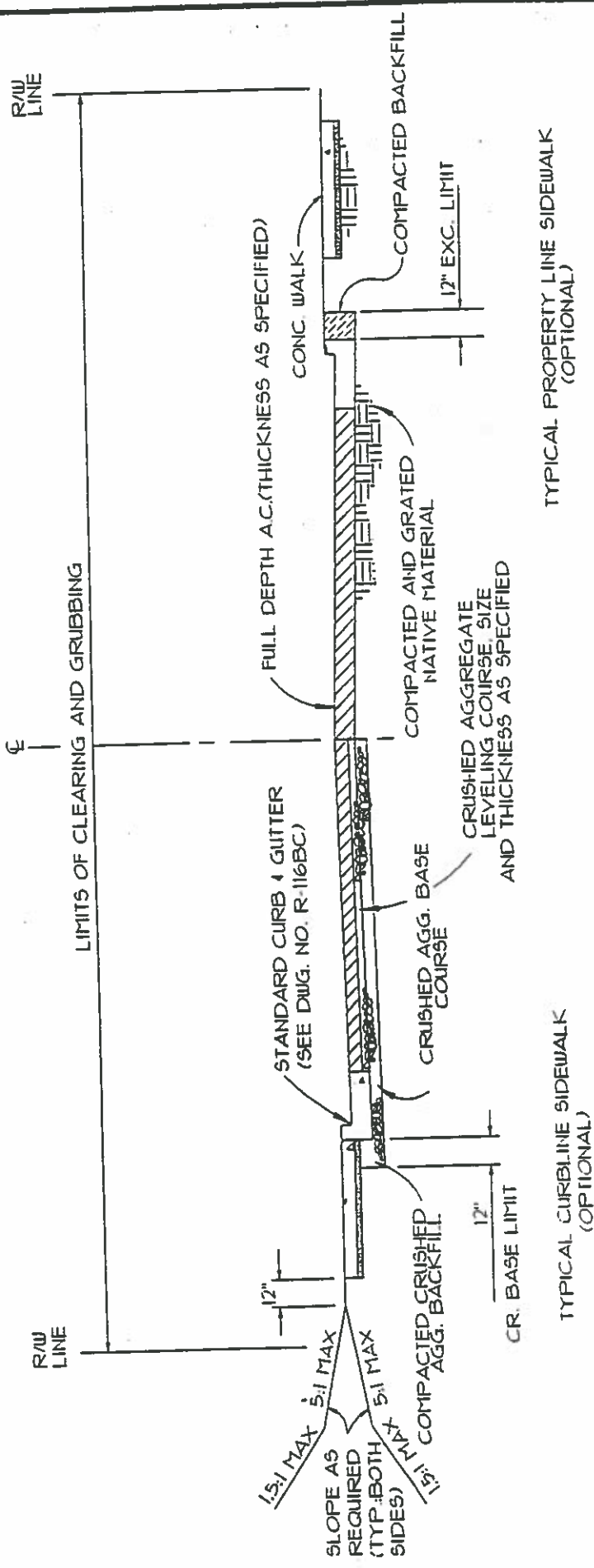
1. DEVELOPMENT RESTRICTED TO THAT WHICH WOULD FIT FUTURE-CURB. DESIGN TO INCLUDE FUTURE CURB GRADES.
2. GEOTEXTILE SUPPORT FABRIC SHALL BE PLACED UNDER AGGREGATE BASE (SEE TECHNICAL SPECIFICATIONS).

CITY OF BAY CITY

TYPICAL RURAL STREET SECTION

DATE:  
MAY 12, 1994

DRAWING NO.  
R-102BC



**ASPHALT PAVING ON NATIVE MATERIAL**  
 1 1/2" CLASS "C" A.C.  
 5 1/2" CLASS "B" A.C.

**ASPHALT PAVING ON ROCK BASE**  
 3" CLASS "C" A.C.  
 2" 3/4"-0"  
 8" 1-1/2"-0"

- NOTE:**
1. TOP OF CURB TO BE SAME ELEVATION AS CENTER OF CROWN
  2. GEOTEXTILE SUPPORT FABRIC SHALL BE BE PLACED UNDER AGGREGATE BASE (SEE TECHNICAL SPECIFICATIONS)

<b>CITY OF BAY CITY</b>	
<b>TYPICAL URBAN STREET SECTION</b>	
DATE: MAY 12, 1994	DRAWING NO. R-101BC

**EXPANSION JOINTS-**

SHALL BE 1/2" PREMOLDED ASPHALT IMPREGNATED MATERIAL OR EQUAL AND WILL EXTEND FROM SUB-GRADE TO FINISH GRADE.

**CONCRETE-**

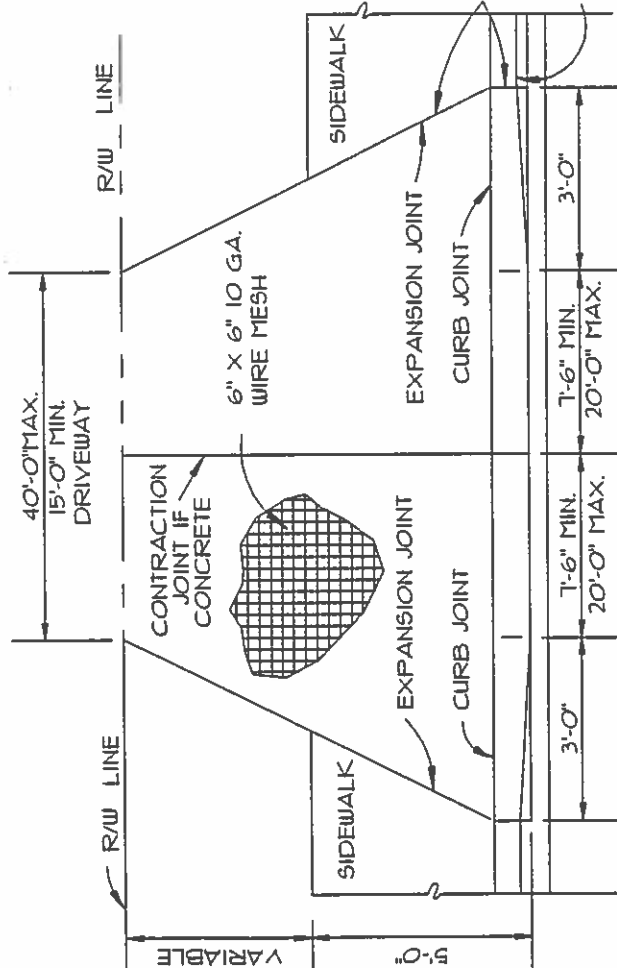
SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 P.S.I. AFTER 28 DAYS, 6 SACK MIX, MIN.

**CURB AND GUTTER-**

SEE STANDARD DETAIL DRAWING.

**D/W APRONS-**

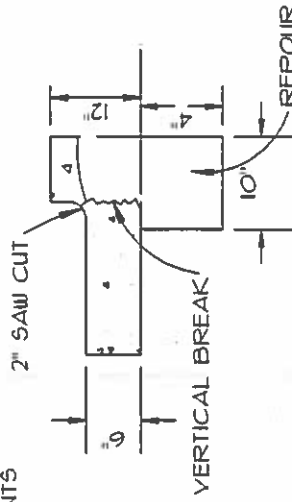
COMMERCIAL AND INDUSTRIAL 6" CONC. PLUS 6" X 6" 10 GA. WIRE MESH



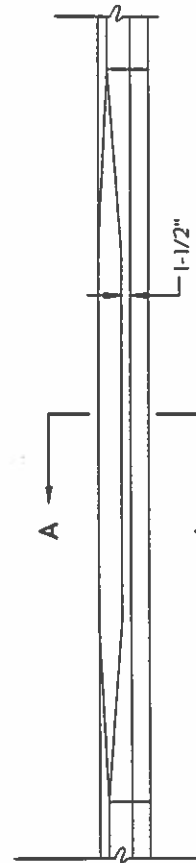
**PLAN**

**CURB JOINTS**

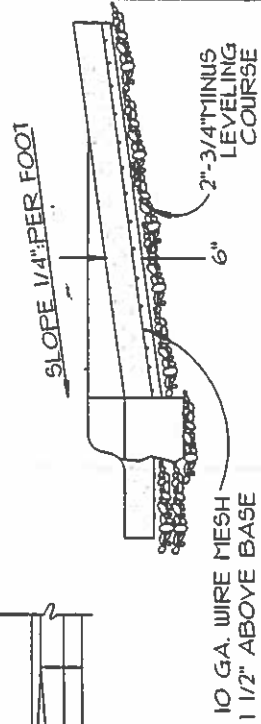
SHALL BE EXPANSION JOINT IF Poured AT SAME TIME OR COLD JOINT IF JOINING EXISTING CURB.



**CURB CUT**



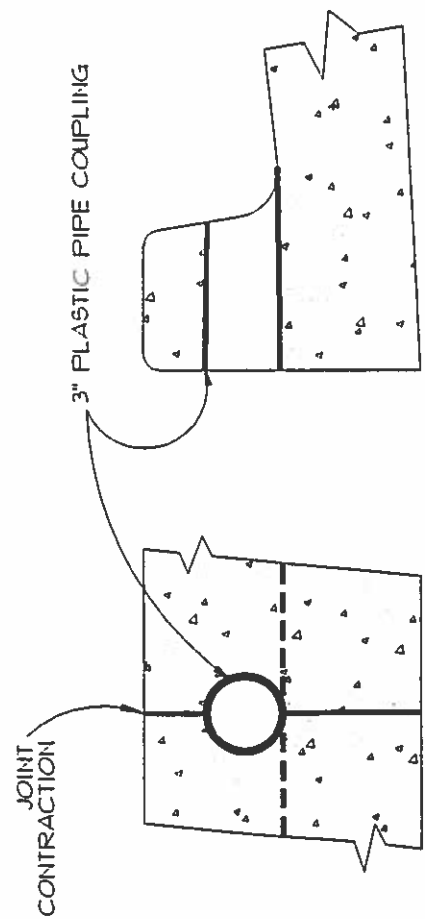
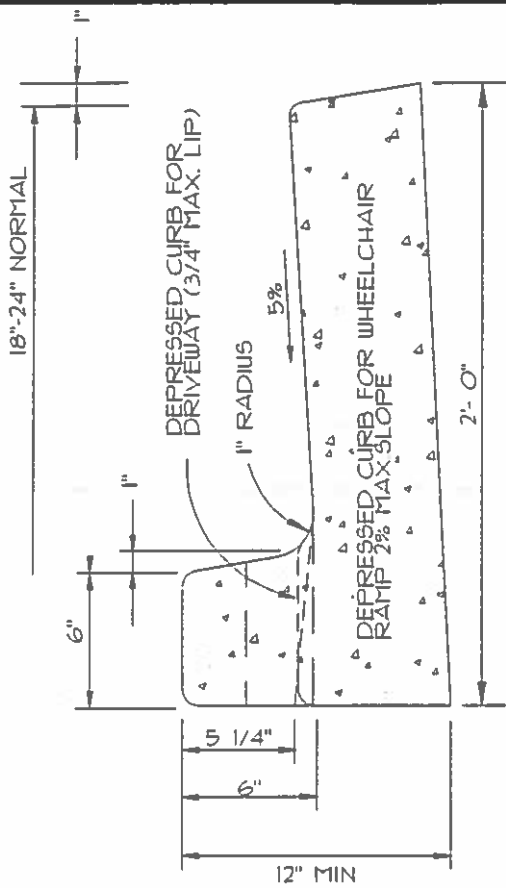
**ELEVATION**



**SECTION A-A**

<b>CITY OF BAY CITY</b>	
<b>STANDARD COMMERCIAL DRIVEWAY</b>	
DATE: MAY 12, 1994	DRAWING NO. R-106BC





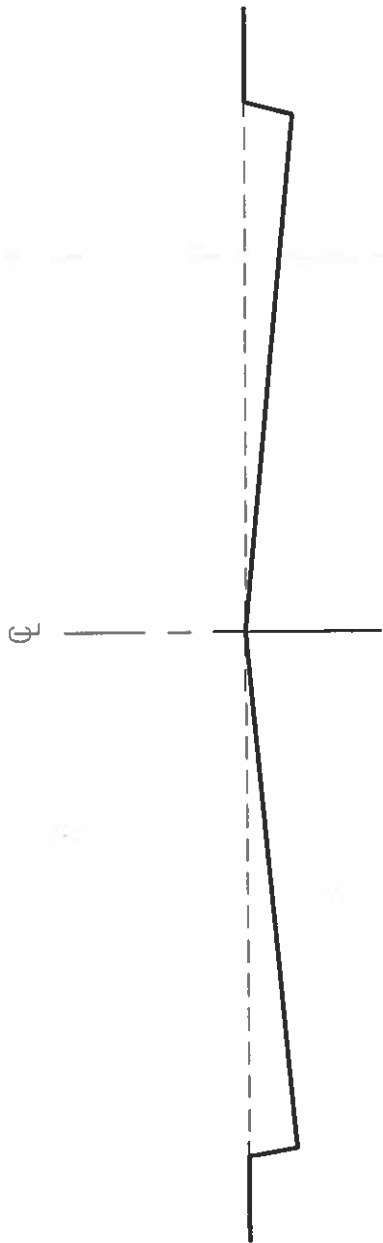
TYPICAL CURB AND GUTTER

DRAINAGE PIPE THROUGH CURB

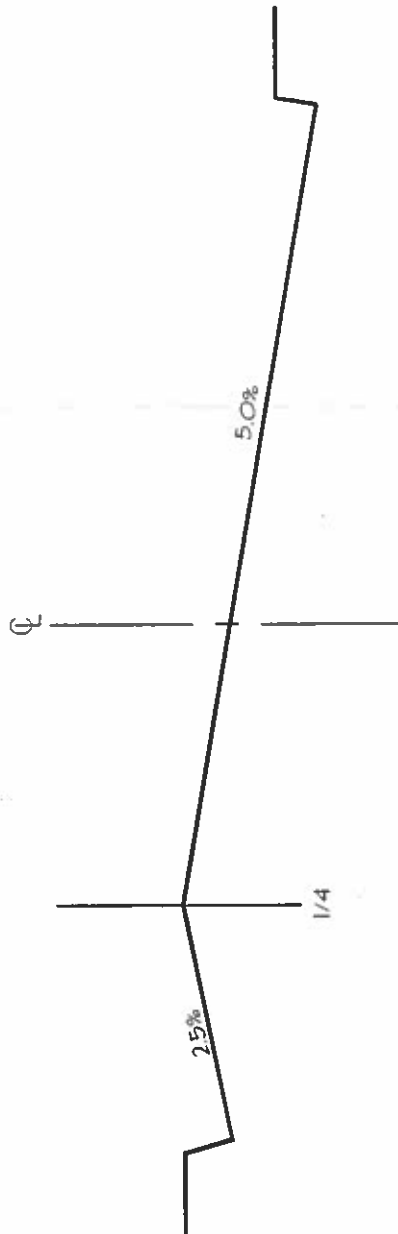
**NOTES**

1. ALL RADII SHALL BE 3/4" EXCEPT AS OTHERWISE SHOWN.
2. CONCRETE TO HAVE A COMPRESSIVE STRENGTH OF 3000 P.S.I. AFTER 28 DAYS.
3. ISOLATION JOINTS SHALL BE PLACED ONLY AS SPECIFIED HEREIN AFTER:
  - 1.) AT EACH COLD JOINT
  - 2.) ON EACH SIDE OF INLETS
  - 3.) AT EACH END OF DRIVEWAYS
4. EXPANSION JOINTS
  - A. TO BE PROVIDED AT EACH POINT OF TANGENCY OF THE CURB
5. CONTRACTION JOINTS
  - A. SPACING TO BE NOT MORE THAN 15'
  - B. THE DEPTH OF THE JOINT SHALL BE AT LEAST 1.5 INCHES
  - C. SHALL BE PLACED ALONG AND OVER BLOCKOUT THROUGH THE CURB AND THROUGH THE SIDEWALK.

CITY OF BAY CITY	
TYPICAL CURB AND GUTTER	
DATE: MAY 12, 1994	DRAWING NO. R-104BC



**STANDARD CROWN**  
 TOP OF CURB AND CENTERLINE SAME CENTER ELEVATION



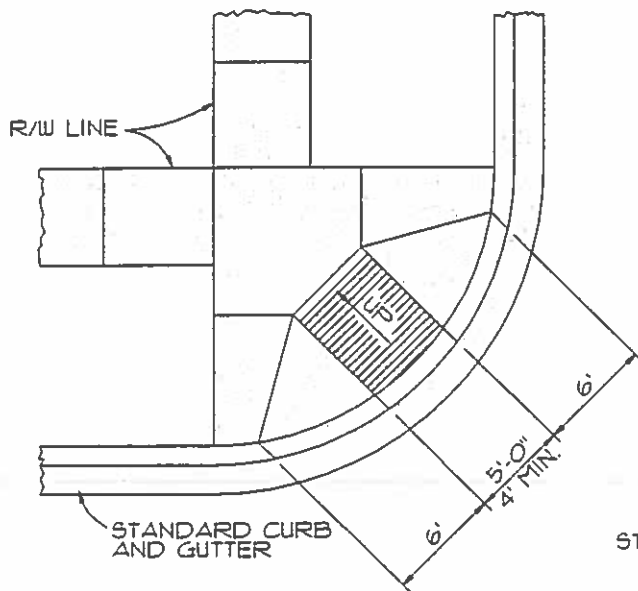
**OFFSET CROWN**

CITY OF BAY CITY

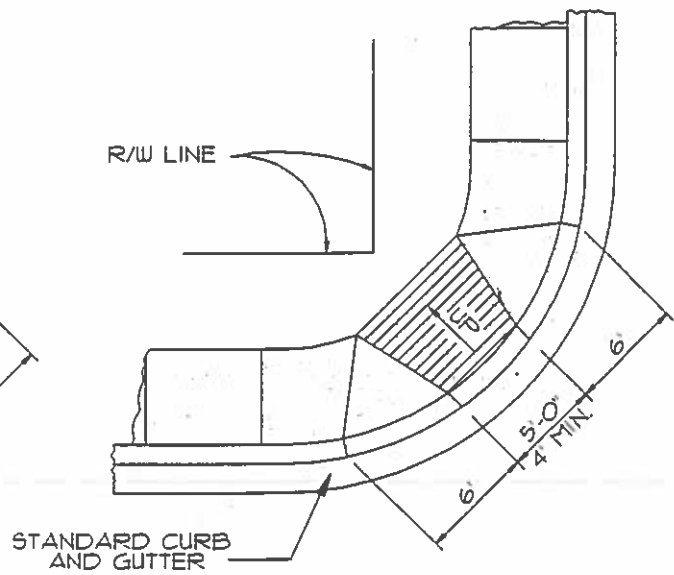
STANDARD CROWN AND  
 OFFSET CROWN  
 TYPICAL SECTIONS

DATE:  
 MAY 12, 1994

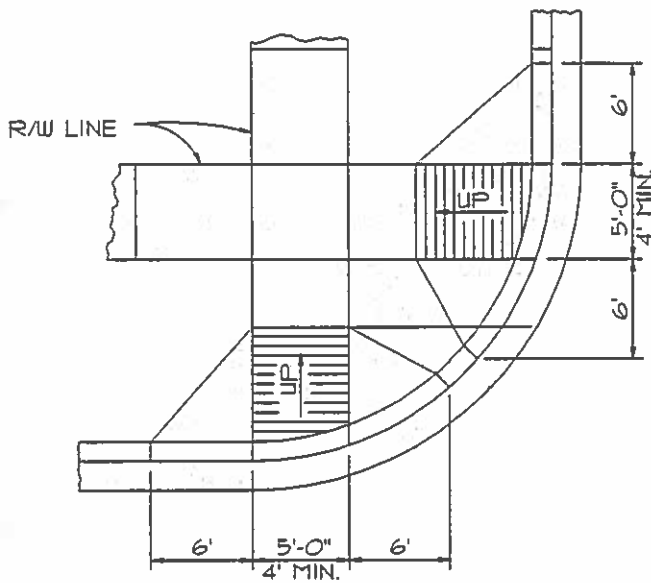
DRAWING NO.  
 R-103BC



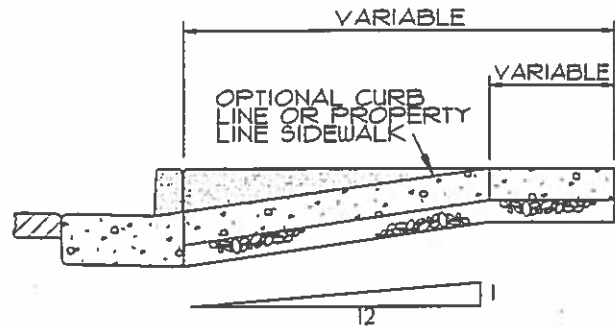
**CENTER RAMP FOR PROPERTY LINE SIDEWALK**  
(RESIDENTIAL AREAS)



**CENTER RAMP FOR CURB LINE SIDEWALK**  
(RESIDENTIAL AREAS)



**END RAMP FOR PROPERTY LINE SIDEWALKS**  
(COMMERCIAL AREAS OR ARTERIAL STREETS)



**SECTION THROUGH RAMP - ALL VIEWS**

**SURFACING OF RAMPS**  
FINISH

**NOTE:**

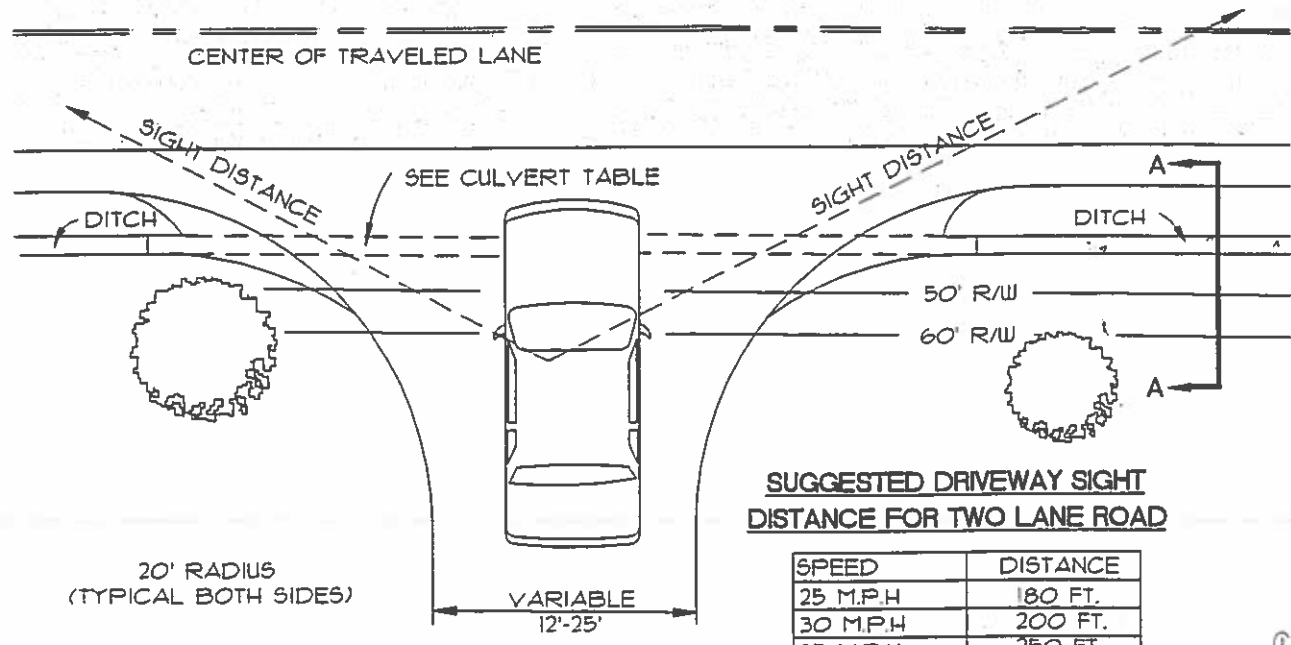
1. THE "AMERICANS WITH DISABILITIES ACT" REQUIRES THAT ACCESS RAMPS TO SIDEWALKS HAVE NO SLOPES GREATER THAN 12 HORIZONTAL TO 1 VERTICAL.
2. GRATINGS IN WALKING SURFACE SHALL HAVE SPACES NO GREATER THAN 1/2" WIDE, HAVE ELONGATED OPENINGS, AND SHALL BE PLACED PERPENDICULAAR TO DIRECTION OF TRAVEL.

**CITY OF BAY CITY**

**WHEELCHAIR RAMP  
AND BYCYCLE RAMP**

DATE:  
MAY 12, 1994

DRAWING NO.  
R-105BC

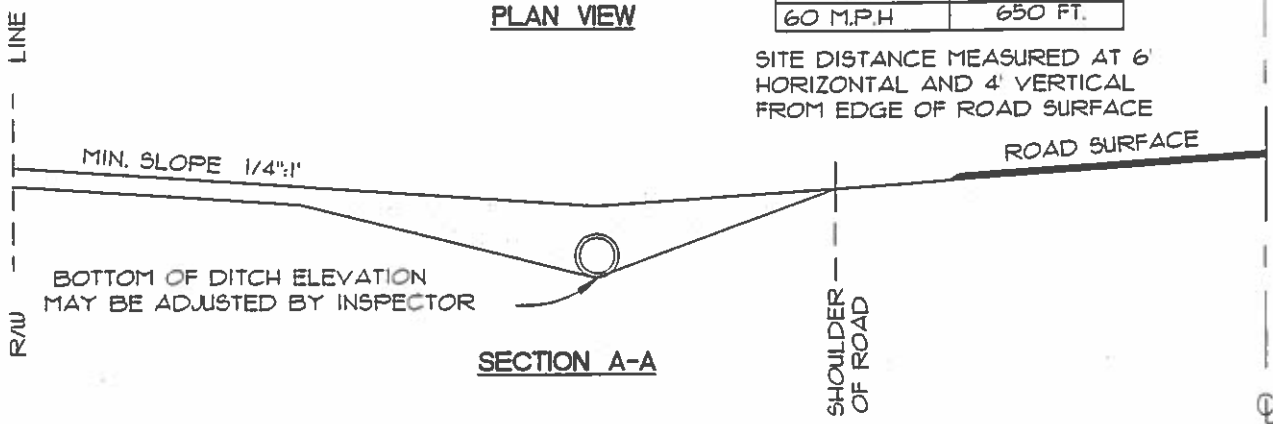


**SUGGESTED DRIVEWAY SIGHT DISTANCE FOR TWO LANE ROAD**

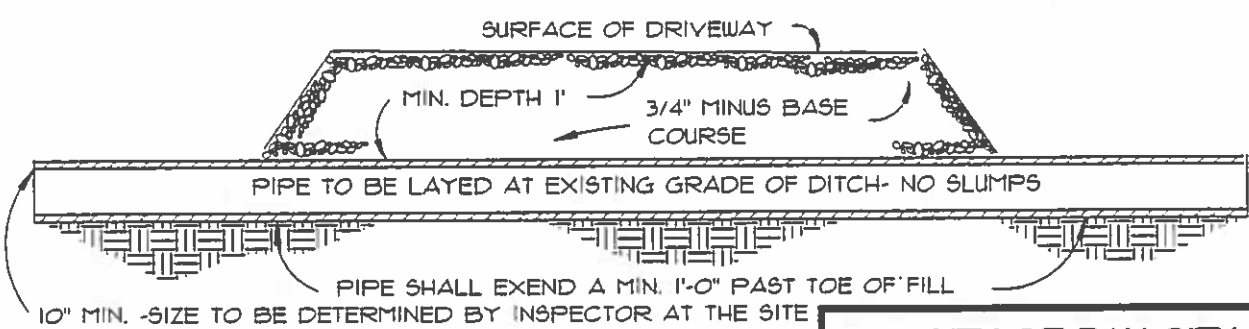
SPEED	DISTANCE
25 M.P.H.	180 FT.
30 M.P.H.	200 FT.
35 M.P.H.	250 FT.
40 M.P.H.	350 FT.
50 M.P.H.	500 FT.
60 M.P.H.	650 FT.

**PLAN VIEW**

SITE DISTANCE MEASURED AT 6' HORIZONTAL AND 4' VERTICAL FROM EDGE OF ROAD SURFACE



**SECTION A-A**

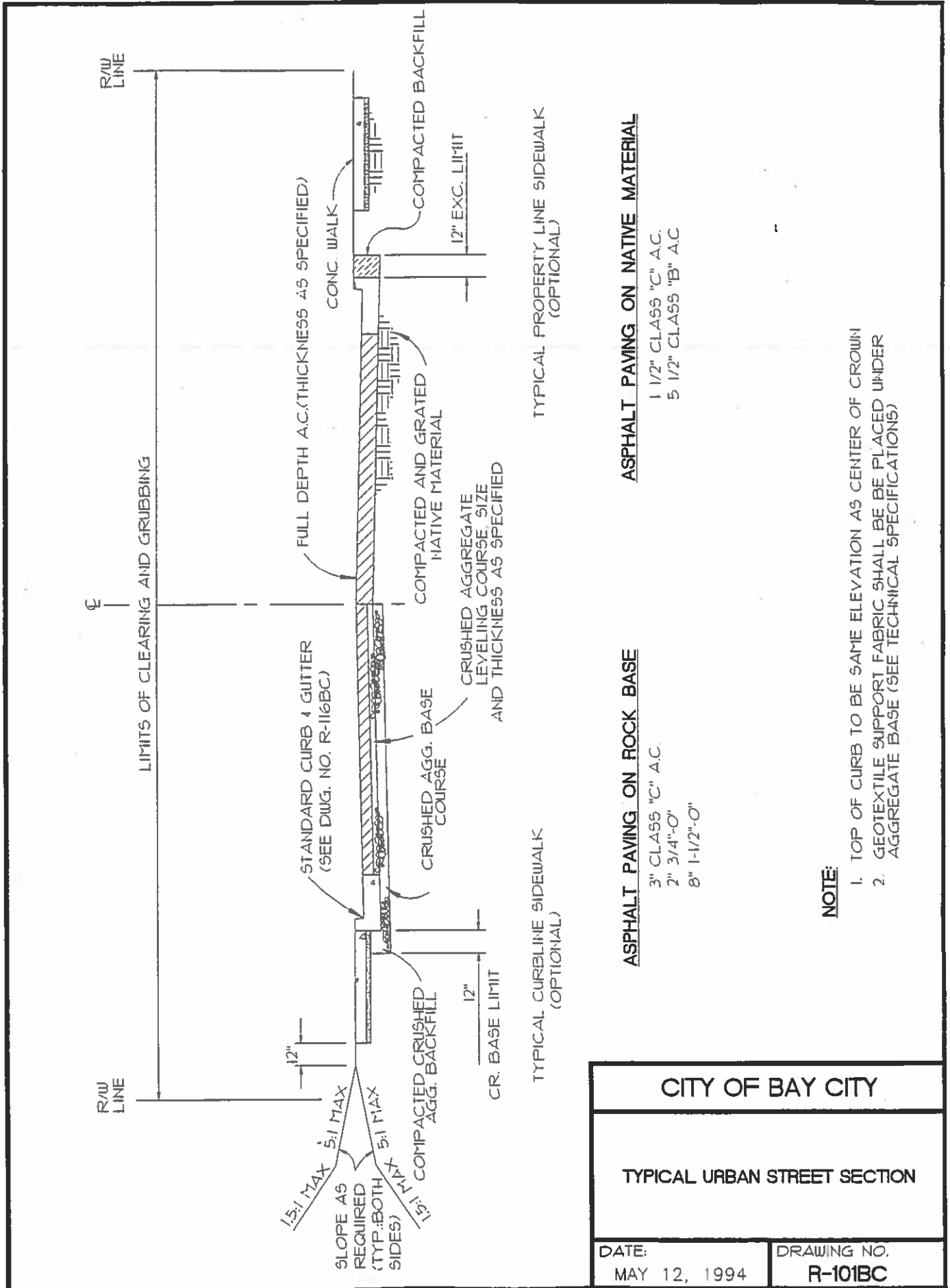


**ELEVATION**

**NOTE:**

IF A.C. DRIVEWAY IS TO BE INSTALLED, USE 2" OF CLASS "B" MIX ON APPROVED BASE.

<b>CITY OF BAY CITY</b>	
<b>STANDARD RURAL DRIVEWAY</b>	
DATE: MAY 12, 1994	DRAWING NO. R-108BC



**ASPHALT PAVING ON NATIVE MATERIAL**

- 1 1/2" CLASS "C" A.C.
- 5 1/2" CLASS "B" A.C.

**ASPHALT PAVING ON ROCK BASE**

- 3" CLASS "C" A.C.
- 2" 3/4"-0"
- 8" 1-1/2"-0"

**NOTE:**

1. TOP OF CURB TO BE SAME ELEVATION AS CENTER OF CROWN
2. GEOTEXTILE SUPPORT FABRIC SHALL BE PLACED UNDER AGGREGATE BASE (SEE TECHNICAL SPECIFICATIONS)

<b>CITY OF BAY CITY</b>	
<b>TYPICAL URBAN STREET SECTION</b>	
DATE: MAY 12, 1994	DRAWING NO. <b>R-101BC</b>

**EXPANSION JOINTS-**

SHALL BE 1/2" PREMOLDED ASPHALT IMPREGNATED MATERIAL OR EQUAL AND WILL EXTEND FROM SUB-GRADE TO FINISH GRADE.

**CONCRETE-**

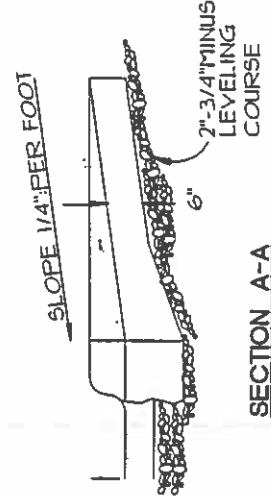
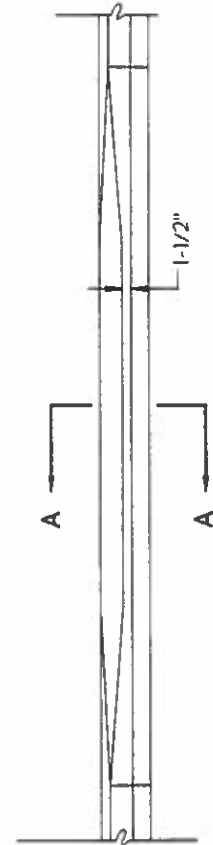
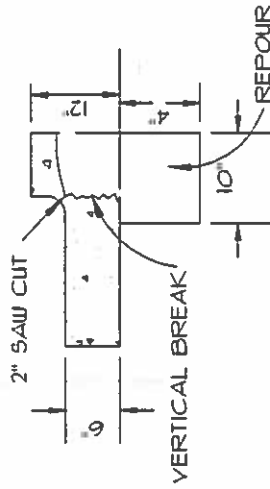
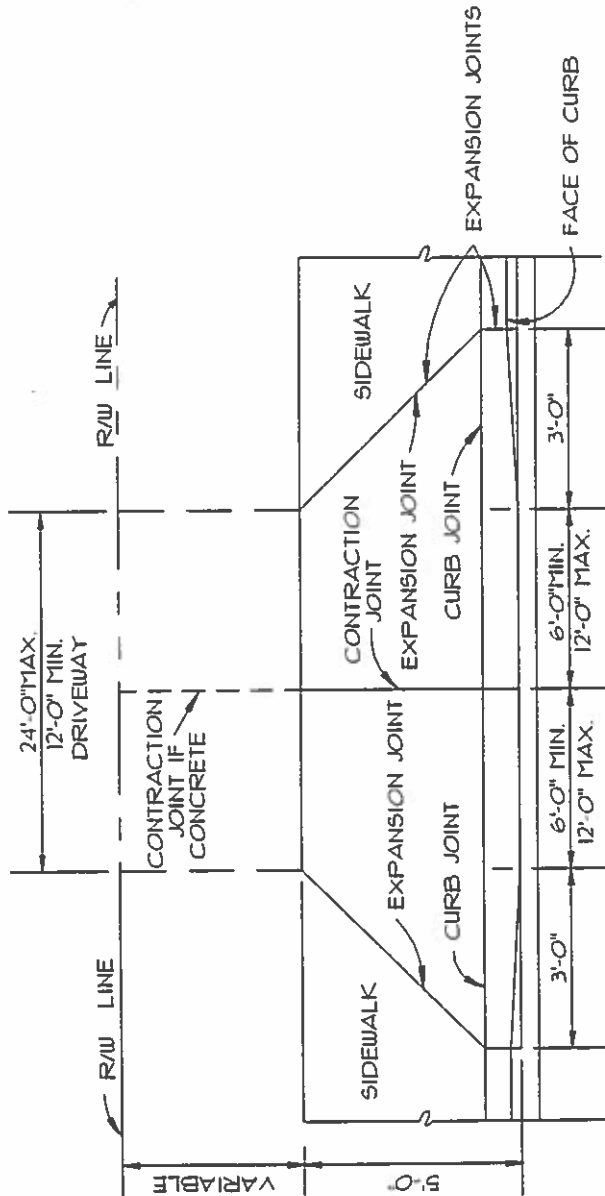
SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 30000 P.S.I. AFTER 28 DAYS, 6 SACK MIX. MIN.

**CURB AND GUTTER-**

SEE STANDARD DETAIL DRAWING.

**CURB JOINTS-**

EXPANSION JOINT IF POURED AT THE SAME TIME OR COLD JOINT IF JOINING EXISTING CURB.

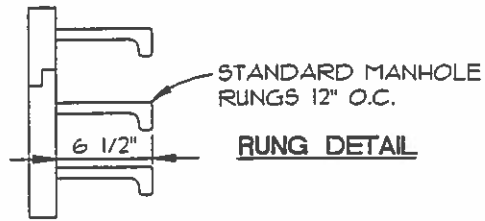


CITY OF BAY CITY

STANDARD RESIDENTIAL DRIVEWAY

DATE: MAY 12, 1994

DRAWING NO. R-107BC



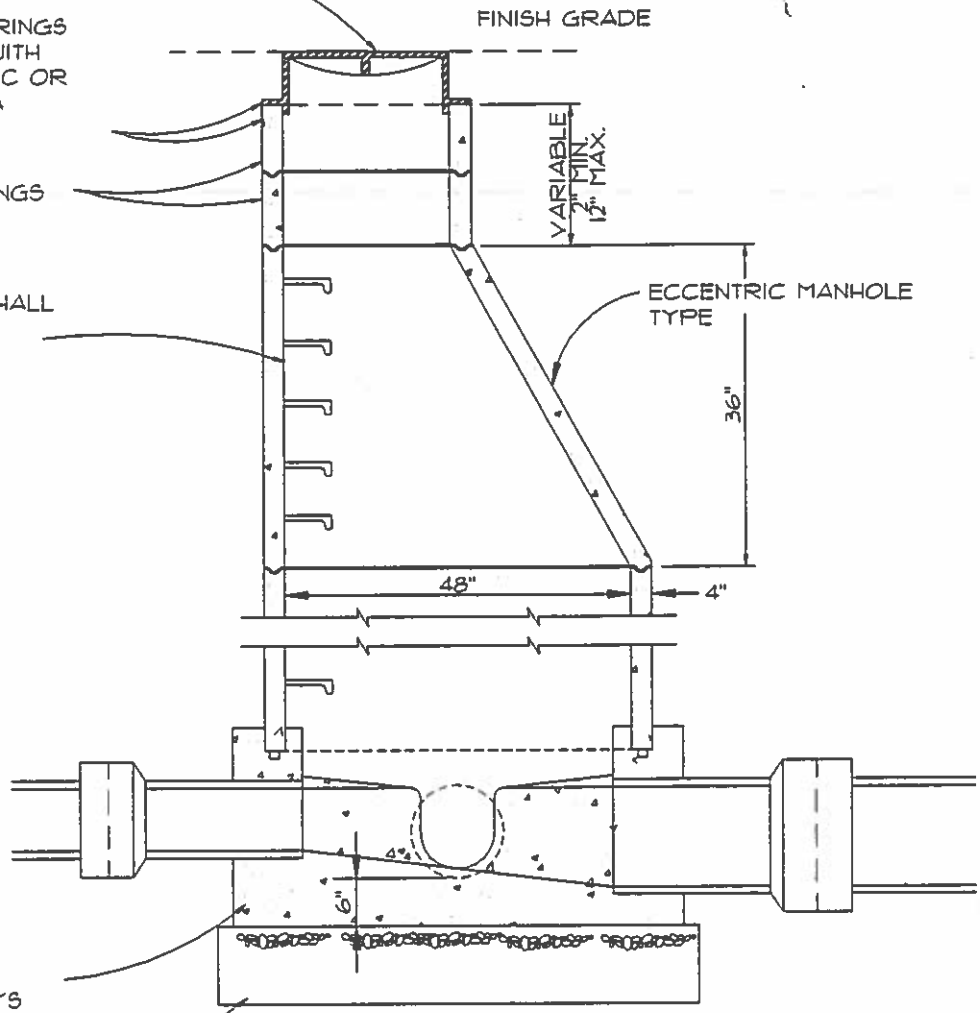
**ALTERNATE JOINT**

MANHOLE FRAME AND COVER AS SPECIFIED.

FRAME AND RISER RINGS SHALL BE SEALED WITH PREFORMED PLASTIC OR RUBBER TO FORM A WATERTIGHT SEAL.

PRECAST RISER RINGS

MANHOLE STEPS SHALL BE PROVIDED AS SPECIFIED ABOVE.

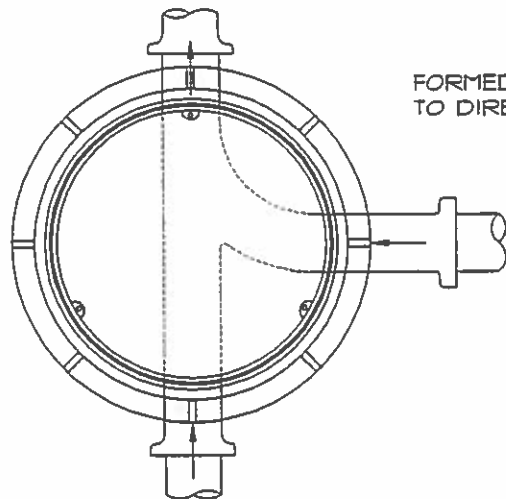
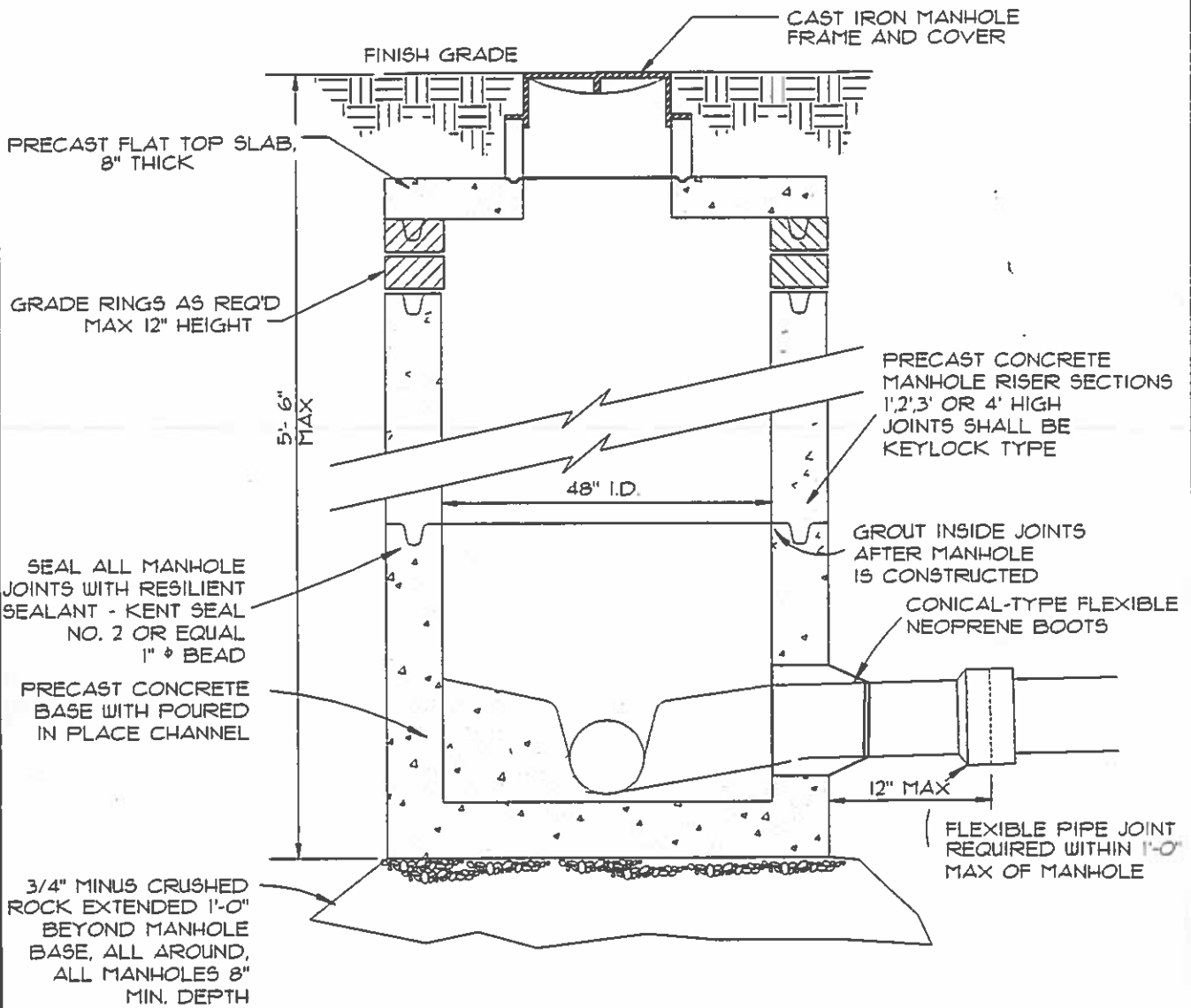


8" COMPACTED BASE COURSE

**NOTE**

1. STANDARD PRECAST MANHOLE SECTION DIAMETER SHALL BE 48".
2. ALL JOINTS TO BE KENT SEAL JOINT MATERIAL OR EQUAL.
3. FORM CHANNEL INVERT AND MAKE SURFACE SMOOTH TO DIRECT FLOW.

<b>CITY OF BAY CITY</b>	
<b>STANDARD STORM SEWER MANHOLE</b>	
DATE: MAY 12, 1994	DRAWING NO. R-110BC



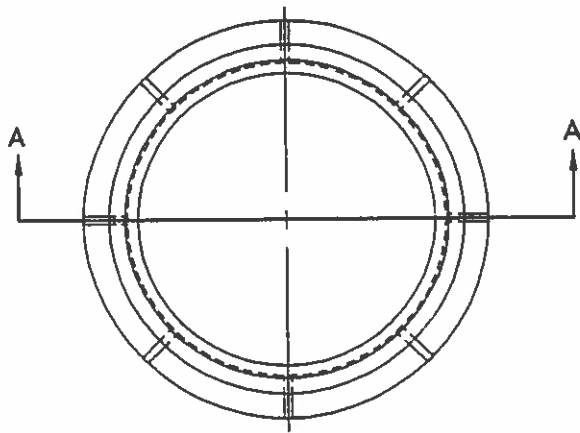
CITY OF BAY CITY

STANDARD STORM SEWER  
SHALLOW MANHOLE

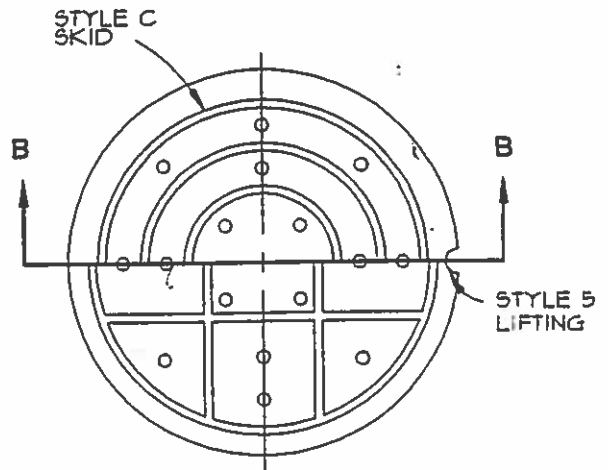
DATE:  
MAY 12, 1994

DRAWING NO.  
R-111BC

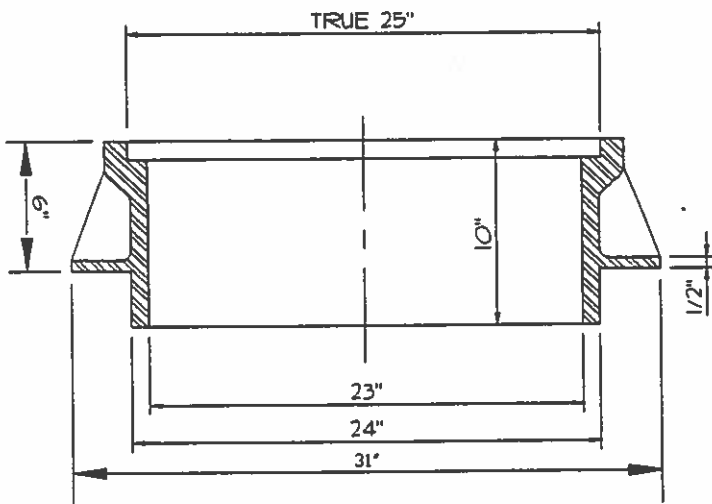




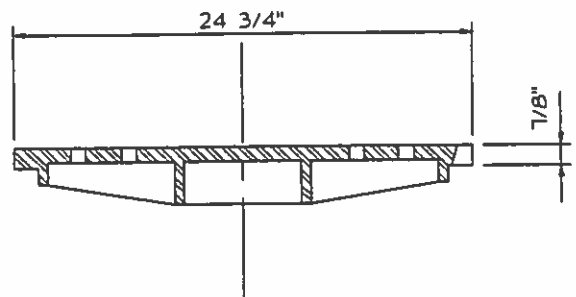
MANHOLE FRAME PLAN



MANHOLE COVER PLAN



SECTION A-A



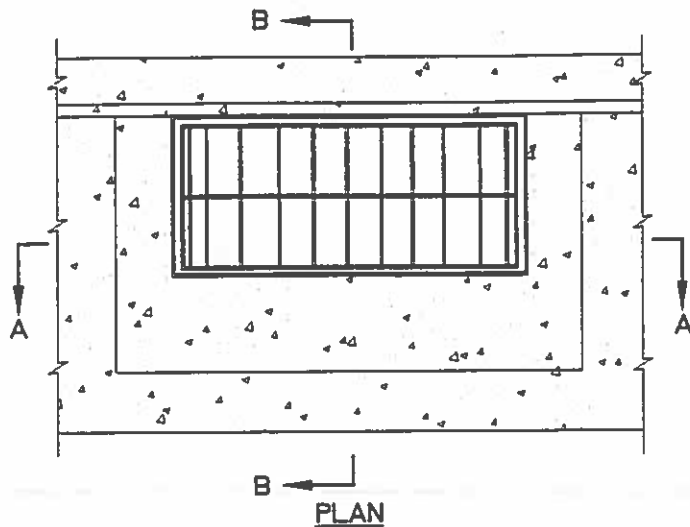
SECTION B-B

CITY OF BAY CITY

STANDARD MANHOLE  
CASTING DETAIL

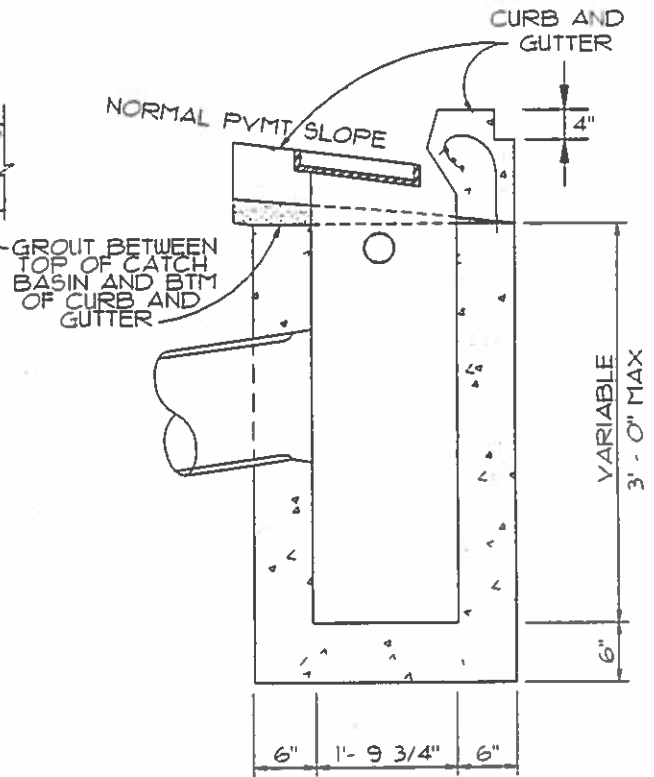
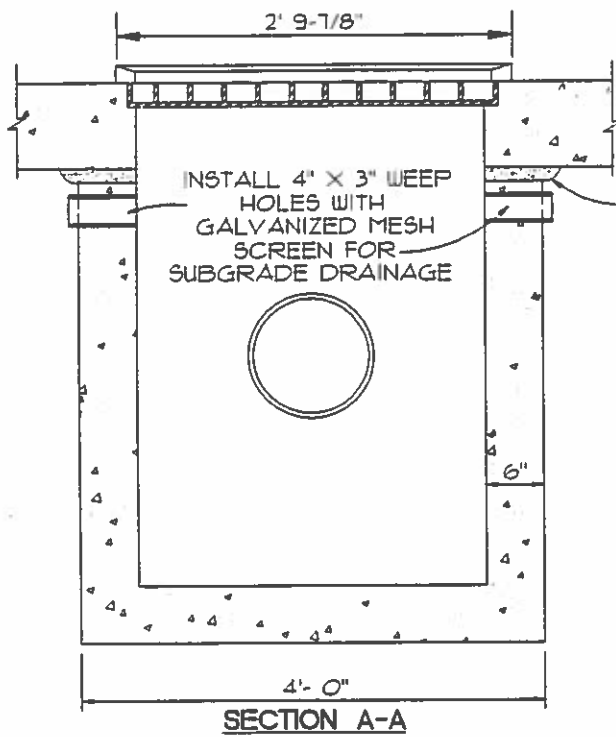
DATE:  
MAY 12, 1994

DRAWING NO.  
R-112BC

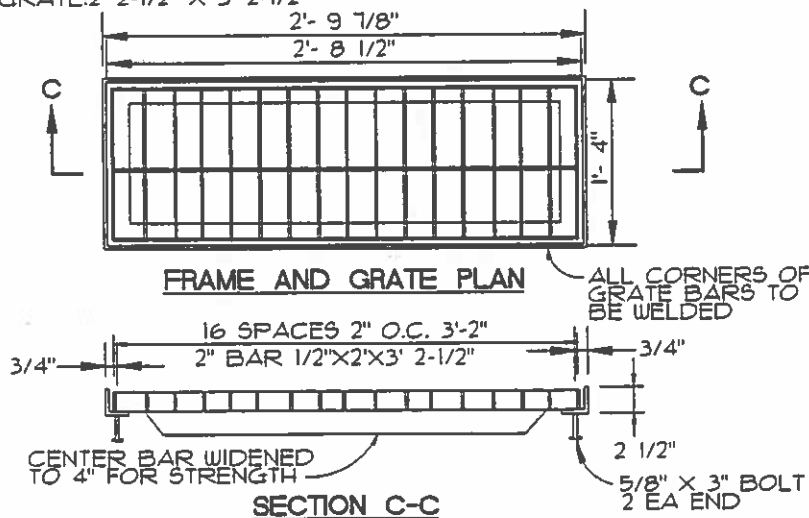


**NOTES:**

1. PRECAST BASE WALLS MAY BE A MINIMUM OF 4" THICK.
2. CONCRETE SHALL BE CLASS 3000.
3. APPROVED CAST IRON FRAMES AND GRATES MAY BE ACCEPTED.



FRAME: 3/8" X 2 1/2" X 2 1/2" STEEL (ASTM A-36) ANGLE  
 GRATE: 2' 2-1/2" X 3' 2-1/2"

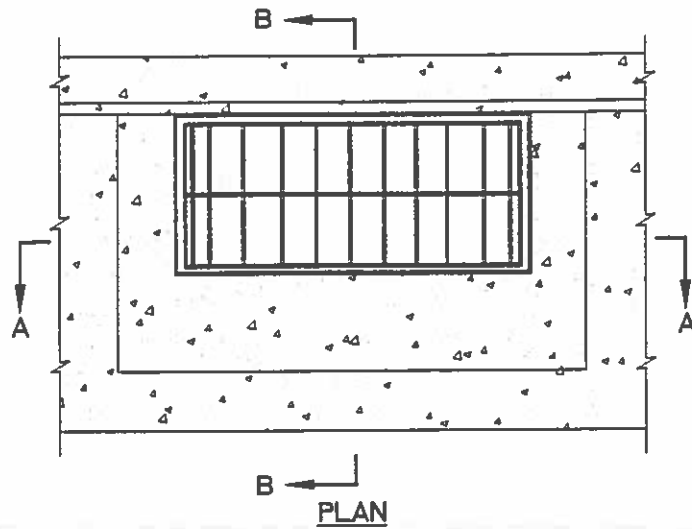


**CITY OF BAY CITY**

**STANDARD CURB INLET**

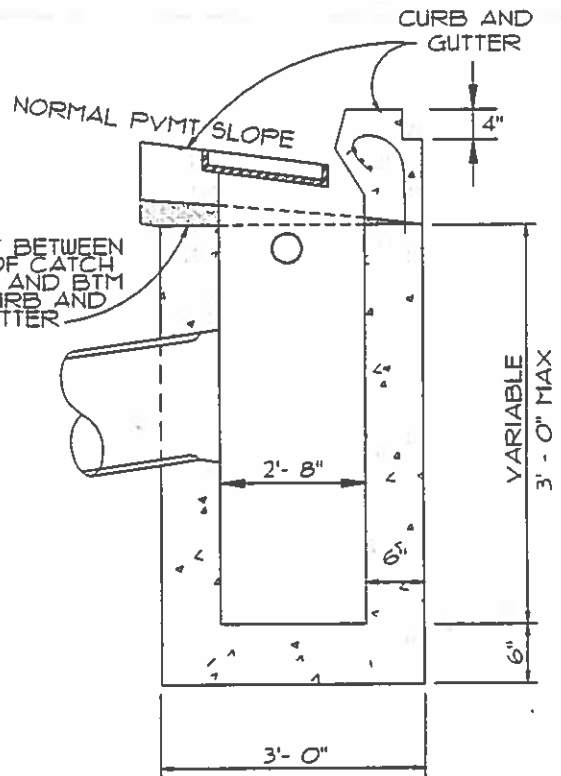
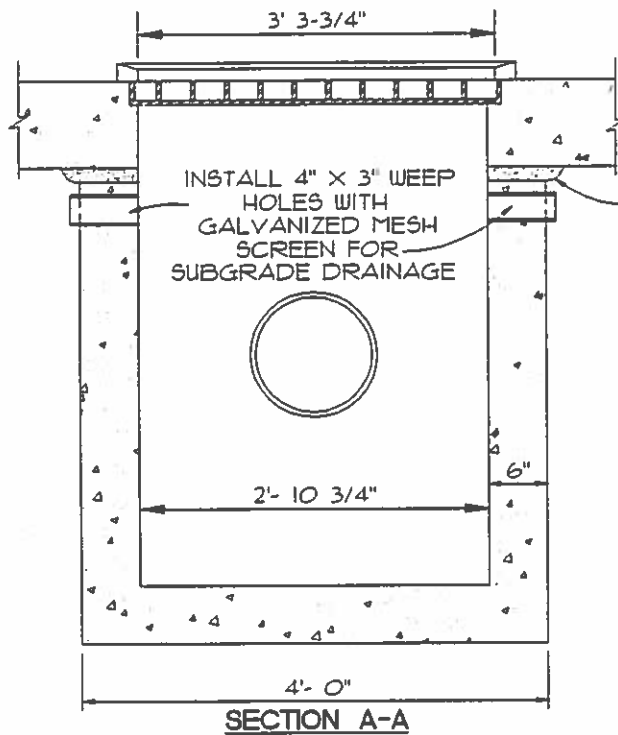
DATE:  
MAY 12, 1994

DRAWING NO.  
R-113BC

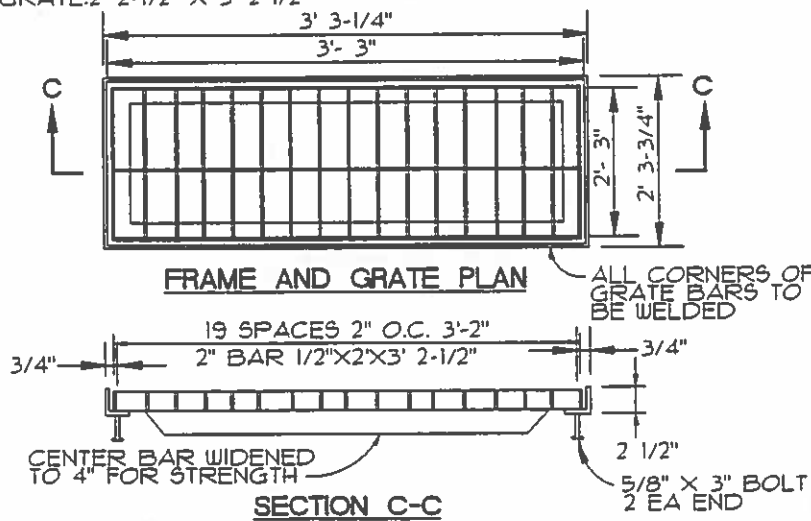


**NOTES:**

1. PRECAST BASE WALLS MAY BE A MINIMUM OF 4" THICK.
2. CONCRETE SHALL BE CLASS 3000.
3. APPROVED CAST IRON FRAMES AND GRATES MAY BE ACCEPTED.



FRAME: 3/8" X 2 1/2" X 2 1/2" STEEL (ASTM A-36) ANGLE  
 GRATE: 2' 2-1/2" X 3' 2-1/2"

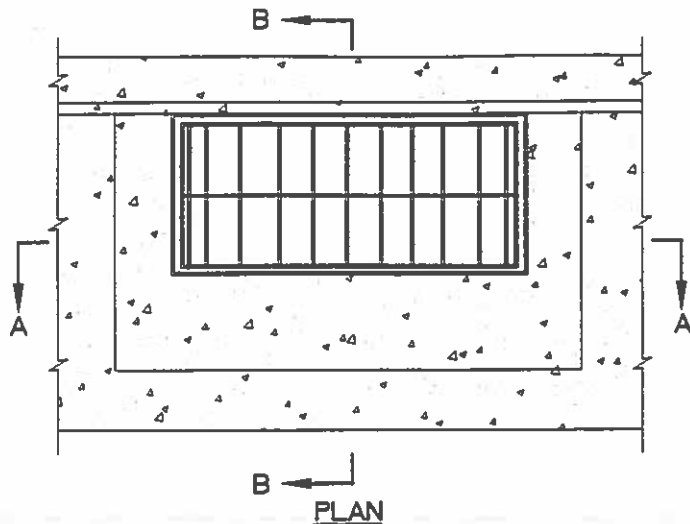


**CITY OF BAY CITY**

**OVERSIZED CURB INLET**

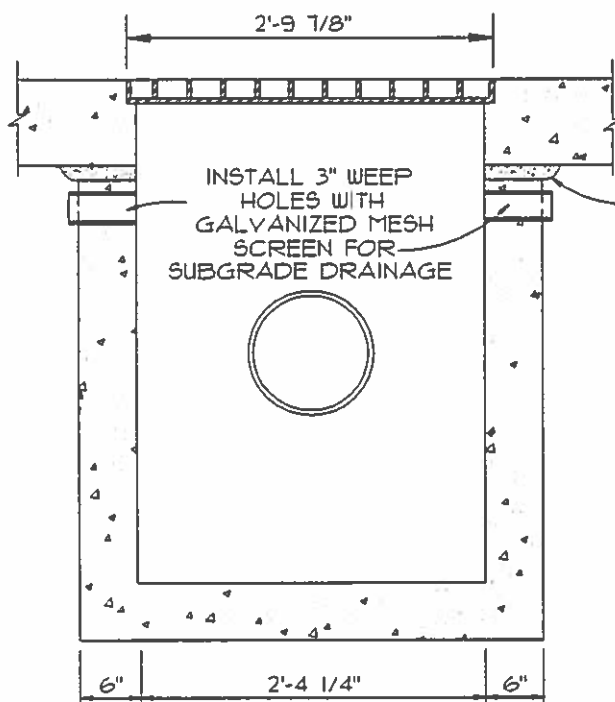
DATE:  
MAY 12, 1994

DRAWING NO.  
R-114BC

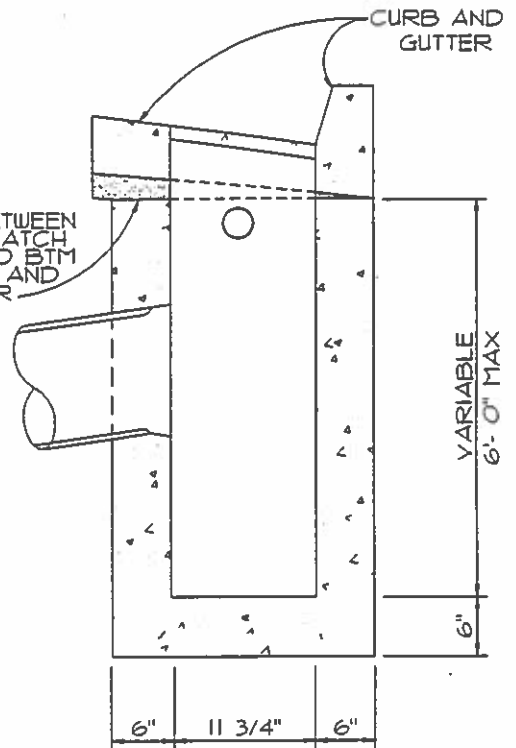


**NOTES:**

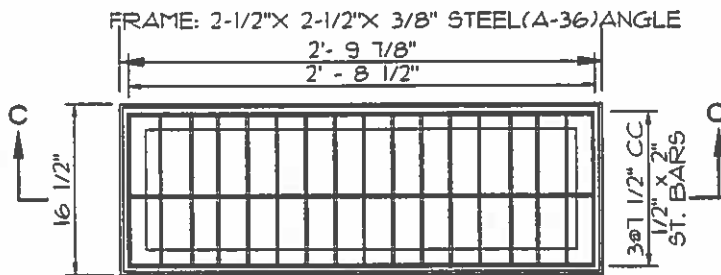
1. PRECAST BASE WALLS MAY BE A MINIMUM OF 4" THICK.
2. CONCRETE SHALL BE CLASS 3000.
3. APPROVED CAST IRON FRAMES AND GRATES MAY BE ACCEPTED.



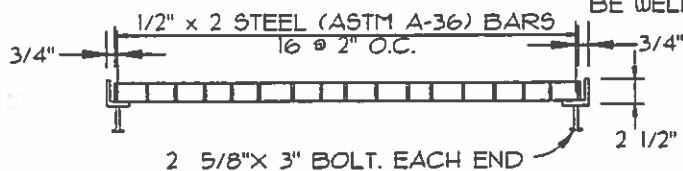
**SECTION A-A**



**SECTION B-B**

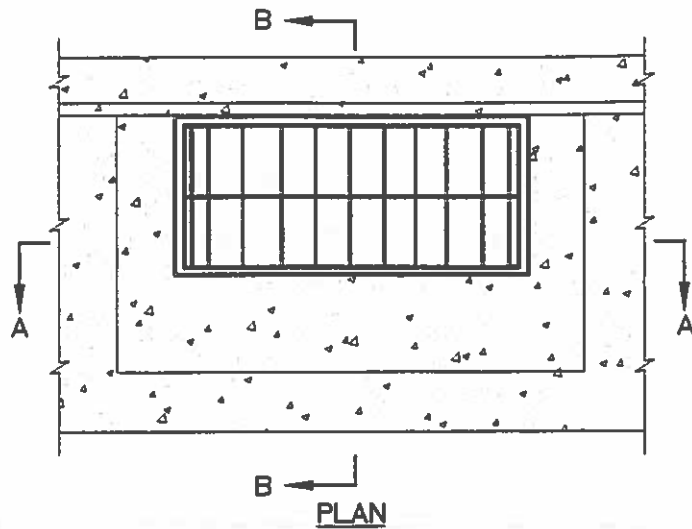


**FRAME AND GRATE PLAN**



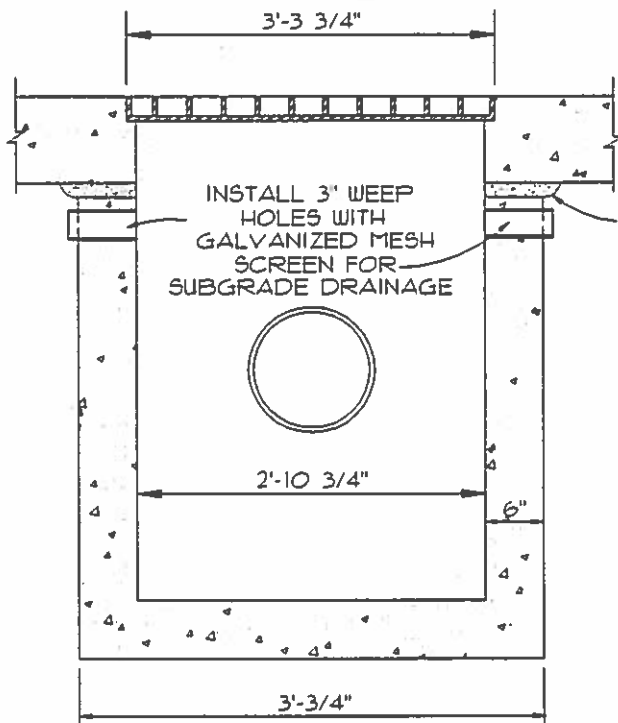
**SECTION C-C**

<b>CITY OF BAY CITY</b>	
<b>CATCH BASIN</b>	
DATE: MAY 12, 1994	DRAWING NO. R-115BC

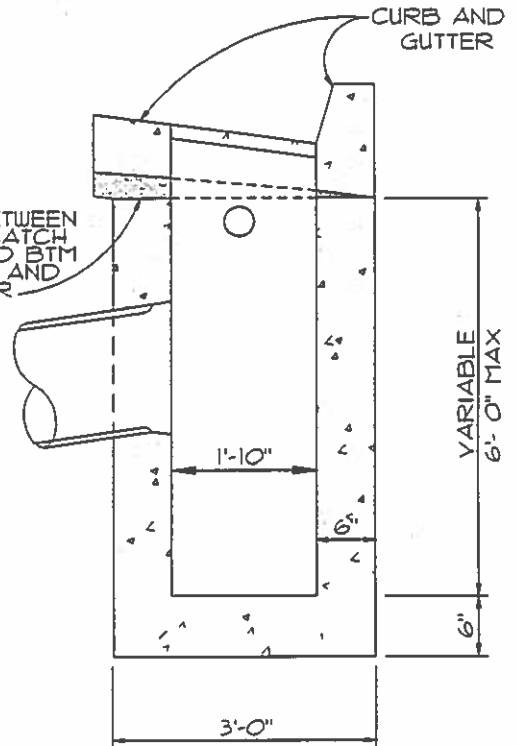


**NOTES:**

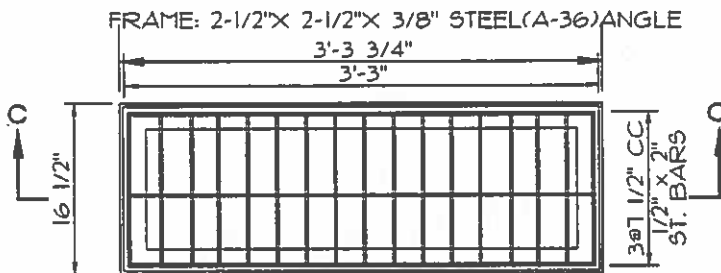
1. PRECAST BASE WALLS MAY BE A MINIMUM OF 4" THICK.
2. CONCRETE SHALL BE CLASS 3000.
3. APPROVED CAST IRON FRAMES AND GRATES MAY BE ACCEPTED.



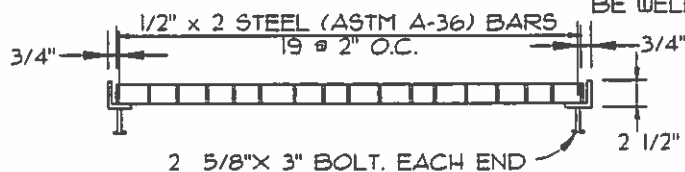
**SECTION A-A**



**SECTION B-B**



**FRAME AND GRATE PLAN**



**SECTION C-C**

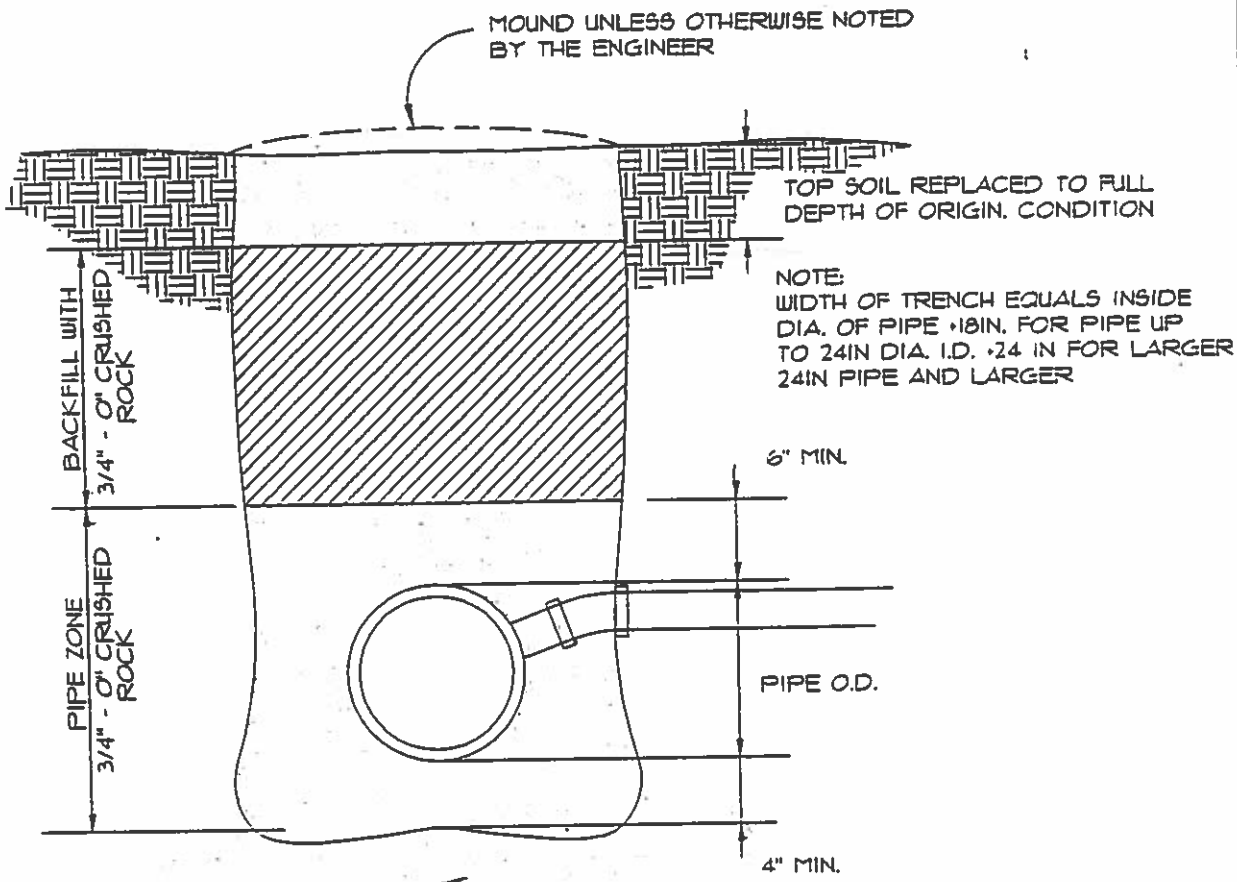
ALL CORNERS OF GRATE BARS TO BE WELDED

**CITY OF BAY CITY**

**OVERSIZE CATCH BASIN**

DATE:  
MAY 12, 1994

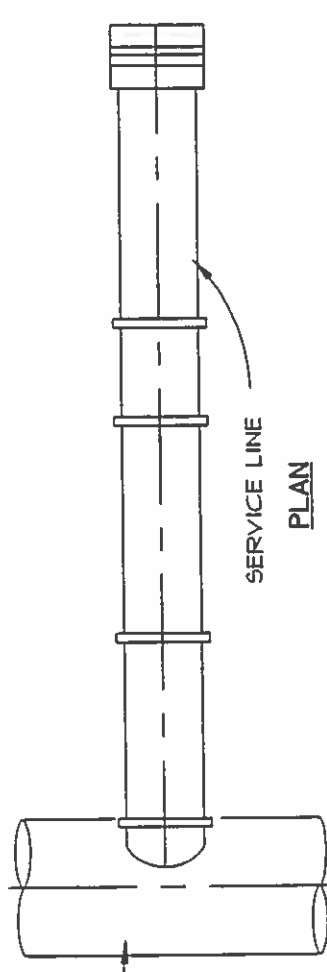
DRAWING NO.  
R-116BC



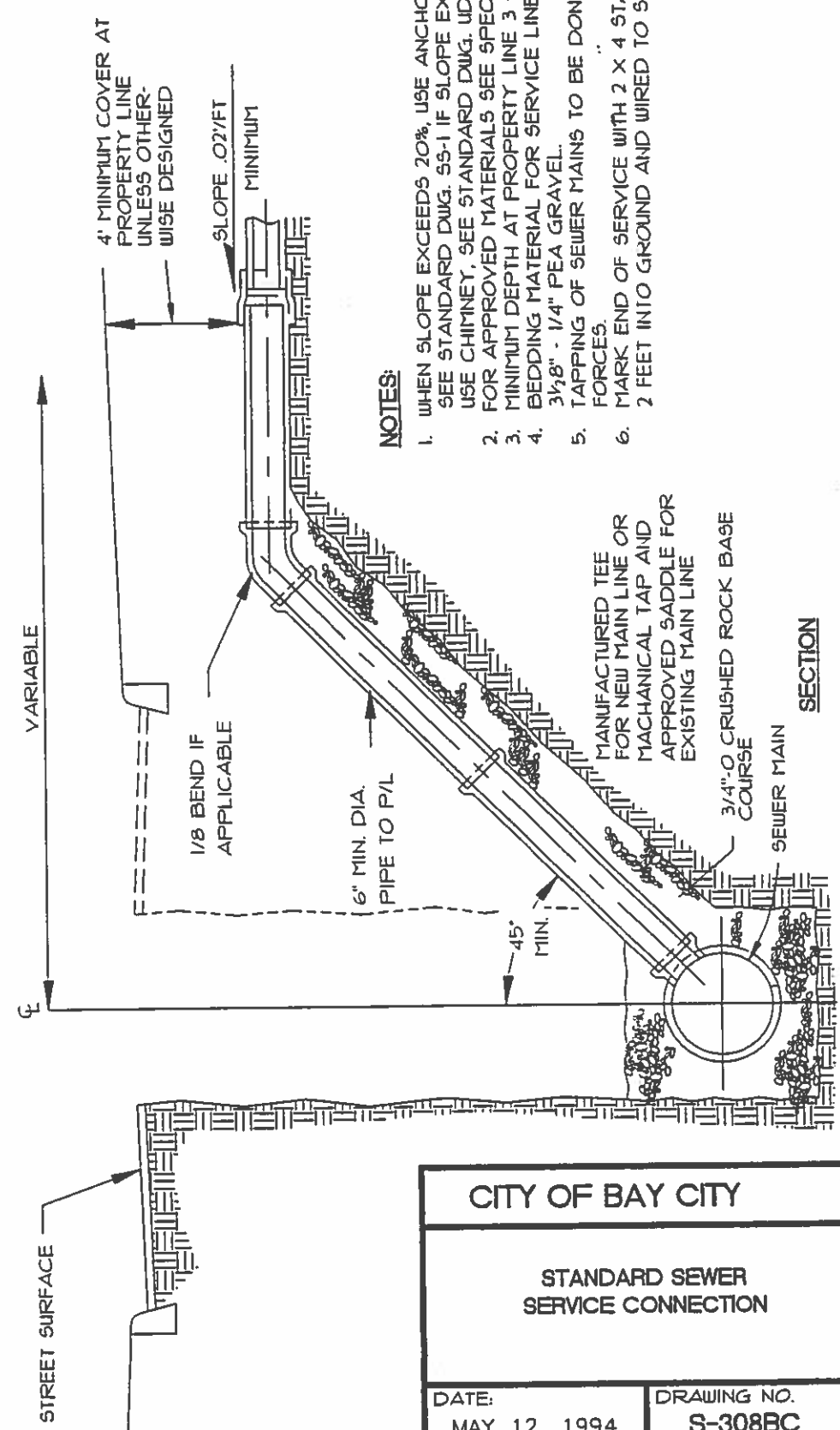
FOUNDATION STABILIZATION AS DIRECTED BY THE ENGINEER.

**NOTE:**  
 IN SPECIAL CASES, SELECT BACKFILL MAY BE SPECIFIED AND USED AS RECOMMENDED BY THE ENGINEER.

CITY OF BAY CITY	
STANDARD SEWER TRENCH DETAIL	
DATE: MAY 12, 1994	DRAWING NO. S-310BC



SERVICE LINE  
PLAN



4' MINIMUM COVER AT  
PROPERTY LINE  
UNLESS OTHER-  
WISE DESIGNED

SLOPE .02/FT  
MINIMUM

1/8 BEND IF  
APPLICABLE

6" MIN. DIA.  
PIPE TO P/L

MANUFACTURED TEE  
FOR NEW MAIN LINE OR  
MECHANICAL TAP AND  
APPROVED SADDLE FOR  
EXISTING MAIN LINE

3/4" O CRUSHED ROCK BASE  
COURSE

SEWER MAIN

SECTION

**NOTES:**

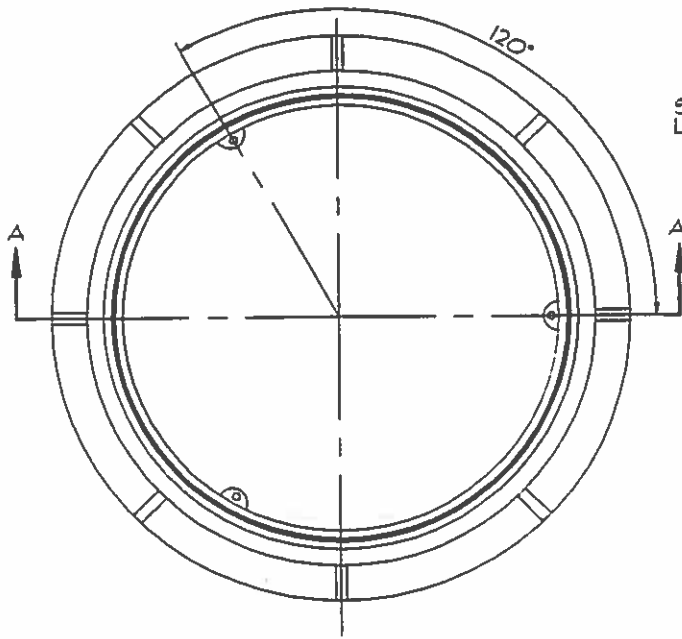
1. WHEN SLOPE EXCEEDS 20%, USE ANCHOR BLOCKS, SEE STANDARD DWG. 55-1 IF SLOPE EXCEEDS 100% USE CHIMNEY, SEE STANDARD DWG. UDI14.
2. FOR APPROVED MATERIALS SEE SPECIFICATIONS.
3. MINIMUM DEPTH AT PROPERTY LINE 3 FEET.
4. BEDDING MATERIAL FOR SERVICE LINES MAY BE 3 1/2" - 1/4" PEA GRAVEL.
5. TAPPING OF SEWER MAINS TO BE DONE BY CITY FORCES.
6. MARK END OF SERVICE WITH 2 X 4 STAKE, DRIVEN 2 FEET INTO GROUND AND WIRED TO SERVICE LINE.

CITY OF BAY CITY

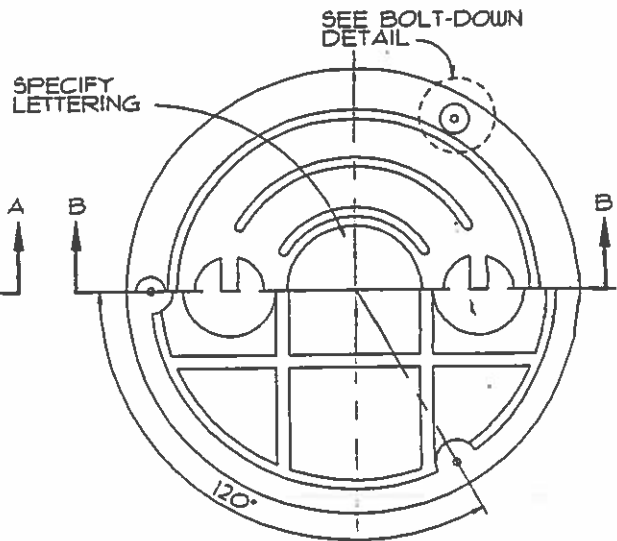
STANDARD SEWER  
SERVICE CONNECTION

DATE:  
MAY 12, 1994

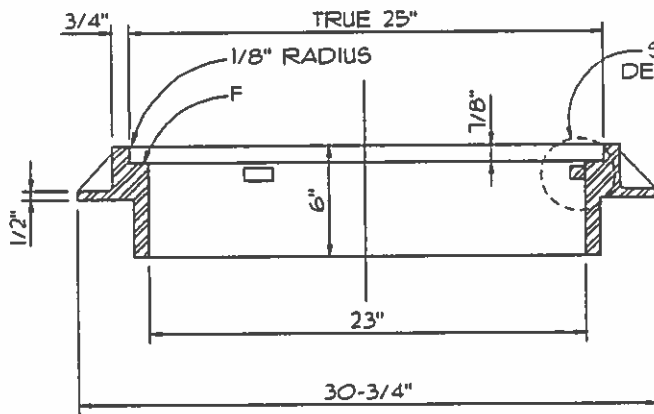
DRAWING NO.  
S-308BC



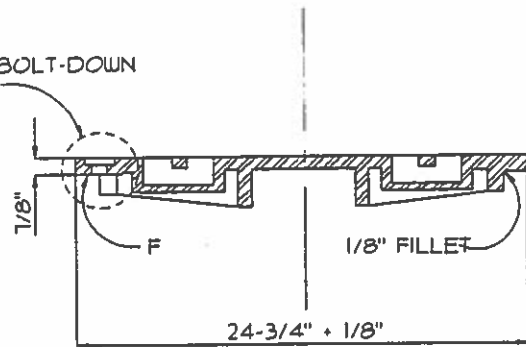
**MANHOLE FRAME PLAN**



**MANHOLE FRAME PLAN**

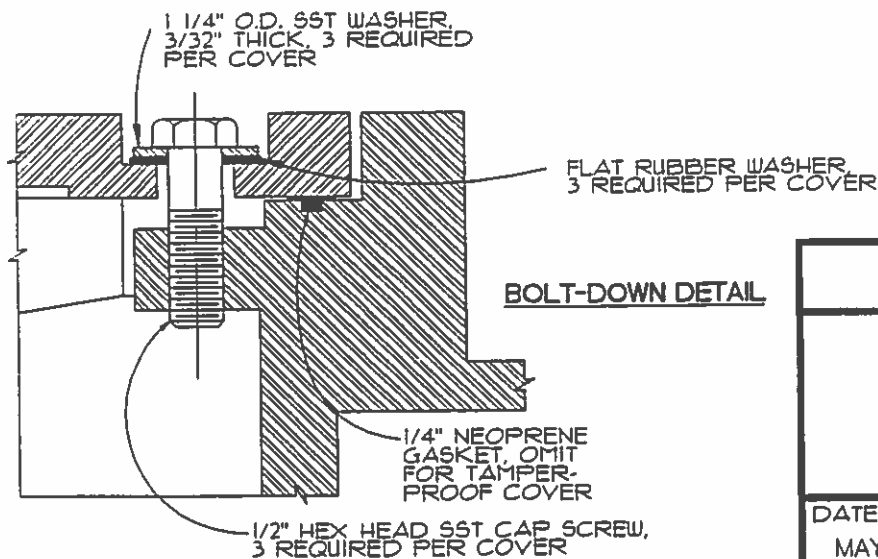


**SECTION A-A**



**SECTION B-B**

**NOTE** LID CENTER MARKING SHALL BE "S" IF USED FOR SEWER



**BOLT-DOWN DETAIL**

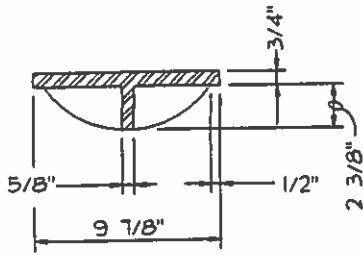
**CITY OF BAY CITY**

**WATERTIGHT MANHOLE  
RING AND COVER**

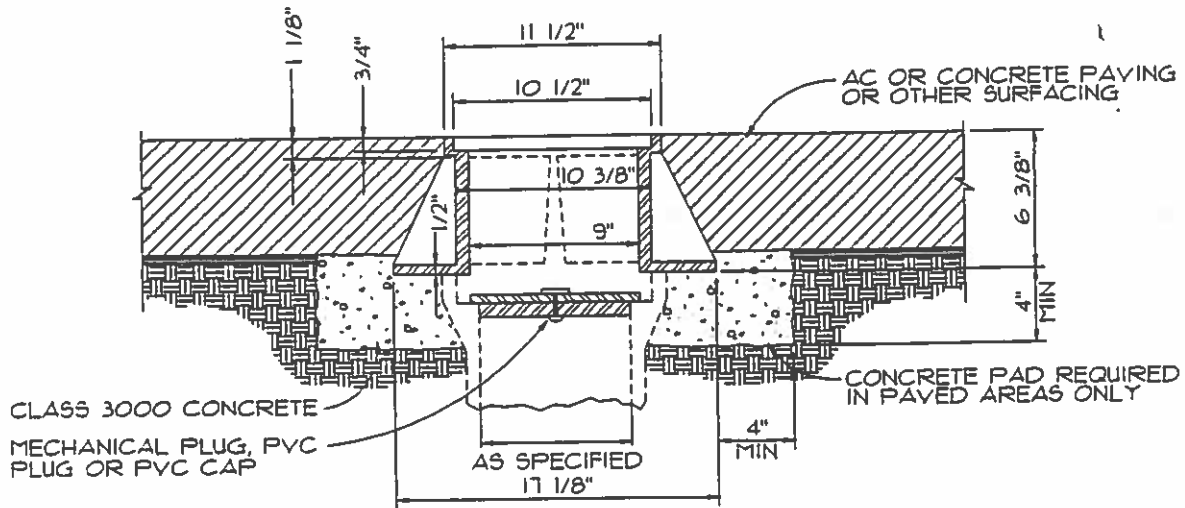
DATE:  
MAY 12, 1994

DRAWING NO.  
S-307BC

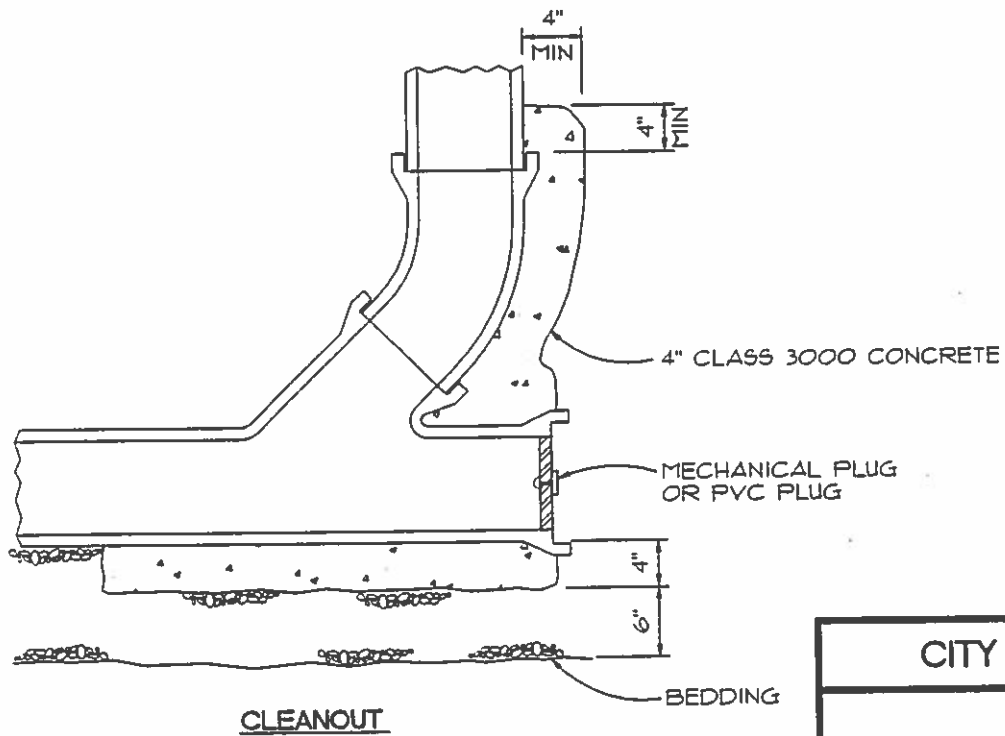




CAST IRON COVER

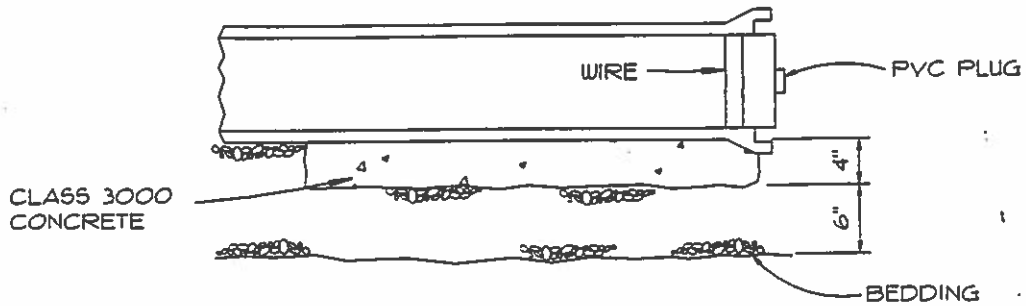


CAST IRON FRAME

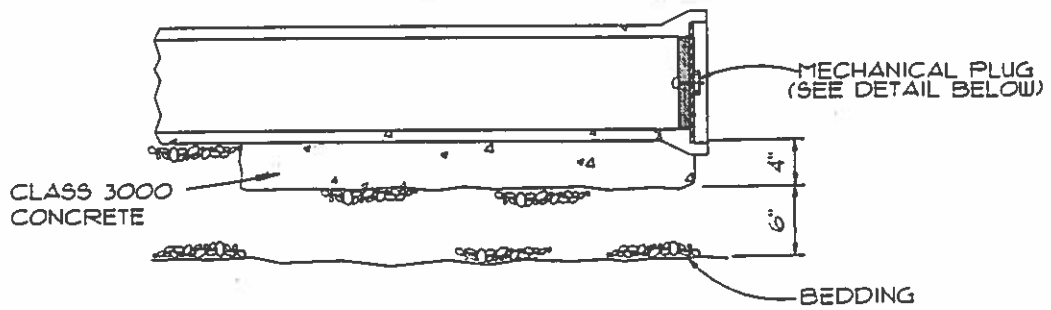


CLEANOUT

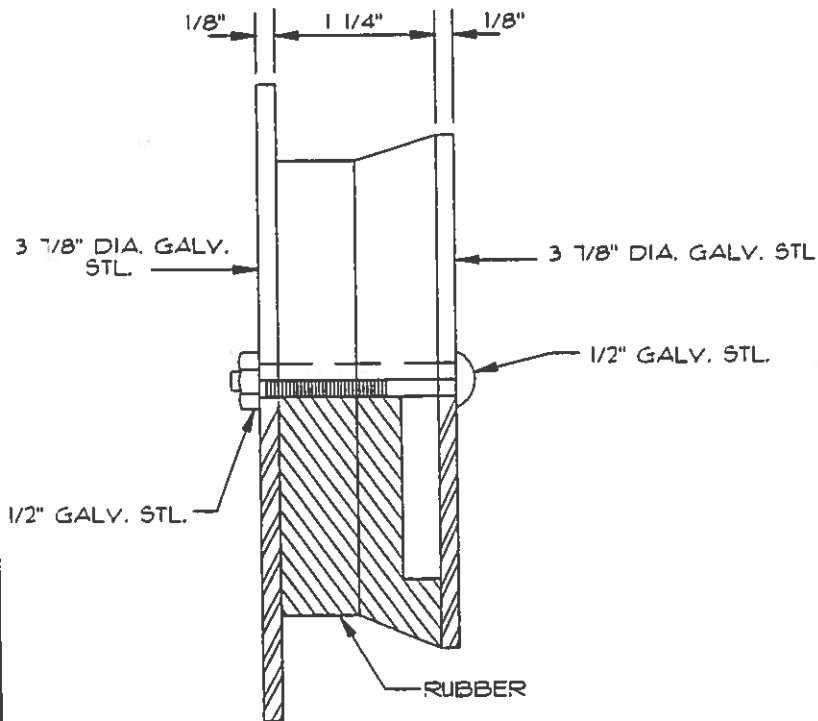
<b>CITY OF BAY CITY</b>	
<b>STANDARD CLEANOUT</b>	
DATE: MAY 12, 1994	DRAWING NO. S-306BC



PVC PLUG



MECHANICAL PLUG



MECHANICAL PLUG DETAIL

<b>CITY OF BAY CITY</b>	
<b>STANDARD PLUGS FOR NEW SANITARY SEWERS</b>	
DATE: MAY 12, 1994	DRAWING NO. S-309BC

MANHOLE FRAME AND COVER AS SPECIFIED.

FRAME AND RISER RINGS SHALL BE SEALED WITH PREFORMED PLASTIC OR RUBBER TO FORM A WATERTIGHT SEAL. GROUT MAY BE USED FOR STORM SYSTEMS.

PRECAST RISER RINGS

MANHOLE STEPS SHALL BE PROVIDED UNLESS SPECIFIED.

STANDARD MANHOLE AS SPECIFIED ON PLANS (SEE STANDARD MANHOLE DETAIL)

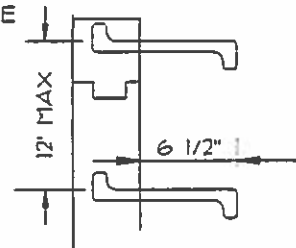
BOTTOM STEP 16" MAX. HEIGHT FROM LEDGE

PRECAST BASE OR POURED CONCRETE BASE, 5 SACK MIX 3000 P.S.I. AT 28 DAYS

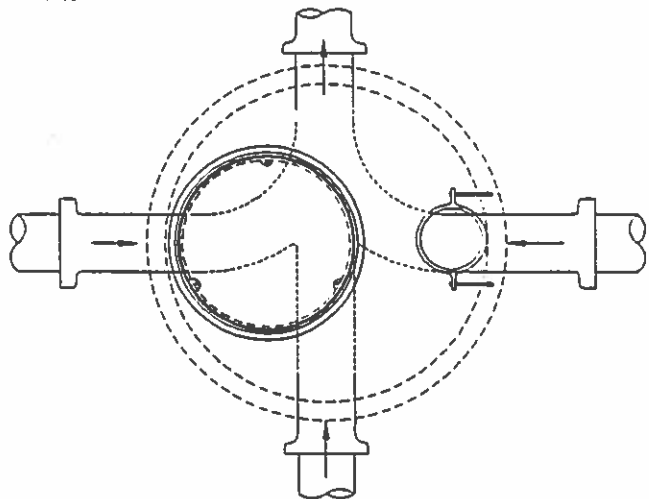
6" COMPACTED BASE COURSE

LATERAL CONNECTION WHERE SHOWN ON PLANS (TYP) MATCH CROWN ELEVATION OF LARGER OUTFLOW PIPE

STANDARD MANHOLE RUNGS 12" O.C.



RUNG DETAIL



FINISH GRADE

VARIABLE 3" MIN. 12" MAX.

ECCENTRIC MANHOLE TYPE

36"



4%

4"

4"

4"

4"

4"

4"

4"

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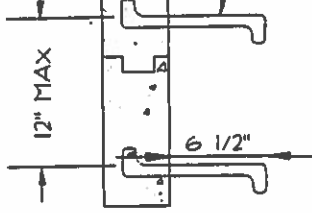
MANHOLE FRAME AND COVER AS SPECIFIED.

FRAME, RISER RINGS AND JOINTS SHALL BE SEALED WITH PREFORMED PLASTIC OR RUBBER TO FORM A WATERTIGHT SEAL.

STANDARD MANHOLE RUNGS 12" O.C.

FINISH GRADE

VARIABLE



RUNG DETAIL

ECCENTRIC MANHOLE TYPE

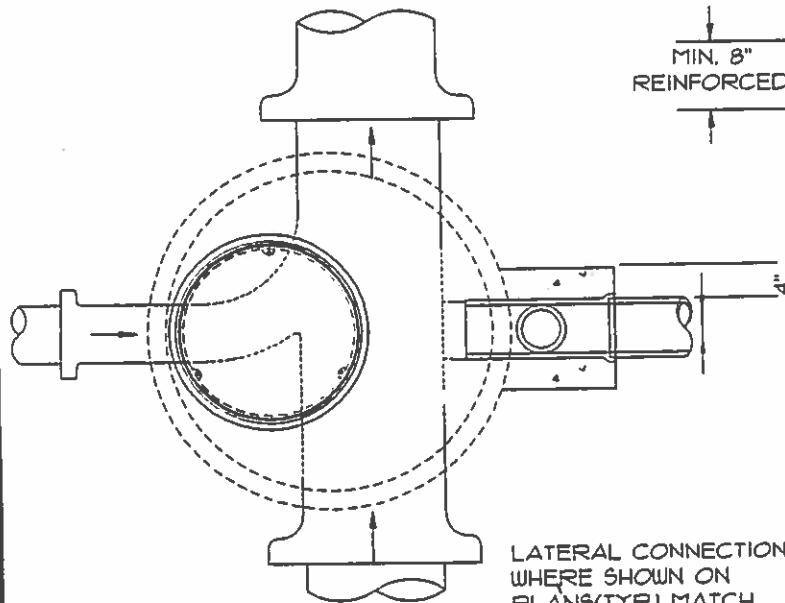
48"

BOTTOM STEP 16" MAX. HEIGHT FROM LEDGE

PRECAST BASE OR POURED CONCRETE BASE, 5 SACK MIX 3000 P.S.I. AT 28 DAYS

6" COMPACTED BASE COURSE

MIN. 8" REINFORCED



LATERAL CONNECTION WHERE SHOWN ON PLANS (TYP) MATCH CROWN ELEVATION OF LARGER OUTFLOW PIPE

CITY OF BAY CITY

MANHOLE DETAILS FOR 24" PIPE AND OVER

DATE: MAY 12, 1994

DRAWING NO. S-304BC

MANHOLE FRAME AND COVER  
AS SPECIFIED.

FINISH GRADE

FRAME, RISER RINGS AND  
JOINTS SHALL BE SEALED WITH  
PREFORMED PLASTIC OR  
RUBBER TO FORM A  
WATERTIGHT SEAL.

VARIABLE

ECCENTRIC MANHOLE  
TYPE

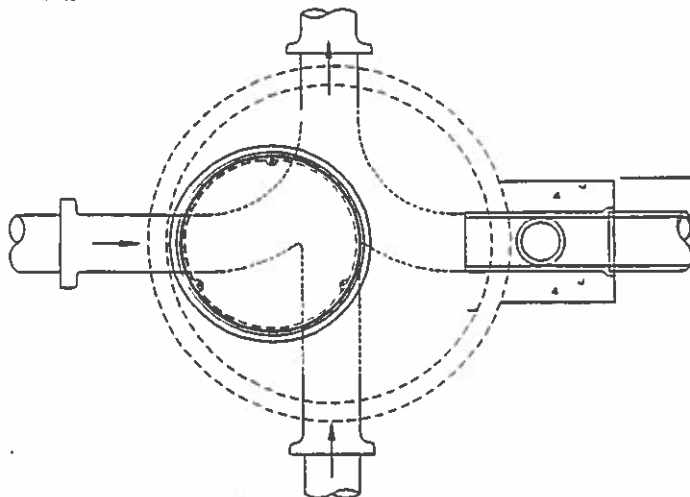
48"  
BOTTOM STEP 16"  
MAX. HEIGHT FROM  
LEDGE

POURED CONCRETE  
BASE, 5 SACK MIX  
3000 P.S.I. AT 28 DAYS

6" COMPACTED BASE COURSE

LATERAL CONNECTION WHERE SHOWN  
ON PLANS(TYP) MATCH CROWN  
ELEVATION OF LARGER OUTFLOW  
PIPE

MIN. 8"  
REINFORCED



CITY OF BAY CITY

STANDARD OUTSIDE  
DROP MANHOLE

DATE:  
MAY 12, 1994

DRAWING NO.  
S-303BC

MANHOLE FRAME AND COVER AS SPECIFIED.

FRAME, RISER RINGS AND JOINTS SHALL BE SEALED WITH PREFORMED PLASTIC OR RUBBER TO FORM A WATER-TIGHT SEAL.

STANDARD MANHOLE RUNGS 12" O.C. (SEE RUNG DETAIL)

BOTTOM STEP 6" MAX. HEIGHT FROM LEDGE

PRECAST OR Poured CONCRETE BASE, 5 SACK MIX 3000 P.S.I. AT 28 DAYS

6" COMPACTED BASE COURSE

FINISH GRADE

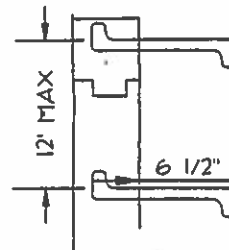
VARIABLE (18" MAX)

ECCENTRIC MANHOLE TYPE

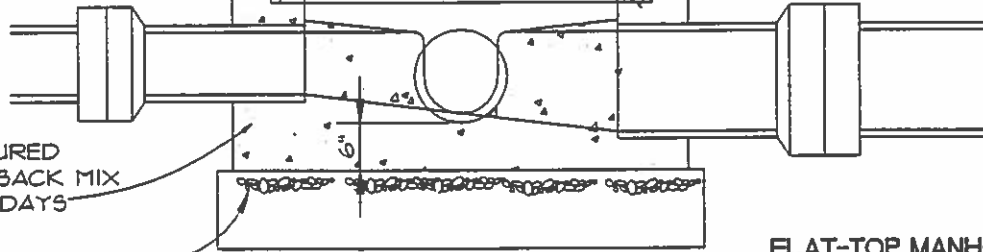
36"

48"

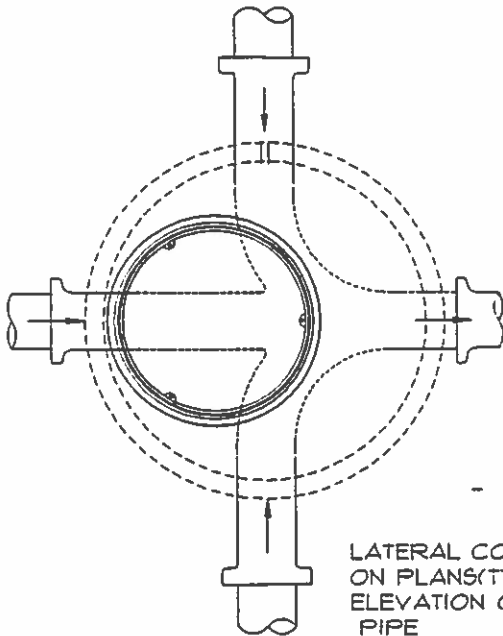
4"



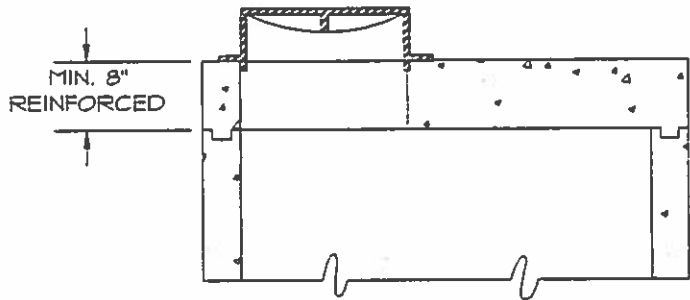
RUNG DETAIL



FLAT-TOP MANHOLE ACCEPTABLE ALTERNATE



LATERAL CONNECTION WHERE SHOWN ON PLANS(TYP), MATCH CROWN ELEVATION OF LARGER OUTFLOW PIPE

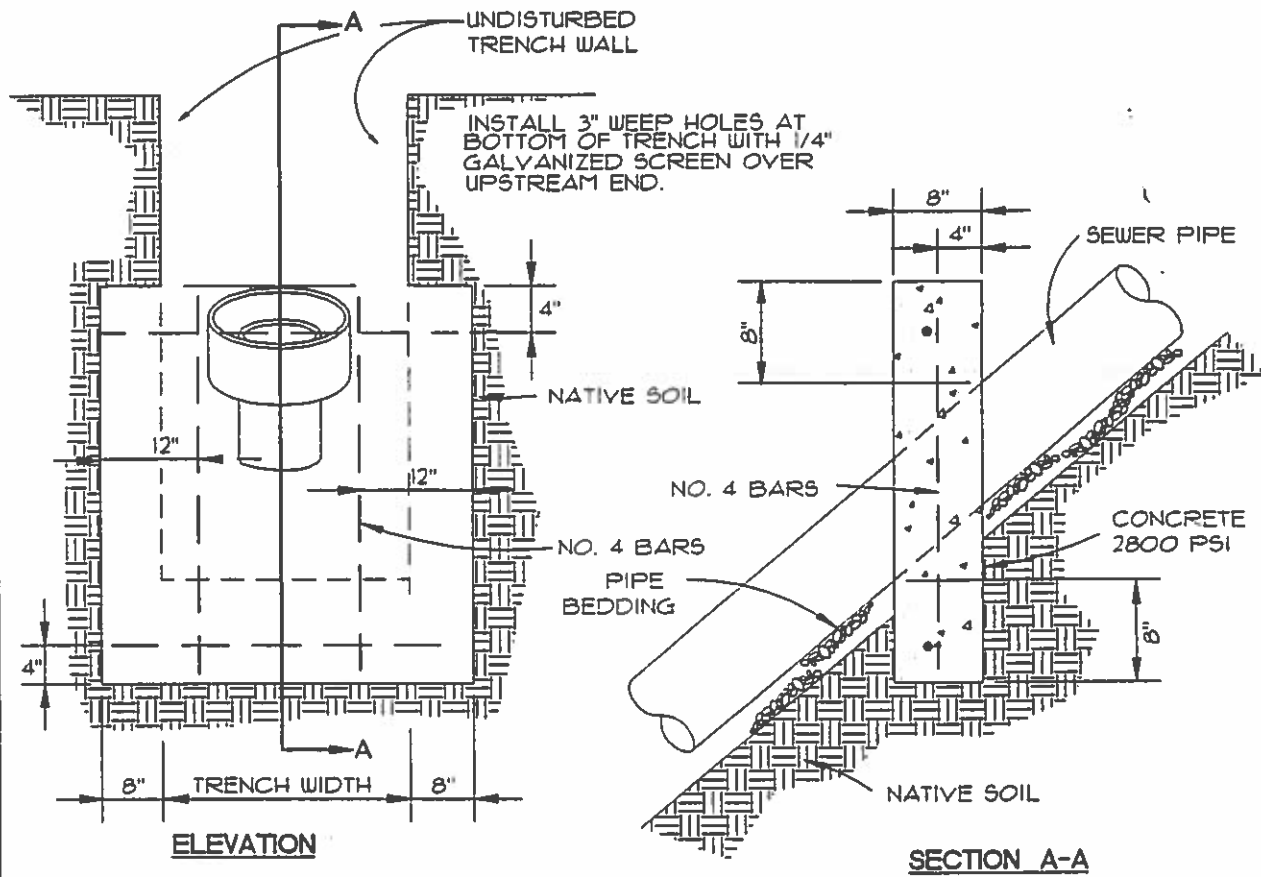


CITY OF BAY CITY

STANDARD MANHOLE

DATE:  
MAY 12, 1994

DRAWING NO.  
S-302BC



**SPACING FOR ANCHOR BLOCK FOR ALL SIZES**

SLOPE %	MINIMUM SPACING (FT)
0 - 19	NO ANCHOR REQUIRED
20 - 34	35
35 - 50	25
OVER 51	15' OR SPECIAL DESIGN

**NOTES:**

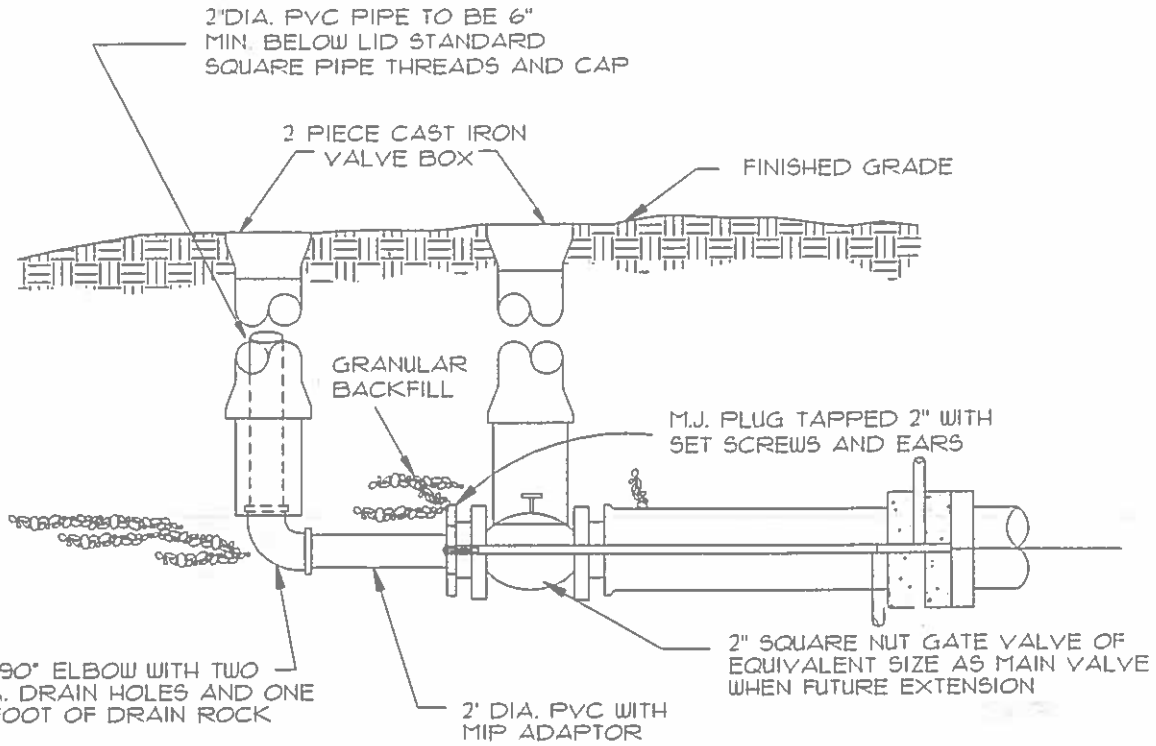
1. CONCRETE ANCHOR WALLS (CLASS 3000) SHALL BE CONSTRUCTED USING FORMS. REMOVE FORMS PRIOR TO BACKFILLING TRENCH.
2. STANDARD ABOVE APPLIES TO SEWER LINES OF 6"-12" DIAMETER. FOR 4" DIAMETER SEWER PIPE, ANCHOR BLOCK IS SAME AS ABOVE WITHOUT REINFORCEMENT. PIPES LARGER THAN 12" DIAMETER SHALL HAVE ANCHOR BLOCKS OF SPECIAL DESIGN.
3. ANCHOR BLOCK SHALL ALWAYS BE LOCATED AT THE BARREL SECTION OF PIPE AND NOT AT THE JOINT.

**CITY OF BAY CITY**

**STANDARD ANCHOR  
BLOCK DETAILS FOR  
SANITARY SEWER**

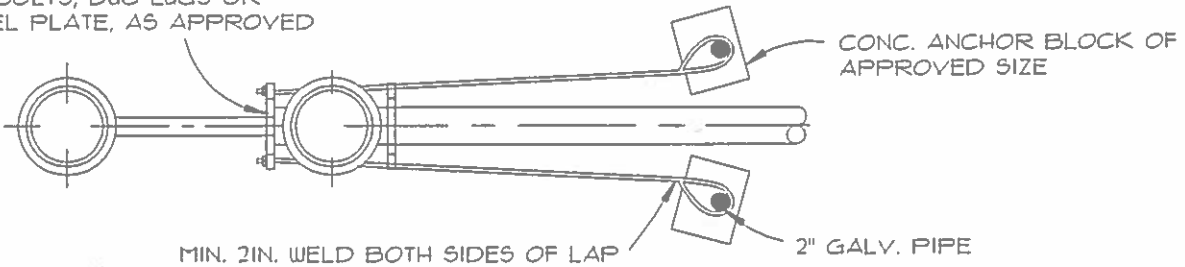
DATE:  
MAY 12, 1994

DRAWING NO.  
S-301BC



**PROFILE**

TIE BOLTS, DUC LUGS OR STEEL PLATE, AS APPROVED



**PLAN**



**STEEL PLATE ALTERNATE FOR M.J. PLUG WITHOUT EARS**

**NOTES:**

1. WRAP MAIN & FITTINGS IN THRUST BLOCK ZONE WITH TWO LAYERS OF POLYETHYLENE FILM TO FACILITATE FUTURE REMOVAL.
2. ANCHOR BLOCK SIZE TO BE SPECIFIED OR APPROVED BY THE CITY.
3. TIE RODS TO BE A 301 STEEL BOLT STOCK WITH 14,000psi TENSILE STRENGTH OR APPROVED EQUAL NUMBER RODS AND SIZE APPROVED BY THE CITY.

**CITY OF BAY CITY**

**STANDARD BLOWOFF ASSEMBLY**

DATE:  
MAY 12, 1994

DRAWING NO.  
W-201BC



RAISED LETTERING

CAST IRON COVER

2" SQUARE OPERATION NUT  
WELDED TO PIPE SHAFT

OPERATOR EXTENSION 1 1/2"  
SCHEDULE 80 PIPE SHAFT

FLAT BAR 2-1/2" x 2-1/2" x 3/8"

3/8" x 3/4" SQUARE HEAD  
CUPPED CAPSCREWS

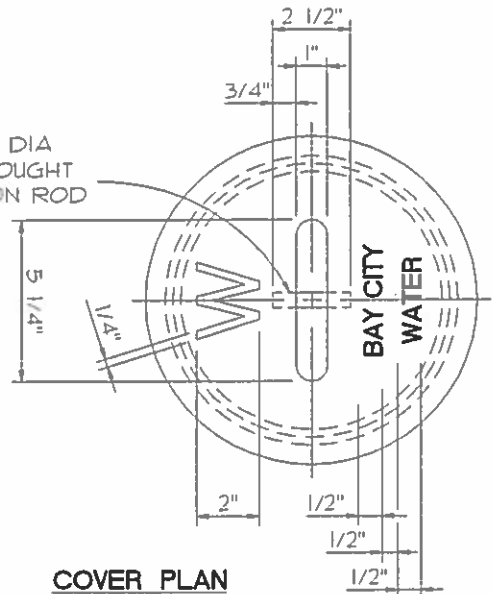
3" x 3" x 3/8" x 2" LONG  
STEEL SQUARE TUBE WELDED ALL  
AROUND TO FLAT BAR

TWO PIECE IRON VALVE  
BOX ASSEMBLY

ROCK GUARD, 1/8" STEEL PLATE:  
DIAMETER = VALVE BOX  
EXTENSION INSIDE DIAMETER  
MINUS 1/2"

**VALVE BOX EXTENSION SECTION**

1/2" DIA  
WROUGHT  
IRON ROD



**COVER PLAN**

**NOTES:**

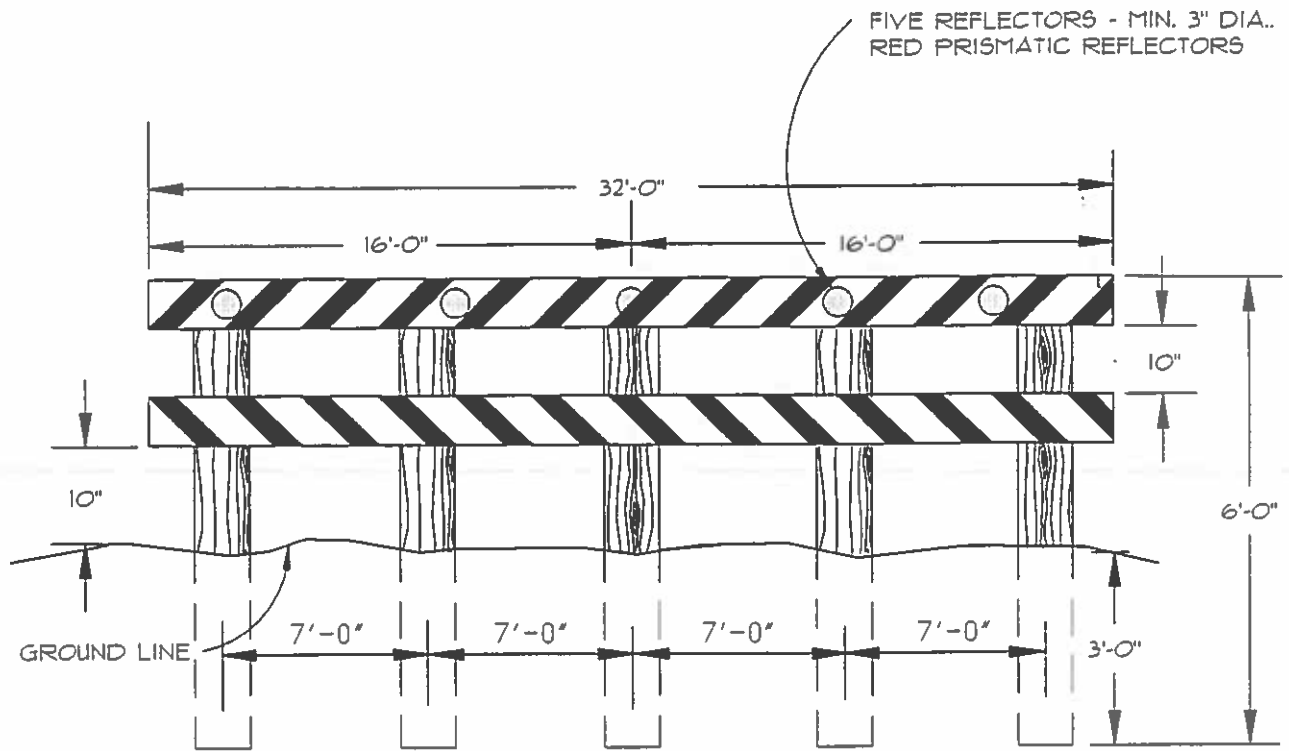
1. VALVE BOX NOT TO REST ON OPERATING ASSEMBLY.
2. OPERATOR EXTENSION REQUIRED WHEN VALVE NUT IS DEEPER THAN 4 FEET FROM FINISH GRADE.
3. CENTER VALVE BOX ON AXIS OF OPERATOR NUT.
4. VALVES 12" AND SMALLER SHALL BE PROVIDED WITH CLASS B BASE ON UNDISTURBED GROUND. VALVES GREATER THAN 12" SHALL BE INSTALLED ON PRECAST CONCRETE PIER BLOCK.
5. VALVE BOX EXTENSION SHALL BE CAST IRON OR PVC (ASTM D 3034).

**CITY OF BAY CITY**

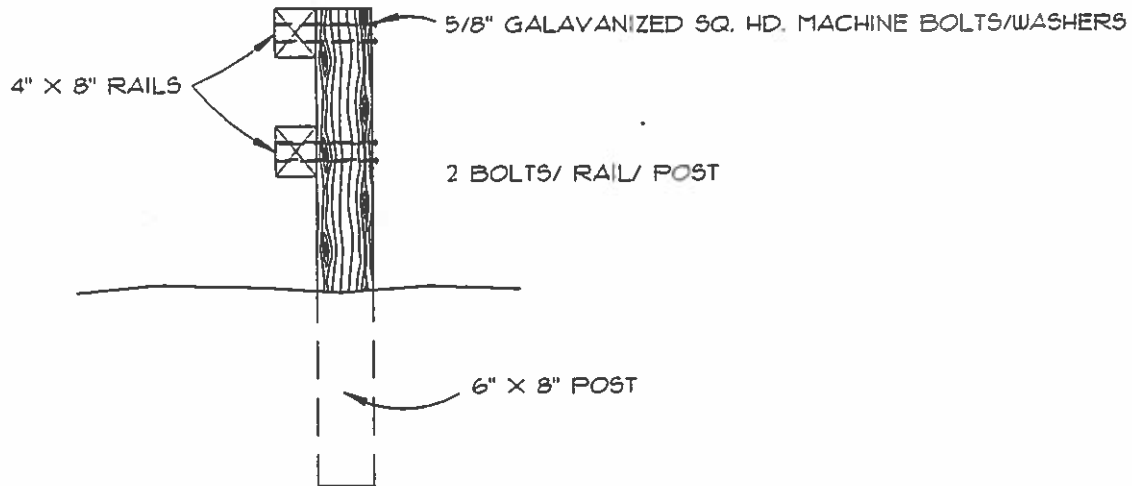
**STANDARD VALVE BOX  
AND COVER**

DATE:  
MAY 12, 1994

DRAWING NO.  
W-202BC



**BARRICADE**



**NOTES:**

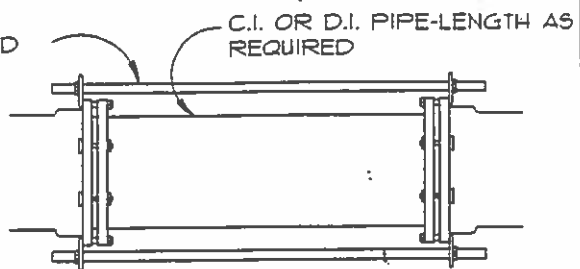
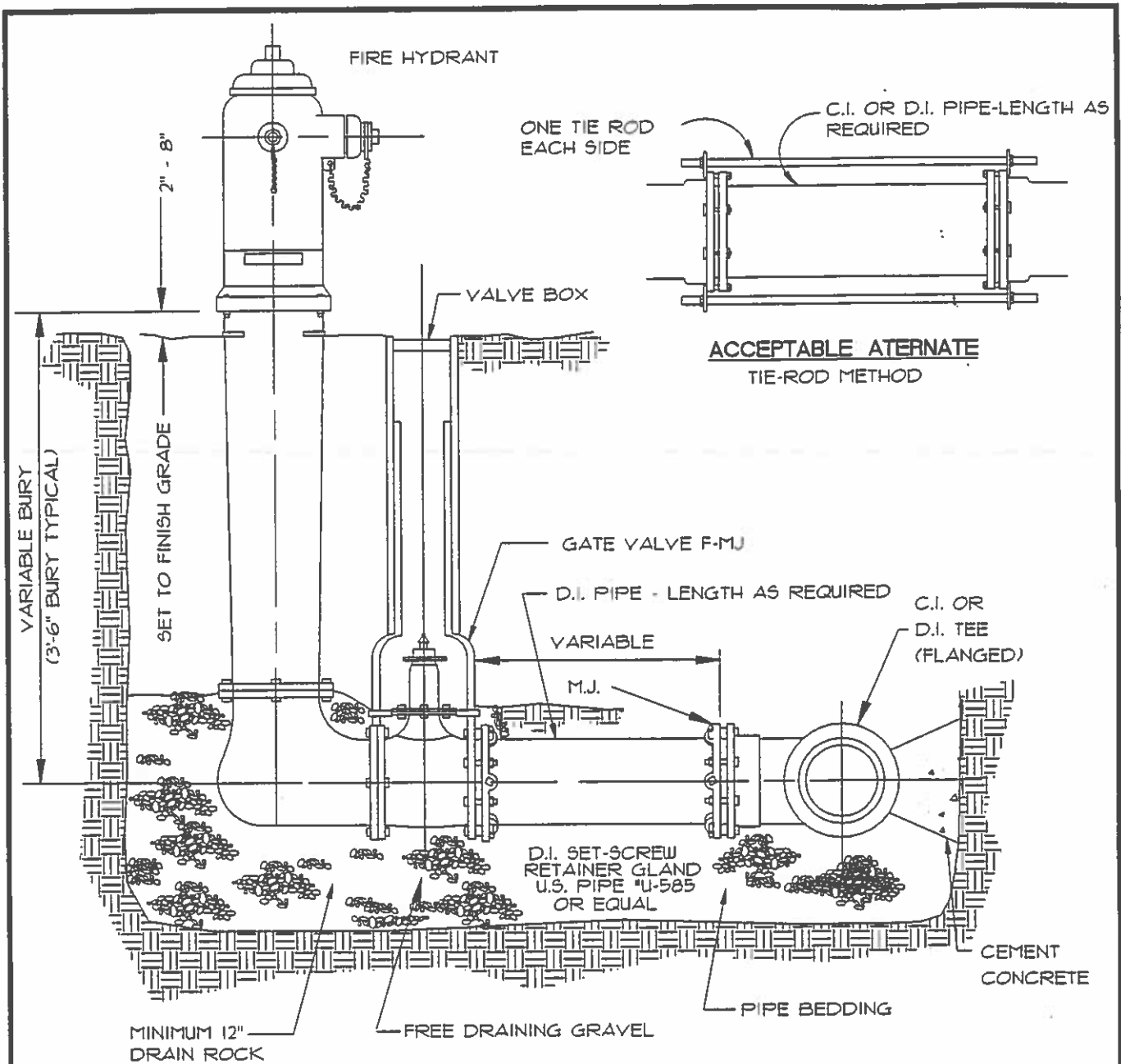
RAILS TO BE PAINTED BLACK WITH  
WHITE STRIPES-POSTS PAINTED WHITE-  
ALL WOOD PRESSURE TREATED.

**CITY OF BAY CITY**

**STREET BARRICADE**

DATE:  
MAY 12, 1994

DRAWING NO.  
R-109BC



**ACCEPTABLE ALTERNATE  
TIE-ROD METHOD**

**NOTES:**

1. TIE RODS TO BE 5/8", A307 STEEL BOLT STOCK WITH 14,000 PSI TENSILE STRENGTH OR APPROVED EQUAL.
2. IF HYDRANT IS NOT INSTALLED ON STUB.
  - A. DELETE PIER BLOCK AND GRAVEL FOR DRAINAGE.
  - B. BOLT 1/2" PLYWOOD COVER OVER OPEN FLANGE OF GATE VALVE.
3. DO NOT PLACE THRUST BLOCKS BEHIND TEE OR HYDRANT

**CITY OF BAY CITY**

**STANDARD FIRE HYDRANT  
INSTALLATION**

DATE:  
MAY 12, 1994

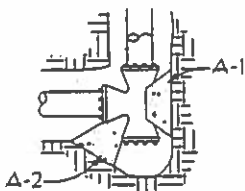
DRAWING NO.  
W-203BC

(HORIZONTAL) BEARING AREA OF THRUST BLOCKS IN SQUARE FEET							(VERTICAL) VOLUME OF THRUST BLOCK IN CUBIC YARDS					
FITTING SIZE	TEE, WYE, DEAD END AND HYDRANT	STRADDLE BLOCK	90° BEND PLUGGED CROSS	TEE PLUGGED ON RUN		45° BEND	22-1/2° BEND	11-1/4° BEND	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
				A-1	A-2							
4	1.0	1.6	1.4	1.9	1.4	1.0	---	---	---	---	---	---
6	2.1	3.7	3.0	4.3	3.0	1.6	1.0	---	1.3	---	---	---
8	3.8	6.5	5.3	7.6	5.4	2.9	1.5	1.0	2.3	1.1	---	---
10	5.9	10.2	8.4	11.8	8.4	4.6	2.4	1.2	3.7	1.8	---	---
12	8.5	14.7	12.0	17.0	12.0	6.6	3.4	1.7	5.5	2.8	1.2	---
14	11.5	---	16.3	23.0	16.3	8.9	4.6	2.3	7.6	3.9	1.7	---
16	15.0	26.1	21.3	30.0	21.3	11.6	6.0	3.0	9.9	5.1	2.3	0.9
18	19.0	---	27.0	38.0	27.0	14.6	7.6	3.8	---	---	---	---
20	23.5	40.8	33.3	47.0	33.3	18.1	9.4	4.7	---	---	---	---
24	34.0	58.8	48.0	68.0	48.0	26.2	13.6	6.8	---	---	---	---

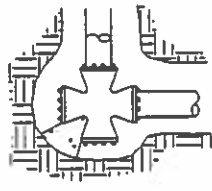
**NOTES:**

- ABOVE BEARING AREAS BASED ON TEST PRESSURE OF 150 PSI AND AN ALLOWABLE SOIL BEARING STRESS OF 2000 POUNDS PER SQUARE FOOT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES AND SOIL BEARING STRESSES, USE THE FOLLOWING EQUATION:  

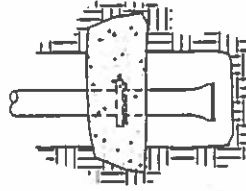
$$\text{BEARING AREA} = (\text{TEST PRESSURE} / 150) \times (2000 / \text{SOIL BEARING STRESS}) \times (\text{TABLE VALUE})$$
- ABOVE VOLUMES BASED ON TEST PRESSURE OF 150 PSI AND THE WEIGHT OF CONCRETE = 4050 POUNDS PER CUBIC YARD. TO COMPUTE FOR DIFFERENT TEST PRESSURES, USE THE FOLLOWING EQUATION: 
$$\text{VOLUME} = (\text{TEST PRESSURE} / 150) \times (\text{TABLE VALUE})$$



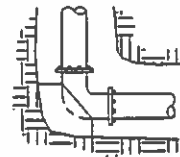
TEE



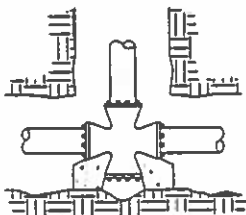
CROSS



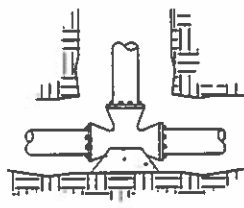
STRADDLE BLOCK



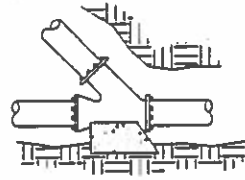
BEND



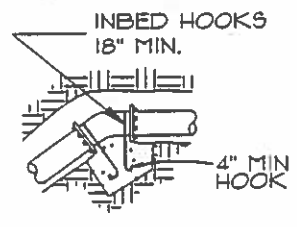
CROSS



TEE



WYE



VERTICAL BEND

**NOTES:**

- CONCRETE THRUSTING BLOCKING TO BE POURED AGAINST UNDISTURBED EARTH.
- CONCRETE SHALL BE KEPT CLEAR OF ALL JOINTS AND ACCESSORIES.
- IF NOT SHOWN ON PLANS REQUIRED BEARING AREAS AND VOLUMES AT FITTING SHALL BE AS INDICATED ABOVE, ADJUSTED IF NECESSARY, TO CONFORM TO THE TEST PRESSURE(S) AND ALLOWABLE SOIL BEARING STRESS(ES) STATED IN THE SPECIAL SPECIFICATIONS.
- BEARING AREAS, VOLUMES AND SPECIAL BLOCKING DETAILS SHOWN ON PLANS TAKE PRECEDENCE OVER BEARING AREAS AND BLOCKING DETAILS SHOWN ON THIS STANDARD DETAIL.

**CITY OF BAY CITY**

**STANDARD THRUST BLOCKING +  
VERTICAL BEND ANCHOR BLOCK  
DETAILS**

DATE:  
MAY 12, 1994

DRAWING NO.  
W-204BC

SIZE	AREA, IN <sup>2</sup>	THRUST AT		NO. OF FULL DIA. BARS WELDED TO PLATES			NO. THREADED BARS		
		150 P.SI	225PSI	5/8 IN.	3/4 IN.	1 IN.	5/8 IN.	3/4 IN.	1 IN.
2	3.1416	300	450	2	WARNING DUC-LUGS WILL NOT HOLD		2	WARNING - NO DUC-LUGS	
4	12.566	1 885	2 827	2			2		
6	28.274	4 241	6 362	2			3		
8	50.265	7 540	11 310	3	2	2	4	3	2
10	78.540	11 781	17 672	5	3	2	6	4	2
12	113.10	16 965	25 448	6	5	3	8	6	3
14	153.94	23 091	34 636	9	6	4	11	8	4
16	201.06	30 159	45 238	11	8	5	15	10	6
18	254.47	38 170	57 256	14	10	6	19	13	7
20	314.16	47 124	70 686	17	12	7	23	16	9
24	452.39	67 858	101 788	24	17	10	33	22	12
30	706.86	106 029	159 044	38	26	15	51	34	19
36	1017.9	152 685	229 028	54	38	21	73	49	27

**TIE ROD REQUIREMENTS**

SIZE	AREA	STRENGTH
5/8	.3068	4 295 LBS
3/4	.4414	6 185
1	.7854	10 996

**FULL DIAMETER BARS**

SIZE	TENSILE AREA	STRENGTH
5/8	.2256	3 158 LBS
3/4	.3340	4 676
1	.6051	8 471

**THREADED BARS**

**NOTES**

1. RODS SHOULD CONFORM TO A307 BOLT STOCK AT 14,000 PSI
2. DESIGN FOR 150 PSI WITH 1.5 SAFETY FACTOR (EQUALLING 225 PSI)
3. 5/8" RODS SHALL GO THROUGH BOLT HOLES, HAVE DUCTILE IRON LUGS, STARR TIE BOLTS, STEEL PLATES
4. 3/4" RODS SHALL GO THROUGH BOLT HOLES, HAVE STARR TIE BOLTS, STEEL PLATES
5. 1" RODS SHALL CONNECT TO STEEL PLATE, STRAPS, OR "EARS"

<b>CITY OF BAY CITY</b>	
<b>TIE ROD REQUIREMENTS</b>	
DATE: MAY 12, 1994	DRAWING NO. W-205BC