CITY OF UMATILLA

STANDARD SPECIFICATIONS

WATER & SEWER UTILITIES

JANUARY 2013

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INTRODUCTION

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INTRODUCTION

1.1 GENERAL

The information set forth in this document is intended to provide minimum standards for improving design and construction of water supply and treatment facilities, wastewater treatment facilities, and transmission, collection and distribution systems. Questions regarding interpretations of the provisions in this document shall be addressed to Umatilla City Hall - Utilities Department .

1.2 DEFINITIONS

Except where specific definitions are used within a specific section, the following terms, phrases, words, and their derivation shall have the meaning given herein when consistent with the context. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number. The word "shall" is mandatory, and the word "may" is permissive.

A. <u>AASHTO</u> - means American Association of State Highway and Transportation Officials. Any reference to AASHTO standards shall be taken to mean the most recently published revision unless otherwise specified.

B. <u>ANSI</u> - means American National Standards Institute. Any reference to ANSI standards shall be taken to mean the most recently published revision unless otherwise specified.

C. <u>As-Built/Record Drawings</u> - means completed construction drawings (one set of reproducible drawings), documenting the actual construction work as it exists in the field, including any changes made from the originally approved drawings and certified by an Engineer, not necessarily the Engineer-of -Record. The Engineer(s) shall be registered in the State of Florida and all drawings shall have the Engineer(s) seal, signature, date and the words "As-Built/Record Drawings" affixed to each sheet of the drawing. Also includes electronic copy of drawings in AutoCadd or DXF format.

D. ASTM - means American Society for Testing Materials. Any reference to ASTM standards shall be taken to mean the most recently published revision unless otherwise specified.

E. AWWA - means American Water Works Association. Any reference to AWWA Standards shall be taken to mean the most recently published revision unless otherwise specified.

F. Contractor - means the person, firm, or corporation with whom the contract for work has been made by the Owner, the Developer, City, or the County.

G. City - means the City of Umatilla, Florida or its designated representative.

H. Cross Connection - means any unprotected actual or potential connection or structural arrangement between a public or a customer's potable water system and any other source or system through which it is possible to introduce into any part of the potable water system any used water, industrial fluid, gas, or substance other than the intended potable water with which the system is supplied.

I. Developer - means the person, firm, or corporation engaged in developing or improving real estate for use or occupancy.

J. Developer's Engineer - means an Engineer or Engineering firm registered with the State of Florida, Department of Professional Regulation, retained by the Developer to provide professional engineering services for a project.

K. DIPRA - means Ductile Iron Pipe Research Association.

L. Director - means the Director of Public Works for the City of Umatilla, Florida acting directly or through an assistant or other representative authorized by him.

M. Drawings - means engineering drawings prepared by an Engineer to show the proposed construction.

N. Dryline Permit - means a construction permit for water and/or sewer lines issued with certain special conditions applied. All such permitted projects cannot be put into service until all special conditions attached to the permit have been met.

O. Engineer - means an Engineer or Engineering firm registered with the State of Florida Department of Professional Regulation.

P. Fire Line - Piping from the water main to point of delivery for exclusively providing fire protection.

Q. FDEP - means State of Florida Department of Environmental Protection.

R. FDOT - means State of Florida Department of Transportation.

S. Geotechnical/Soils Engineer - means a Registered Florida Engineer who provides services related to terrain evaluation and site selection, subsurface exploration and sampling, determination of soil and rock properties, foundation engineering, settlement and seepage analysis, design of earth and earth retaining structures, the design of subsurface drainage systems and the improvement of soil properties and foundation conditions, and testing and evaluation of construction materials.

T. Manual On Uniform Traffic Control Devices - means the United States Department of Transportation Manual on Uniform Traffic Control Devices, latest edition.

U. Lake County - means Lake County, Florida.

V. NEMA - means National Electrical Manufacturers Association. Any reference to NEMA Standards shall be taken to mean the most recently published revision unless otherwise specified.

W. NSF - means National Sanitation Foundation. Any reference to NSF Standards shall be taken to mean the most recently published revision unless otherwise specified.

X. OSHA - means the Federal Occupational Safety and Health Administration.

Y. Owner - means the person, firm, corporation, or governmental unit holding right of possession of the real estate upon which construction is to take place.

Z. Plans - means drawings as defined herein above.

A.A. Point of Connection - shall mean, for potable water and/or reclaimed water, to be the outlet side of the meter designated to serve the customer. For unmetered reclaimed water the point of connection shall be at the property line.

B.B. Public Potable Water Supply Systems shall mean wells, treatment systems, disinfection systems, reservoirs or other storage and high service pumping, pipes, lines, valves, meters, water mains and services, used or having the present capacity for future use in connection with the obtaining and supplying of potable water for domestic consumption, fire protection, irrigation, consumption by business, or consumption by industry. Without limiting the generality of the foregoing definition, the system shall embrace all necessary appurtenances and equipment and shall include all property, rights, easements and franchises relative to any such system and deemed necessary or convenient for the operation thereof.

C.C. Reclaimed Water - means water that has received at least advanced secondary treatment, high level disinfection and is reused after flowing out of the wastewater treatment facility. Water receiving additional treatment may be used in public access areas, when in compliance with the FDEP requirements pursuant to Chapter 62-610, FAC.

D.D. Right-of-Way - means the City, County or FDOT Right-of-Way

E.E. Road Construction Specifications – means City, County or FDOT Road Construction Standard Specifications

F.F. Specifications - means the specifications contained in the Appendix of this Code.

G.G. Standard Drawings - means the detailed drawings in the Appendix of this Code.

H.H. Standard Specifications - means the Department of Transportation, State of Florida, Standard Specifications for Road and Bridge Construction, latest edition.

I.I. Traffic Control and Safe Practices Manual- means the State of Florida Department of Transportation Manual on Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operation, latest edition.

J.J. Utility Accommodation Guide - means the State of Florida Department of Transportation Utility Accommodation Guide, latest edition.

K.K. Water Mains - means water transmission mains, distribution mains, pipes, fittings, valves, hydrants, services, meters and miscellaneous related appurtenances.

L.L. Water Meter - means that device which registers water flow to a customer with all appurtenances.

M.M. Water Service Line - The pipe from the water main to the point of connection.

N.N. Wastewater Mains - means wastewater gravity sewers, manholes, force mains, pump stations, fittings, valves, service laterals, and miscellaneous related appurtenances.

O.O. Wastewater Service Lateral - means those service laterals or force mains from the customer's property line to the wastewater main and all appurtenances.

P.P. Work - means the labor, materials, equipment, supplies, services and other items necessary for the execution, completion and fulfillment of the contract.

1.3. TRANSFER TO THE CITY OF ON-SITE WATER AND SEWER FACILITIES IN DEVELOPMENTS

A. Dedication to City - This subsection shall apply to all proposed water and wastewater mains to be owned, operated or maintained by the City. All new water mains or wastewater mains in subdivisions shall be dedicated to City in areas where the City presently can provide service or could provide service through a pipeline or contractual arrangement with another utility.

New water mains or wastewater mains located within Florida Public Service Commission (FPSC) certificated areas, areas where the City will not provide service, or in areas where services are provided by a not-for-profit or quasi-governmental entity will not be dedicated to the City.

B. Prior to water and sewer plan approval by the City Engineer and execution of water and sewer main extension applications to state agencies by the City, the builder or developer shall be required to execute a developer's agreement. This agreement shall run with the land and be binding on the developer, its successors, assigns and any other subsequent owner of the land, setting forth such reasonable provisions governing developer and City responsibility pertaining to the installation of service facilities; the interconnection of plumber's lines with the facilities of the City; the manner and method of payment of contributions, fees and charges; guaranteed revenue provisions; standards of construction or specifications; regulations, policies, practices and procedures of the City; prohibitions against improper use of the City's facilities; and other matters normally associated with and contained in developer agreements. Developer agreements shall only apply to specific parcels of property and are not assignable or transferable in any manner to any other parcel of property.

C. Each developer who has constructed a portion of the water mains and wastewater mains on the developer's own property prior to interconnection with the City's existing or proposed facilities shall convey such component parts of the water mains and wastewater mains to the City by “bill of sale” in form satisfactory to the City Attorney, together with such evidence as may be required by the City; that the water and wastewater mains proposed to be transferred to the City are free of all liens and encumbrances; that the City Engineer has approved the construction of said lines and accepted the tests to determine that such construction is in accordance with the criteria established by the City and that the City Council has evidenced its acceptance of such lines for the City's ownership, operation and maintenance.

D. The developer shall maintain accurate cost records establishing the construction costs of all utility facilities constructed by the developer and proposed to be transferred to the City. Such cost information shall be furnished to the City concurrently with the “bill of sale”, and such cost information shall be a prerequisite for the acceptance by the City of the portion of the water and wastewater mains constructed by the developer.

E. The City may refuse connection and deny the commencement of service to any consumer seeking to be connected to portions of the water and wastewater mains installed by the developer until such time as the provisions of this section have been fully met by the developer or the developer's successors or assigns.

SECTION 2

WATER SUPPLY SYSTEM DESIGN

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WATER SUPPLY SYSTEM DESIGN

2.1 GENERAL

This section sets forth the general requirements for the design of the water supply system.

2.2 PLAN REVIEW, APPROVAL, CONSTRUCTION, AND ACCEPTANCE OF WATER AND WASTEWATER IMPROVEMENTS

A. Plans and Specifications

1. Master Plan

   Whenever possible, the entire water and wastewater systems shall be shown on a single Master Plan. The Master Plan shall indicate the general locations of all mains, manholes, valves, hydrants, services and service laterals with respect to the proposed development improvements and the existing water and wastewater systems. Main sizes shall be indicated on the Master Plan. The city shall require (7) sets of drawings for review.

2. Plan and Profile

   All gravity sewers, all wastewater force mains, and off-site water mains shall be drawn in plan and profile. On-site water mains may be shown in plan view only.

   Whenever possible, on-site water and wastewater systems shall be shown on the same drawing sheet. As a minimum, the plan and profile drawings shall include the following information:

   a. General information such as north arrow, names of designer and Engineer, revision block with dates, graphic scale(s) and sheet number.

b. Profile with elevations at one (1) foot interval, or more frequently if required by good design practice.

c. Development layout with horizontal and vertical controls.

d. All potential conflicts with other utility and drainage systems.

e. All manhole locations and rim elevations for manholes either in or outside of paved areas.

f. Pipe data including size, lengths, material, and slopes.

g. Size, type, and locations of fittings, valves, hydrants, air release/vacuum relief, and other related appurtenances.

h. Limits of pipe deflection not generally included on drawings.

i. Description and limits of special exterior coatings.

j. Description and limits of special bedding requirements.

k. Pipe restraint requirements.

l. Details of connection to existing systems.

m. Separate site plan(s) showing location(s) and general layout of wastewater pumping stations with details, working elevations and schedules.

n. Construction notes regarding cover, horizontal and vertical control, special construction requirements, and references to standard and special details.

3. <u>Details</u>

The Drawings shall include all applicable Standard Drawings. Special details shall be prepared by the Developer's Engineer for aerial and underwater crossings of rivers, streams, canals and ditches. Other special details shall be prepared by the Developer's Engineer as required the City Engineer.

4. Scale

The master plan shall be prepared at a scale not to exceed 1" to 400'. Plan and profile sheets shall not exceed a horizontal scale of 1" to 50'. Special details shall be of sufficiently large scale to show pertinent construction information.

B. General Criteria

1. City Utility Service Area

a. General

Where available, the owner of every lot or parcel of land within the city utility service area developed for residential, public, commercial office, industrial, warehousing or multifamily use shall connect the premises or cause the premises to be connected with the City’s water distribution system.

b. Service / Criteria

Availability of water and sewer will be as defined in the City Land Development Regulations.

2. Rural Land Area

a. In the rural land area where an existing public or privately-owned water system has the capacity and desire to expand and provide service to a proposed development, the standards in Paragraph 1.b., Service Criteria, above shall apply.

b. When there is no existing public or privately-owned water system available with expansion capability, the proposed development shall either develop and provide a central water system or if the project density cannot support such a system, individual wells may be provided, subject to the rules and regulations of the State of Florida, Department of Health and Rehabilitative Services and the appropriate water management district rules and regulations.

3. Approval

All construction drawings for water supply systems shall require approval of the City Engineer and Public Works Department.

4. Submittals

Requirements for submittal of construction drawings for water supply systems:

a. Drawings

Plans shall meet same scale and size requirements as Improvement Plans and shall be integrated into Improvement Plans when applicable.

b. Permits

Permits for construction of water supply facilities shall be obtained by the developer from City, County, and from Florida Department of Environmental Protection, prior to commencing construction.

c. Prepared by Engineer

Drawings for water supply facilities shall be prepared by a Florida registered professional engineer and submitted to the City. Submit the same number of copies of drawings as required for Improvement Plans.

5. Testing

Hydrostatic testing of water systems shall be certified and conform to the current requirements of the Florida Department of Environmental Protection.

C. Subdivision Related Water and Wastewater Mains

1. General

This section shall apply to all proposed community water and wastewater systems and mains to be owned, operated or maintained by the City, or in the City rights-of-way. These improvements shall be constructed in compliance with this Manual unless a waiver is granted by the City Council in accordance with City of Umatilla Land Development Code.

2. Design and Plan Review

Design of water and wastewater mains associated with City approved subdivisions shall be in compliance with the design standards in this article, and the specifications outlined in the City Land Development Regulations. Drawings will be reviewed and approved by the City Engineer and the City Public Works Department as part of the subdivision review and approval process.

3. Construction Inspection

Inspection of water and wastewater mains shall be in accordance with criteria established in the City Land Development Regulations. The City Engineer, Public Works Director, or their designated representative shall inspect the water and wastewater mains to ensure their compliance with requirements in the Appendix.

After all required water or wastewater mains have been installed, the Developer's Engineer shall submit certification to the City that the water and wastewater mains have been constructed in substantial conformance with the approved drawings and specifications. Non-compliance with approved plans or specifications or evidence of faulty materials or workmanship shall be called to the attention of the Developer or Developer's Engineer and if not corrected in an expeditious manner, all work on the project will be suspended and/or certificate of occupancy withheld. Laboratory tests may be required when appropriate.

4. Maintenance Materials, and Workmanship Warranty Bond

A bond shall be posted by the Developer and executed by a company authorized to do business in the State of Florida that is satisfactory to the City, payable to City in the amount of twenty (20) percent of the estimated construction cost of all required water and wastewater mains to be owned and maintained by the City. Such bond shall guarantee maintenance of all water and wastewater mains intended to be owned and maintained by the City for a two (2) year period, and the materials, workmanship and structural integrity of water and wastewater systems, and miscellaneous related facilities, excluding mechanical equipment for a one (1) year period, commencing after a Certificate of Completion has been issued by the City. The manufacturer's warranty will be acceptable for mechanical equipment. As an alternative to the provision of a surety bond, the Developer may provide for the deposit of cash in an escrow account or a letter of credit acceptable to the City.

5. Certificate of Completion/Approval for Maintenance and Acceptance

After successful completion of all water and wastewater mains, and after receipt of the required documents outlined in this Section, the City will provide a "Certificate of Completion" verifying the satisfactory construction of all water and wastewater mains intended to be owned and maintained by the City. After the one (1) year Warranty Period, verification by the City of satisfactory performance of all water and wastewater mains construction and compliance with The Developer's Agreement, the City will issue the "Approval for Maintenance", thereby releasing the Developer from further responsibilities.

Approval and acceptance of water and wastewater mains shall be in accordance with the criteria established in this Section.

6. Miscellaneous Water and Wastewater Mains

All water and wastewater mains constructed which are intended to be owned, operated or maintained by the City, shall be designed, reviewed, inspected and accepted in strict compliance with the criteria established hereinabove.

7. Compliance With Other Regulatory Requirements

It shall be the responsibility of the Developer to obtain and comply with all applicable Federal, State and Local regulatory permits.

8. As-Built/Record Drawings

The Developer's Engineer shall submit one (1) Reproducible Original and four (4) certified sets of As-Built/Record Drawings to the City prior to issuance of Certificate of Completion for the improvements. The Developer's Engineer shall be responsible for recording information on the approved Drawings concurrently with construction progress. As-Built/Record Drawings submitted to the City as part of the project acceptance shall comply with the following requirements:

a. Drawings
Drawings shall be legibly marked to record actual construction.

b. Actual Locations
Drawings shall show actual location of all underground and above ground water and wastewater piping and related appurtenances. All changes to piping location including horizontal and vertical locations of utilities and appurtenances shall be clearly shown and referenced to permanent surface

improvements. Drawings shall also show actual installed pipe material, class, etc.

c. Field Changes
Drawings shall clearly show all field changes of dimension and detail including changes made by field order or by change order.

d. Details
Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown.

e. Manholes & Valve Boxes
Location of all manholes, hydrants, valves, and valve boxes shall be shown. All valves shall be referenced from at least two and preferably three permanent points.

f. Dimensions
Dimensions between all manholes shall be field verified and shown. The inverts and grade elevations of all manholes shall be shown.

g. Signed and Sealed
Each sheet of the Drawings shall be signed, sealed and dated by the Developer's Engineer as being "As-Built/Record Drawings." Construction Drawings simply stamped "As Built" or "Record Drawings" and lacking in above requirements will not be accepted, and will be returned to the Developer's Engineer. The "Certificate of Completion" will not be issued until correct "As-Built/Record Drawings" have been submitted.

h. Electronic Data
The Developer's Engineer shall also submit on an Auto cad Disc or DXF File the required As-Built/Record Drawings. The engineer's seal with his signature shall be on the letter of transmittal.

D. Water Mains

1. System Design Criteria

   a. Type of Water Mains

      The City will approve Drawings for water supply mains and extensions only when such mains are designed and constructed in accordance with the criteria set forth in this Manual.

   b. Design Period

      Water mains should be designed for a 30 year life span and for the estimated ultimate tributary population, as delineated in the approved City Water Master Plan (latest edition) except in considering parts of the system that can be readily increased in capacity. Water systems shall be designed to satisfy the domestic water demand and fire protection requirements for the area.

   c. Location

      Water mains shall be located in dedicated rights-of-way or dedicated utility easements. When installed in rights-of-way, water mains shall, in general, maintain a consistent alignment with respect to the centerline of the road. All water mains located outside of dedicated rights-of-way shall require a minimum 20' easement. If a water main is located adjacent to a road right-of-way, a minimum 10' easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. All easements are subject to the approval and acceptance by the City. Water mains shall not be placed under retention ponds, retention pond berms, tennis courts, or any vertical structures. Water mains shall not be located along side or rear lot lines.

2. Design Basis

   a. Average Daily Flow and Peak Flows

Average daily water flow shall be calculated by referencing the Equivalent Residential Connection (ERC) flow rates as outlined in Appendix . The Appendix is subject to revision by amendment to this Manual. Maximum daily and peak hourly water flow rates shall be calculated by referencing the service area peaking factors to be determined by the City Utility Department.

b. Fire Flow Requirements

General: Water distribution systems and/or water main extensions shall be designed and constructed in accordance with the requirements of the City Fire Codes, the Insurance Services Offices (National Board of Fire Underwriters), as stated in their Fire Protection Rating Schedule "Needed Fire Flow" section and state codes.

Single-Family or Duplex Residential Dwellings: For single family or duplex residential development, not exceeding two (2) stories in height, a central water system shall be used for fire protection water supply which meets the requirements in Table 2-1 with a minimum residual system pressure of 20 psi.

Multi-Family, Commercial, Industrial, Institutional, and All Other Types: For multi-family residential developments, commercial or industrial developments, institutional or other types of structures the fire protection requirements shall be in accordance with the requirement of the City Fire Codes, the Insurance Services Office (National Board of Fire Underwriters), as stated in the Fire Protection Rating Schedule "Needed Fire Flow" section and state codes. In all cases, the minimum fire flows shall not be less than required for single family or duplex residential dwellings in Table 2-1.

Fire Flow Duration: Fire flow duration shall be 2-hours for fire flow demands up to 2,500 gallons per minute (gpm) and 3-hours for fire flow demands in excess of 2,500 gpm.

TABLE 2-2
MINIMUM FIRE FLOW REQUIREMENTS
FOR RESIDENTIAL DWELLINGS

1. Using the peak hourly demand rate, calculated by the Project Engineer, determine from Table 2-1 the minimum required fire flow rates in gallons per minute (to be used in designing water distribution system). For single family, multi-family and manufactured home developments in areas having less than 9 units per acre, fire flow rates, times and storage shall be based on the Table 2-1.

Table 2-1

PEAK HOURLY DOMESTIC DEMAND RATE IN GPM	MINIMUM REQUIRED FIRE FLOW IN GPM	TOTAL FLOW TIME IN HOURS	AVAILABLE STORED OR PUMPABLE WATER(1)
0 to 50	500	0.50	* 10,000
51 to 100	500	1.00	** 20,000
101 to 200	750	1.50	** 40,000
201 to 300	1,000	2.00	** 75,000
301 to 400	1,250	2.50	** 120,000
401 to 500	1,500	3.00	** 175,000
501 to 600	1,500	3.25	200,000
601 to 750	1,750	3.50	250,000
751 to 1,000	2,000	4.00	350,000
1,251 to 1,500	2,500	5.00	600,000
Over 1,500	(3)	(3)	***

2. For areas having 9 or more units per acre, multi-family residential areas and commercial, institutional or industrial areas fire flow rates, times and storage shall be based on the table below.

Table 2-2

PEAK HOURLY DOMESTIC DEMAND RATE IN GPM	MINIMUM REQUIRED FIRE FLOW IN GPM	TOTAL FLOW TIME IN HOURS	AVAILABLE STORED OR PUMPABLE WATER(1)
0 to 50	1,000	1.00	** 50,000
51 to 100	1,500	2.00	** 100,000
101 to 200	1,500	2.50	** 125,000
201 to 300	1,500	3.00	** 160,000
301 to 400	1,500	3.50	** 200,000
401 to 500	1,500	3.75	** 225,000
501 to 600	1,500	4.00	250,000
601 to 750	1,750	4.00	300,000
751 to 1,000	2,000	4.00	350,000
1,001 to 1,250	2,250	4.50	450,000
1,251 to 1,500	2,500	5.00	600,000
Over 1,500	(3)	(3)	***

Notes: ** This does not include hydropneumatic tank storage capacity.

** Where two wells are provided and total pump capacity exceeds 100% of combined peak hourly domestic demand rate and required fire flow demand rate, fire flow storage tanks are not required.

*** To be calculated by project engineer.

c. Design Calculations

Developer's Engineer shall submit signed, sealed and dated design calculations with the Drawings for all water distribution projects. Calculation shall show the water mains will have sufficient hydraulic capacity to transport peak hourly flows and the combination of maximum daily flows and fire flows while meeting the pressure requirements of Section 2.2.C.3.,. Head losses through meters and backflow devices shall also be included in calculations.

3. Details of Design and Construction

a. Pressure

All water mains shall be designed in accordance with Section 2.2.B.2 above. The system shall be designed to maintain a minimum pressure of 20 psi at all points in the distribution system under all conditions of flow. Higher pressures may be required at commercial, industrial and high density residential areas. The normal working pressure in the distribution system should be approximately 65 psi, but in no case less than 35 psi on the downstream side of a meter. For pressures greater than 80 psi special provisions such as pressure reducers may be required at the service connection. Surge protection shall be provided. Design friction losses for water mains shall be as specified as to this manual.

b. Diameter

Only 4", 6", 8", 10", 12", 16", 20", 24", 30", 36", 42", 48", and 54" diameter water mains shall be permitted. In cul-de-sac areas with a maximum length of 500 feet of pipe, a 4" looped connection may be permitted to prevent dead ends. As a minimum, 6" looped systems shall be required in low density residential projects. Where looping of mains is not practical, minimum 8" mains shall be required, unless detailed calculations are submitted to substantiate the sufficiency of a 6" main. In commercial, industrial, and high density residential areas, minimum 8" looped mains shall be required. Larger size mains shall be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in Section 2.2.C.3.a above.

c. Fire Hydrant Location and Spacing

As a minimum, specifications outlined herein and applicable City Fire Codes shall apply. In addition, flushing hydrants shall be placed at 1000 feet intervals to provide for proper flushing for all off-site mains.

d. Dead Ends

In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins whenever practical, as determined by the City Engineer.

Where dead-end mains occur, they shall be provided with a fire hydrant or with an approved flushing hydrant or blow-off (should meter all water used for flushing) for flushing purposes. Flushing devices shall be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.

e. Valves

Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves shall be located at not more than 300 foot intervals in commercial, industrial and high density residential areas and at not more than 500 foot intervals in all other areas. Appropriate valves shall also be provided at all areas where water mains intersect to ensure effective isolation of water lines for repair, maintenance or future extension.

f. Separation of Water Mains and Sewers

Refer to the horizontal and vertical separations and to the FDEP Rules and Regulations. The more stringent requirements shall apply. No water pipe shall pass through or come in contact with any part of a sanitary sewer manhole.

Extreme caution should be exercised when locating water mains at or near certain sites such as sewage treatment plants or industrial complexes. Individual septic tanks must be located and avoided.

g. Surface Water Crossings

The City shall be consulted before final Drawings are prepared. Requirements outlined in Sections 3.2.D.3.f and 3.2.D.3.g shall apply. All above ground pipe shall be painted as specified in Appendix C for water mains.

h. Air Relief Valves

At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or automatic air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur. See Standard Drawings

i. Chamber Drainage

Chambers, pits or manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer.

j. Disinfection Following Repair or Replacement

Any part of the City water system which has direct contact with finished water and has been out of service for repair, alteration, or replacement shall be disinfected as outlined in Appendix C.2.f. of this Manual.

4. Water Services and Connections

Water services and connections shall conform to the applicable provisions of the Appendices and the Standard Drawings. Only 1", 1-1/2", 2", 4", 6", 8" and 12" services will be permitted. Where water services greater than 12" are required, dual services shall be provided. Water services and connections to existing City systems up to 4" are available from the City after payment of applicable fees and charges. Services and connections to new water systems and to existing systems, sizes 6" and larger shall be made by the Contractor.

5. Water Metering

a. General

All water service connections shall be metered. In general, the method of metering will follow the guidelines listed below. However, the Developer's Engineer must obtain approval before finalizing the design of the metering system. Meters for irrigation or reuse must be provided.

b. Single Family, Duplex, and Multi-Family Subdivisions with Public Rights of Way

Each unit shall be individually metered. Single and double services shall be installed at property lines as indicated by the Standard Drawings.

c. Single Family and Duplex Subdivisions with Private Streets

Individual meters may be permitted in accordance with Sub-Section 2.2.C.5.b above, if the private streets are designed to City Standards and easements are dedicated over the entire private street common areas. In addition, sufficient area must be available outside of paved areas to locate water mains, services, and meters.

d. Commercial, Industrial, and Institutional Projects Without Private Fire Lines

In general, each building shall be individually metered. Meter(s) shall be located in the public rights of way at the property line.

e. Commercial, Industrial, Institutional, Multi-Family with Private Streets, Apartments, and Condominium Projects with Private Fire Lines

In general all such projects shall require installation of a fire line master meter or dual system. Dual systems shall require installation of a detector check valve or double detector check valve as determined by the City Engineer. Individual meters to each unit must be provided subject to the Developer executing a Meter Installation and Easement Agreement.

f. Shopping Centers

In general, shopping centers shall require installation of a fire line master meter or a detector check valve. Individual meters to each unit may be considered on a case-by-case basis subject to the Developer executing a Meter Installation and Easement Agreement.

g. Meter Installation

All meters in a City maintained system will be installed and inspected by the City after payment of applicable fees and charges. All meters less than 2" in size will be installed underground in an approved meter box. Meters 2" and larger may be installed above ground. In general, meters larger than 4" shall be located in a meter easement located adjacent to the public right of way.

h. Meter Sizing

Size of all meters shall be determined by the City Engineer and the City Public Works Department. The Developer's Engineer shall provide sufficient information on estimated peak flows and low flows so that meter size can be determined. The Developer's Engineer shall include head losses through metering device when designing the water system. Refer to Head Loss Tables in manufacturer's literature.

i. Meter Type

All meters shall be radio-read meters. All meters shall be compatible with all Neptune meter reading equipment and billing software.

6. Material, Installation and Testing

Applicable provisions of the City Land Development Regulations shall apply.

7. Location and Identification

A means for locating and identifying all water mains and valves shall be provided in accordance with Details

8. Cross Connection Control

a. General

In order to protect the public water supply system from contamination due to cross-connections, the Developer shall install City approved backflow prevention devices where there is the potential of a non potable substance coming into contact with or connected to the public water system. Some of the common instances requiring installation of cross connection control devices are listed below. However, the Developer's Engineer must obtain City approval before finalizing the design of a Cross Connection Control Device.

b. Commercial, Industrial, and Multi-Family Residential

All commercial and industrial projects shall, as a minimum, require installation of city approved double check valve type backflow prevention device. Projects with a higher degree of hazard may be required to install an approved reduced pressure principle device or other approved device.

All projects with fire sprinkler and standpipe systems, and projects with extensive on-site water systems shall be required, as a minimum, to install an approved double check valve type backflow assembly.

c. Irrigation Systems

The appropriate type of back flow preventer device shall be determined by the city on a case by case basis. A backflow prevention device of the correct type shall be utilized on all potable water lines supplying irrigation systems.

SECTION 3

SANITARY SEWAGE FACILITIES DESIGN

5. Emergency Operation

SECTION 3
SANITARY SEWAGE FACILITIES DESIGN

3.1 GENERAL

This section includes the general requirements for the design of a sanitary sewage facility.

3.2 PLAN REVIEW, APPROVAL, CONSTRUCTION AND ACCEPTANCE OF WASTEWATER IMPROVEMENTS

For information regarding submittal of construction plans for a sanitary sewer system, refer to Section 2.2. For information regarding requirements for the submittal of As-Built Record Drawings, refer to Section 2.2.C.8. Definitions applicable to this section can be found in the City of Umatilla Land Development Regulations.

A. General Requirement

1. City Utility Service Area

a. Availability

Where available, the owner of every lot or parcel of land within the city utility service area developed for residential, public, commercial office, industrial, warehousing or multifamily use shall connect the premises or cause the premises to be connected with the City sewer and reclaimed water distribution system.

If an existing sewage treatment facility is not available and all lots are greater than one (1) acre in size, the proposed development shall either design and construct a central sewage system or construct individual septic tank systems subject to the rules and regulations of the State of Florida, Department of Health and Rehabilitative Services.

b. Exemptions

(1) Any domestic wastewater facility having a design capacity of 2,000 gallons, average daily flow or less, which serves the complete wastewater treatment and disposal needs of a single establishment or development.

(2) Septic tanks drain field systems and other on-site commercial sewage systems with sub-surface disposal of a design capacity of less than 5,000 gallons average daily flow, which serves the complete wastewater disposal needs of a single establishment. This exception does not include restaurant facilities with greater than 3,000 gallons average daily flow, industrial facilities, or commercial laundry facilities.

2. Rural Land Area

a. When an existing sewage treatment facility with excess capacity is not located within one quarter (1/4) mile, the proposed development shall design and construct a central sewage system. The lines will remain dry until city sewer is available. Individual septic tank systems may be provided subject to the rules and regulations of the State of Florida, Department of Health and Rehabilitative Services. Once sewer is provided the septic tanks shall be pumped, collapsed and backfilled. A sewer stub out with a utility easement shall be in place for the tie-in. After review of drawings by the city engineer it is deemed that a wastewater pump will be required for the development, then land for the station will be provided by the owner and deeded to the city.

3. Construction Plan Submittal

All construction drawings for sanitary sewer systems including sewage treatment plants shall require approval of the City Engineer and the City Utility Department.

4. Requirements for Submittal

Requirements for submittal of construction drawings for sanitary sewer systems:

a. Drawings shall meet same scale and size requirements as Improvement Plans and shall be integrated into Improvement Plans when applicable.

b. Permits for construction of sewer facilities shall be obtained by the developer from City, County, and from Florida Department of Environmental Regulation, prior to commencing construction.

c. Drawings for sewer facilities shall be prepared by a Florida registered professional engineer and submitted to the City Engineer. Submit the same number of copies of plans as required for Improvement Plans.

d. Testing shall be certified and conform to the City specifications.

5. Requirements for Submittal of As-Built Drawings:

As-built Reproducible Original plan and profile views of the sewer system shall be prepared by the engineer of record at the completion of each phase of the project and submitted to the City.

The plan view shall clearly indicate manhole number, size and material of pipe and location of materials relative to manholes. Location of proposed or existing force main shall also be indicated on plan view. Profile views shall indicate manhole number, rim and invert elevations (if more than one, invert label North, South, etc.) and distance between manholes on center.

B. Definitions

Design Flow - The flow of water in a pipe when either half full or full and expressed in gallons per minute, gallons per day, or cubic feet per second.

C. Design of Gravity Sewers

1. General Considerations

a. Type of Sewers

The City will approve drawings for new sewer systems and/or new sewer extensions only when designed as a separate sanitary system in which precipitation, runoff and groundwater are excluded.

b. Design Period

Sewer systems should be designed for a 30 year life span, and for the estimated ultimate tributary population, as delineated in the approved City Wastewater Master Plan (latest edition) except in considering parts of the systems that can be readily increased in capacity.

c. Location

Gravity sewers shall be located in dedicated rights-of-way or utility easements. Whenever possible, sewers shall be located under pavement in dedicated rights-of-way. All sewers located outside of dedicated rights-of-way shall require a minimum 20' easement. Where the proposed sewer exceeds 8 feet in depth, additional easement may be required. If a gravity sewer is located adjacent to a road right-of-way, a minimum 10' easement (or more depending on sewer depth) shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. All easements are subject to the approval and acceptance by the City. Gravity sewers shall not be placed under retention ponds, retention pond berms, tennis courts, or any vertical structures. Gravity sewers shall not be located along side or rear lot lines.

2. Design Basis

a. Average Daily Flow

The gravity sewer design shall be based on full ultimate development as known, or projected. Average daily wastewater flow shall be calculated by the ERC method as outlined in City Land Development Regulations. The regulations are subject to revision by amendment to this Manual.

b. Peak Design Flow

Gravity sewers shall be designed on the basis of ultimate development maximum rates of flow, which shall be the product of selected peak factors times the accumulative average daily flow as calculated above. In general, the following minimum peak factors shall be applicable for the range of average daily flow rates.

Flow Range	Peak Factor
Flows to 100,000 GPD	4.0
100,000 GPD to 250,000 GPD	3.5
250,000 GPD to 1,000,000 GPD	3.0
Flows greater than 1,000,000 GPD	2.5

For design, average daily flows above 2,000,000 GPD, peaking factors less than 2.5 may be considered if substantiated by extensive data. Under no circumstances shall peaking factors less than 2.0 be allowed.

c. Design Calculations

Developer's Engineer shall submit signed, sealed and dated design calculations with the Drawings for all sewer projects. Calculations shall show that sewers will have sufficient hydraulic capacity to transport all design flows. Gravity sewers shall be designed to flow ½ full @ peak flow.

3. Details of Design and Construction

a. Minimum Size

No gravity sewer main conveying wastewater shall be less than 8" in diameter.

b. Minimum Cover

The minimum cover over gravity sewers shall be no less than 3' calculated from the finished grade. Exceptions to this requirement may be made for a short length of pipe where structural considerations are incorporated in the design.

c. Slope

All sewers shall be designed and constructed to give minimum velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula using an "n" value of 0.013. The following minimum slopes shall be provided; however, slopes greater than these are desirable:

Sewer Size	Minimum Slope in feet per 100'
8"	0.40
10"	0.28
12"	0.22
14"	0.17
15"	0.15
16"	0.14
18"	0.12
20"	0.11
21"	0.10
24" and larger	0.08

Note: Based upon Mannings Formula using an "n" value of 0.013.

Under special conditions, if detailed justifiable reasons are given, slopes slightly less than those required for the 2.0 feet per second velocity when flowing full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected, the Developer's Engineer must furnish his computations of the depths of flow in such pipes at minimum, average, and peak rates of flow.

Where design velocities greater than 10 feet per second (only for peak instantaneous flows) are attained, due to topography or other reasons, special provisions shall be provided for sewer protection. Refer to Subsection 3.2.C.2.a and b above.

Sewers shall be laid with uniform slope between manholes.

d. Size and Alignments

Size conversion between manholes shall not be allowed. All sewers shall be laid with straight alignments between manholes.

e. Additional Requirements

Main pool drains and back wash systems, spas, and storm drain systems shall not connect to any gravity sanitary sewer system.

In general, all sewer extensions for future connections shall terminate at a manhole. The City may allow such extensions without a terminal manhole on a case by case basis subject to all of the following conditions:

(1) Total sewer extension length shall be limited to 50'.

(2) Sewer extension location at the initiating manhole shall be plugged to the satisfaction of the City.

(3) Such sewer extensions shall not be a part of the accepted sewer facilities. This shall be clearly delineated on the Drawings.

(4) All such sewer extensions shall be inspected and accepted as part of the future construction phase.

4. Manholes

a. Location

Manholes shall be installed at the end of each gravity sewer; at all changes in grade, size or alignment; at all sewer intersections; and at distances not greater than 400'.

b. Type

An outside drop pipe shall be provided for a sewer entering a manhole where its invert elevation is 24" or more above the manhole invert.

Where the difference in elevation between the incoming sewer invert and the manhole invert is less than 24" the manhole invert shall be filleted to prevent solids deposition.

c. Diameter

For sewers 24" in diameter and smaller, the minimum inside diameter of manholes shall be 48". For sewers between 24" and 36", the minimum inside diameter shall be 60". For sewers larger than 36" in diameter, a 72" inside diameter manhole shall be provided.

A minimum access cover diameter of 22" shall be provided.

d. Flow Channel

The flow channel through manholes shall be made to conform in shape and slope to that of the sewers. Flow direction changes in excess of 90º shall not be included in sewer alignments without special consideration. When directional changes exceeding 45º degrees occur, an additional flow line elevation drop of 0.1' across manholes shall be provided. Benching shall be provided which shall have a minimum slope of 2" per foot.

e. Materials

Manholes shall be constructed of precast units as specified in Appendix B. Brick manholes shall not be permitted. Cast-in-place manholes may be accepted on a case by case basis for conflict resolution.

High density polyethylene (manholes) (HDPE) shall be designed with anti-flotation anchors when applicable and may be allowed upon the specific written approval of the City Engineer.

Fiberglass manholes may be allowed upon the approval of the City Engineer.

f. Castings

Cast iron frames and covers shall be as specified in Appendix B. Bolt down and/or gasketed covers shall be provided where manholes are located in areas subject to ponding or flooding.

g. Inflow Prevention Lids

Inflow prevention lids acceptable to the City shall be provided for manholes not in the crown or center of the roadway or in areas subject to ponding or flooding.

5. Service Connections

a. General

Service connection shall be through a lateral and miscellaneous appurtenances, all as shown on Shop Drawing Details to connect the gravity sewer to the house or establishment being served.

b. Size and Length

Service laterals and fittings shall be a minimum of 6" in diameter. All service laterals shall be less than 100' in length.

c. Slope

Service laterals shall have a minimum slope of 1%.

d. Connection

In general, service laterals shall not be allowed to discharge into sanitary manholes, except at terminal manholes. A case by case exception to this requirement may be allowed if the lateral discharges at the same elevation as the manhole invert.

6. Grease Traps

a. General

All Food Preparation/Service Establishments shall have outside grease traps sized as discussed herein, although a minimum capacity shall be 750 gallons. All wastewater flow from the kitchen areas of these establishments must flow through approved grease traps prior to entering the City system.

b. Sizing Procedures

Once the gallon per day usage for an establishment has been determined, use that figure to determine the appropriate sized grease trap as noted below.

Gallons Per Day	Grease Trap Capacity - Gallons
2,600	750*
4,900	1,200
7,200	1,600
9,500	2,000**
11,800	2,400
14,100	2,800

* Minimum Size

** Above 2,000 gallons, multiple tanks in series may be used, but in all cases, tanks shall be of same size.

c Fast Food Restaurants

Single grease trap capacity shall be sized at the rate of 10 gallons per seat. If two (2) grease traps are used in series, total capacity of the grease traps shall be based on 5 gallons per seat.

d. General Restaurants

Single grease trap capacity shall be sized at the rate of 20 gallons per seat. If two (2) grease traps are used in series, total capacity of the grease traps shall be based on 10 gallons per seat.

e. 24-Hour Restaurants

Single grease trap capacity shall be sized at the rate of 30 gallons per seat. If two (2) grease traps are used in series, total capacity of the grease traps shall be based on 15 gallons per seat

f. Convention Center/Manufacturing Cafeterias

Single grease trap capacity shall be sized at the rate of 3 gallons per meal. If two (2) grease traps are used in series, total capacity of the grease traps shall be based on 1.5 gallons per meal.

g. Miscellaneous Food Preparation/Service Establishments

Developer's Engineer shall consult with the City Engineer personnel before finalizing the design.

7. Materials, Installation and Testing and Reporting

Applicable provisions of City Land Development Regulations shall apply.

D. Design of Wastewater Force Mains

1. General Considerations

a. Design Period

Force main systems shall be designed for a 30 year life span and the estimated ultimate tributary population, as delineated in the approved City Wastewater Master Plan (latest edition) except in considering parts of the systems that can be readily increased in capacity.

b. Location

Force mains shall be located in dedicated rights-of-way or utility easements. When installed in rights-of-way, force mains shall maintain a consistent alignment with respect to the centerline of the road where possible. All force mains located outside of dedicated rights-of-way shall require a minimum 20' easement. If a force main is located adjacent to a road right-of-way, a minimum 10' easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. All easements are subject to approval and acceptance by the City. Force mains shall not be placed under retention ponds, retention pond berms, tennis courts, or any vertical structures. Force mains shall not be located along side or rear lot lines.

2 Design Basis

a. Average Daily Flow

Provisions of Section 3.2.C.2.a shall apply.

b. Peak Design Flow

Provisions of Section 3.2.C.2.b shall apply.

c. Design Calculations

Developer's Engineer shall submit signed, sealed and dated design calculations with the Drawings for all force main projects. Calculations shall show that force mains will have sufficient hydraulic capacity to transport all design flows.

3. Details of Design and Construction

a. Velocity and Diameter

At design pumping rates, a cleansing velocity of at least 2.5 feet per second should be maintained. Maximum velocity at design pumping rates should not exceed 8 feet per second for ductile iron pipe or 5 feet per second for PVC pipe. The minimum force main diameter shall be 4". Only 4", 6", 8", 10", 12", 16", 20", 24", 30", 36", 42", 48", and 54", diameter force mains shall be permitted.

b. Design Friction Losses

Friction losses through force mains shall be based on the Hazen and Williams formula. In the use of Hazen and Williams formula, the value for "C" shall be 120. "C" values greater than 130 shall not be allowed.

When initially installed, force mains may have a significantly higher "C" factor. The higher "C" factor should be considered only in calculating maximum power requirements and duty cycle time of the motor.

c. Design Pressure and Restraint

The force main and fittings, including all restrained joint fittings and thrust blocking, shall be designed to withstand pump operating pressures and pressure surges, but not less than 100 psi.

d. Termination

Force mains shall not terminate directly into a gravity sewer line. Force mains should enter the gravity sewer system at a point not more than 1' above the flow line of the receiving manhole. For instance where force mains terminate into a manhole, then that manhole must be fiberglass lined.

e. Air Release and Vacuum Relief Valves

Air release valves, or air/vacuum relief valves, shall be provided, as necessary, to prevent air locking and vacuum formation. All such valves shall be clearly delineated on the force main profile in the drawings. The Developer's Engineer shall submit calculations to the City justifying the valve sizing. See additional requirements in Appendix B.

f. Aerial Crossings

i. Structural support

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent overturning and settlement.

ii. Expansion Protection

Expansion joints shall be provided between the aerial and buried sections of the pipe.

iii. Flood Clearance

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe shall be placed no lower than 1' above the 100 year flood elevation.

iv. Pipe Material and Joints

Flanged joints shall be used. Pipe and flange material shall be ductile iron, minimum class 53. All above ground pipe shall be painted as specified in Appendix B.6.d. above ground wastewater force mains. Use of epoxy coated steel pipe may be allowed on a case by case basis.

v. Valves

Underground plug valves shall be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. An air release/vacuum relief valve shall be installed at the high point of the crossing.

vi. Guards

Appropriate guards shall be installed at both ends of the crossing to prevent public access to the pipe.

vii. Permits and Requirements of Other Agencies

It shall be the responsibility of the Developer to obtain all applicable regulatory permits. When the Aerial Crossing is accomplished by attachment to a bridge or drainage structure, the Developer shall meet all requirements of the Agencies who own or have jurisdiction over such structures.

g. <u>Underwater Crossings</u>

i. Pipe Material and Cover

A minimum cover of 3' plus a 6" concrete slab or concrete bag stabilization shall be provided over the pipe. The pipe material shall meet appropriate AWWA Standards for use in submerged conditions.

ii. Valves

Valves shall be provided at both ends of the water crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding. Both valves shall be provided in a manhole or a valve vault.

iii. Permits

It shall be the responsibility of the Developer to obtain all applicable regulatory permits.

h. <u>Valves</u>

Sufficient plug valves shall be provided on force main systems to facilitate effective isolation of the pipe system for repairs and maintenance. On straight runs of force mains, valve spacing shall not exceed 1000'. Additional valves shall be provided where force mains intersect or to facilitate isolation of pipe segments.

4. Material, Installation and Testing

Applicable provisions of Appendix B shall apply.

5. Location and Identification

A means for locating and identifying all force mains and valves shall be provided in accordance with the provisions in Appendix B.6.n. and the Standard Drawings.

6. Additional Requirements

While designing force main systems, consideration shall be given to possible future connecting pumping stations. If applicable, this requirement shall be reviewed with the City prior to finalization of the design.

E. Wastewater Pump Stations

1. General Considerations

The design standards outlined in this section apply to wastewater pump stations discharging 3,000 gallons per minute or less. All such pump stations shall be submersible type stations. For designing pump stations discharging more than 3,000 gallons per minute, the type of pump station and the basis of design shall be reviewed with the City and approval obtained before proceeding with the design.

2. Design Basis

a. Design Flows

Design flows shall be based upon the total ultimate development flow from all contributory areas to the pump station. The design average daily flow shall be computed as outlined in Section 3.2.C.2.a. The design pumping capability of the station shall be based upon the Peak Design Flow which shall be calculated by multiplying the design average flow with the applicable minimum peaking factors as outlined below:

Design Average Daily Flow	Minimum Peaking Factor for Peak Design Flow
Flows to 100,000 GPD	4.0
100,000 GPD to 250,000 GPD	3.5
250,000 GPD to 1,000,000 GPD	3.0
Flows greater than 1,000,000 GPD	2.5

For design average daily flows above 2,000,000 GPD, peaking factors less than 2.5 may be considered if substantiated by extensive data. Under no circumstances shall peaking factors less than 2.0 be allowed.

b. Number of Pumps

For pump stations with a peak design flow of 1,000 GPM or less, a minimum of two (2) pump units shall be provided. Where the peak design flow exceeds 1,000 GPM, three (3) or more units shall be provided. See Section 3.2.C.2.c. for standby requirements.

c. Pump and Motor Selection

Pump station shall be capable of pumping the peak design flow with the largest pumping unit out of service. Pumps shall be capable of meeting all system hydraulic conditions without overloading the motors. In addition a minimum 5 HP motor will be required. Head capacity curves shall be prepared and submitted to the City along with the pump station drawings. Such curves shall be based upon the friction losses outlined in Section 3.2.D.3.b of this Manual. Head capacity curves shall verify that the pumps are operating at peak or near peak efficiency and are suitable for the design flow application. Pump and motor selection and head capacity curves shall reflect hydraulic conditions in cases where receiving force main systems are interconnected to additional pumping stations. If justifiable, smaller motor sizes will be considered by the City Engineer.

d. Design Calculations

Developer's Engineer shall submit signed, sealed and dated design calculations for all wastewater pump stations. Calculations shall include head capacity curves with copies of manufacturers pump curves, hydraulic analysis of force main system, operating cycle calculations with wet well sizing, and buoyancy calculations.

3. Details of Design and Construction

a. Flooding

Wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage by the 100 year flood. Wastewater pumping stations should remain fully operational and accessible during the 100 year flood. Regulations of Local, State and Federal agencies regarding flood plain obstructions shall be considered.

b. Accessibility

The pumping station shall be readily accessible by, maintenance vehicles during all weather conditions. The access road to the pumping station shall be paved. The facility shall not be located in road rights-of-way. In a phased development, a stabilized access road may be accepted during the initial phase with paving to be accomplished in the later phase.

c. Buoyancy

Buoyancy of the pump station structures shall be considered and adequate provisions shall be made for protection.

d. Pump Requirements

Submersible wastewater pumps shall comply with the requirements spelled out in Appendix B.7.e. Only approved pumps listed in Appendix B shall be allowed. Submersible pumps and motors shall be designed specifically for raw sewage use, including totally submerged operation during a portion of each pumping cycle. Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.

Pumps shall be capable of handling raw sewage and passing spheres of at least 3" in diameter. Pump suction and discharge openings shall be at least 4" in diameter.

e. Wet Well Requirements

Wet well shall be minimum 6' diameter and shall have a minimum 4.5' depth below the lowest invert. Additional depth shall be provided based on station design and cycle time.

Pumping levels shall be set to provide a minimum capacity between operational water levels sufficient to allow a minimum of five (5) minutes between successive starts of the pumps.

Pump-off water levels shall provide adequate submergence to preclude pump inlet vortexing, or air binding. Operational maximum water levels shall not exceed the invert elevation of the influent pipe.

The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet.

The wet well shall be coated or lined as specified by the City.

No interior ladders shall be permitted in the wet well.

f. Pump Station Water System

All wastewater pump stations shall be provided with a water system with adequate capacity and pressure for station wash down and other requirements. The station water system shall be completely separated from the potable water supply by means of a reduced pressure type backflow preventer or other City approved system.

g. Electrical equipment, Power Supply and Power Cords

Requirements in Appendix B.7.f. shall apply.

h. Controls

Requirements in Appendix B.7.f. shall apply.

i. Site Sizing and Easement Requirements

Pump station sites shall be sized as delineated on the "Pump Station Site Plan" in the Standard Drawings. The Developer shall dedicate pump station site by warranty deed or plat to the City. Dedicated easements shall also be required around the site as delineated on the "Pump Station Site Plan" in the standard drawings. In general, the site for the paved access road shall also be dedicated to the City by Warranty deed or plat. An exception to this requirement may be allowed on a case by case basis in the form of an ingress/egress easement for the access road.

j. Site Fencing

Fencing at the pump station site perimeter shall comply with the technical criteria established in Appendix B.7.q. In general, all pump station sites shall be fenced. However, exception to this requirement may be made for pump stations serving residential areas only, on a case by case basis as approved by the City and subject to adequate landscape screening. Refer to the City Land Development Regulations.

4. Flow Meters

Indicating, totalizing and recording flow measurement shall be provided at pumping stations designed to handle peak flows of 1,000 GPM or more. Applicable provisions of Appendix B shall apply.

Bypass piping around the meter shall be provided for all stations with flow meters to facilitate meter maintenance.

5. Emergency Operation

All pump stations shall be provided with a riser, with appropriate coupling device and valving, to the discharge pipe in order to connect portable pumps and appurtances. In addition, stand-by emergency generators shall be provided at all wastewater pumping stations in the sewer system. Such stand-by generator facilities shall comply with the requirements spelled out in Appendix B.7.f. All such generators shall be rated and designed to operate the pump station under design conditions.

SECTION 4
WELLFIELDS AND WATER SUPPLY

a. Water Sampling.

b. Analyses.

5. Reports

a. Driller's Log.

b. Rate of Penetration

c. Stratigraphic Log

6. Identification of Principal Aquifers

a. Identification

b. Differentiation:

4.4 WATER WELL DESIGN STANDARDS

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   b. Types of Well Cased:
2. Casing Diameter
3. Casing Wall Thickness
   a. Minimum Thickness:
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4. Casing Material
   a. Manufacturing Standards for Single-Ply Carbon-Steel Well Casing
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   c. Two-Ply Steel Casing Material Properties
      1. Chemical Composition, Present:
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5. Joints
6. Drive Shoes
7. Well-Casing Installation
8. Seating or Sealing of Well Casing
9. Completion of Well Site
   a. Temporary Capping:
   b. Height of Casing Above Ground:
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B. Well Screens

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   a. Length:
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    a. Naturally Developed Wells
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    c. Total Aperture Area
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6. Screen Strength
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    a. Punched- or Louvered-Pipe Screens
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    a. Joints:
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    a. Gravel-Pack Thickness.
    b. Gravel-Pack Location
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    a. Specific Gravity:
    b. Minimum Specific Gravity:
    c. Non-round Pieces:
    d. Acid Solubles:
    e. Washed Material:
    f. Iron And Manganese:
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    a. Gravel-Pack Gradation:
    b. Gravel-Pack To Formation-Sand Ratio:
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3. Measurement of Operating Parameters During Development
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    c. Measurement Of Sand Content:
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    a. Quantity Of Gravel:
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    a. Step-Drawdown Test:
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3. Water-Level Measurements:
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H. Well Disinfection
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2. Disinfectant
3. Disinfection Procedure
    a. Overdosing Requirement:
    b. Contractor's Responsibility:
4. Disinfection of Gravel Pack Wells
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I. Water Quality Testing
1. General Considerations
2. Sampling Procedures
    a. Field Tests:
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J. Abandonment of Test Holes, Partially Completed Wells, and Completed Wells
1. General
    a. Need For Sealing Of Wells:
    b. Restoration Of Geological Conditions:
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a. Liner-Pipe Removal:

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b. Quantity Of Sealing Material:

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SECTION 4
WELLFIELDS AND WATER SUPPLY

4.1 GENERAL

This section covers the withdrawal of surface waters or groundwater for potable water treatment and provides for minimum requirements for design and construction of surface water intake structures or groundwater wells. It is designed to meet the needs for sub-regional or regional water supply facilities.

A. Protection of Water Resources

1. The contractor shall take all precautions necessary, or other actions as may be required, to permanently prevent contaminated water or water having undesirable physical or chemical characteristics from entering the water body from which the structure is to draw its supply. The contractor shall also take all necessary precautions during the construction period to prevent contaminated water, gasoline, or any other contaminant from entering the water body, either through the opening or by seepage through the ground surface.

4.2 SURFACE WATER INTAKE FACILITIES DESIGN

A. Required Reference: Facilities shall comply with the design and installation requirements as established by the Florida Department of Environmental Protection. The criteria set forth in the "Ten State Standards - Recommended Standards for Water Works" should be used as a design guide for the intake structures.

B. Additional design Standards: Additional design standards and standard requirements stated in this Manual shall also apply.

4.3 WATER WELLS AND WELLFIELDS

A. General

1. Scope

The scope of this section covers public water supply well diameters ranging from 8" through 30" (203 mm through 762 mm).

a. Purpose of section. This section provides minimum requirements for the construction of a potable water supply well and simplifies the writing of specifications by permitting direct reference to specific sections, tables, figures, or appendices.

b. Not a specification. It is not the purpose of this section to serve as a specification nor is it written in such a manner that a set of well specifications can be properly developed by stating that the well should conform to AWWA Standard A100-84 without using additional specification criteria.

2. Definitions

The following definitions apply to this section:

i. Abandoned well: A well whose purpose and use have been permanently discontinued or a well that is in such a state of disrepair that its purpose cannot be reasonably achieved.

ii. Absorption: The penetration of molecules or ions of one substance into the interior of a solid or liquid.

iii. Acidizing: The process of introducing acid into a well or surrounding geological formations.

iv. Adsorption: Attachment of gases, liquids, or dissolved substances on the surface of solids.

v. Air line: A small-diameters pipe installed in the well and charged with air for the purpose of measuring the water level.

vi. Alignment: The variation of the well centerline from true straightness.

vii. Anion: A negatively charged ion or radical.

viii. Annular space: The space between the inner well casing and the outer well casing or bore hole.

ix. Apparent specific gravity: The ratio of the weight of a given volume of material to an equal volume of water under standard conditions.

x. Aquitard: A body of earth material of low permeability that can absorb water but cannot transmit it at a rate sufficient for economic extraction by wells. (An aquiclude is defined as a formation that will not transmit any water. An aquiclude is never found in nature).

xi. Aquifer: A geologic formation, group of formations, or part of a formation that contains water in its void or pores that may be removed economically and used as a source of water supply. Unconsolidated alluvial deposits of sand and gravel and consolidated sandstone are examples of water-bearing strata.

xii. Artesian well: A well in an aquifer where the groundwater is confined under pressure and the water level stands above the top of the confined aquifer it tops.

xiii. Bailer: A long, narrow bucket made of pipe with a valve in the bottom used to remove cuttings from the hole.

xiv. Bailer (flat bottom): A type of bailer (or sampler) that is fitted with a flat bottom check valve for removing earth materials from the bottom of the hole.

xv. Bentonite: A highly plastic, highly absorptive, colloidal clay composed largely of the mineral montmorillonite.

xvi. Cake thickness: The thickness of filter cake deposited against porous media by the drilling fluid.

xvii. Capillarity: The action by which the surface of a liquid, where it contacts a solid, is elevated or depressed because of the relative attraction of the molecules of the liquid for each other and for those of the solid.

xviii. Capillary fringe: The zone immediately above the water table in which water is held by capillarity.

xix. Casing: A tubular retaining structure that is installed in the hole to maintain the well opening (for example, steel, PVC, fiberglass).

xx. Centralizer: A tool used to center the casing in the hole.

xxi. Coefficient of viscosity: The force required to maintain a unit difference in velocity between two layers of water a unit distance apart.

xxii. Cone of depression (confined aquifers): The depression, roughly conical in shape, produced in the pressure surface (piezometric surface) by a well, or wells, pumping in a confined aquifer.

xxiii. Cone of depression (water table or phreatic aquifers): The depression, roughly conical in shape, produced in the water level by a well, or wells, pumping in an unconfined aquifer.

xxiv. Confined groundwater: Groundwater under pressure greater than atmospheric pressure.

xxv. Consolidated formation: Strata of sedimentary, igneous, or metamorphic type rock, which can be porous and permeable to provide an aquifer.

xxvi. Deep well: The term deep has no real significance relative to the actual depth of a well. Such use is eliminated from technical and legal applications in factor or specific depths.

xxvii. Dogleg: Used to describe abrupt deflection in the straightness of the well within a short distance.

xxiii. Drawdown: The difference in elevation between the static water elevation the water elevation under pumped conditions.

xxix. Drilling fluid: A medium, typically composed of a mixture of bentonite clay and water, used to hydraulically remove the drill cuttings from the hole as drilling takes place.

xxx. Drive shoe: A special steel collar, with a cutting edge, fastened onto the bottom of the casing to protect the lower edge of the casing as it is driven.

xxxi. Effective size: The sieve-size opening that will pass 10 percent of a representative sample of the filter material; for example, if the size distribution of the particles is such that 10 percent of a sample is finer than 0.45 mm, the filter material has an effective size of 0.45 mm.

xxxii. Electrolyte: A chemical that dissociates into positive and negative ions when dissolved in water, increasing the electrical conductivity of the water.

xxxiii. Filtration properties: Ability of the drilling fluid to form a controlled filter cake on the side of the hole under static conditions.

xxxiv. Gravel-packed well: A well in which gravel filter material is placed in the annular space of the well (also known as filter pack).

xxxv. Groundwater: Water that occupies all the voids within a geologic stratum. Commonly referred to as the zone of saturation.

xxxvi. Groundwater divide: A line on a potentiometric surface on each side of which the groundwater flow is downward in a direction away from the line.

xxxvii. Grout: A fluid mixture of Portland cement and water (neat cement) of a consistency that can be forced through a pipe and placed as required. Various additives, such as sand, bentonite, and hydrated lime, are included in the mixture to meet certain requirements.

xxxviii. Heterogeneous: Pertaining to a substance having different characteristics at different locations. A synonym is non-uniform.

xxxix. Homogeneous: Pertaining to a substance having the same characteristics at different locations. A synonym is uniform.

xl. Hydraulic gradient: The change in static head per unit of distance in a given direction.

xli. Hydrologic properties: The properties of a geologic stratum that control the movement and storage of groundwater or surface water.

xlii. Laminar flow: Movement of fluid particles in essentially parallel paths.

xliii. Liner: A casing, screen, or other device inserted into a larger casing, screen, or open hole as a means of sealing off undesirable material or maintaining the structural integrity of the well.

xliv. Packer: A device placed in a well that plugs or seals the well at a specific point.

xlv. Perched groundwater: Groundwater in a saturated zone that is separated from the main body of groundwater by semipermeable material.

xlvi. Perforations: A series of opening in a well casing.

xlvii. Permeability: The capacity of a porous medium for transmitting water.

xlviii. Plumbness: The drift, inclination, or horizontal deviation of the well centerline from vertical.

xlix. Potentiometric surface (Potentiometric head): The level to which water would rise in a tightly cased well penetrating an aquifer. The water table and artesian pressure surfaces are particular potentiometric surfaces.

l. Pumping level: The water level in the well when pumping is in progress.

li. Recovery level: The water level in the well at a measured point in time after the pump has been stopped.

lii. Safe yield: The overage annual amount of groundwater that could be extracted from a groundwater basin (or reservoir) over a long period of time without causing a long term reduction of groundwater quantity, quality, or other undesirable impacts.

liii. Specific capacity: The ratio of well discharge to the drawdown produced, measured inside the well (gpm/ft of drawdown).

liv. Semiconfined aquifer: An aquifer that receives recharge in the form of leakage through underlying or overlying semipermeable formations (aquitards).

lv. Static level: The stabilized water level in a nonpumped well.

lvi. Storage coefficient: The volume of water that an aquifer releases from or takes into storage per unit surface area of aquifer per unit change in the component of head normal to that surface. In a water table aquifer the storage coefficient is essentially the some as its porosity.

lvii. Telescoping: A method of fitting or placing one casing inside another or introducing screen through a casing diameter larger than the diameter of the screen.

lviii. Test hole: Hole used only to obtain information on groundwater quality and/or geologic or hydrologic conditions.

lix. Test well: Completed well for pumping used to obtain information on capacity, groundwater quality, geologic and hydrologic conditions, and related information.

lx. Transmissivity: The rate at which water is transmitted through a unit width of an aquifer under G unit hydraulic gradient.

lxi. Tremie pipe: A device that carries materials to a designated depth in the hole.

lxii. Unconsolidated formation: Loose, soft rock-material strata of sedimentary, igneous, or metamorphic type rock, which includes sand, gravel, and mixtures of sand and gravel.

lxiii. Uniformity coefficient: A ratio of the sieve-size opening that will just pass 60 percent of a representative sample of the filter material divided by that sieve-size opening that will just pass 10 percent of the material.

lxiv. Water table: The upper surface of the zone of saturation in an unconfined formation at which the pressure is atmospheric.

lxv. Well efficiency (E): The formation loss (head loss required to produce flow) divided by the total drawdown observed in the well. This quotient is expressed as the percentage (from Jacob's method).

lxvi. Well screen: A special form of slotted or perforated well casing that admits water from an aquifer consisting of unconsolidated granular material while preventing the granular material from entering the well.

lxvii. Zone of aeration: The zone above the water table in which the interstices are partly filled with air. The term is replaced by unsaturated zone. It includes the capillary fringe.

lxviii. Zone of saturation: The zone below the water table in which all interstices are filed with groundwater.

3. Developer Submittals

The developer shall submit certifications and reports as required in this code.

4. Permits

a. Responsibility: Unless otherwise specified, it shall be the responsibility of the Developer or City to provide and sign all permits required by local, state or federal agencies.

b. Governmental Requirements: It shall be the responsibility of the contractor or bidder to meet applicable governmental requirements that are in existence on the date of the bid opening and that are designated as the responsibility of the contractor, unless otherwise provided for in the project specifications.

5. Protection of Groundwater Resources

The contractor shall take all precautions necessary, or other actions as may be required, to permanently prevent contaminated water or water having undesirable physical or chemical characteristics from entering, through the opening made by the contractor in construction of the well, the stratum from which the well is to draw its supply. The contractor shall also take all necessary precaution during the construction period to prevent contaminated water, gasoline, or any other contaminant from entering the well, either through the opening or by seepage through the ground surface.

B. Investigation of Geologic/Hydrologic Conditions and Groundwater Quality

1. Standard Conditions: The standards set forth in this section for evaluating and reporting the data pertinent to the investigation of geologic/hydrologic conditions and groundwater quality can be applied to exploratory test-hole or test-well drilling in addition to production wells.

a. Well Efficiencies: Pumped well efficiencies and transmissibility, storage capabilities of aquifers, and groundwater quality may be determined through data acquired from test bore holes and test wells.

b. Test Boreholes: Test boreholes provide geo-hydrologic information on aquifers and, may serve as observation wells.

c. Draw down Tests: Step-draw down tests conducted in test wells serve to facilitate the design of production wells.

d. Draw down Test Data: The data obtained from both interference and step draw down testing shall be used to determine the amount of water that can be safely withdrawn from or added to aquifer storage during any given time period.

2. Formation Sampling

a. Formation Samples: Formation samples shall be taken every 10' (3.05 m) and at each change in formation. Particular care shall be taken in collecting samples from expected producing zones.

b. Additional Samples: At the direction of the City, the contractor shall obtain additional samples from water-bearing formations for laboratory analysis. Duplicate samples shall be retained until the results of the analysis are received.

c. Sample Preservation: Samples shall be collected, dried, and preserved in separate jars, bags, or other containers of at least 500-gram capacity for each interval. Containers shall be plainly marked with well designation, owner, location, depth interval, and date and time the sample was taken.

d. Storage: The contractor shall be responsible for the safe storage of formation samples until such time as they are accepted by the City.

e. Delivery: Time, place, and mode of delivery shall be directed by the City.

3. Geophysical Logging

Various geophysical logs are commercially available and may be required at the discretion of the City. The geophysical bore-hole logs shall provide qualitative and quantitative information on aquifer types and characteristics.

4. Water Sampling and Analyses When Designated

a. Water Sampling: Water samples shall be taken for purposes of chemical analyses from each aquifer designated as a possible source of development. The method used to collect the sample shall not contaminate the aquifer.

b. Analyses: The analyses of the water shall be done in accordance with the requirements of all governing regulatory agencies. Temperature, pH, and dissolved gases shall be determined by field test and recorded.

5. Reports

a. Driller's Log: During drilling and completion of the well, the contractor shall maintain a complete log, as applicable, setting forth the following items:

i. The reference point for all depth measurements.

ii. The depth at which each change of formation occurs.

iii. The depth at which the first water was encountered.

iv. The location and thickness of each aquifer.

v. The identification of the material of which each aquifer is composed.

vi. The depth interval from which each water and formation sample was taken.

vii. The depth at which the bore-hole diameter changes.

viii. The depth to the static water level (SWL) and observable changes in SWL with well depth.

ix. Total depth of completed well.

x. Location limits of lost circulation zones.

xi. The depth of the surface or sanitary seal, if applicable.

xii. The nominal hole diameter of the well bore above and below the casing seal.

xiii. The quantity of cement installed for the seal, if applicable.

xiv. The depth and description of the well casing.

xv. Data regarding well-screen type, size, and placement in the well bore.

xvi. The sealing off of water-bearing strata,, if any, and the exact location thereof.

xvii. Any and all other pertinent information required by the well specifications.

b. Rate of Penetration: During the drilling of the hole, a time log shall be maintained showing rate of penetration as well as types of bits used in each portion of the hole.

c. Stratigraphic Log: A Stratigraphic log shall be prepared to accompany the set of drilling samples, noting (1) depth; (2) strata thickness; (3) lithology, including: size, range, and shape of constituent particles, as well as smoothness, rock type, and rate of penetration; and (4) such special notes as might be helpful. The material shall be described according to the USGS standard size grade scales.

6. Identification of Principal Aquifers

a. Identification: Principal aquifers occurring throughout the depth of a well shall be identified using interpretation of results generated by geophysical bore-hole, logging devices. Identification shall be made by a qualified engineer, hydrogeologist, or well-drilling contractors.

b. Differentiation: Differentiation of principal aquifers in a well shall be determined on the basis of formation samples obtained.

4.4 WATER WELL DESIGN STANDARDS

A. Well Casings

1. General

This section sets forth standards applicable to permanent casings for water wells. Selection of temporary casings used only for construction is left to the contractor unless otherwise specified by the City.

a. Permanent Casing: Permanent well casings shall be continuous and watertight from top to bottom of the casing except for well screens.

b. Type of Wells Cased: Permanent protective casings shall be provided for all types of well construction.

2. Casing Diameter

Casings shall meet the minimum diameter requirements given in Table 4-1.

TABLE 4-1
STANDARD WELL CASING/SIZES OF WELLS

Casing Diameter Required			
Maximum Horizontal Dimension on Pump Assembly		Minimum Inside Diameter (ID) of Well Casing	
4"	(101.6 mm)	5"	(127.0 mm)
5"	(127.0 mm)	6"	(152.4 mm)
6"	(152.4 mm)	8"	(203.2 mm)
8"	(203.2 mm)	10"	(254.0 mm)
10"	(254.0 mm)	12"	(304.8 mm)
12"	(304.8 mm)	14"	(355.6 mm)
14"	(355.6 mm)	16"	(406.4 mm)
16"	(406.4 mm)	18"	(457.2 mm)

3. Casing Wall Thickness

Well-casing wall thickness shall be sufficient to withstand anticipated formation and hydrostatic pressures imposed on the casing during its installation, well development, and use.

a. Minimum Thickness: The minimum wall thickness for carbon steel and black iron pipe casing shall be in accordance with Table 4-2 for standard casing or Table 4-3 for two-ply casing, whichever is applicable.

TABLE 4-2

MINIMUM THICKNESS FOR STEEL WELL CASING - SINGLE CASING

Depth of Casing ft (m)	NOMINAL CASING DIAMETER - INCHES (MM)									
	8 (203)	10 (254)	12 (305)	14 (356)	16 (406)	18 (457)	20 (508)	22 (559)	24 (610)	30 (762)
0-100 (0-30)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)
100-200 (30-60)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)
200-300 (60-90)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)
300-400 (90-120)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	3/8 (9.52)
400-600 (120-180)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	3/8 (9.52)	7/16 (11.11)
600-800 (180-240)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	3/8 (9.52)	3/8 (9.52)	7/16 (11.11)
800-1000 (240-300)	1/4 (6.35)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	7/16 (11.11)	7/16 (11.11)	1/2 (12.70)
1000-15000 (300-450)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	3/8 (9.52)	3/8 (9.52)	7/16 (11.11)	* ---	* ---
1500-2000 (450-600)	1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	3/8 (9.52)	7/16 (11.11)	7/16 (11.11)	* ---	* ---

* As specified by the purchaser

mm- Millimeter

TABLE 4-3
MINIMUM THICKNESS FOR TWO-PLY STEEL WELL CASING*

Depth of Casing ft (m)	DIAMETER - INCHES (MM)								
	10 (254)	12 (305)	14 (356)	16 (406)	18 (457)	20 (508)	22 (559)	24 (610)	30 (762)
0-100 (0-30)	12 (2.66)	12 (2.66)	12 (2.66)	12 (2.66)	10 (3.42)	10 (3.42)	10 (3.42)	10 (3.42)	8 (4.18)
100-200 (30-60)	12 (2.66)	21 (2.66)	12 (2.66)	10 (3.42)	10 (3.42)	10 (3.42)	10 (3.42)	8 (4.18)	8 (4.18)
200-300 (60-90)	12 (2.66)	12 (2.66)	10 (3.42)	10 (3.42)	10 (3.42)	10 (3.42)	8 (4.18)	8 (4.18)	8 (4.18)
300-400 (90-120)	12 (2.66)	12 (2.66)	10 (3.42)	10 (3.42)	10 (3.42)	8 (4.18)	8 (4.18)	8 (4.18)	8 (4.18)
400-600 (120-180)	10 (3.42)	10 (3.42)	10 (3.42)	10 (3.42)	8 (4.18)	8 (4.18)	8 (4.18)	8 (4.18)	8 (4.18)
600-800 (180-240)	10 (3.42)	10 (3.42)	10 (3.42)	8 (4.18)	8 (4.18)	8 (4.18)	6 (4.94)	6 (4.94)	6 (4.94)
More than 800 (More than 240	10 (3.42)	8 (4.18)	8 (4.18)	8 (4.18)	8 (4.18)	6 (4.94)	6 (4.94)	6 (4.94)	6 (4.94)

* Values are United States Standard Steel Thickness Gauge (mm).
mm- Millimeter

b. Plastic Casings: Plastic well-casing thickness, where used, shall conform with the requirements stated in ASTM F480.

4. Casing Material

All casing material shall be new and shall conform to one of the material standards listed in Table 4-4.

TABLE 4-4
WATER-WELL CASING MATERIALS

a. Manufacturing Standards for Single-Ply Carbon-Steel Well Casing

ANSI/AWWA C200
API Spec. 5L
ASTM A53
ASTM A139

. b. Manufacturing Standards for Alternative Single-Ply Well-Casing Materials:

Casing Material	Mfg. Standard
Carbon Steel	ASTM A211
High Strength, Low-Alloy Steel	ASTM A714
Stainless Steel	ASTM A409
Plastic	ASTM F480

c. Two-Ply Steel Casing, Material Properties

1. Chemical Composition, Present:

Carbon	0.20-0.30
Manganese	0.85-1.30
Phosphorus	0.05 maximum
Sulfur	0.05 maximum
Silicon	0.12 maximum
Copper	0.20 maximum

2. Physical Properties:

Yield Strength, psi (MPa)	55,000-70,000 (378-483)
Ultimate Strength, psi (MPa)	80,000-95,000 (552-655)
Elongation, percent in 8 in. (200 mm)	17-25
Rockwell "B" Hardness	80-90
Elastic Ratio	69-73

5. Joints

Casing joints shall be of the type listed in Table 4-5.

TABLE 4-5
WELL-CASING JOINT STANDARDS

Casing Material	Type of Joint	Standard
Steel	Welded or threaded	AWWA C206
Plastic	Treaded or solvent-welded	ASTM F480
Two-Ply	Welded	AWWA C206

6. Drive Shoes

Special, steel drive shoes shall be heat treated (Rockwell C Hardness 30-32) SAE 1040 steel ring or equal.

7. Well-Casing Installation

The method of installation shall be at the option of the drilling contractor, provided the installation process does not alter the shape, size, configuration, or strength of the casing as called for in this section.

8. Seating or Sealing of Well Casing

Seating or sealing of well casings shall conform to FDEP regulations.

9. Completion of Well Site

At all times during the progress of the work, the contractor shall use reasonable precautions to prevent either tampering with the well or the entrance of foreign material or surface water into the well.

a. Temporary Capping: Temporary capping of well. On completion of the well, the contractor shall install a suitable threaded, flanged, or welded cap or compression seal to prevent any surface pollutants from entering the well.

b. Height of Casing Above Ground: The watertight casing of any well shall extend not less than 24" (610 mm) above the final ground level elevation and not less than 24" (610 mm) above the hundred year flood level of record, whichever is higher.

c. Equipment Placement: Any equipment that will permit direct open access to the well shall also meet the height requirements and shall be sealed or screened to prevent entrance of foreign matter, surface water, or contaminants into the well.

d. Site Grading: The ground immediately surrounding the top of the well casing shall be sloped away from the well to prevent surface runoff from entering the completed well.

B. Well Screens

1. General

This section sets forth standards for screens to be used for water wells.

2. Screen Diameter

The diameter of the well screen selected shall be the minimum size permitted that will maintain an aperture (slot) entrance velocity of 0.1 -1.5 fps (0.03-0.45 m/s) or less and a vertical velocity not greater than 5 fps (1.52 m/s), as determined in conjunction with the screen-length formula below, based on the maximum flow in gallons per minute specified. In the event it is anticipated that the pump setting will be into or through the screen, the minimum inside diameter of the screen shall conform to Table 4-1. The actual design aperture entrance velocity shall be subject to approval of state and local regulatory agencies.

3. Screen Length

a. Length:. The minimum length of a well screen shall be determined by the following formula:

$$L = \frac{Q}{A_c V_c (7.48)}$$

Where:

L	=	length of screen (feet)
Q	=	quantity specified (gpm)
Ac	=	effective aperture area per foot of screen in square feet (The effective aperture area shall be taken as one half the total aperture area) (square feet/foot)
Vc	=	design entrance velocity (fpm)

b. Other Design Factors: Other factors must be considered specifically for each individual well installation.

i. All available information on the character of the water-bearing formation must be evaluated for proper well design.

ii. When cost factors have limited the acquisition of additional aquifer data, a more conservative design criteria for entrance velocities is recommended.

iii. Consideration, such as approach velocities, turbulent versus laminar flow, and velocity distribution, both into the screen and through the aquifer, are not automatically taken into account by the usual screen design criteria.

iv. Screen length for a highly efficient well is determined by thickness and hydrogeologic character of the aquifer.

4. <u>Screen-Aperture Size</u>

a. <u>Naturally Developed Wells</u>: In naturally developed wells, screen apertures shall be sized in accordance with the following criteria:

i. Where the uniformity coefficient of the formation is greater than 6, the aperture size shall be that which retains 30%-40% of the aquifer sample.

ii. Where the uniformity coefficient of the formation is less than 6, the aperture size shall be that which retains 40%-50% of the aquifer sample.

iii. If the water in the formation is corrosive or the accuracy of the sample is in doubt, select a size that will retain 10% more than is indicated in the preceding paragraphs.

iv. Where fine sand overlies coarse sand, use the fine-sand-size aperture for the top 2' (0.61m) of the underlying coarse sand. The coarse-size aperture shall not be larger than twice the fine-sand size.

b. <u>Gravel-packed Wells</u>: For gravel-packed wells, the screen-aperture openings shall be of such size to retain between 85% and 100% of gravel-pack material.

c. <u>Total Aperture Area</u>: The total aperture area of the well screen shall be that which will result in entrance velocities equal to or less than those set forth in Section 4.4.B.2.

5. <u>Material</u>

To reduce the possibility of corrosion, the well screen and its fittings shall be fabricated of Type 304 stainless steel unless otherwise specified.

6. Screen Strength

Screens shall be designed to minimize the possibility of damage during installation, development, and use. The contractor shall submit screen strength specifications (for example, collapse and tensile strength) as well as supporting drawings and data to the owner.

7. Screen Construction

Unless a specific type of construction is required by the City's specifications or is dictated by strength requirements, well screens shall be constructed by one of the methods described below.

a. Punched- or Louvered-Pipe Screens: Openings shall be punched in pipe in such a way that no material is removed from the pipe wall. The spacing and size of openings shall be uniform.

b. Wire-Wound, Continuous-Slot Screens: Continuous-slot well screen shall be of all-welded construction.

i. Special shaped wire shall be helically longitudinal rods and welded at each point of intersection.

ii. The inlet-slot openings between adjacent turns of the outer wire shall widen inwardly so as to be nonclogging.

iii. Screen end fittings shall be made of the some material as the screen body and shall be securely welded to each screen section.

iv. Perforated-pipe base screens. Pipe conforming to the requirements for well-casing specified in Table 4-2 shall be perforated with uniformly spaced and size round hole openings. Telescoped over this shall be a continuous-slot, Type 304 stainless steel screen.

8. Screen Joints and Spacers

a. Joints: Joints between screen sections and blank pipe spacers shall be welded or threaded and shall be sand tight, straight, and as strong as the screen itself.

b. Spacers: Spacers between screen sections shall be of the some material as that used for the casing if greater than 5' (1.52m) long. If less than 5' (1.52m) in length they shall be made of the same material as the screen.

c. Joining Screens to Casings: The joint between the well screen and the casing shall be made by any one of the methods described herein and shall be sand tight.

d. Screen Casing Seals.:

i. A nonmetallic seal of neoprene or rubber made to fit the casing surrounding the screen shall be attached to the screen or screen casing to affect the seal, and the screen or screen casing shall extend at least 2' (0.61m) into the exterior casing.

ii. A lead packer shall be expanded to fill the space between the screen and the casing. This lead packer shall be manufactured for this purpose and be attached to the screen or screen casing.

iii. The space between the screen casing and the casing shall be filled with neat cement to form a seal at least 1/2" (38mm) thick and 3' (0.91m) in length.

iv. Where the construction of the well is of the gravel-packed type and the screen casing overlaps at least 50' (15.2m) into the casing above and the space between the two is filled with gravel, no other seal will be required unless specified by state or federal regulations.

e. Continuous Casing and Screen: When the screen and casing are one continuous unit from the bottom of the well to the top of the well, joints may be of any of the types approved for casing in Table 4-5.

9. Sealing Bottom of Screen

The bottom of the deepest screen or screen casing shall be sealed by any one of the methods described below.

a. Threaded or Welded Plate: A threaded or welded plate shall be installed at the bottom of the screen or well-casing extension. The plate shall be made of the some material as that used for the screen or the well casing to which the plate is attached.

b. Self-Closing Valve: A self-closing valve shall be installed at the bottom of the screen or casing and shall then be covered by a cement plug at least 1' (0.30m) deep.

C. Gravel Pack

1. General

This section refers to those applications in water-well construction where the gravel-pack material is installed in the annular space between the screen (and casing) and bore hole for the purpose of stabilizing the aquifer material.

2. Gravel-Pack Thickness and Location

a. Gravel-Pack Thickness: Selection of the gravel-pack thickness surrounding the screen is dependent on individual aquifer characteristics.

i. Minimum thickness to allow for proper placement of gravel pack shall be 4" (102 mm).

ii. The maximum grovel-pack thickness usually does not exceed 12" (305 mm).

b. Gravel-Pack Location: Placement of the gravel filter shall be made in locations adjacent to the well screens and shall extend above the screen at least 20' (6.10m).

3. Material and Impurities

a. Specific Gravity: The gravel-pack material shall have an overage specific gravity of not less than 2.5.

b. Minimum Specific Gravity: Not more than 1%, by weight, of the material shall have a specific gravity of 2.25 or less.

c. Non-round Pieces: Thin, flat, or elongated pieces, the maximum length dimension of which shall not exceed three times the minimum width, shall not be in excess of 2%, by weight.

d. Acid Solubles: Not more than 5% of the gravel shall be soluble in hydrochloric acid.

e. Washed Material: The material shall be washed and free of shale, mica, clay, dirt, loam, and organic impurities of any kind.

f. Iron and Manganese.: The materials shall contain no iron or manganese in a form or quantity that will adversely affect the well water supply.

4. Gradation

Tests for gradation of gravel-pack material shall be in accordance with the method of testing as specified in ASTM C136.

a. Gravel-Pack Gradation: Gravel-pack gradation shall be determined by taking the 50th percentile (for example, 50% of the grains having diameters greater than d50) of the finest aquifer material to be filtered.

b. Gravel-Pack to Formation-Sand Ratio: Gravel-pack to formation-sand ratio at the 50th percentile point shall fall within the range of 6:1 or 4:1.

c. Uniformity Coefficient: The uniformity coefficient of the gravel pack shall not exceed 2.5.

d. Distribution Curve: The gravel-pack size-distribution curve shall parallel the main part of the formation-sand distribution curve for formation sands having a uniformity coefficient less than 2.5.

5. Gravel-Pack Samples

Samples of gravel-pack, including sieve analysis shall be approved by the City in advance of delivery and placement,

a. Labeling of Samples: All samples shall be plainly labeled to indicate the source of the material, the date, and the name of the supplier.

b. Method of Sampling: Methods of sampling shall be in accordance with ASTM D75.

6. Delivery and Storage

The gravel-pack material shall be delivered to the well site upon approval by the City.

The material may be delivered in bags or in bulk.

i. Materials delivered in bags shall be protected from weather until installed.

ii. Materials delivered in bulk shall be stored on a surface covered with a 2-mil plastic sheet.

iii. Contaminated material. Material for the gravel-pack that comes in contact with the ground shall not be used and all materials shall be protected from contamination until installed.

7. Method of Installation

a. Placement: Gravel shall be placed to ensure continuity of the gravel pack without bridging, voids, or segregation.

b. Drilling Fluid: Before the introduction of gravel-pack, the drilling fluid shall be reconditioned, unless different properties are needed to protect the well, until it has the following properties;

i. Weight - maximum of 68 lb/cu. ft. (1083 kg/m3)

ii. Viscosity - maximum of 30x, API Marsh-Funnel test

iii. Sand content of fluid in the system - maximum of 1%, by volume

c. Unusual Drilling Conditions: Where aquifer conditions make it necessary to continue drilling operations with drilling fluid that does not meet these standards, the drilling contractor shall be responsible for the complete removal of drilling mud and development of the well.

8. Disinfection

The gravel-pack shall be disinfected in accordance with Section 4.4.H as it is installed.

D. Grouting and Sealing

1. General

Grouting consists of sealing by filling the annular space between the casing and bore hole with a substance that hardens.

2. Sealing Requirements

The well shall be sealed to prevent the entrance of any water from any source other than from the aquifers selected.

a. Surface of Sanitary Seal: The annular space around the conductor and/or well casing, from surface to designated depth, shall be grouted and shall not be less than 1.5" (38 mm).

b. Sealing of Uncompleted Bore Hole: Sealing of an uncompleted bore hole shall be performed in accordance with the requirements set forth in Section 4.4.J.

c. Sealing of Select Zones: All zones containing water of undesirable quality or zones to be protected but excluded from final well completion shall be grouted from a point at least 5' (1.52m) above the zone to a point at least 5' (1.52m) below the zone.

d. Sealing of Production Casing: Requirements of Section 4.4.J. shall apply to the sealing of production casing if no other sealing has occurred.

3. Materials

a. Neat-Cement Grout: Grout shall consist of a mixture of API Spec. 10, Class G cement (or Class B similar to ASTM C150 Type II) and water in the ratio of 0.67 cu ft [5.0 gal (19.0 L)] of water per 94 lb (42.6 kg) sack of cement weighing approximately 118 lb/cu ft (1880 kg/m3). A maximum of 6%, by weight, bentonite and 2%, by weight, calcium chloride may be added.

b. Pozmix-Cement Grout: Grout shall consist of a mixture of 50%, by volume, Pozzolan A 74 lb/cu ft 1179 kg/m^3 and 50%, by volume, API Spec. 10, Class G cement with 0.77 cu ft (21.8 L) of water per 84 pound (38.1 kg) of mixture. To this mixture may be added a maximum of 2%, by weight, bentonite and a maximum of 2%, by weight, calcium chloride, at the discretion of the contractor.

c. Portland Cement-Concrete Grout: Grout shall contain 5.3 sacks of portland cement, ASTM C150 Type II, per cubic yard (0.76m^3) of concrete and a maximum of 7 gallons (26.5 L) of water per 94 pound (42.6kg) sack of cement. The maximum slump shall be 4" (102 mm). The aggregate shall consist of 47% sand and 53% coarse aggregate, conforming to ASTM C33.

i. The maximum size aggregate should be 0.75 " (19 mm).

ii. Concrete seal shall not be placed in an annulus of less than 3 " (75 mm).

d. Sand-Cement Grout: Grout shall consist of a mixture of portland cement (ASTM C 150 Type II), sand, and water in the proportion of not more than 2 parts, by weight, of sand to 1 part of cement with not more than 6 gallons (22.7L) of water per 94 pound (42.6kg) sack of cement.

4. Methods of Placement

Grouting shall be performed to ensure a complete seal of the annulus designated.

E. Plumbness and Alignment

1. General

The completed well shall be constructed round, plumb, and true to line as defined in this section. Tests for plumbness and alignment shall be made after completed construction of the well.

2. Tolerances

The following tolerances shall be maintained by the contractor:

a. Plumbness: The maximum allowable horizontal deviation (drift) of the well from the vertical shall not exceed two thirds of the smallest inside diameter of that part of the well being tested per 100' (30.5M) of depth.

b. Alignment: The alignment must be satisfactory for the successful operation of the permanent pumping equipment.

i. Alignment shall be tested by lowering into the well a section of pipe or a dummy 40' (12.2m) long.

ii. This pipe or dummy shall move freely throughout the tested interval.

iii. The outside diameter of the pipe or dummy shall not be more than 0.5" (12.7mm) smaller than the diameter of that part of the casing or hole being tested.

iv. If a dummy is used, it shall consist of a rigid spindle with a minimum of three truly cylindrical rings, each ring being a minimum of 12" (305mm) wide.

v. The rings shall be located one at each end and one in the center.

vi. Alternate-alignment tolerance. Alternate-alignment tolerance may be required for shallower wells after consideration of depth, formations, casing straightness, well diameter versus pump diameter, and local experience.

vii. The maximum allowable horizontal distance between the actual well centerline and a straight line representing the proposed pump centerline (this line being constructed to minimize the horizontal distance between the centerlines) shall not exceed one half the difference between the inside diameter of the casing or hole in that part of the well being tested and the desired maximum outside diameter of the proposed pump indicated in Table 4-1, to be installed.

3. Depth of Applied Tolerances

The tolerances set forth in Section 4.4.E.2 above shall apply from the top of the well to the maximum depth specified for the tolerance requirements in the well specifications.

F. Well Development

1. General

Well development consists of the application of appropriate techniques designed to bring the well to its maximum production capacity with attendant optimizing of well efficiency, specific capacity, stabilization of aquifer material, and control of suspended solids.

2. Development Test

The well shall be tested for development using a well pump.

a. Test Pump Capacity: The pump and prime mover shall have a capacity in excess of the anticipated lift, and final production capacity of the well and the pump shall be set to a depth in excess of the anticipated pumping level. The method used shall permit adjustable flow rates for the pumping.

b. Discharge Piping: Discharge piping shall be provided of sufficient diameter and length to conduct water to a point designated by the City, together with orifices, meters, or other devices that will accurately measure the flow rate.

c. Completing Development: Development shall continue until the following conditions have been met:

i. Sand contents shall average not more than 5 mg/L for a complete pumping cycle of 2 hours duration when pumping at the designated capacity.

ii. Not less than 10 measurements shall be taken at equal intervals to permit plotting of sand content as a function of time and production rate and determination of average content for each cycle.

iii. There shall be no increase in specific capacity during at least 24 continuous hours of pumping and surging.

3. Measurement of Operating Parameters During Development

a. Discharge Rate: The device used to measure the pump discharge rate shall have a minimum accuracy of 95%.

b. Water Elevations: Water elevations in the well shall be measured to the accuracy specified at each of the various pumping rates.

c. Measurement of Sand Content: Sand content shall be measured with a centrifugal sand sampler as described in Rossum, John R., Control of Sand in Water Systems; Journal American Water Works Association, 46:2:123 (Feb. 1954).

4. Development Records

Complete records of all development work shall be maintained.

a. Quantity of Gravel: For gravel-pack wells, the quantity of gravel added during development shall be recorded.

b. Data to Record: The following data shall be included in the work record:

i. Quantity and description of material brought into the well

ii. Static and pumping water levels

iii. Methods of measurement

iv. Duration of each operation

v. Observation of results

vi. Production rates and specific capacity

vii. Sand content as a function of production rate and time

viii. Sand content as a function of production rates and specific capacity

ix. All other pertinent information

G. Performance Testing

1. General

Tests for well performance are necessary to secure water samples for analysis and to determine well capacity, drawdown, and production on a long-term basis.

2. Testing Methods

a. Step-Drawdown Test: A step-drawdown test shall be conducted to determine pumped-well capacity and to obtain data from which to design the permanent production pump.

i. The well shall be pumped at progressively increasing fractions of the maximum discharge capacity as determined during the final development phase.

ii. The length of each discharge step shall be long enough to plot a straight-line trend of drawdown versus logarithm of time since pumping began.

b. Constant-Rate Tests: After the step-drawdown test, a constant-rate test shall be conducted at a designated capacity to determine time draw-down characteristics of the pumped well and any observation wells.

i. The well shall be pumped at a constant rate until a straight-line trend is observed on a plot of water level versus logarithm of time.

ii. Recovery time of the pumping well and any observation wells to be used in the test should be such that a straight-line trend is observed in all of the wells on a plot of water level versus the logarithm of time.

3. Water-Level Measurements

Water-level measurements shall be obtained prior to, during, and after the pumping test in order to acquire background information (static water levels), the effects of pumping (pumping water levels), and a profile of the recovery of the water level from pumping level to original state. The measurement frequency of water levels during pumping shall be such that adequate definition of the time drawdown data is made available.

4. Pumping-Test Interruption

The contractor shall conduct any specified pumping tests without any interruptions or fluctuations that may affect the accuracy of the required pumping results.

5. Records and Reports

The contractor shall maintain all records and shall submit to the City accurate written reports regarding water levels, pumping rates, time intervals, and other pertinent details on testing of the production well and all observation wells used in the test period.

H. Well Disinfection

1. General

The well shall be disinfected to remove bacteriological contamination that may cause the well-water supply to be unsafe for human consumption.

2. Disinfectant

A chlorine solution of water and available chlorine compounds shall be used for disinfecting the well.

3. Disinfection Procedure

The chlorine solution used for disinfecting the well shall be of such volume and strength and shall be so applied that a concentration of at least 50 mg/L of available chlorine shall be obtained for the entire water depth of the well. The chlorine solution shall be prepared and applied to produce a contaminant-free sample.

a. Overdosing Requirement: If the samples continue to show bacteriological contamination, the contractor shall prepare and apply to the entire depth of the well a total volume of the chlorine solution equal to at least four (4) times the volume of water in the well and shall allow this solution to remain in the well for a period of at least 2 hours.

b. Contractor's Responsibility: The contractor's responsibility will be fulfilled on completion of the above disinfection requirements.

4. Disinfection of Gravel Pack Wells

During the addition of the gravel to a gravel-pack well, the material shall be disinfected.

a. Single Aquifer: In single aquifer wells, the gravel-pack material shall be disinfected by maintaining and circulating a solution containing a chlorine residual of at least 50 mg/L. The circulating fluid shall be sampled at suitable intervals and tested for chlorine residual.

b. Multi-Aquifer: In multi-aquifer wells, the gravel shall be disinfected by adding 0.5 pound (0.23 kg) of calcium hypochlorite tablets per ton of gravel. The tablets shall be distributed as uniformly as practical.

I. Water Quality Testing

1. General Considerations

Water quality (physical, biochemical, and chemical composition) shall be determined by analysis of water samples collected from the well.

2. Sampling Procedures

The procedures outlined in the latest edition of Manual of Methods for Chemical Analysis of Water and Wastes, US Environmental Protection Agency, shall be followed.

a. Field Tests: Water temperatures, pH, and dissolved gases shall be determined on samples collected and analyzed in the field.

b. Samples for Local-Regulation Test: Water samples shall be taken at the end of the pumping test for chemical analyses as required by the city or state.

c. Analytical Procedures: All analyses performed shall be in accordance with methods as prescribed by regulatory agencies having jurisdiction over the well construction, or potable supply standards.

J. Abandonment of Test Holes, Partially Completed Wells, and Completed Wells

1. General

Abandoned test holes, including test wells, uncompleted wells, and completed wells shall be sealed.

a. Need for Sealing of Wells:

i. Eliminate physical hazard

ii. Prevent contamination of groundwater

iii. Conserve yield and hydrostatic head of aquifers

iv. Prevent intermixing of desirable and undesirable waters.

b. Restoration of Geological Conditions: The guiding principle to be followed by the contractor in the sealing of abandoned wells is the restoration, as for as feasible, of the controlling geological conditions that existed before the well was drilled or constructed.

2. Sealing Requirements

A well shall be measured for depth before it is sealed to ensure freedom from obstructions that may interfere with effective sealing operations.

a. Liner-Pipe Removal: Removal of liner pipe from some wells may be necessary to ensure placement of an effective seal.

b. Exception to Removing Liner Pipe: If the liner pipe cannot be readily removed, it shall be perforated to ensure the proper sealing required.

c. Sealing Materials and Placement: Concrete, cement grout, or neat cement shall be used as primary sealing materials and shall be placed from the bottom upward by methods that will avoid segregation or dilution of material.

3. Records of Abandonment Procedures

Complete accurate records shall be kept of the entire abandonment procedure to provide detailed records for possible future reference and to demonstrate to the governing state or local agency that the hole was properly sealed.

a. Depths Sealed. The depth of each layer of all sealing and backfilling materials shall be recorded.

b. Quantity of Sealing Material Used: The quantity of sealing materials used shall be recorded. Measurements of static water levels and depths shall be recorded.

c. Changes Recorded: Any changes in the well made during the plugging, such as perforating casing, shall be recorded in detail.

GENERAL

WATER

WATER cont.

- W-19 Locating Wire Splice Detail
- W-20 Fire Hydrant Assembly Perpendicular to Main
- W-21 Fire Hydrant Assembly Parallel to Main
- W-22 Fire Flow Assembly Below Ground with Non Traffic Lid
- W-23 Fire Flow Assembly Below Ground with Traffic Lid
- W-24 Backflow Preventor Assembly Below Ground with Non Traffic Lid
- W-25 Backflow Preventor Assembly Below Ground with Traffic Lid
- W-26 Single Detector Check Assembly Below Ground with Non Traffic Lid
- W-27 Single Detector Check Assembly Below Ground with Traffic Lid
- W-28 Double Detector Check Assembly Below Ground with Non Traffic Lid
- W-29 Double Detector Check Assembly Below Ground with Traffic Lid
- W-30 Double Detector Check Assembly Above Ground
- W-31 Temporary Jumper Connection Detail

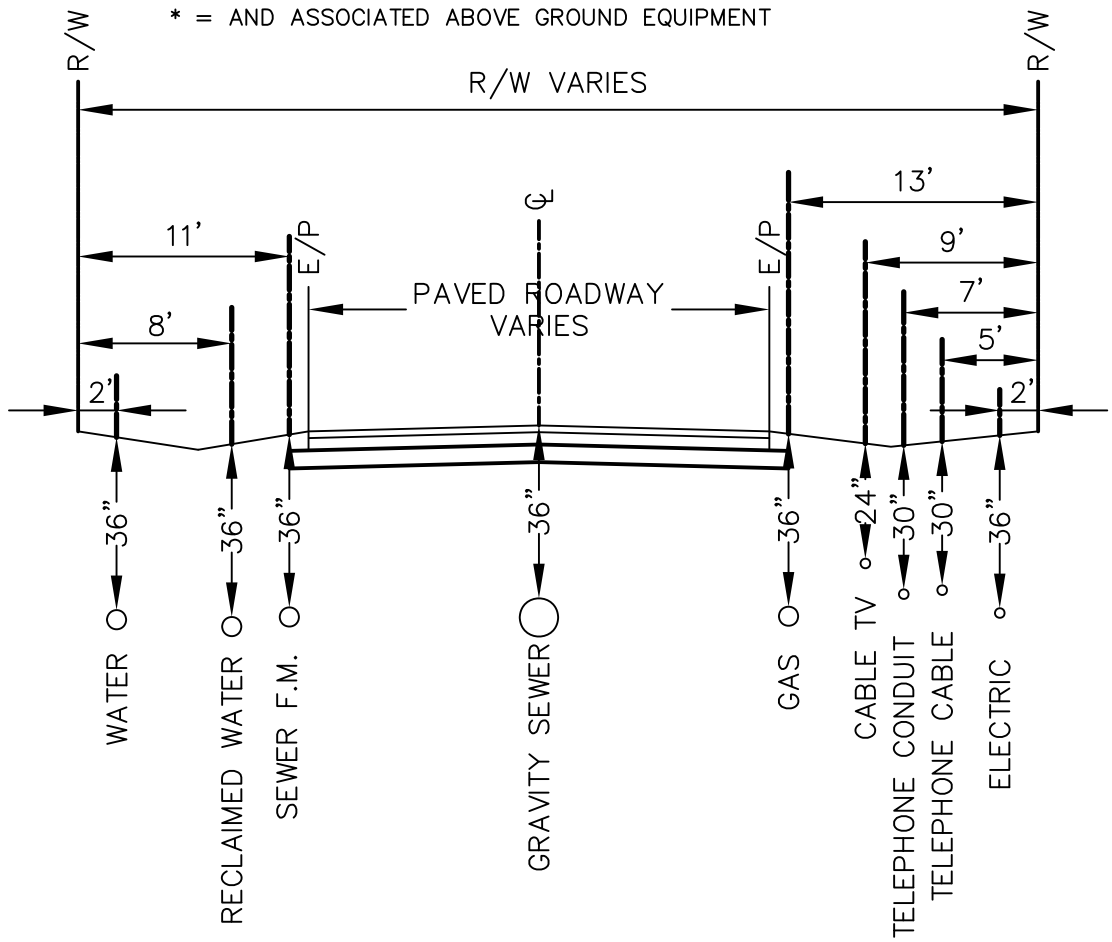
SANITARY

- S-1 Minimum Slope for Gravity Sewer
- S-2 Precast Concrete Manhole less than 5' Depth
- S-3 Precast Concrete Manhole less than 5' to 12' Depth
- S-4 Precast Concrete Manhole over 12' Depth
- S-5 Fiberglass Manhole
- S-6 Sanitary Sewer Manhole Flow Channel
- S-7 Precast Concrete Manhole Joint Construction
- S-8 Sanitary Sewer Manhole Stubout
- S-9 Sanitary Drop Connection
- S-10 Precast Concrete Manhole Alternate Base Construction
- S-11 Standard Manhole Frame and Cover
- S-12 Single Sanitary Sewer Service
- S-13 Double Sanitary Sewer Service
- S-14 Sanitary Sewer Service Residential Cleanout
- S-15 Plug Valve and Box Detail
- S-16 Typical Lift Station and Valve Vault Section View
- S-17 Typical Lift Station and Valve Vault Plan View
- S-18 Service Pedestal
- S-19 Air or Combination Air/Vacuum Release Valve
- S-20 Air or Combination Air/Vacuum Release Valve
- S-21 Offset Air or Combination Air/Vacuum Release Valve
- S-22 Permanent Blowoff Assembly
- S-23 Sewer Main Tap

UTILITY	DISTANCE FROM R/W	UNDERGROUND DEPTH
WATER	2'	36"
RECLAIMED WATER	8'	36"
SEWER F.M.	11'	36"
GAS	13'	36"
CABLE T.V.	9'	24"
TELEPHONE CONDUIT	7'	30"
TELEPHONE CABLE	5'	30"
ELECTRIC (UNDERGROUND)	2'	36"
*ELECTRIC POLES	TANGENT w/ R/W	N/A

AERIAL CABLES SHALL BE 18' ABOVE ℄ GRADE. CABLE T.V. & COMMUNICATION CABLES MAY BE REDUCED TO 16' IF VALID EXTENUATING CIRCUMSTANCES CAN BE SHOWN.

* = AND ASSOCIATED ABOVE GROUND EQUIPMENT



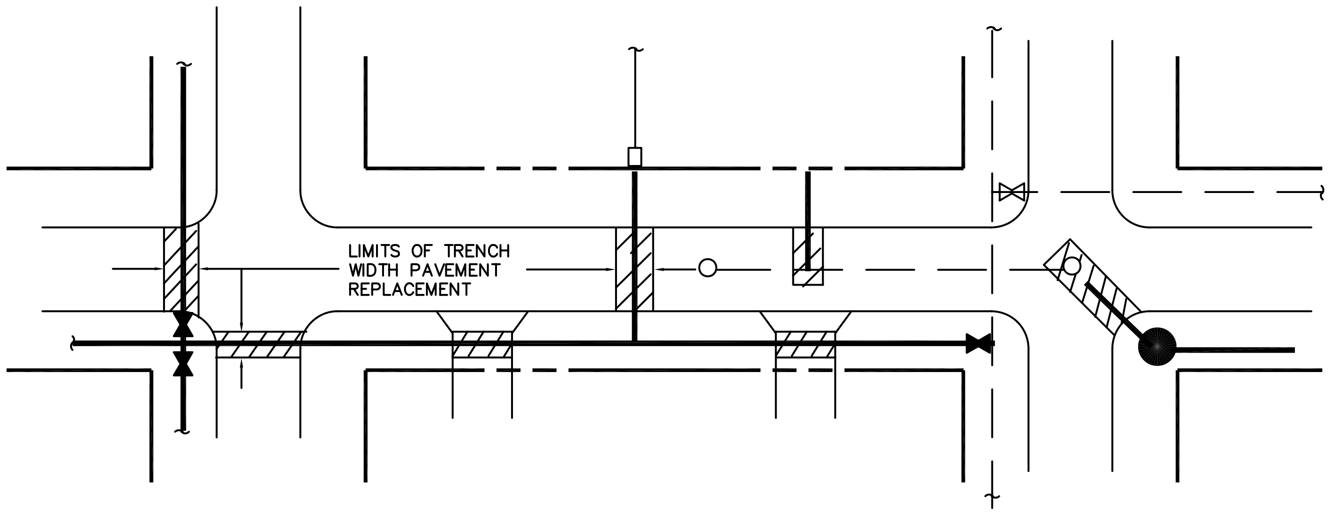
UNLESS OTHERWISE APPROVED BY PUBLIC WORKS DIRECTOR

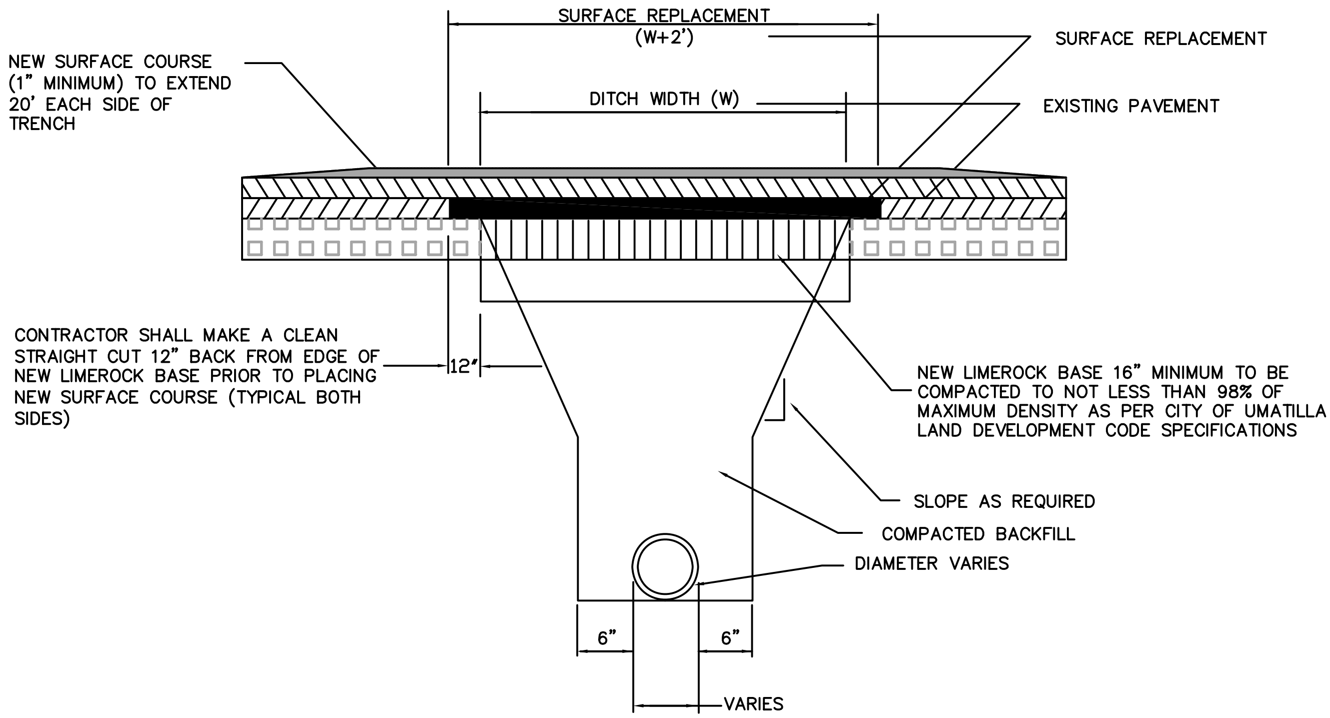
CITY OF UMATILLA

UTILITY POSITIONS IN RIGHT-OF-WAY

STANDARD DETAILS

DETAIL G-1





NOTES:

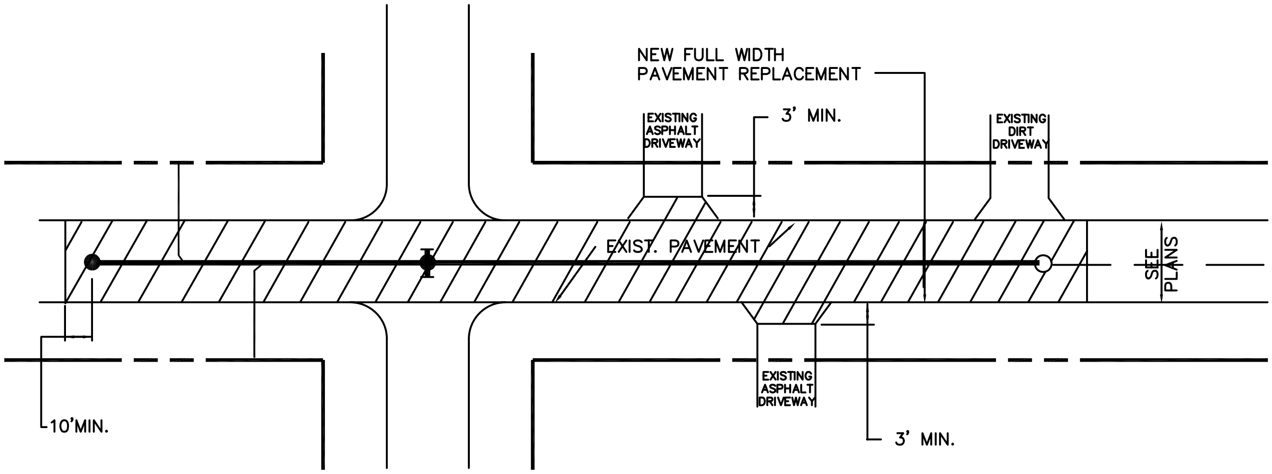
1. UNLESS OTHERWISE SPECIFIED, MATERIALS AND METHODS OF OPERATION REQUIRED TO INSTALL NEW AND REPLACEMENT PAVEMENT SHALL BE IN ACCORDANCE WITH THE LATEST APPLICABLE REQUIREMENTS AND SPECIFICATIONS FOR ROADS CONTAINED IN THE CITY OF UMATILLA LAND DEVELOPMENT CODE.
2. PAVEMENT SHALL BE REMOVED TO NEATLY SAWED STRAIGHT EDGES. SAWCUTS SHALL BE MADE TO MIN. DEPTH OF 1-1/2"(INCHES).
3. BACKFILL SHALL BE IN ACCORDANCE WITH SPECIFICATIONS OF THE CITY OF UMATILLA LAND DEVELOPMENT CODE.
4. SURFACE TREATED PAVEMENT JOINTS SHALL BE LAPPED AND FEATHERED.
5. THE TYPE AND THICKNESS OF THE NEW SURFACE MATERIAL SHALL BE CONSISTENT WITH THAT OF THE EXISTING SURFACE BUT IN ALL CASES SHALL MEET THE MINIMUM STANDARDS ESTABLISHED BY THE DRAWINGS AND SPECIFICATIONS.

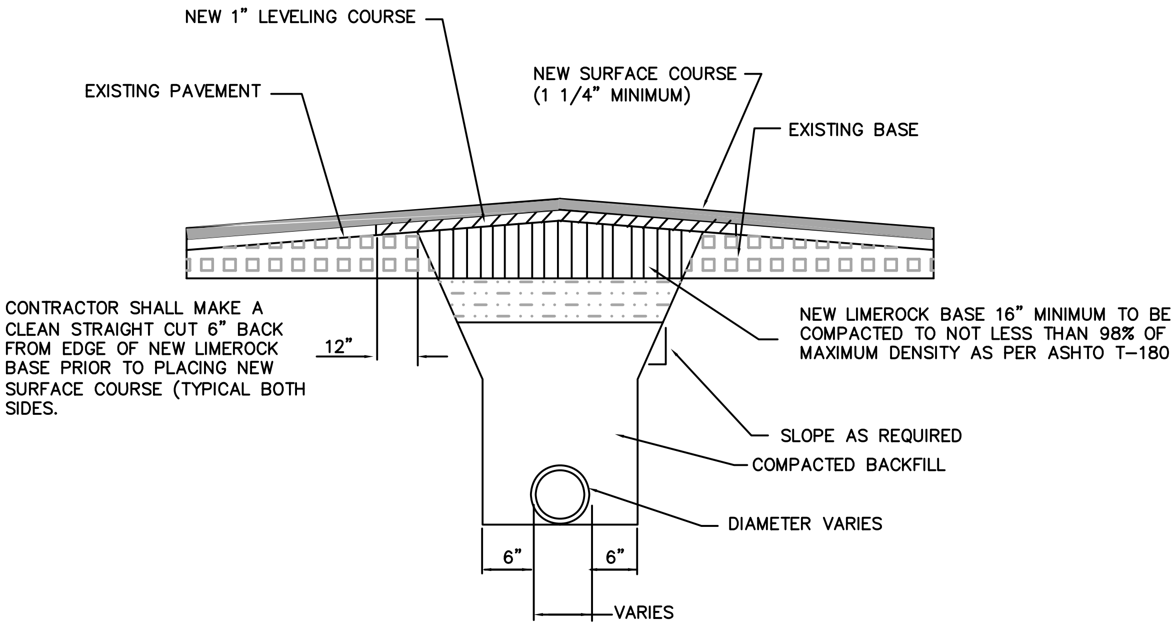
CITY OF UMATILLA

TRENCH WIDTH PAVEMENT REPLACEMENT

STANDARD DETAILS

DETAIL G-2





NOTES:

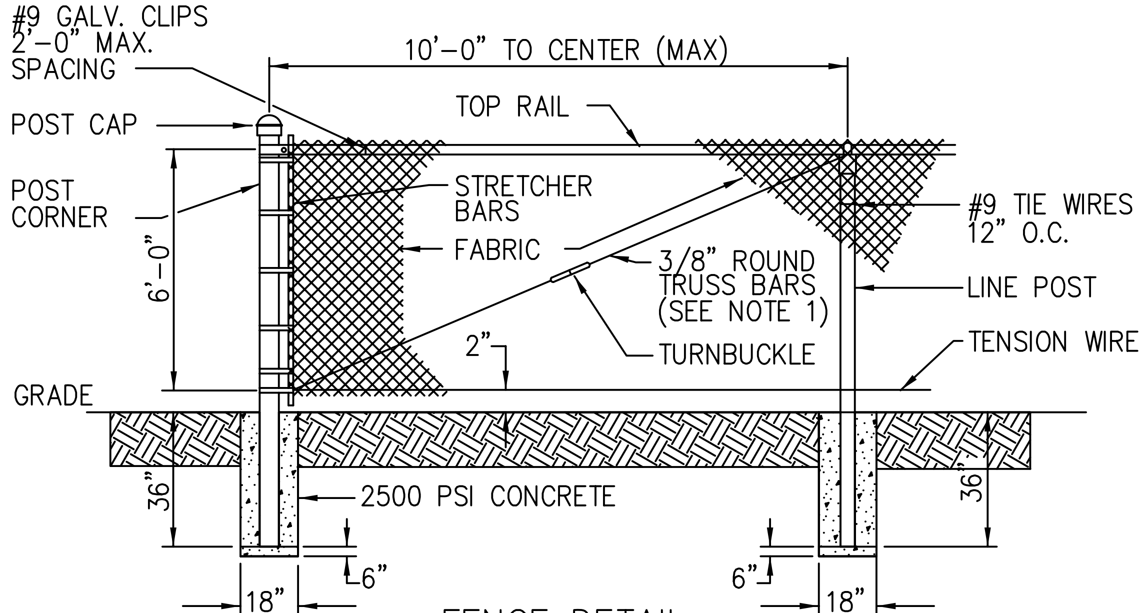
1. UNLESS OTHERWISE SPECIFIED, MATERIALS AND METHODS OF OPERATION REQUIRED TO INSTALL NEW AND REPLACEMENT PAVEMENT SHALL BE IN ACCORDANCE WITH THE LATEST APPLICABLE REQUIREMENTS AND SPECIFICATIONS FOR THE CITY OF UMATILLA.
2. BACKFILL MATERIAL ABOVE ONE FOOT OVER TOP OF PIPE SHALL BE PLACED IN LAYERS NOT TO EXCEED 12 INCHES AND COMPACTED TO 98 PERCENT OF ITS MAXIMUM DENSITY AT + OR – 2% OF OPTIMUM MOISTURE CONTENT AS DETERMINED BY THE LABORATORY STANDARD PROCTOR TEST (ASHTO T180).
3. TYPICAL SECTION SHALL BE CONSISTENT WITH AND GOVERNED BY EXISTING ROADWAY SECTION WITH MINIMUM ROADWAY REQUIREMENTS TO BE AS SHOWN.
4. ALL EXISTING DRIVEWAYS AND ROADWAYS SHALL HAVE PAVEMENT RETURNS PAVED DURING THE ROAD PAVING OPERATION.
5. IF IN THE OPINION OF THE ENGINEER, THE EXISTING ROADWAY IS DAMAGED TO THE EXTENT THAT THE EXISTING PAVEMENT SHOULD BE REMOVED OR IF THE ENTIRE PAVEMENT IS REMOVED DURING PIPELINE INSTALLATION, THE STABILIZED SUBGRADE AND LIMEROCK BASE SHALL BE CONSTRUCTED AS AS DESCRIBED ABOVE. THE BASE SHALL THEN BE PRIMED AND A NEW SURFACE COURSE AT LEAST 1 1/4" THICK PLACED.

CITY OF UMATILLA

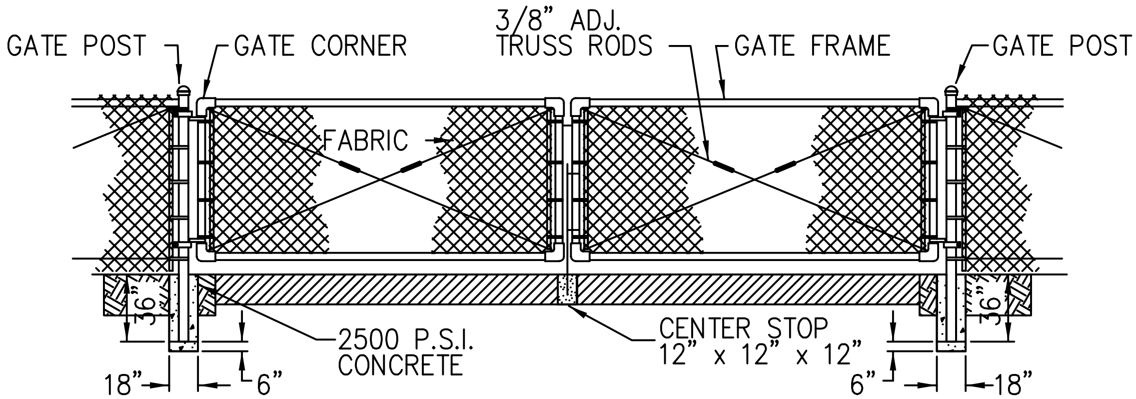
RECONSTRUCTION / REPLACEMENT

STANDARD DETAILS

DETAIL G-3



FENCE DETAIL

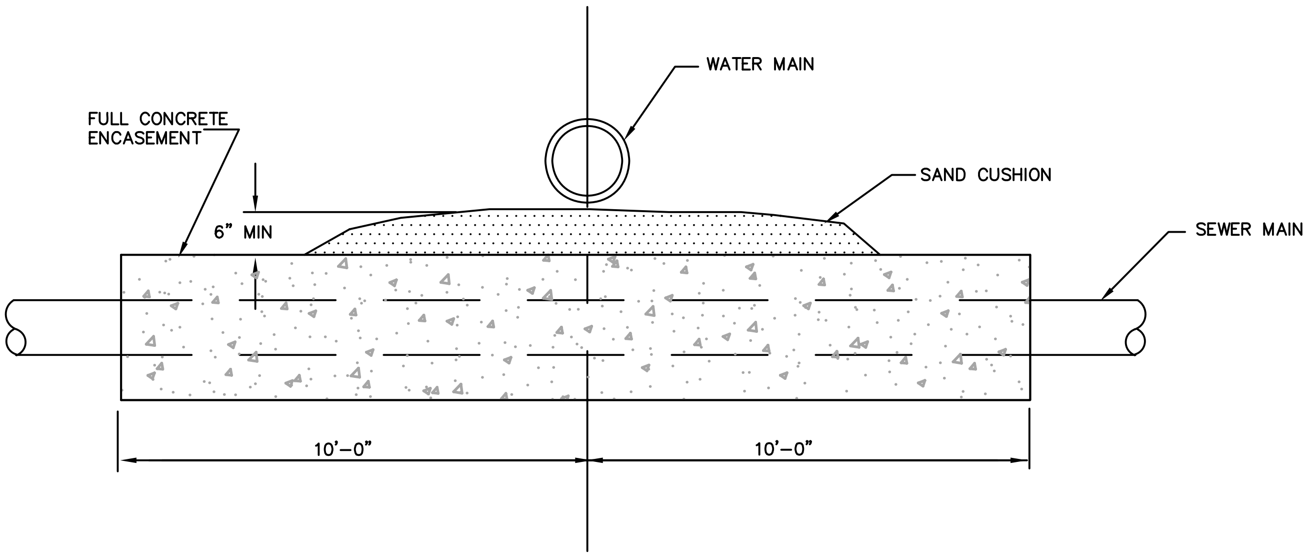


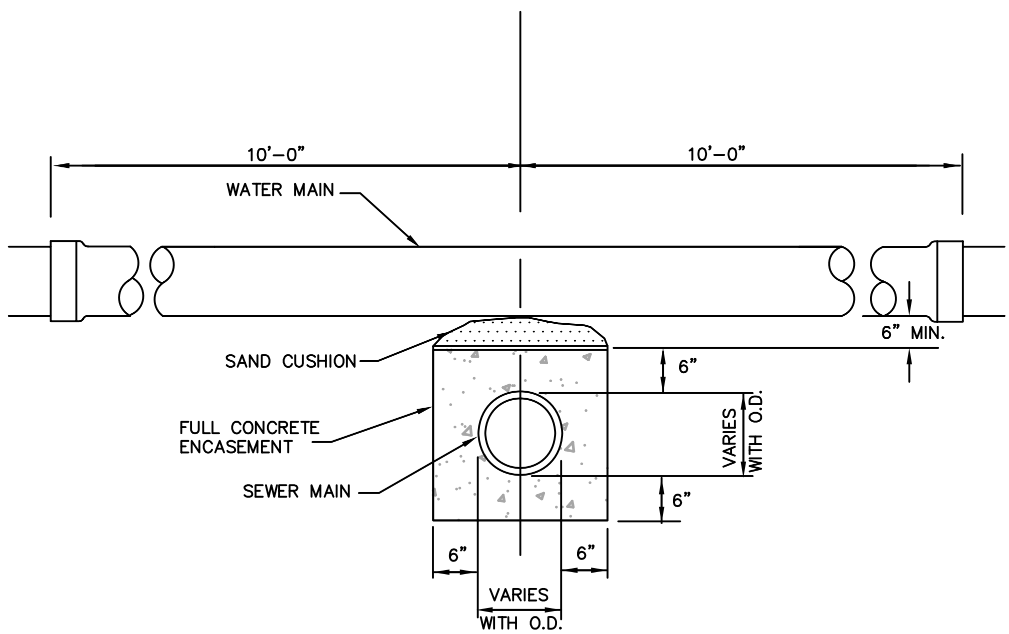
DOUBLE SWING GATE DETAIL

NOTES:

1. TRUSS BARS ARE REQUIRED FOR EACH GATE SECTION AND THE FIRST SPAN ON EACH SIDE OF A CORNER POST ONLY.

	CITY OF UMATILLA	CHAIN LINK FENCE	STANDARD DETAILS DETAIL G-4





NOTES:

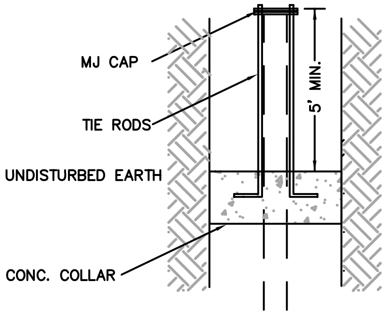
1. USE CONCRETE ENCASEMENT WHERE VERTICAL CLEARANCE BETWEEN WATERMAIN AND SEWER IS 18" OR LESS.
2. WHEN CROSSING SEWER ONE FULL JOINT OF WATER MAIN SHALL BE CENTERED OVER THE SEWER MAIN.
3. CONCRETE FOR ENCASEMENT SHALL BE 2500 PSI.
4. ENCASEMENT TO BE PLACED ON UNEXCAVATED OR COMPACTED SOIL.

CITY OF UMATILLA

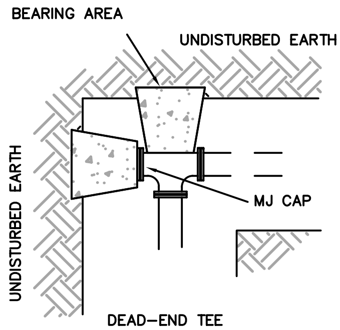
CONCRETE ENCASEMENT

STANDARD DETAILS

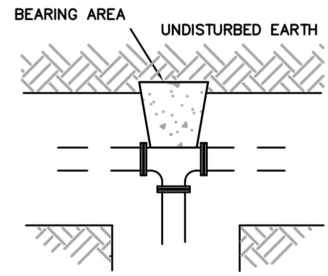
DETAIL G–5



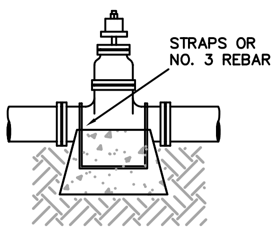
DEAD-END



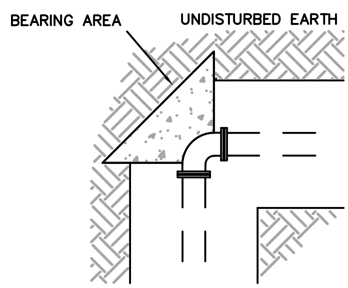
DEAD-END TEE
WITH MJ CAP
OR PLUG



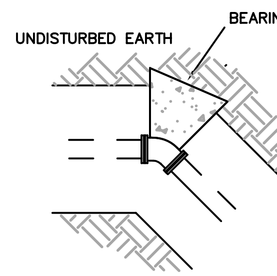
TEE



VALVE ANCHOR
(EACH SIDE)
TREAT AS DEAD-END



90° BEND



45° BEND AND SMALLER

BEARING AREA OF THRUST BLOCKS IN SF
FOR SOIL STRENGTH = 2000 PSF
(HORIZONTAL BENDS)

FITTING SIZE	DEAD-ENDS	BEND ANGLE			
		90°	45°	22 1/2°	11 1/4°
4	1.0	1.3	1.0	1.0	1.0
6	2.1	3.0	1.6	1.0	1.0
8	3.8	5.3	2.9	1.5	1.0
10	5.9	8.3	4.5	2.3	1.2
12	8.5	12.0	6.5	3.3	1.7
14	11.5	16.3	8.8	4.5	2.3
16	15.1	21.3	11.5	5.9	3.0
18	19.1	27.0	14.6	7.4	3.7
20	23.6	33.3	18.0	9.2	4.6
24	33.9	48.0	26.0	13.2	6.7

NOTES:

1. THESE THRUST BLOCK DETAILS ARE INTENDED FOR RESTRAINING HORIZONTAL FORCES ONLY. FOR VERTICAL BENDS DOWNWARD, GRAVITY THRUST BLOCKS SHALL BE USED. CONSULT PROJECT ENGINEER FOR DETAILS.
2. THRUST RESTRAINT SHALL BE INCORPORATED AT ALL BENDS, REDUCERS, OFFSETS TEES, DEAD ENDS, AND VALVES. THIS APPLIES TO BOTH HORIZONTAL AND VERTICAL CHANGES IN DIRECTION.
3. CONCRETE FOR THRUST BLOCKS SHALL BE CLASS "I", 2500 PSI MINIMUM
4. A NON-POROUS MATERIAL SHALL BE PLACED AROUND THE ENTIRE FITTING TO PROTECT THE BOLTS FROM THE CONCRETE. (POLYETHYLENE SHEETING SUGGESTED)
5. THRUST BLOCK BEARING AREA SHALL BE BASED ON SOIL BEARING STRENGTH = 2000 PSF
6. THRUST BLOCK SHALL BE REQUIRED TO BEAR AGAINST UNDISTURBED MATERIAL. WHERE TRENCH WALL HAS BEEN DISTURBED, EXCAVATE ALL LOOSE MATERIAL AND EXTEND THRUST BLOCK TO UNDISTURBED MATERIAL (AS SHOWN).
7. BACKFILL SHALL CONSIST ENTIRELY OF CLEAN SAND. ANY MUCK ENCOUNTERED SHALL BE REPLACED WITH ACCEPTABLE BACKFILL.
8. THRUST BLOCK BEARING AREA SHALL BE DETERMINED BY THE APPROPRIATE FORMULA AS FOLLOWS; BUT IN NO CASE SHALL THE BEARING AREA BE LESS THAN ONE (1) SF.

   BENDS:

   $$T = \frac{2 * PA * SIN(a/2)}{S}$$

   DEAD-ENDS:

   $$T = \frac{P * A}{S}$$

   T = AREA OF BEARING SURFACE (SF) ONE (1) SF MINIMUM
   A = PIPE CROSS SECTIONAL AREA (SQ. IN.)
   P = MAXIMUM SYSTEM DESIGN PRESSURE (PSI) 150 PSI TYPICAL
   S = SOIL BEARING STRENGTH (PSF)
   a = DEGREE OF BEND

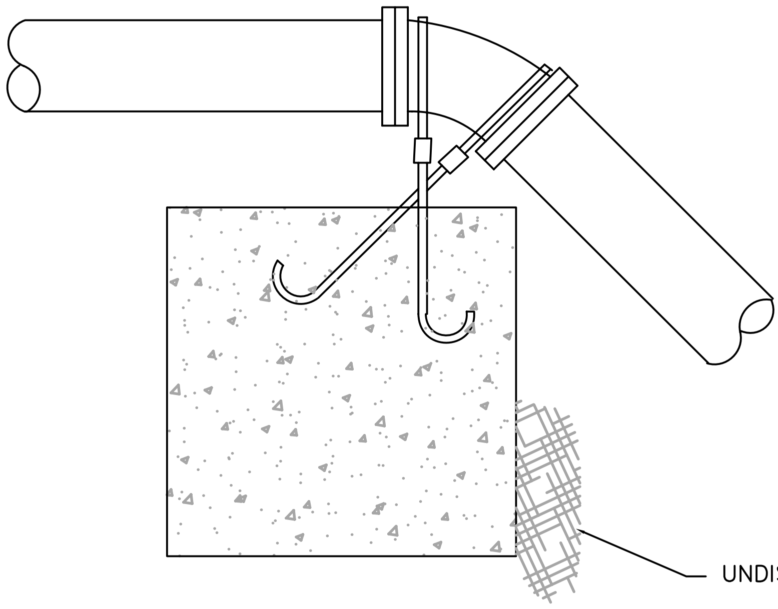
9. BLOCK HEIGHT SHALL BE CHOSEN SUCH THAT THE BLOCK WIDTH IS NO MORE THAN ONE (1) TO TWO (2) TIMES THE BLOCK HEIGHT. IN NO CASE SHALL THE BLOCK HEIGHT BE LESS THAN THE PIPE DIAMETER.

CITY OF UMATILLA

THRUST BLOCKS

STANDARD DETAILS

DETAIL G-6

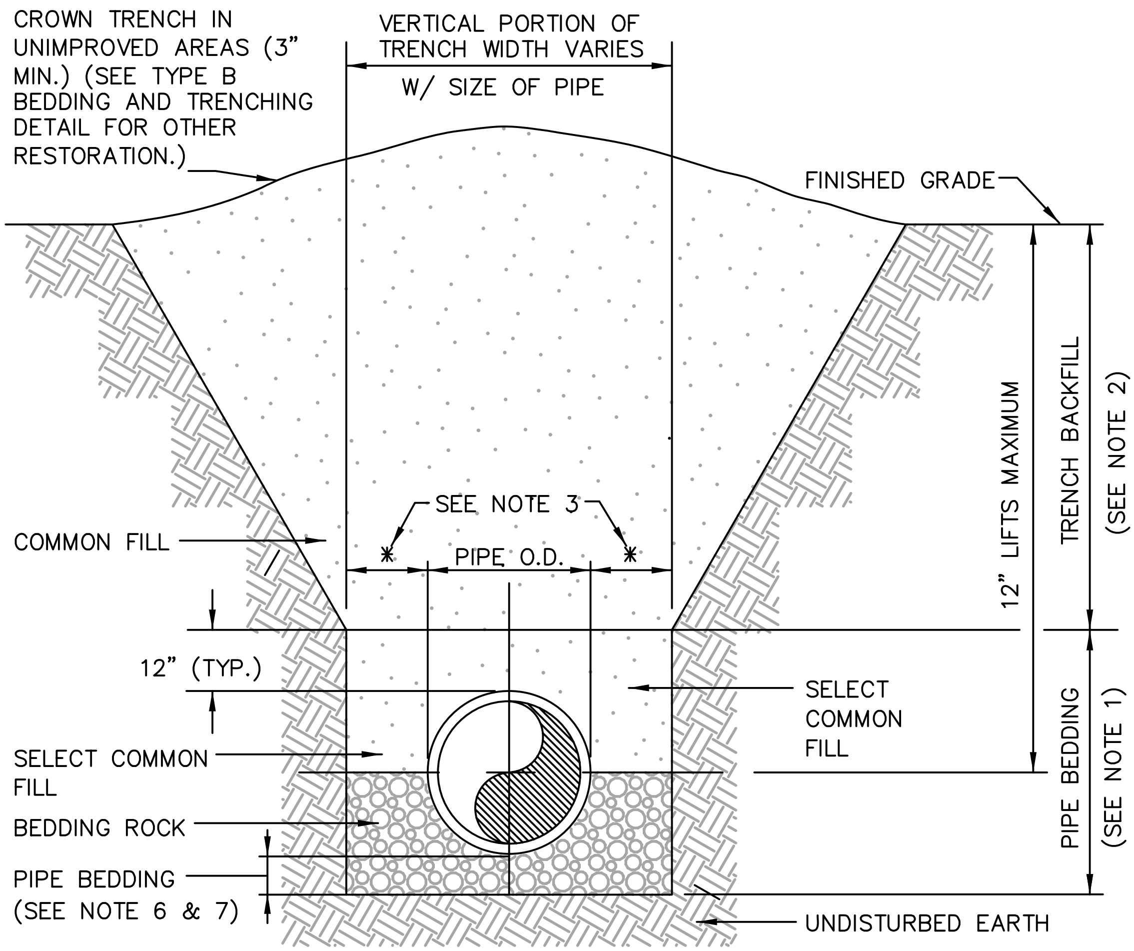


VOLUME OF THRUST BLOCK IN CUBIC YARDS (VERTICAL BENDS)			
FITTING SIZE	BEND ANGLE		
	45°	22 1/2°	11 1/4°
4	0.5	0.3	0.1
6	1.1	0.6	0.3
8	2.0	1.1	0.5
10	3.1	1.7	0.9
12	4.4	2.4	1.2
14	6.1	3.3	1.7
16	7.9	4.3	2.2

ANCHOR ROD SIZES		
FITTING SIZE	ROD SIZE	EMBEDMENT
12" OR LESS	#6	30"
14" – 16"	#8	36"

NOTES:

1. THRUST BLOCK VOLUMES FOR VERTICAL BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURE OF 150 PSIG AND THE WEIGHT OF CONCRETE = 4050 LBS/CU. YD. TO COMPUTE VOLUMES FOR DIFFERENT TEST PRESSURES, USE THE FOLLOWING EQUATION: VOLUME = (TEST PRESSURE/ 150 X (TABLE VALUE).
2. KEEP CONCRETE CLEAR OF JOINT AND JOINT ACCESSORIES.
3. THRUST BLOCKS FOR VERTICAL BENDS HAVING DOWNWARD RESULTANT THRUSTS SHALL BE THE SAME AS FOR HORIZONTAL BENDS.
4. 2500 P.S.I. CONCRETE SHALL BE USED FOR ALL THRUST BLOCKS.
5. QUANTITIES ARE GIVEN FOR CONCRETE ANCHORS IN DRY SOIL. QUANTITIES OF CONCRETE ANCHORS TO BE USED BELOW THE GROUND WATER TABLE SHALL BE CALCULATED BY MULTIPLYING ABOVE VALUES BY 1.76.



NOTES:

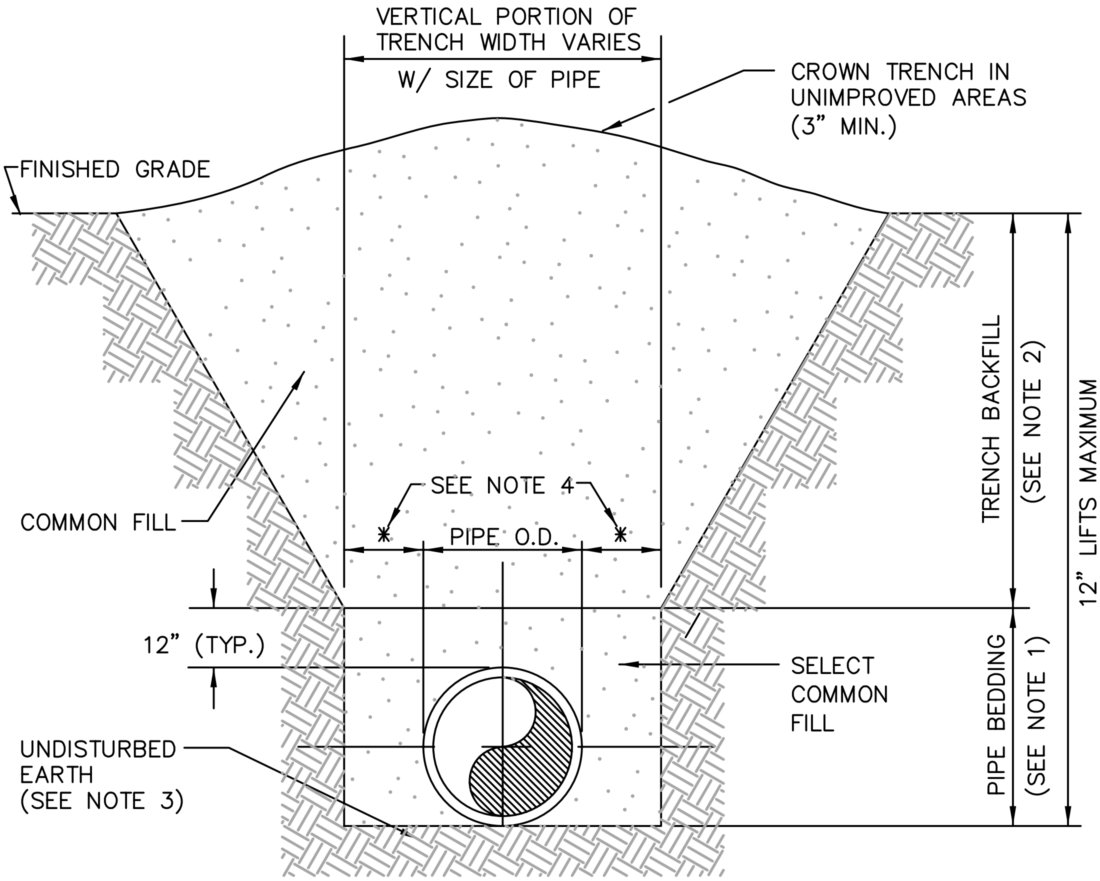
1. PIPE BEDDING: SELECT COMMON FILL COMPACTED TO 98% OF THE MAXIMUM DENSITY AS PER AASHTO T–180.
2. TRENCH BACKFILL: COMMON FILL COMPACTED TO 95% (98% under roadways) OF THE MAXIMUM DENSITY AS PER AASHTO T–180.
3. (*): 15" MAX. FOR PIPE DIAMETER LESS THAN 24", AND 24" MAX. FOR PIPE DIAMETER 24" AND LARGER.
4. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION.
5. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF THE FLOW.
6. WHEN REQUIRED BY THE ENGINEER, GRAVITY SEWERS SHALL UTILIZE TYPE A BEDDING. BEDDING DEPTH SHALL BE 4" MINIMUM FOR PIPE DIAMETER LESS THAN 15", AND 6" MINIMUM FOR PIPE DIAMETER 16" AND LARGER.
7. DEPTH FOR REMOVAL OF UNSUITABLE MATERIAL SHALL GOVERN DEPTH OF BEDDING ROCK BELOW THE PIPE. THE REQUIRED REMOVAL OF UNSUITABLE MATERIAL TO REACH SUITABLE FOUNDATION. WILL BE DETERMINED IN THE FIELD BY THE ENGINEER.

CITY OF UMATILLA

TYPE A BEDDING AND TRENCHING

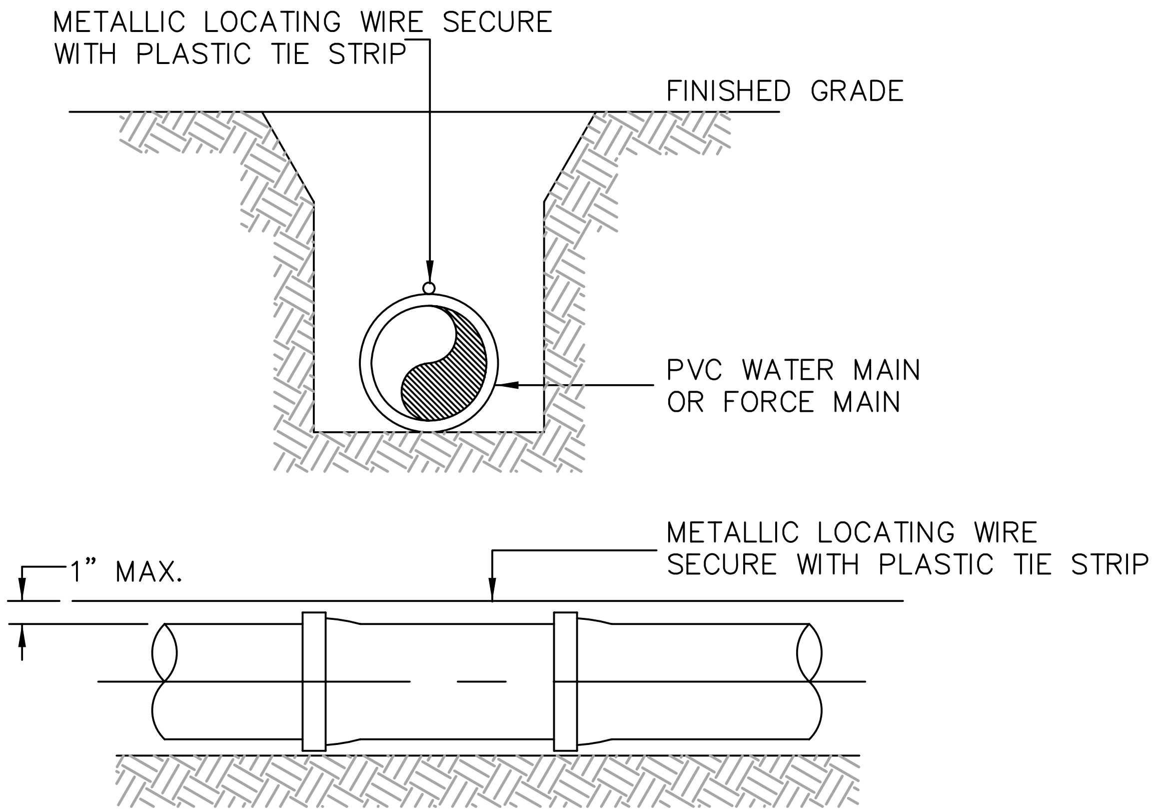
STANDARD DETAILS

DETAIL G–8



NOTES:

1. PIPE BEDDING: SELECT COMMON FILL COMPACTED TO 98% OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
2. TRENCH BACKFILL: COMMON FILL COMPACTED TO 95% (98% under roadways) OF THE MAXIMUM DENSITY AS PER AASHTO T-180.
3. PIPE BEDDING UTILIZING SELECT COMMON FILL OR BEDDING ROCK IN ACCORDANCE WITH TYPE A BEDDING AND TRENCHING DETAIL MAY BE REQUIRED AS DIRECTED BY THE ENGINEER.
4. (*): 15" MAX. FOR PIPE DIAMETER LESS THAN 24", AND 24" MAX. FOR PIPE DIAMETER 24" AND LARGER.
5. WATER SHALL NOT BE PERMITTED IN THE TRENCH DURING CONSTRUCTION.
6. ALL PIPE TO BE INSTALLED WITH BELL FACING UPSTREAM TO THE DIRECTION OF THE FLOW.
7. FINAL RESTORATION IN IMPROVED AREAS SHALL BE IN COMPLIANCE WITH ALL APPLICABLE REGULATIONS OF GOVERNING AGENCIES. SURFACE RESTORATION WITHIN CITY OF UMATILLA, LAKE COUNTY, FDOT RIGHT-OF-WAY SHALL COMPLY WITH REQUIREMENTS OF RIGHT-OF-WAY UTILIZATION REGULATIONS/PERMIT AND ROAD CONSTRUCTION SPECIFICATIONS.



NOTES:

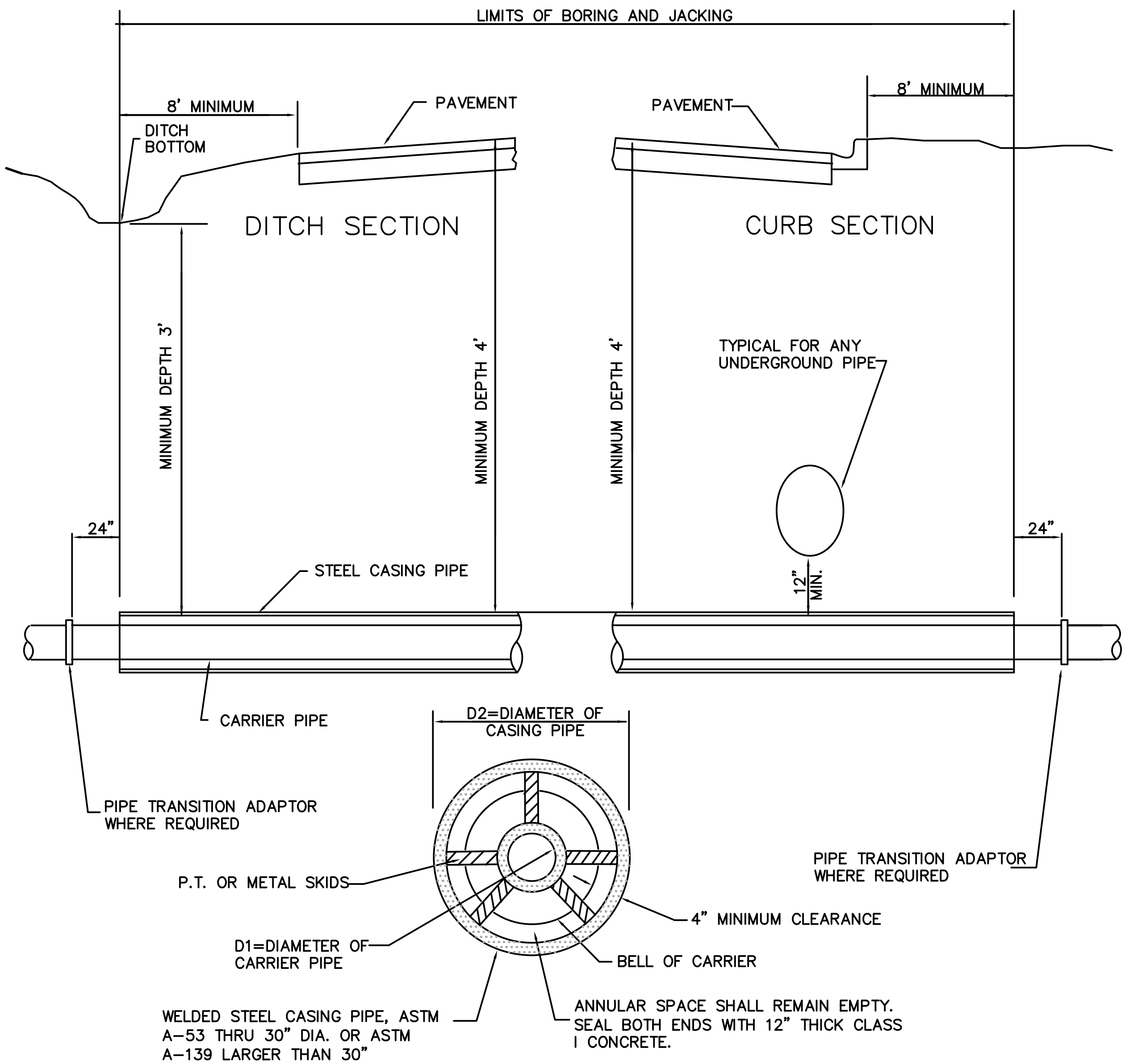
1. PVC PIPE SHALL REQUIRE INSULATED METALLIC LOCATING WIRE (14 GAUGE COPPER) CAPABLE OF DETECTION BY A CABLE LOCATOR AND SHALL BE BURIED DIRECTLY ABOVE THE CENTERLINE OF THE PIPE.
2. LOCATING WIRE SHALL TERMINATE AT EACH VALVE BOX AND BE CAPABLE OF EXTENDING 12" ABOVE TOP OF BOX IN SUCH A MANNER SO AS NOT TO INTERFERE WITH VALVE OPERATION.
3. USE DUCT TAPE OR PLASTIC TIES, (7' MAX.) AS NECESSARY TO HOLD WIRE DIRECTLY ON THE TOP OF THE PIPE.
4. ALL WIRE CONNECTIONS IN VALVE BOXES SHALL BE SPLICED TOGETHER AND TAPED.

CITY OF UMATILLA

PVC PIPE LOCATING WIRE

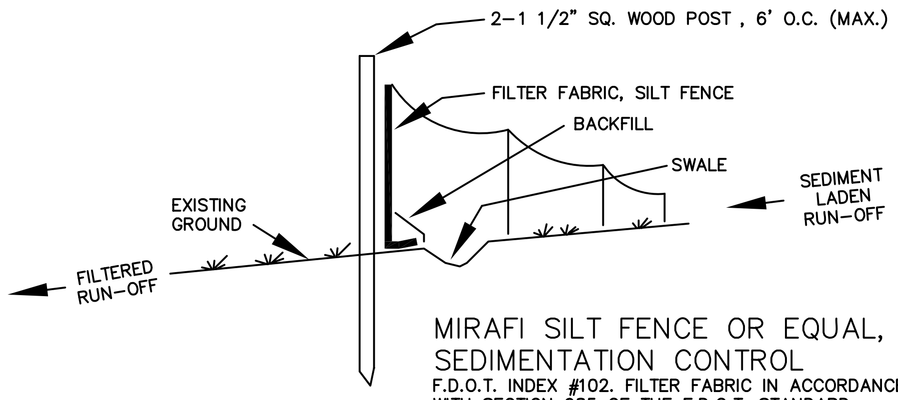
STANDARD DETAILS

DETAIL G-10



NOTES:

1. JACK AND BORE METHOD SHALL BE USED FOR ANY CROSSING INVOLVING LARGER THAN 4" DIAMETER PIPE. CROSSINGS INVOLVING 4" OR LESS DIAMETER PIPE MAY BE DONE USING OTHER APPROVED METHODS FOLLOWING MANUFACTURER'S PROCEDURES. IN ALL CASES A PERMIT MUST BE ISSUED BY THE CITY OF UMATILLA ENGINEERING DEPT. PRIOR TO THE WORK BEING PERFORMED, AND A CITY INSPECTOR SHALL BE ON SITE WHILE SAID WORK IS BEING PERFORMED.
2. ROTATION OF CARRIER PIPE INSIDE THE CASING PIPE WILL NOT BE PERMITTED. MECHANICAL OR FLANGED JOINT PIPE SHALL BE USED TO HELP PREVENT SUCH ROTATION.
3. ALL REQUIREMENTS OF FDOT AS SPECIFIED IN THE FDOT "UTILITY ACCOMMODATION GUIDE" SHALL BE ADHERED TO WHEN CROSSING HIGHWAYS. THE MORE STRINGENT REQUIREMENTS BETWEEN THE FDOT AND THE CITY OF UMATILLA SHALL GOVERN IN ALL CASES OF CONFLICT.
4. THE INSIDE DIAMETER OF THE CASING SHALL BE A MINIMUM OF 4" GREATER THAN THE OUTSIDE DIAMETER OF THE CARRIER PIPE BELL OR COUPLING.
5. IN ADDITION TO THE SUPPORT ARRANGEMENT OF TIMBER OR METAL SKIDS, THE CONTRACTOR SHALL PROVIDE 4' LONG SKIDS FOR EACH LENGTH OF CARRIER PIPE AT THE SPRING LINE AND ON TOP ADJACENT TO THE BELL END OF THE PIPE DESIGNED TO PREVENT LATERAL OR VERTICAL REPLACEMENT. MANUFACTURED PIPE SUPPORTS SUCH AS "PSI" OR OTHERS MAY BE SUBSTITUTED WITH THE CITY OF UMATILLA'S WRITTEN APPROVAL.
6. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF CASING OR TUNNEL LINER PIPE INSTALLATION FOR THE ENGINEER'S APPROVAL PRIOR TO FABRICATION OF PIPING, CASING, AND APPURTENANCES.
7. ALL REQUIREMENTS OF THE RAILROAD AS SPECIFIED BY THE AMERICAN RAILWAY ENGINEERING ASSOCIATION AND THE RAILROAD COMPANY SHALL BE ADHERED TO WHEN CROSSING RAILROADS. THE MORE STRINGENT REQUIREMENTS BETWEEN THE R/R AND THE CITY OF UMATILLA SHALL GOVERN IN ALL CASES OF CONFLICT.



MIRAFI SILT FENCE OR EQUAL, SEDIMENTATION CONTROL
F.D.O.T. INDEX #102. FILTER FABRIC IN ACCORDANCE WITH SECTION 985 OF THE F.D.O.T. STANDARD SPECIFICATIONS.

NOTES:

1. TEMPORARY EROSION CONTROL STRUCTURE TO BE UTILIZED DURING CONSTRUCTION AT AREAS DESIGNATED BY ENGINEER OR AREAS ON-SITE WHERE UNSTABILIZED GRADES MAY CAUSE EROSION PROBLEMS. EROSION CONTROL STRUCTURE MAY BE REMOVED AFTER UPSLOPE AREA HAS BEEN STABILIZED BY SOD, OR COMPACTED AS DETERMINED BY THE ENGINEER.
2. CONSTRUCT STORMWATER SYSTEMS BEFORE ANY BUILDING OR ROAD CONSTRUCTION IS STARTED.
   a.) PROTECT SYSTEM FROM SILTING AND DEBRIS BY METHODS PROVIDED IN DETAILS.
   b.) PROTECT SWALE BOTTOM FROM SEALING BY EXCAVATING ALL SILT DEPOSITS DURING CONSTRUCTION. THIS SHALL BE DONE BEFORE SOD & SEEDING & MULCHING IS FINISHED

THE FOLLOWING LIST REPRESENTS A BASIC EROSION AND SEDIMENT CONTROL PROGRAM WHICH IS TO BE IMPLEMENTED TO HELP PREVENT OFF-SITE SEDIMENTATION DURING AND AFTER CONSTRUCTION OF THE PROJECT.

PERMANENT EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AT THE EARLIEST PRACTICAL TIME CONSISTENT WITH GOOD CONSTRUCTION PRACTICES. ONE OF THE FIRST CONSTRUCTION ACTIVITIES SHOULD BE THE PLACEMENT OF PERMANENT AND TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AROUND THE PERIMETER OF THE PROJECT OR THE INITIAL WORK AREA TO PROTECT THE PROJECT, ADJACENT PROPERTIES AND WATER RESOURCES.

TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE COORDINATED WITH PERMANENT MEASURES TO ASSURE ECONOMICAL, EFFECTIVE AND CONTINUOUS CONTROL THROUGHOUT THE CONSTRUCTION PHASE. TEMPORARY MEASURES SHALL NOT BE CONSTRUCTED FOR EXPEDIENCY IN LIEU OF PERMANENT MEASURES.

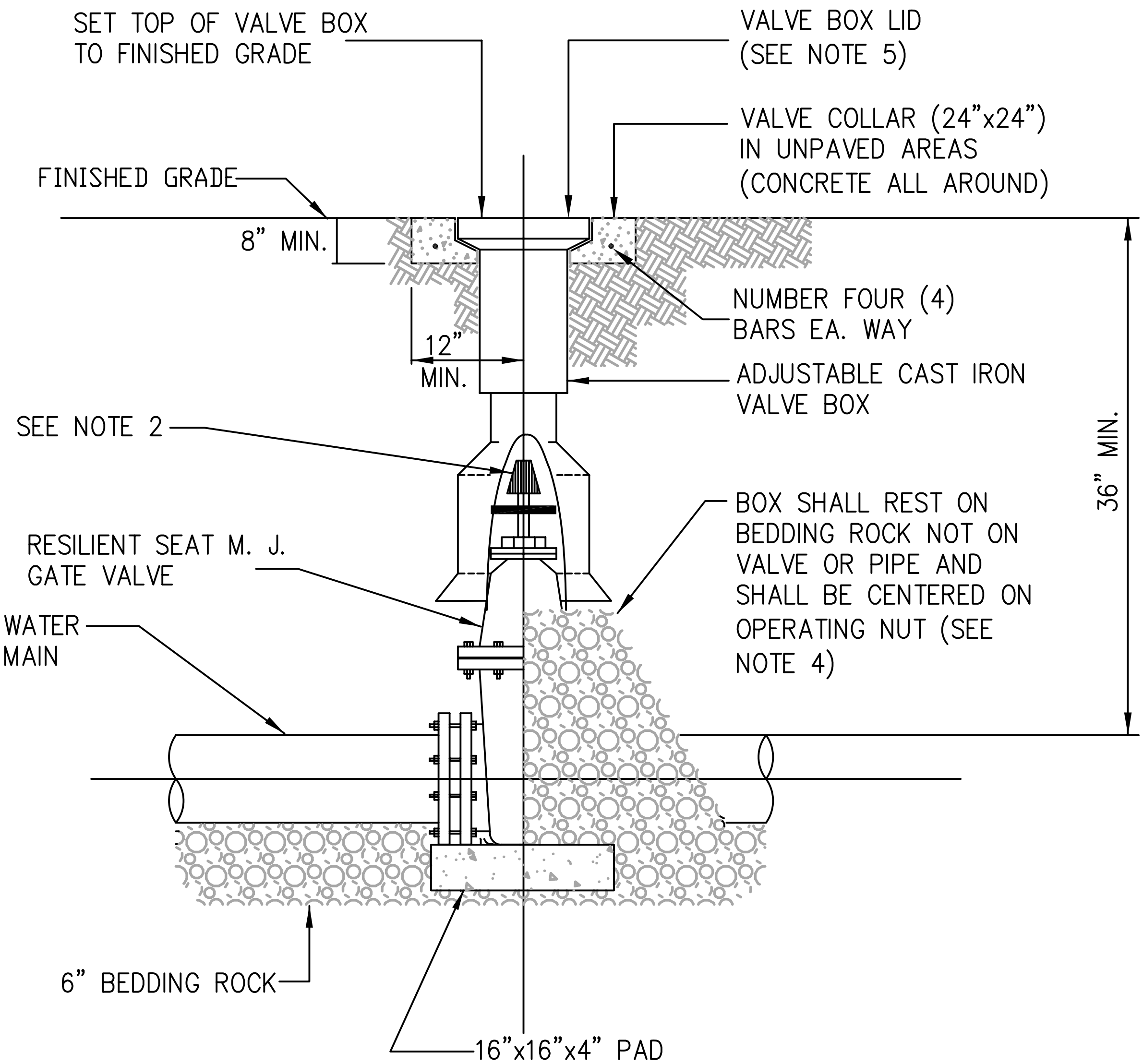
EROSION AND SEDIMENT CONTROL MEASURES SHALL BE ADEQUATELY MAINTAINED TO PERFORM THEIR INTENDED FUNCTION DURING CONSTRUCTION OF THE PROJECT.

NECESSARY REPAIRS TO BARRIERS OR REPLACEMENT OF BARRIERS SHALL BE ACCOMPLISHED PROMPTLY.

SEDIMENT DEPOSITS SHOULD BE REMOVED AFTER EACH RAINFALL. THEY MUST BE REMOVED WHEN THE LEVEL OF DEPOSITION REACHES APPROXIMATELY ONE-HALF THE HEIGHT OF THE BARRIER.

MATERIAL FROM SEDIMENT TRAPS SHALL NOT BE STOCKPILED OR DISPOSED OF IN A MANNER WHICH MAKES THEM READILY SUSCEPTIBLE TO BEING WASHED INTO ANY WATERCOURSE BY RUNOFF OR HIGH WATER.

ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE BARRIERS ARE NO LONGER REQUIRED SHALL BE DRESSED TO CONFORM TO THE EXISTING GRADE, PREPARED AND SEEDED.



NOTES:

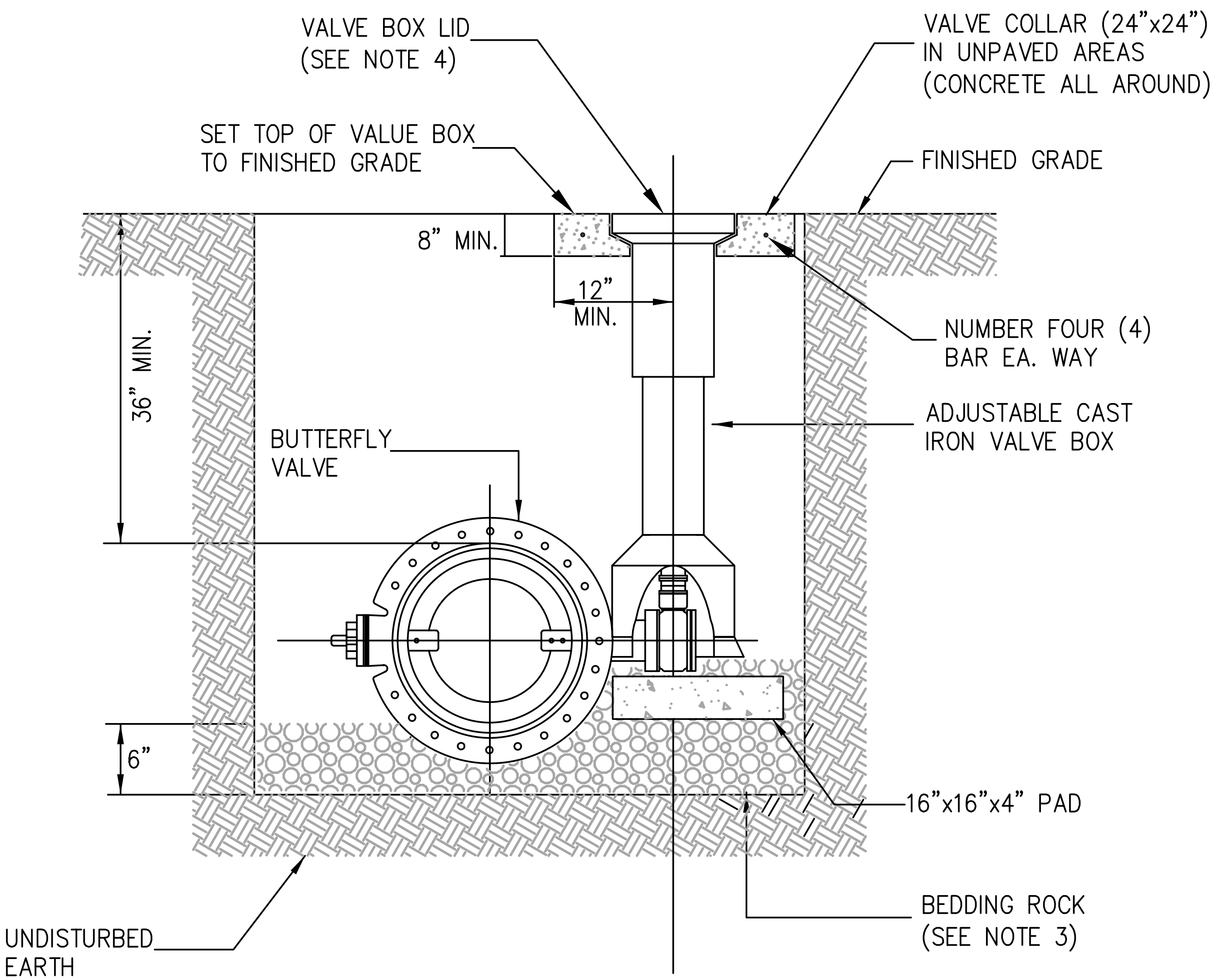
1. PVC EXTENSIONS SHALL NOT BE USED ON VALVE BOX INSTALLATION.
2. THE ACTUATING NUT FOR DEEPER VALVES SHALL BE EXTENDED TO COME UP TO A MAXIMUM OF 4 FOOT DEPTH BELOW FINISHED GRADE.
3. GATE VALVES SHALL BE USED WITH ALL WATER MAINS (10" OR LESS IN DIAMETER) UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS.
4. WHEN VALVE BOX IS TO BE INSTALLED IN ROADWAY OR OTHER TRAFFIC AREAS SET VALVE BOX ON FIVE (5) SOLID COMMON BRICKS.
5. VALVE BOX LID TO BE LETTERED WITH THE WORD "WATER".

CITY OF UMATILLA

GATE VALVE AND BOX

STANDARD DETAILS

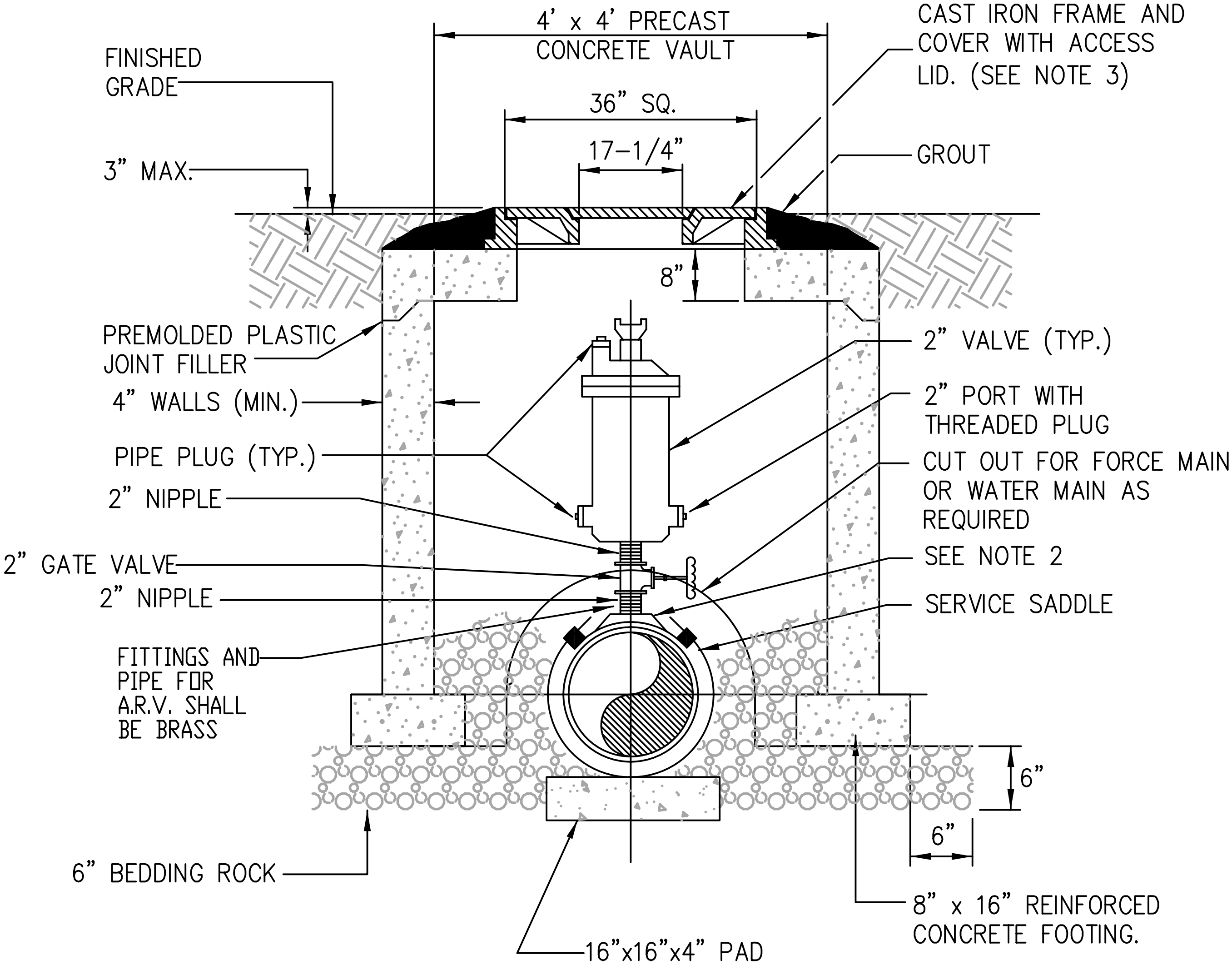
DETAIL W-1



NOTES:

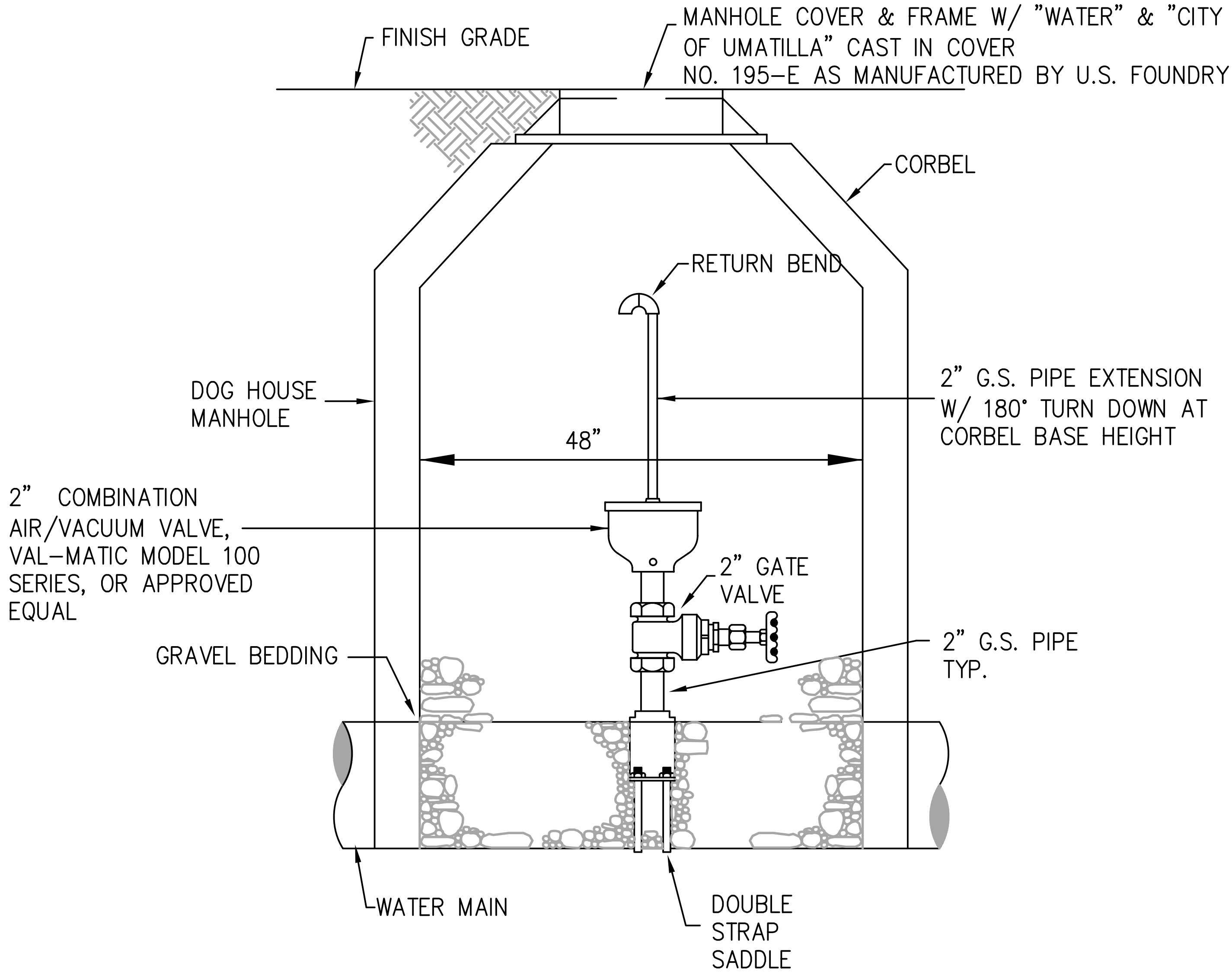
1. PVC EXTENSIONS SHALL NOT BE USED ON VALVE BOX INSTALLATION.
2. ALL WATER SHUT-OFF VALVES LARGER THAN TEN (10) INCHES IN DIAMETER SHALL BE BUTTERFLY VALVES.
3. WHEN VALVE BOX IS TO BE INSTALLED IN ROADWAY OR OTHER TRAFFIC AREAS SET VALVE BOX ON FIVE (5) SOLID COMMON BRICKS.
4. VALVE BOX LID TO BE LETTERED WITH THE WORD "WATER".
5. THE ACTUATING NUT FOR DEEPER VALVES SHALL BE EXTENDED TO COME UP TO MAXIMUM 4 FOOT DEPTH BELOW FINISHED GRADE.

	CITY OF UMATILLA	***BUTTERFLY VALVE AND BOX***	***STANDARD DETAILS*** ***DETAIL W-2***



NOTES:

1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE. CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY OF UMATILLA PRIOR TO INSTALLATION.
2. THE MINIMUM DIMENSION FROM TOP OF PIPE TO FINISHED GRADE SHALL BE 3.0 FEET.
3. CAST IRON FRAME AND COVER SHALL BE BY "U.S. FOUNDRY" MODEL 7665, OR APPROVED EQUAL. LID SHALL BE LETTERED WITH THE APPROPRIATE WORD "WATER" AND "CITY OF UMATILLA".



NOTES:

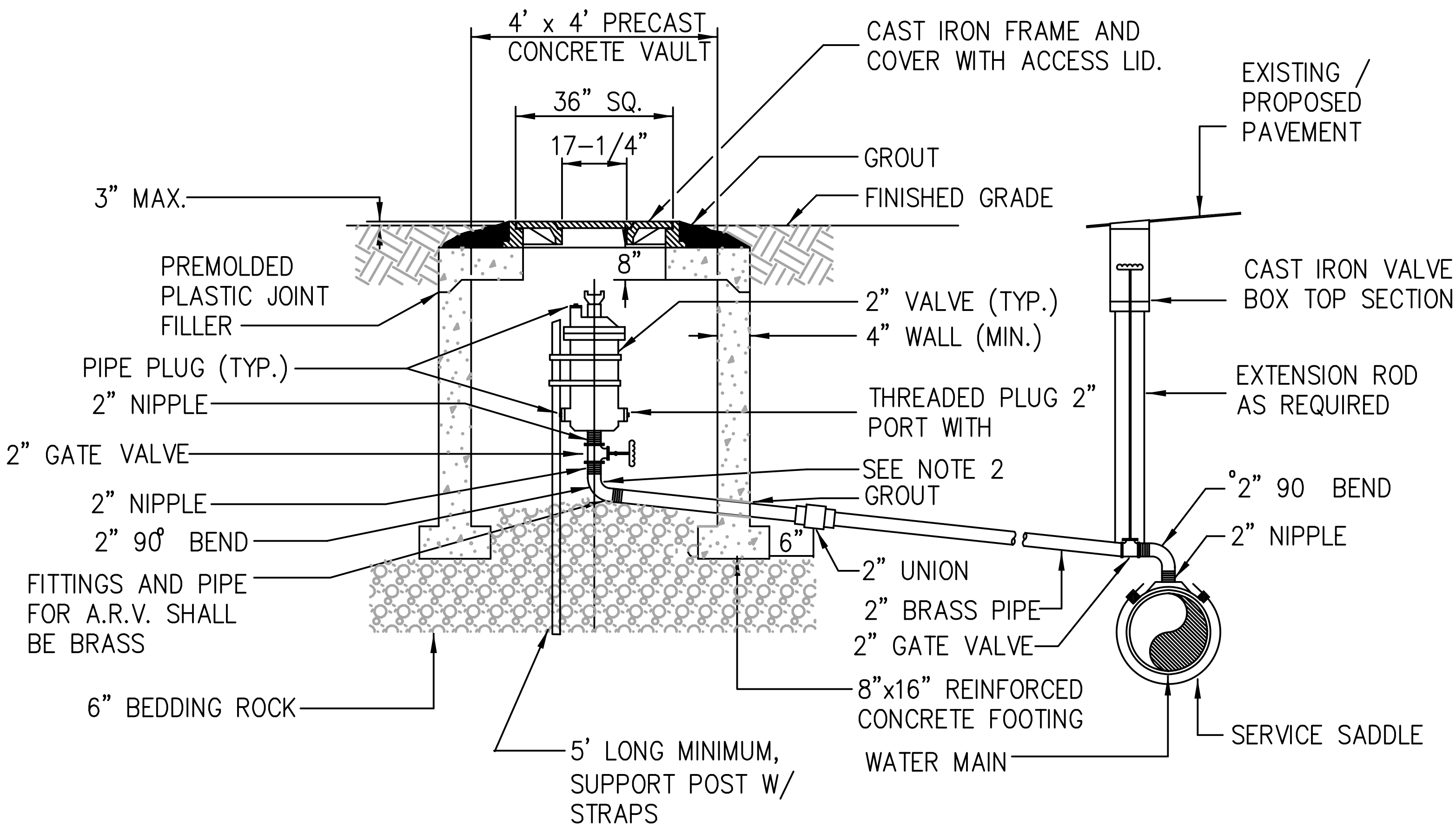
1. THE MINIMUM DIMENSION FROM TOP OF PIPE TO FINISHED GRADE SHALL BE 3.0 FEET.
2. DOUBLE STRAP SADDLE AND WRAP WITH TWO LAYERS OF WIDE PLASTIC OR POLY TAPE WITH STAINLESS STEEL STRAP.
3. PIPE INSTALLATION SHALL BE SUCH THAT THE ARV IS LOCATED AT THE HIGHEST POINT IN THE RESPECTIVE SEGMENT.
4. INTERIOR AND EXTERIOR CONCRETE SURFACES SHALL RECEIVE PROTECTIVE COATING AS SPECIFIED FOR STANDARD MANHOLES.
5. CAST IRON FRAME, COVER AND ACCESS LID SHALL BE INSTALLED FLUSH WITH FINISHED GRADE.
6. COVER SHALL READ "WATER" AND "CITY OF UMATILLA".

CITY OF UMATILLA

AIR OR COMBINATION AIR/VACUUM RELEASE VALVE

STANDARD DETAILS

DETAIL W-4



NOTES:

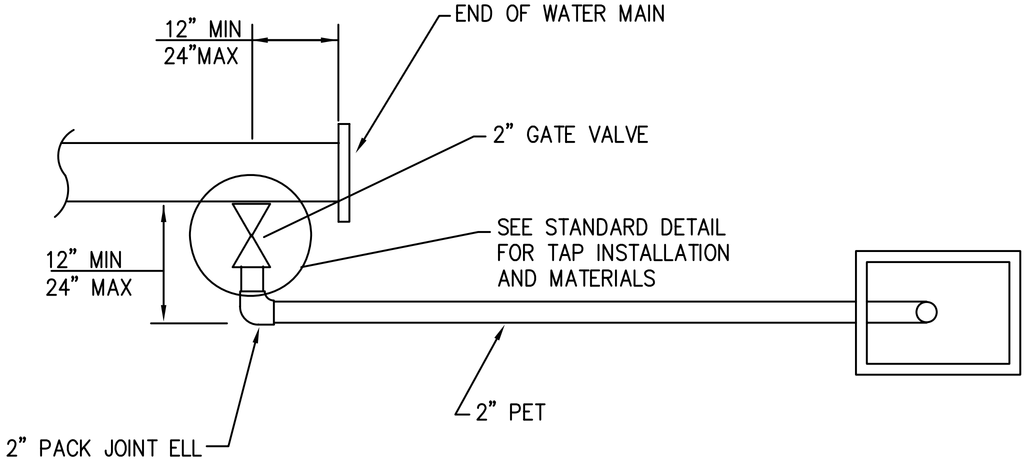
1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE. CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY OF UMATILLA PRIOR TO INSTALLATION.
2. THE MINIMUM DIMENSION FROM ELBOW INVERT TO FINISHED GRADE SHALL BE 2.0 FEET.
3. LID TO BE "U.S. FOUNDRY" MODEL 7665 OR APPROVED EQUAL, LETTERED WITH THE APPROPRIATE WORD "WATER" AND "CITY OF UMATILLA".

CITY OF UMATILLA

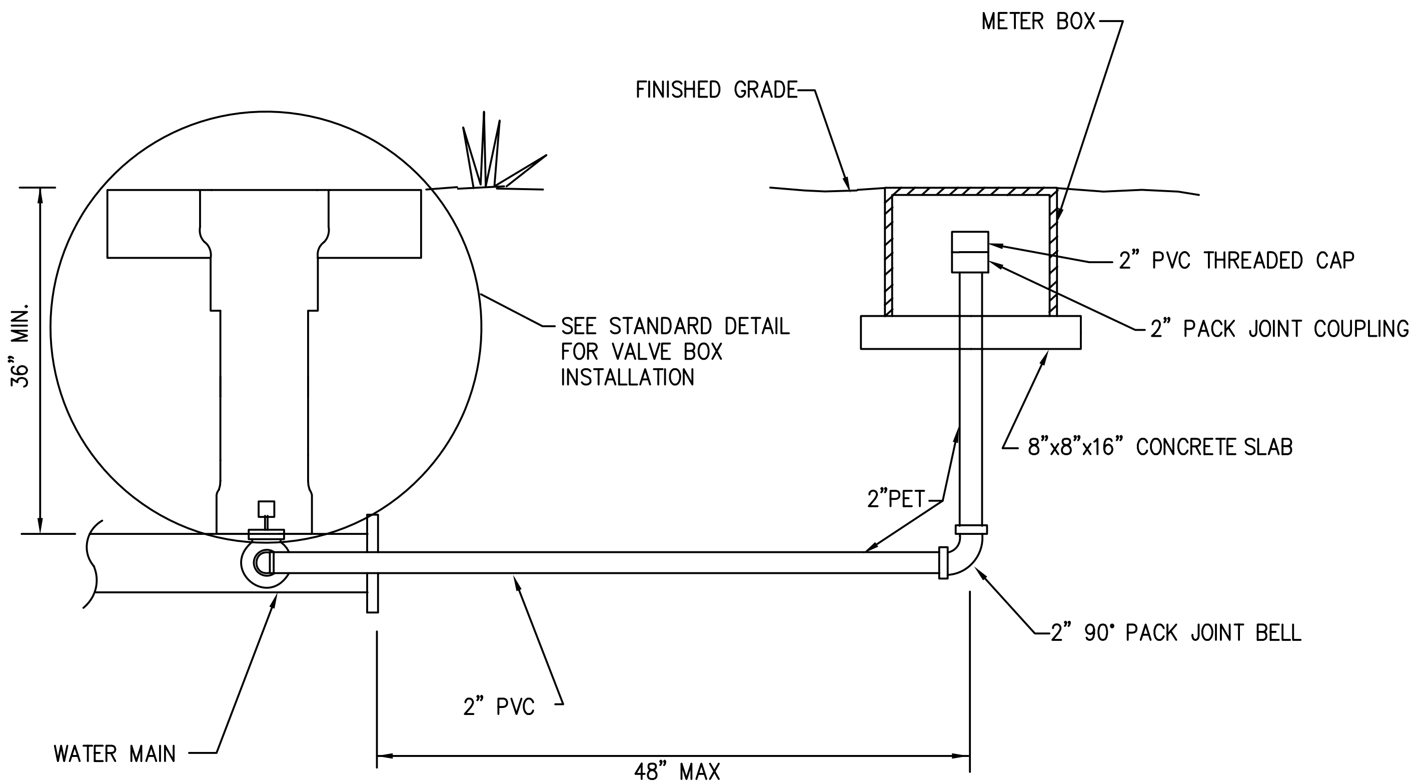
OFFSET AIR OR COMBINATION AIR/VACUUM RELEASE VALVE

STANDARD DETAILS

DETAIL W-5



PLAN VIEW



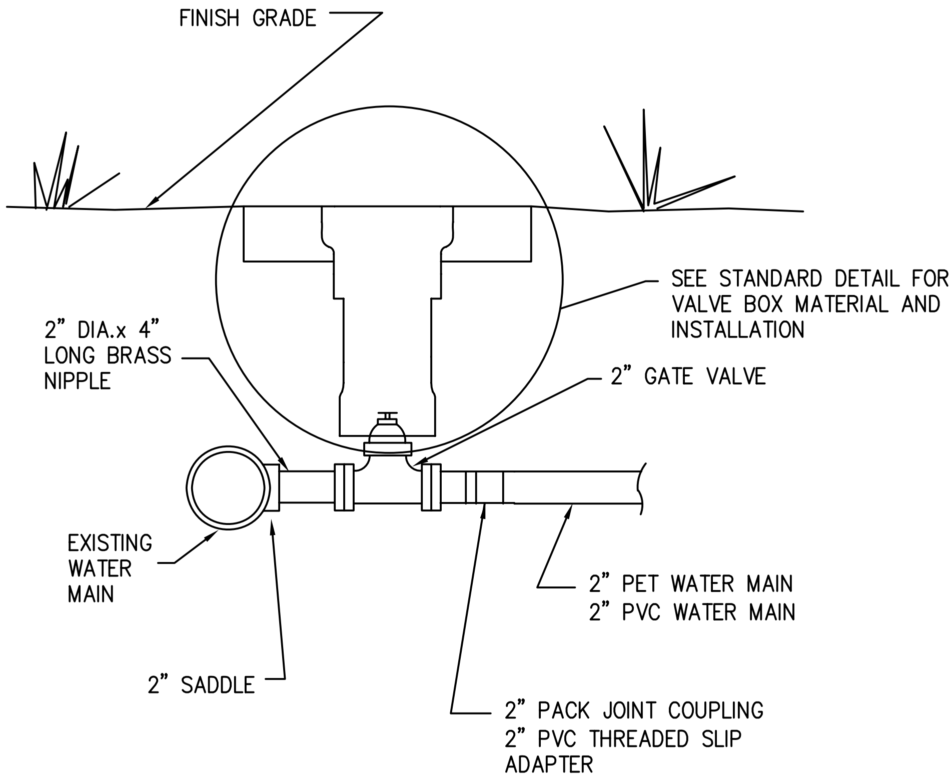
PROFILE VIEW

CITY OF UMATILLA

PERMANENT BLOWOFF ASSEMBLY

STANDARD DETAILS

DETAIL W-6



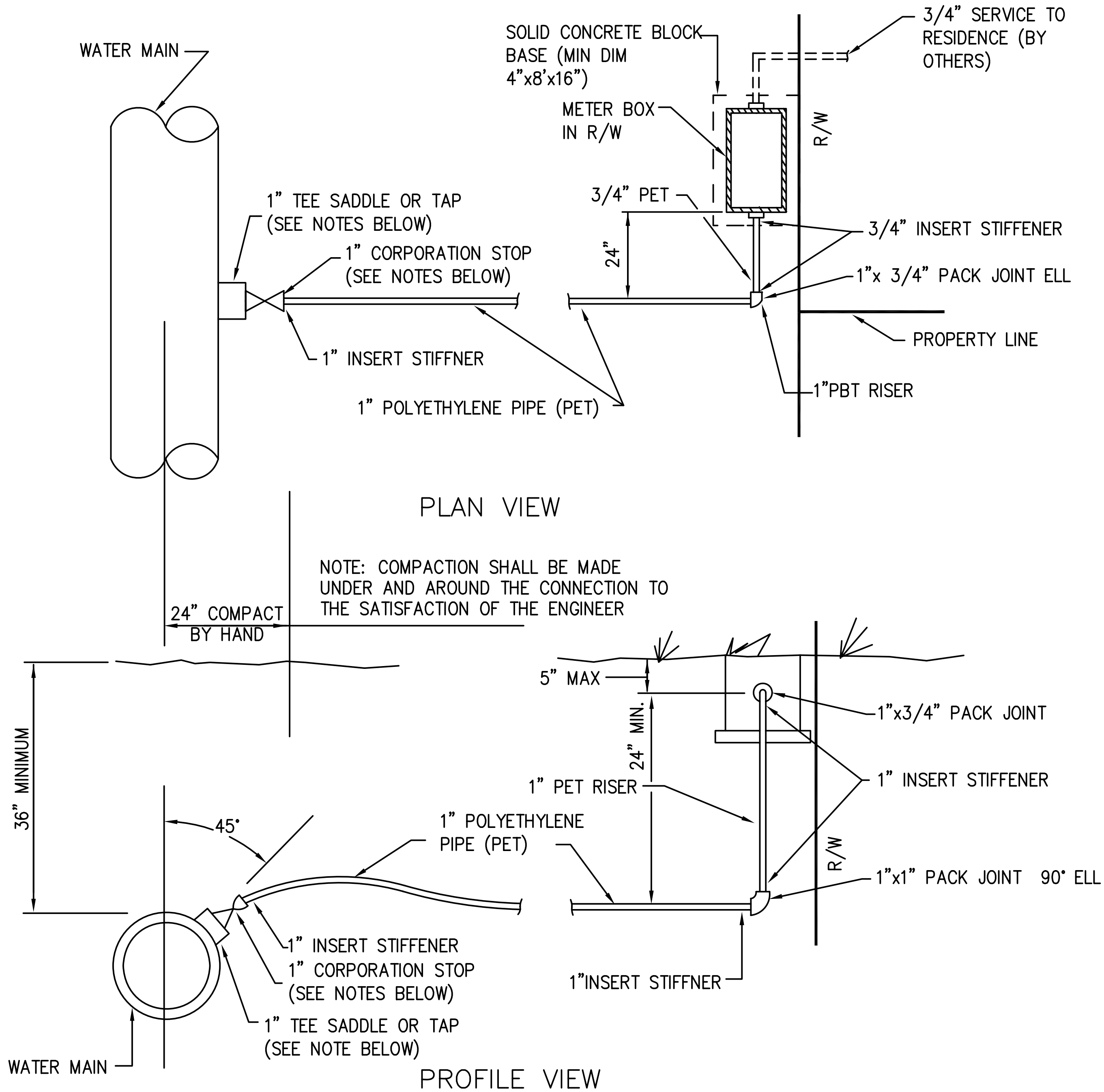
FOR 2" P.V.C. / P.E.T.

CITY OF UMATILLA

WATER MAIN TAP

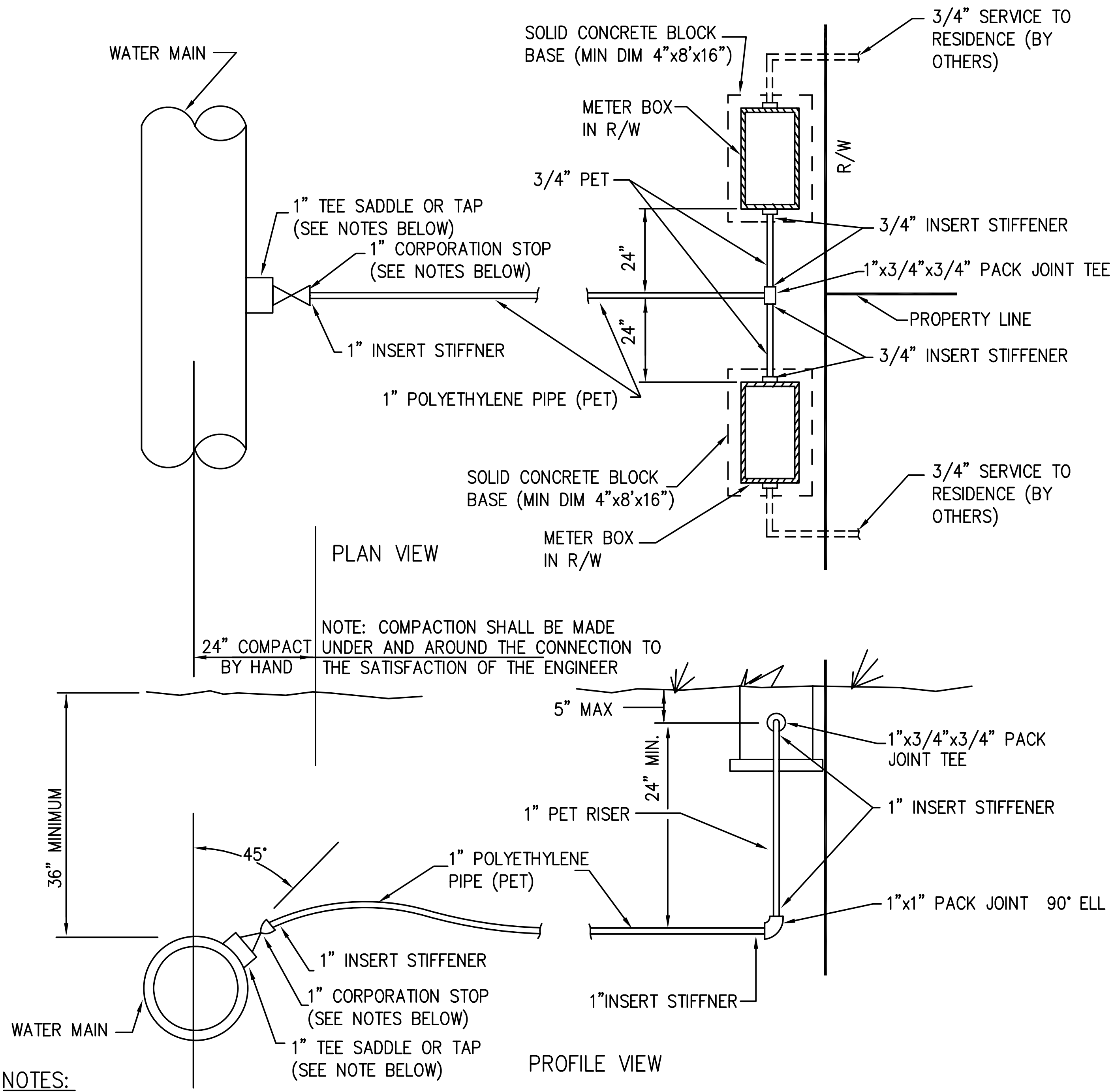
STANDARD DETAILS

DETAIL W-7



NOTES:

1. METER BOXES SET IN PAVEMENT SHALL BE CONCRETE WITH COVER AND METER READERS LID.
2. WATER SERVICE TO BE INSTALLED WITH SOLID COPPER LOCATING WIRE. SEE STANDARD DETAIL FOR LOCATING WIRE INSTALLATION.
3. ON NEW 2" PVC WATER MAINS, A 2" x 1" REDUCING TEE AND 1" CORPORATION STOP SHALL BE USED WHEN INSTALLING SERVICE CONNECTIONS.
4. ON EXISTING 2" GALVANIZED WATER MAINS, A SERVICE CLAMP AND 1" CORPORATION STOP SHALL BE USED WHEN INSTALLING SERVICE CONNECTIONS.
5. ON NEW OR EXISTING WATER MAINS WITH A DIAMETER LARGER THAN 2", A 1" TAP SHALL BE MADE INTO THE MAIN AND A 1" CORPORATION STOP SHALL BE USED WHEN INSTALLING SERVICE CONNECTIONS.
6. THE BRASS EXPANSION CONNECTION SUPPLIED WITH THE METER BOX SHALL BE DELIVERED TO THE ENGINEERING INSPECTOR AT THE TIME OF FINAL INSPECTION.
7. ROAD CROSSINGS NEED TO BE SLEEVED ON SERVICE CONNECTIONS.
8. INSTALLATION TO INCLUDE APL MAGNETIC MARKER



NOTES:

1. METER BOXES SET IN PAVEMENT SHALL BE CONCRETE WITH COVER AND METER READERS LID.
2. WATER SERVICE TO BE INSTALLED WITH SOLID COPPER LOCATING WIRE. SEE STANDARD DETAIL FOR LOCATING WIRE INSTALLATION.
3. ON NEW 2" PVC WATER MAINS, A 2" X 1" REDUCING TEE AND A 1" CORPORATION STOP SHALL BE USED WHEN INSTALLING SERVICE CONNECTIONS.
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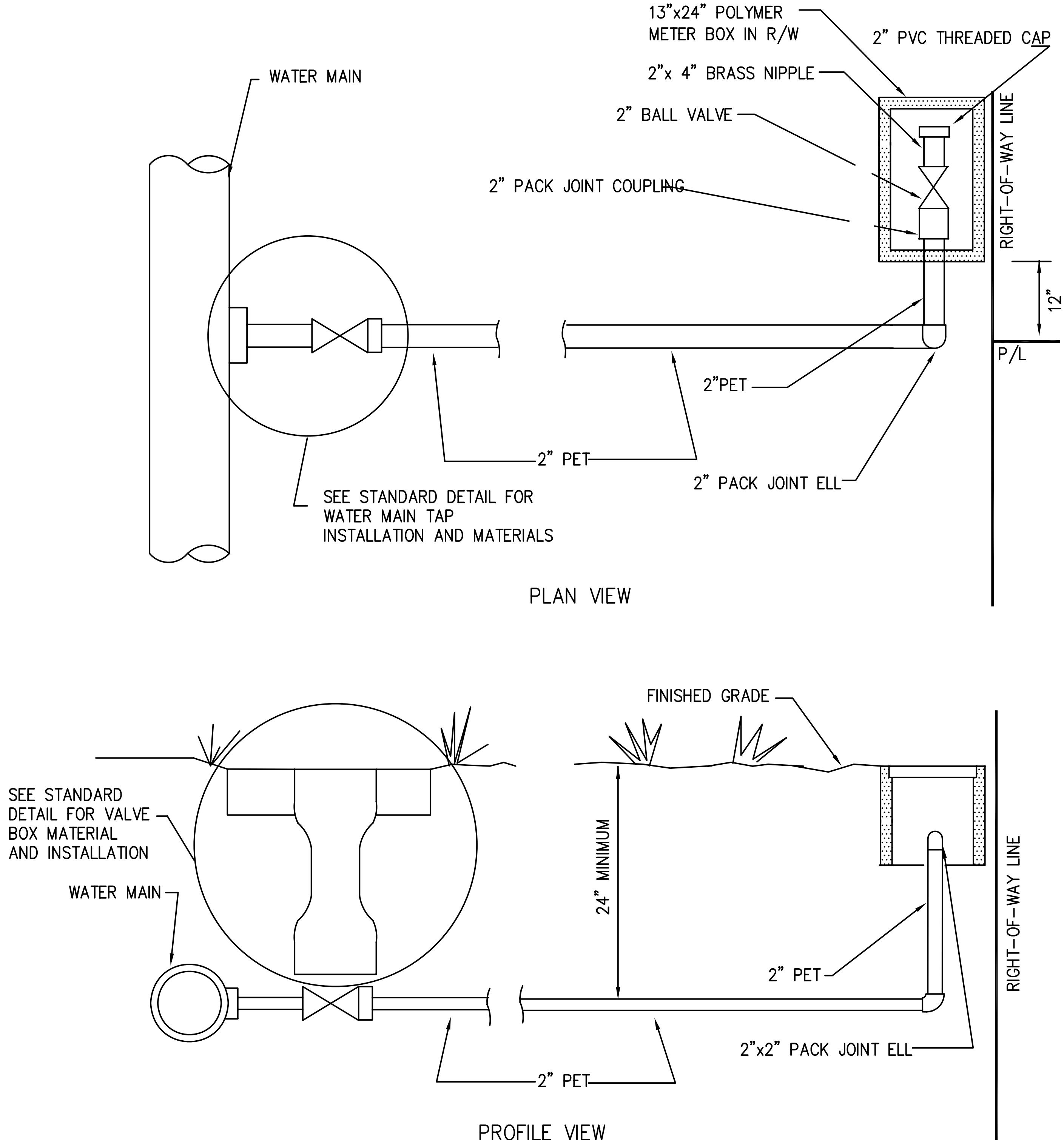
5. ON NEW OR EXISTING WATER MAINS WITH A DIAMETER LARGER THAN 2", A 1" TAP SHALL BE MADE INTO THE MAIN AND A 1" CORPORATION STOP SHALL BE USED WHEN INSTALLING SERVICE CONNECTIONS.
6. THE BRASS EXPANSION CONNECTION SUPPLIED WITH THE METER BOX SHALL BE DELIVERED TO THE ENGINEERING INSPECTOR OF FINAL INSPECTION.
7. ROAD CROSSINGS NEED TO BE SLEEVED ON SERVICE CONNECTIONS.
8. INSTALLATION TO INCLUDE APL MAGNETIC MARKER

CITY OF UMATILLA · Best of All · LAKE COUNTY FLA.	CITY OF UMATILLA	WATER SERVICE DOUBLE 3/4" WATER SERVICE	STANDARD DETAILS DETAIL W-9



NOTES:

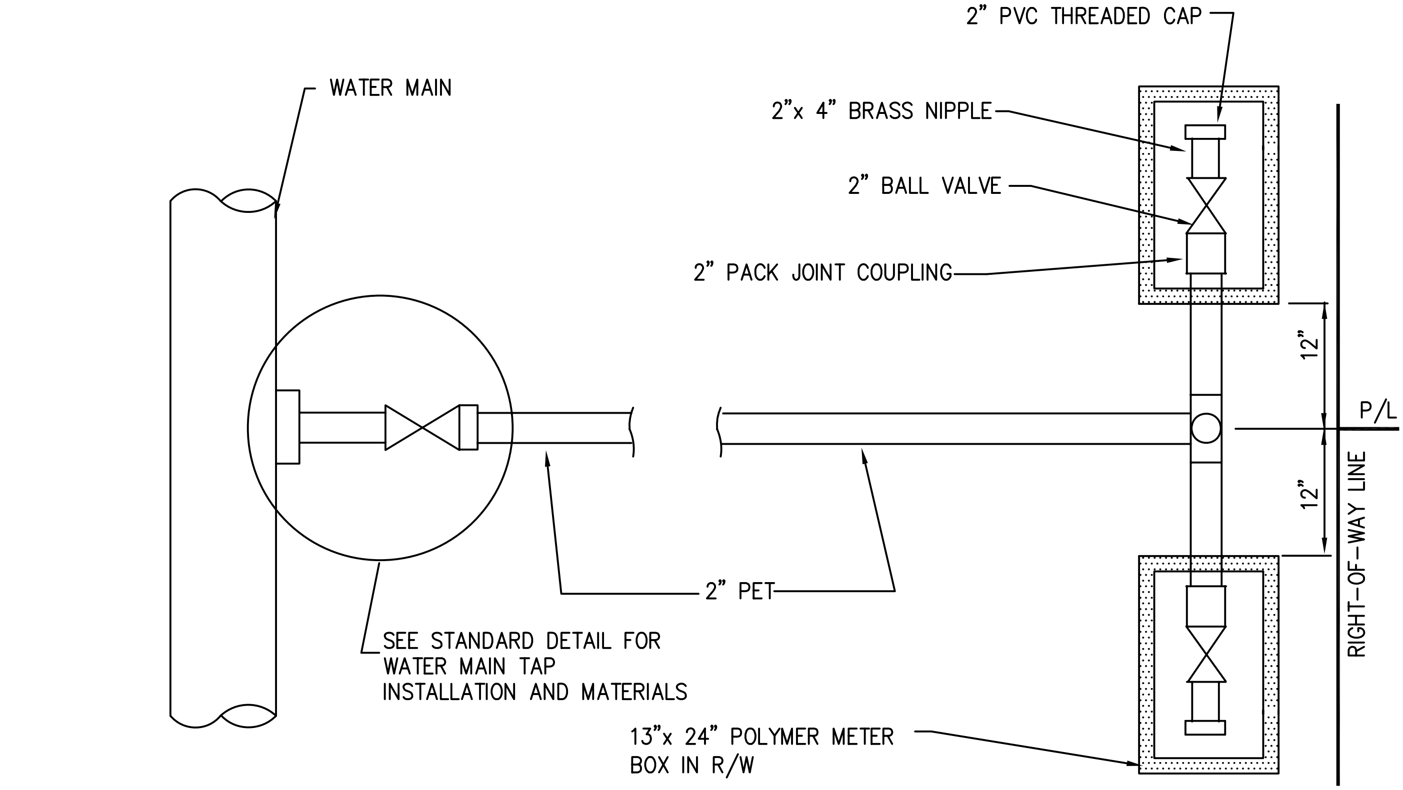
1. WATER SERVICE TO BE INSTALLED WITH A SOLID COPPER LOCATING WIRE SEE STANDARD DETAIL FOR LOCATING WIRE INSTALLATION.
2. ROAD CROSSINGS NEED TO BE SLEEVED ON SERVICE CONNECTIONS.
3. INSTALLATION TO INCLUDE APL MAGNETIC MARKER.

CITY OF UMATILLA

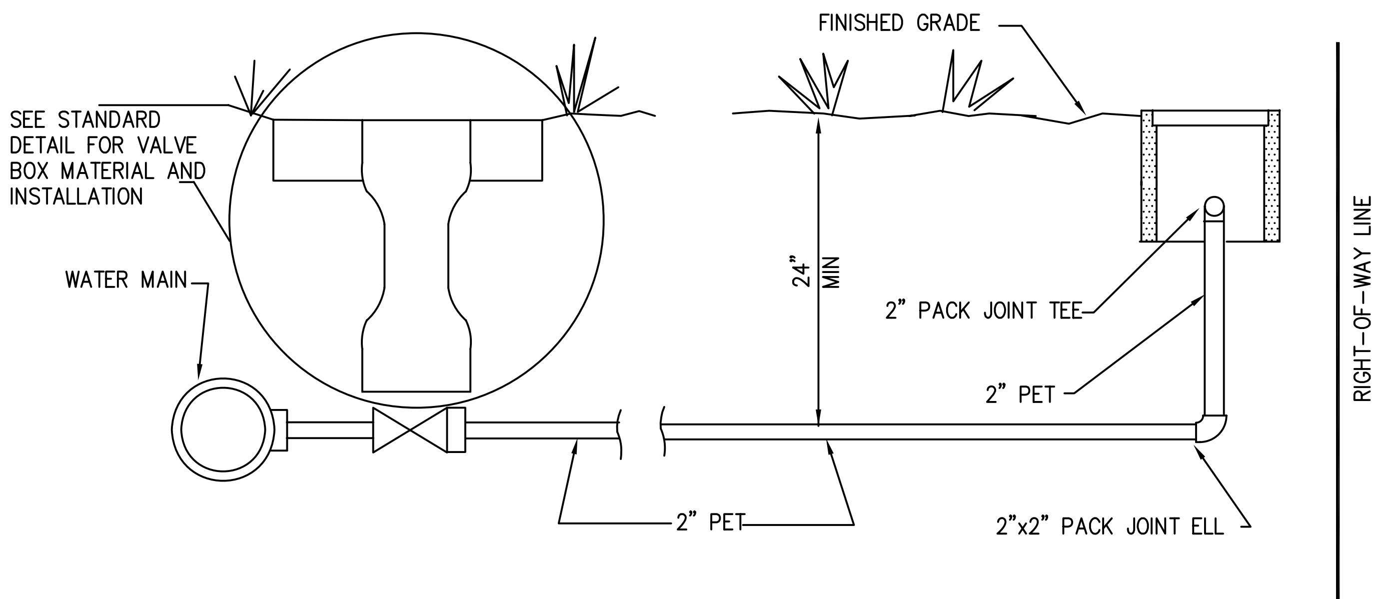
WATER SERVICE SINGLE 2" WATER SERVICE

STANDARD DETAILS

DETAIL W-10



PLAN VIEW



PROFILE VIEW

NOTES:

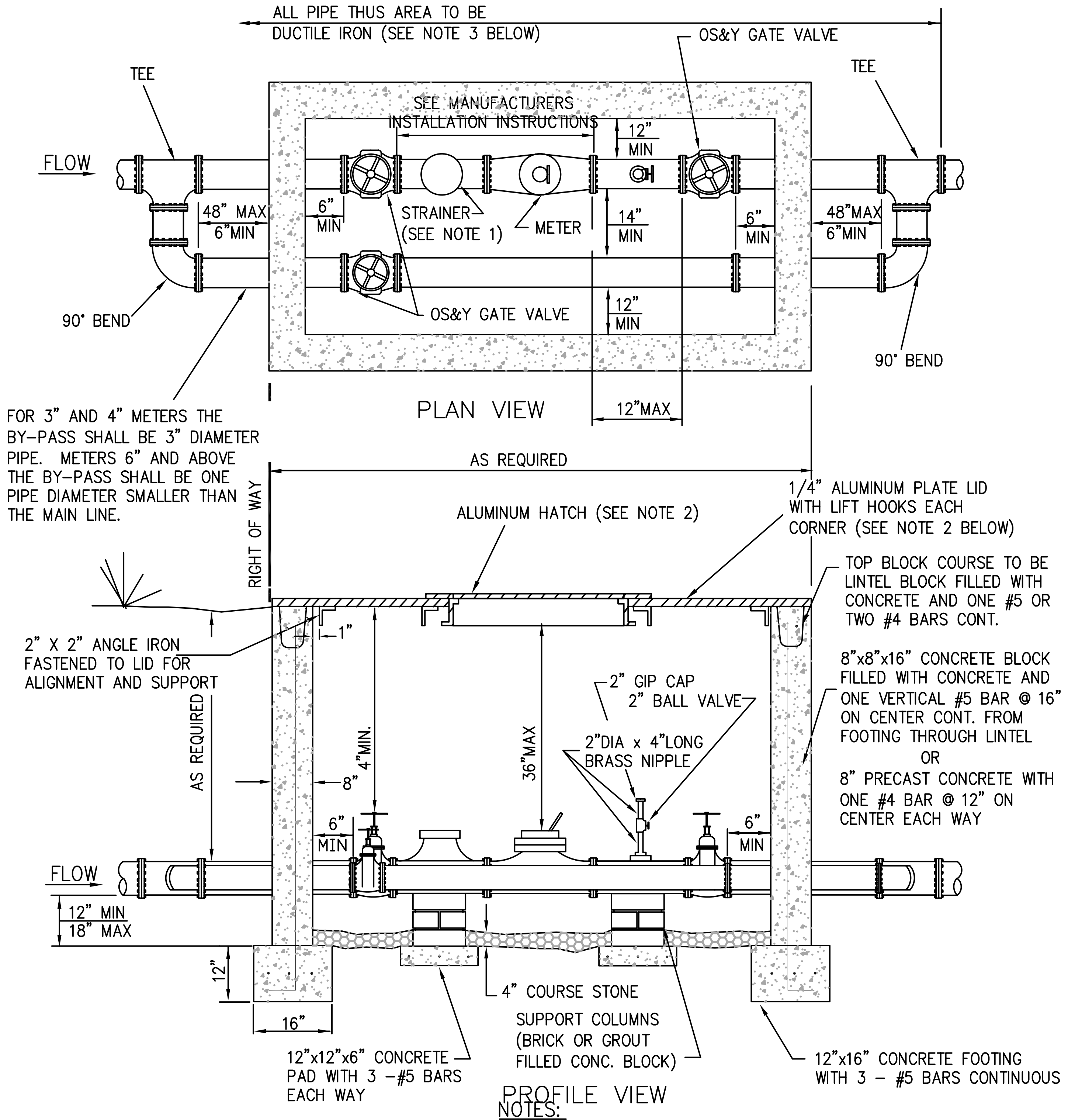
1. WATER SERVICE TO BE INSTALLED WITH A SOLID COPPER LOCATING WIRE SEE STANDARD DETAIL FOR LOCATING WIRE INSTALLATION.
2. ROAD CROSSINGS NEED TO BE SLEEVED ON SERVICE CONNECTIONS.
3. INSTALLATION TO INCLUDE APL MAGNETIC MARKER.

CITY OF UMATILLA

WATER SERVICE DOUBLE 2" WATER SERVICE

STANDARD DETAILS

DETAIL W-11

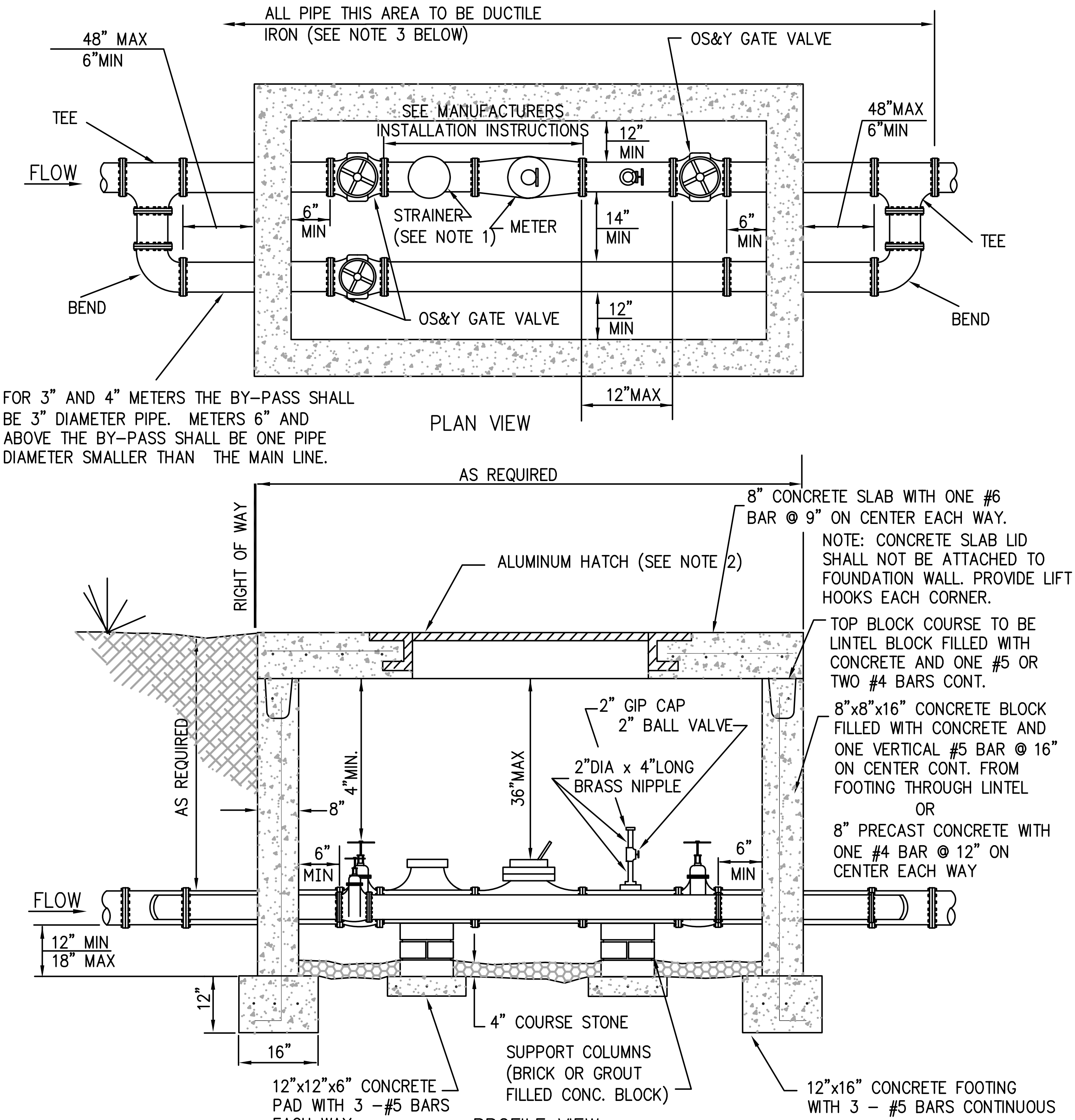


PROFILE VIEW

NOTES:

1. METERS SHALL BE FURNISHED WITH STRAINERS APPROVED BY THE METER MANUFACTURER AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
2. ALUMINUM HATCH SHALL BE 30" X 30" FOR METERS 3" AND 4". HATCH FOR METERS 6" AND ABOVE SHALL BE 42" X 42".
3. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
4. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.
5. ROAD CROSSINGS NEED TO BE SLEEVED ON SERVICE CONNECTIONS.

	CITY OF UMATILLA	**COMMERCIAL WATER SERVICE 3" AND ABOVE NON-TRAFFIC LID**	**STANDARD DETAILS** **DETAIL W-12**

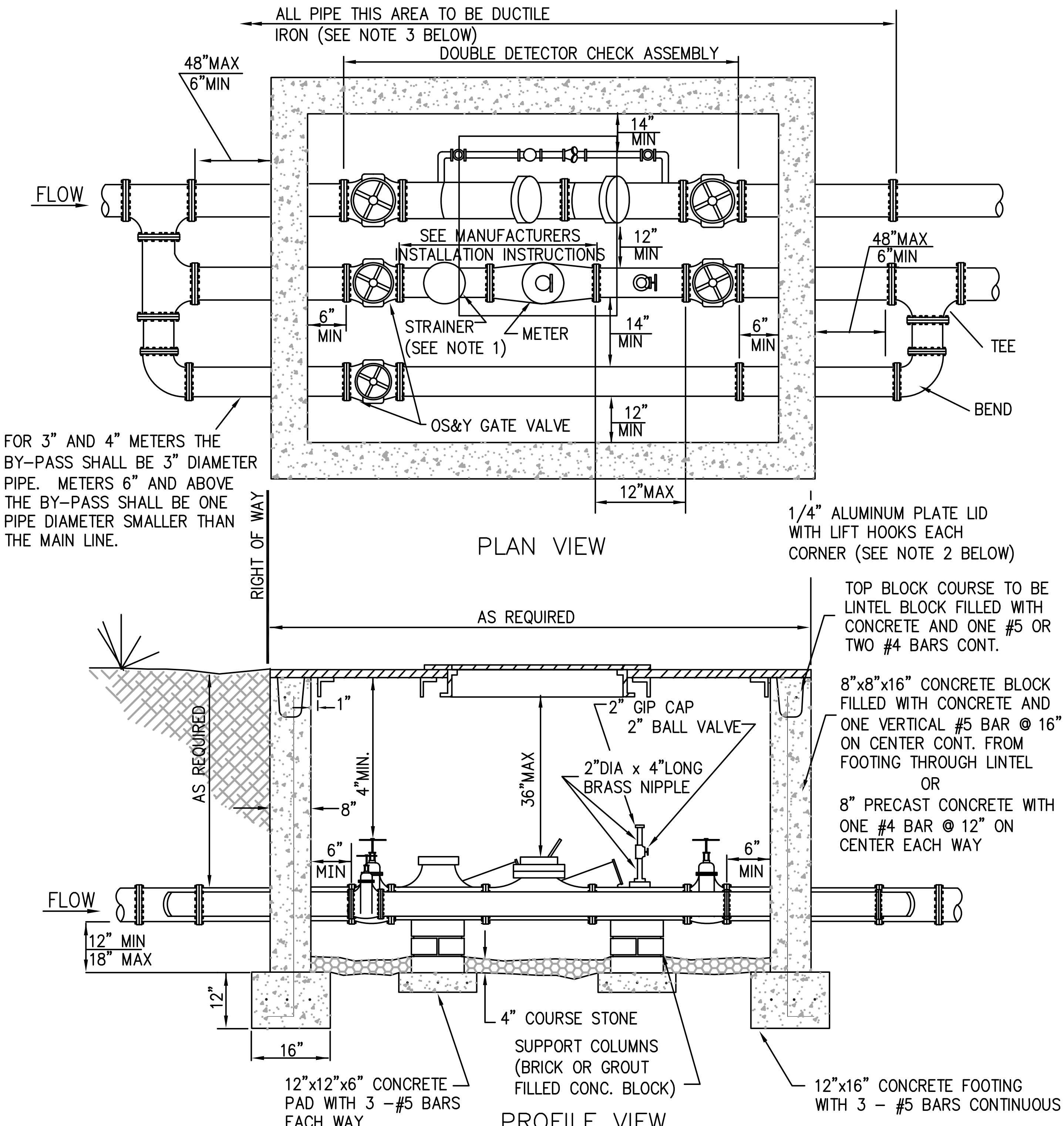


PROFILE VIEW

NOTES:

1. METERS SHALL BE FURNISHED WITH STRAINERS APPROVED BY THE METER MANUFACTURER AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
2. ALUMINUM HATCH SHALL BE 30" X 30" FOR METERS 3" AND 4". HATCH FOR METERS 6" AND ABOVE SHALL BE 42" X 42".
3. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
4. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.
5. ROAD CROSSINGS NEED TO BE SLEEVED ON SERVICE CONNECTIONS.

CITY OF UMATILLA · Best of All · LAKE COUNTY FLA.	CITY OF UMATILLA	**WATER SERVICE 3" AND ABOVE WITH TRAFFIC LID**	**STANDARD DETAILS** **DETAIL W-13**



NOTES:

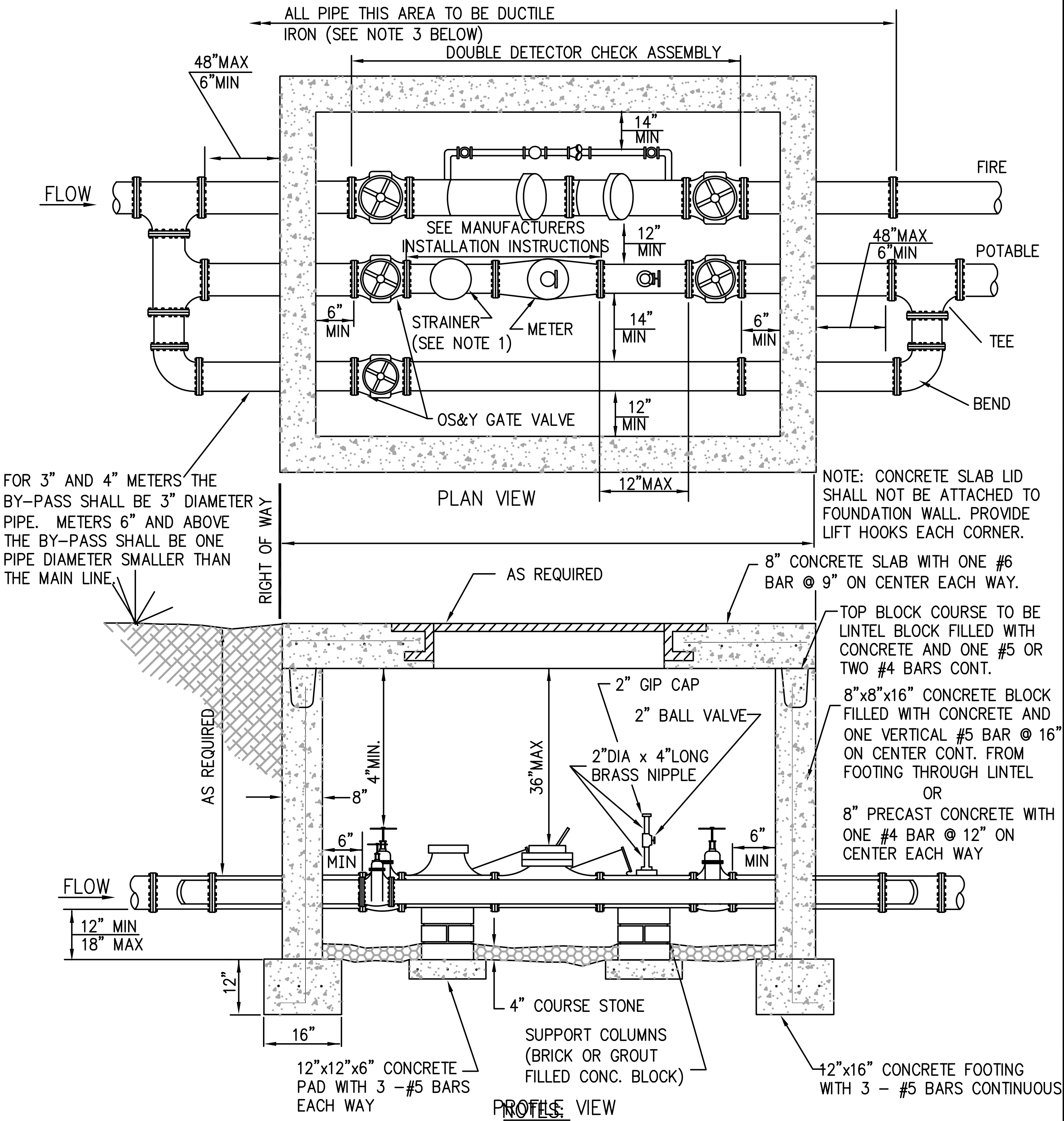
1. METERS SHALL BE FURNISHED WITH STRAINERS APPROVED BY THE METER MANUFACTURER AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
2. ALUMINUM HATCH SHALL BE 30" X 30" FOR METERS 3" AND 4". HATCH FOR METERS 6" AND ABOVE SHALL BE 42" X 42".
3. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
4. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

CITY OF UMATILLA

WATER/FIRE SERVICE 3" AND ABOVE WITH NON-TRAFFIC LID

STANDARD DETAILS

DETAIL W-14



NOTES:

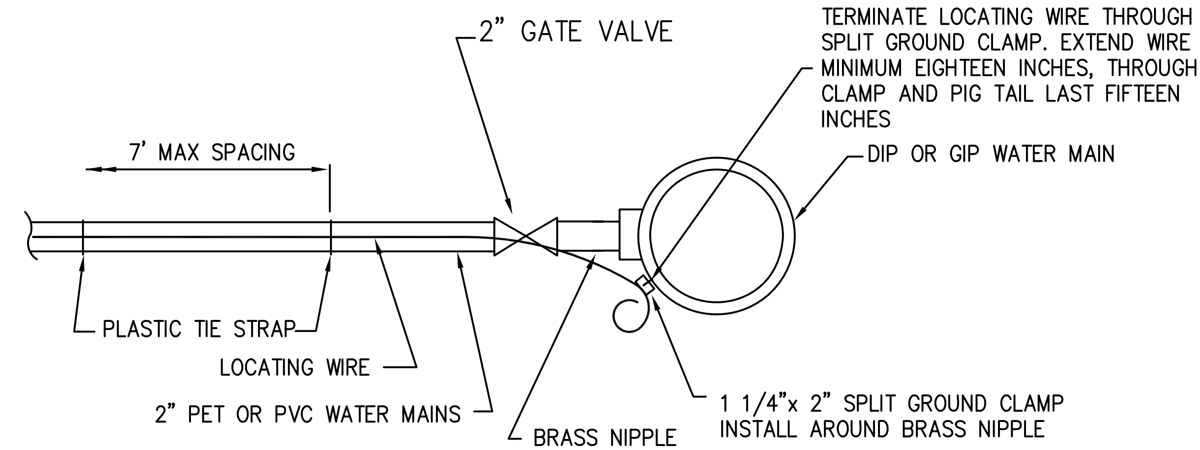
1. METERS SHALL BE FURNISHED WITH STRAINERS APPROVED BY THE METER MANUFACTURER AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
2. ALUMINUM HATCH SHALL BE 30" X 30" FOR METERS 3" AND 4". HATCH FOR METERS 6" AND ABOVE SHALL BE 42" X 42".
3. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
4. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

CITY OF UMATILLA

WATER/FIRE SERVICE 3" AND ABOVE WITH TRAFFIC LID

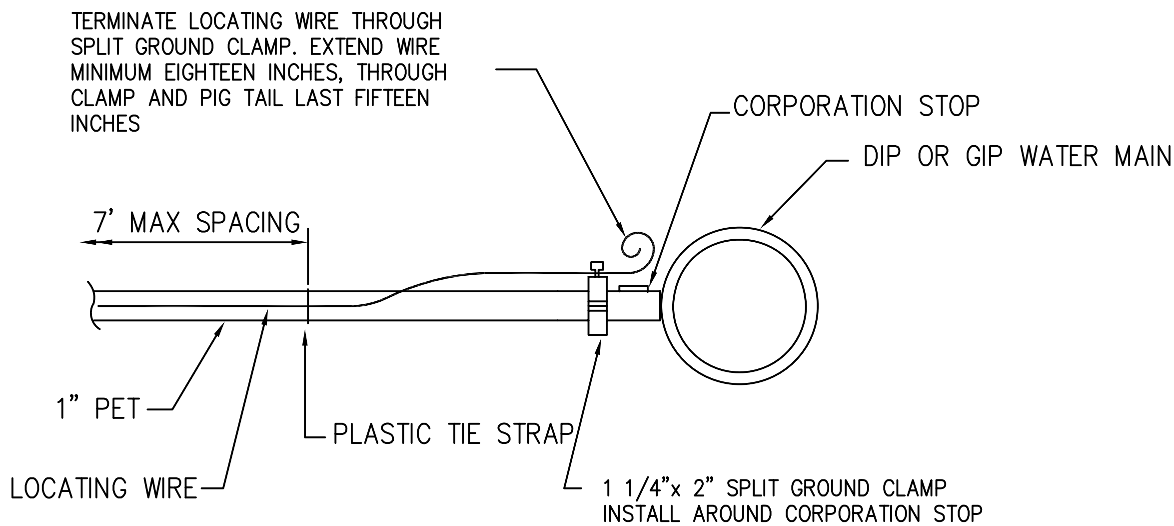
STANDARD DETAILS

DETAIL W-15



CONNECTION TO DIP OR GIP MAINS

2" WATER SERVICE



CONNECTION TO DIP OR GIP MAINS

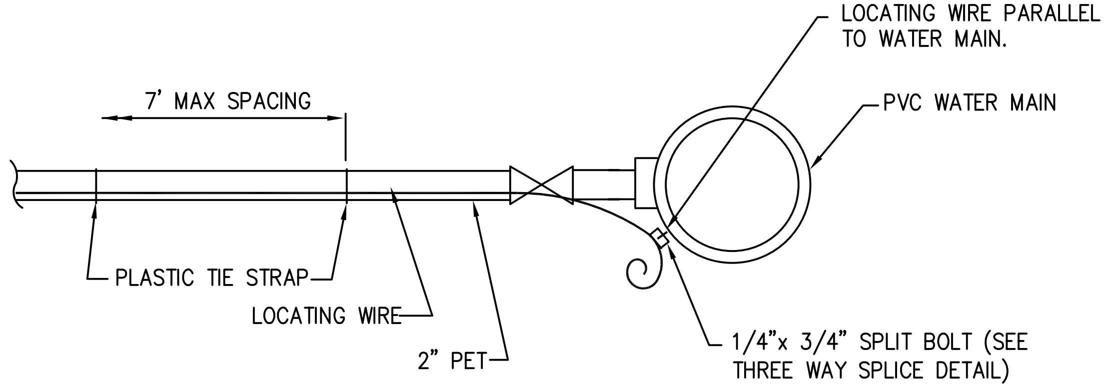
3/4" WATER SERVICE

CITY OF UMATILLA

LOCATING WIRE CONNECTION TO DIP OR GIP MAIN

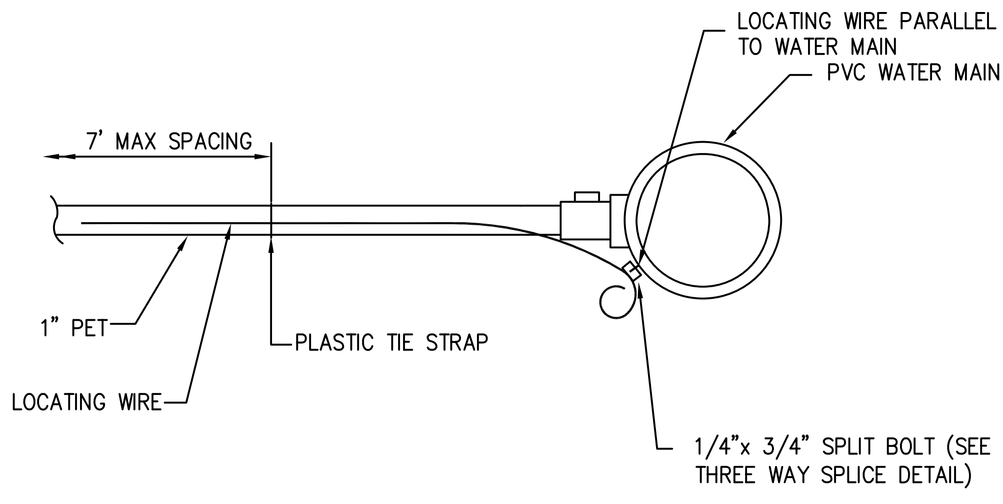
STANDARD DETAILS

DETAIL W-16



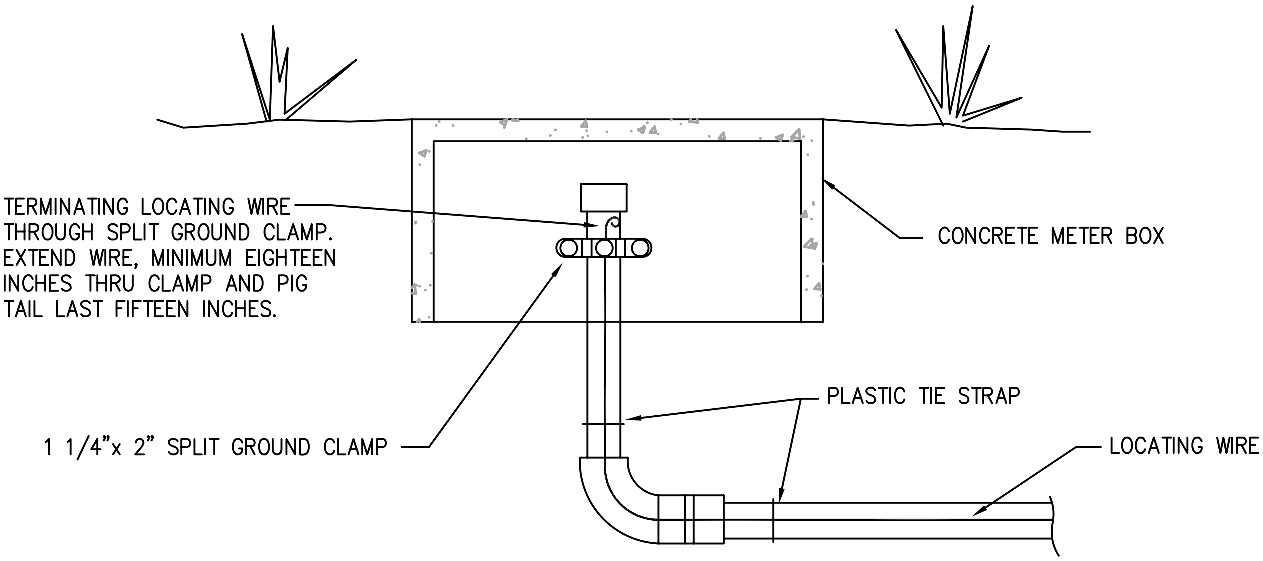
CONNECTION TO PVC WATER MAIN

MULTI FAMILY WATER SERVICE



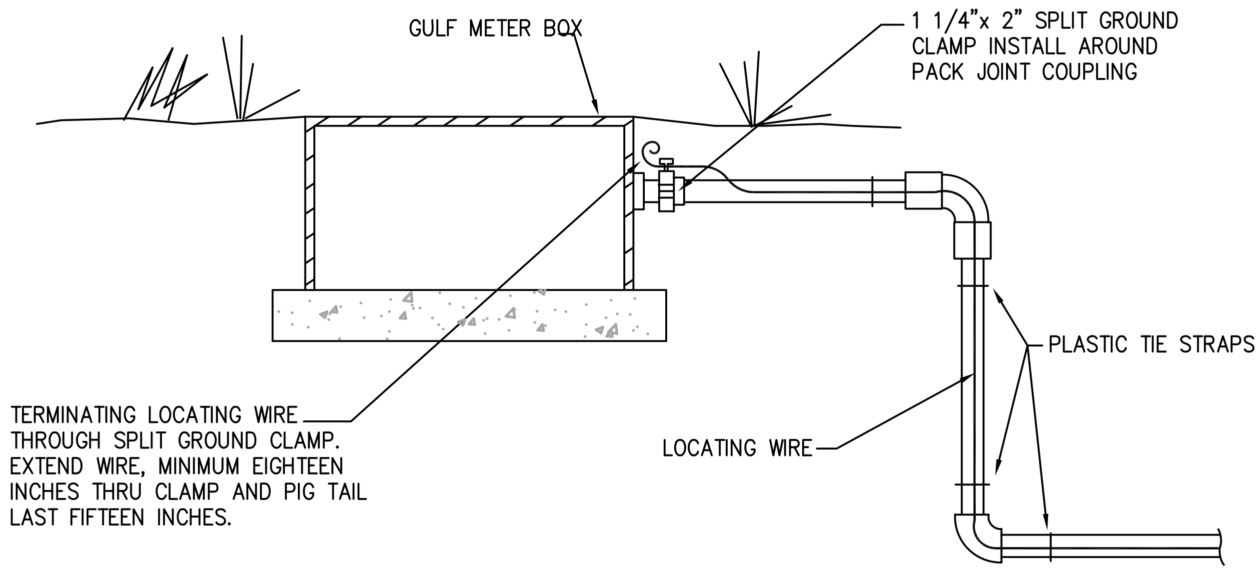
CONNECTION TO PVC WATER MAIN

SINGLE FAMILY WATER SERVICE



TERMINATION AT METER BOX

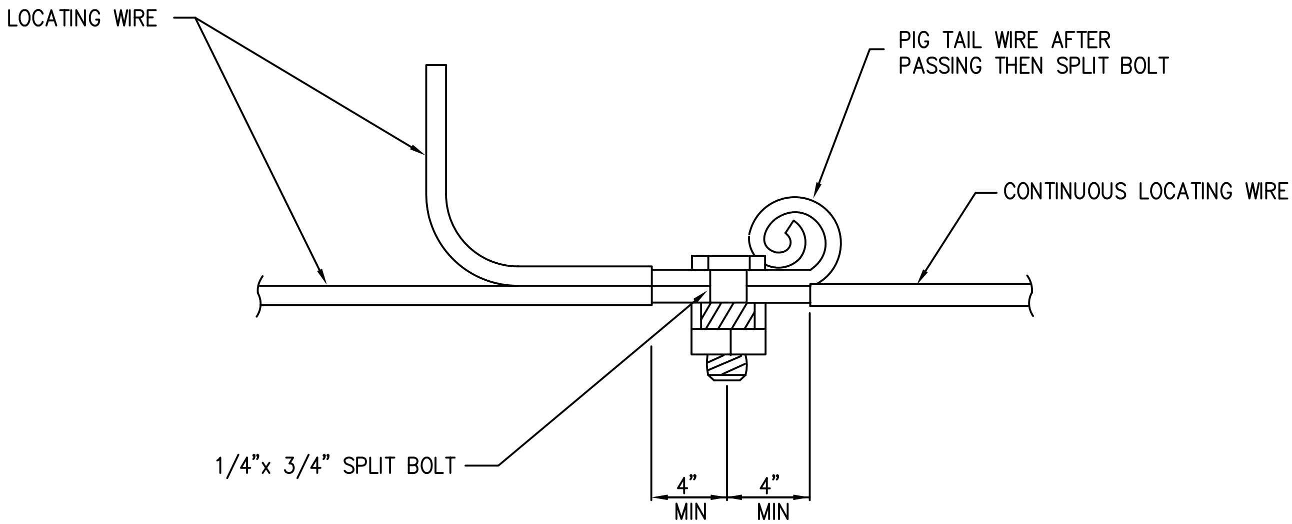
2" WATER SERVICE



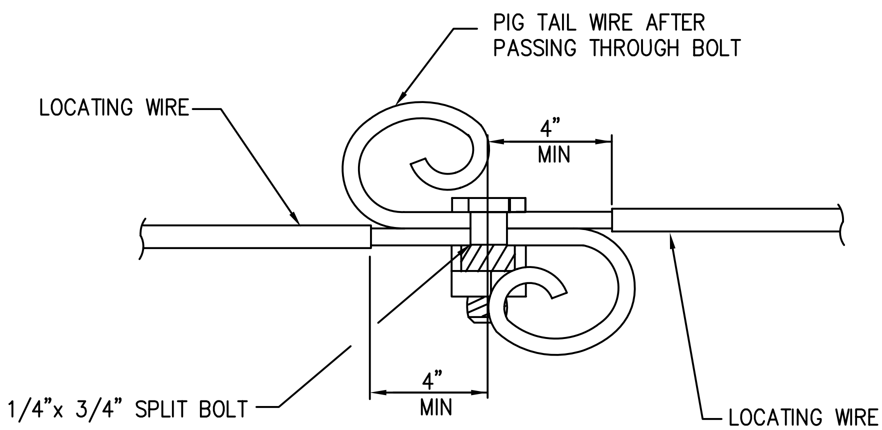
TERMINATION AT METER BOX

3/4" WATER SERVICE

	CITY OF UMATILLA	LOCATING WIRE TERMINATION AT METER BOX	STANDARD DETAILS DETAIL W-18



THREE WAY SPLICE

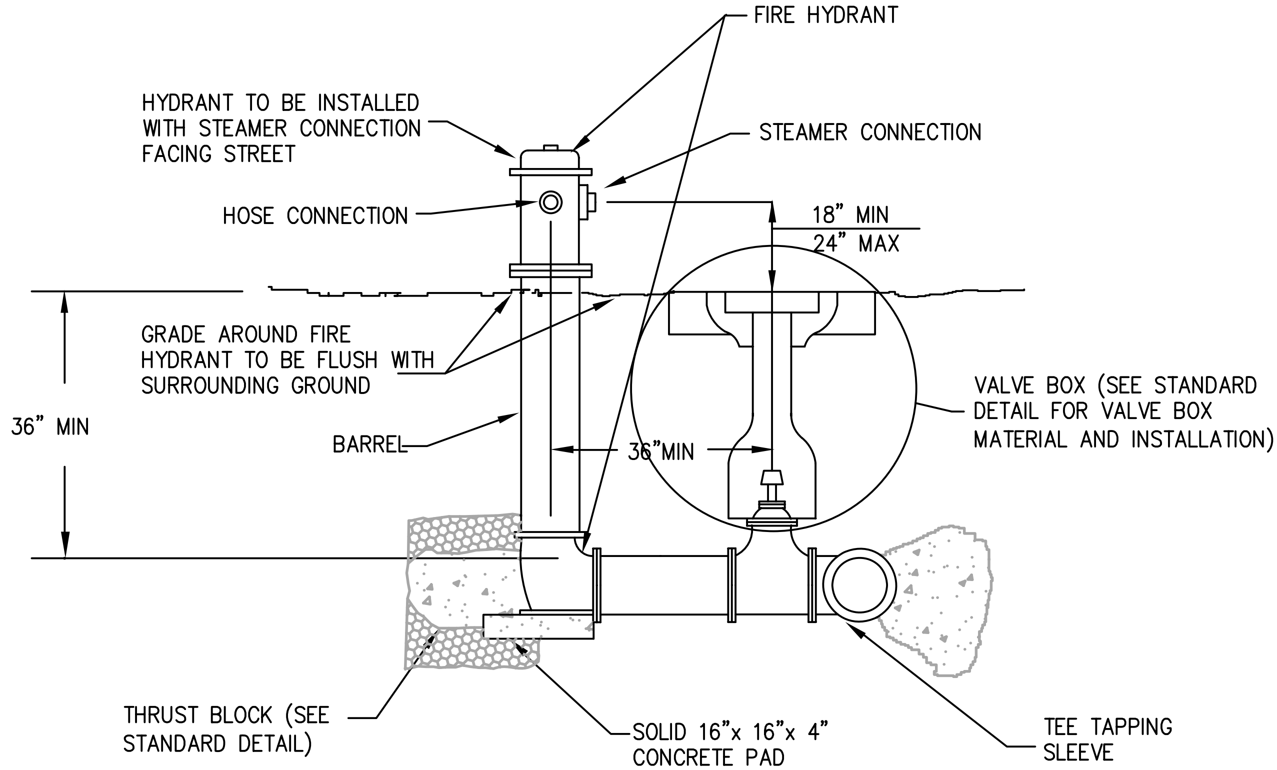


SINGLE SPLICE

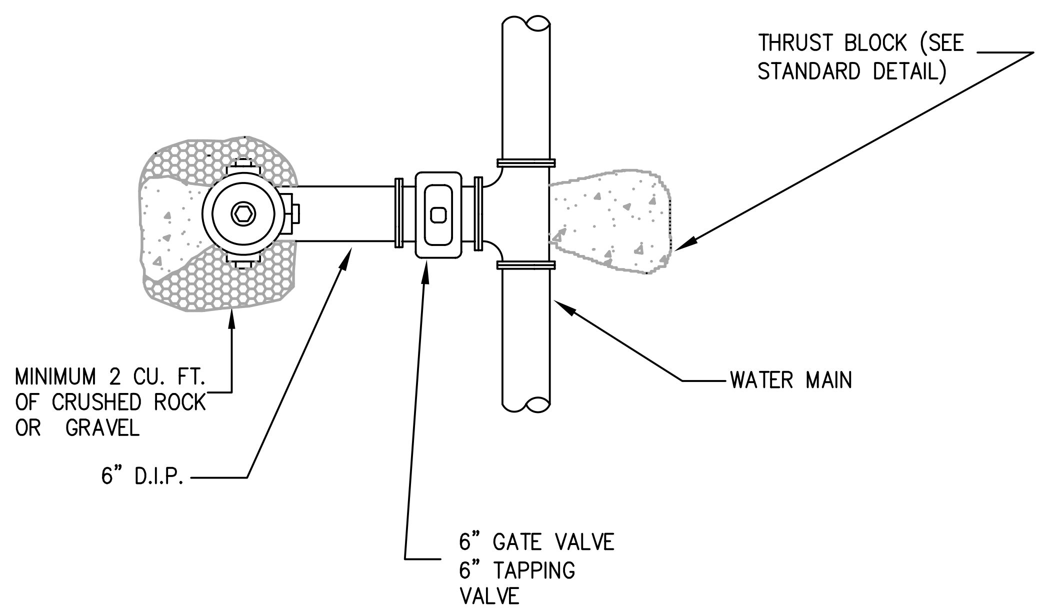
CITY OF UMATILLA

LOCATING WIRE
SPLICE DETAIL

STANDARD DETAILS
DETAIL W-19



PLAN VIEW



PROFILE VIEW

NOTES:

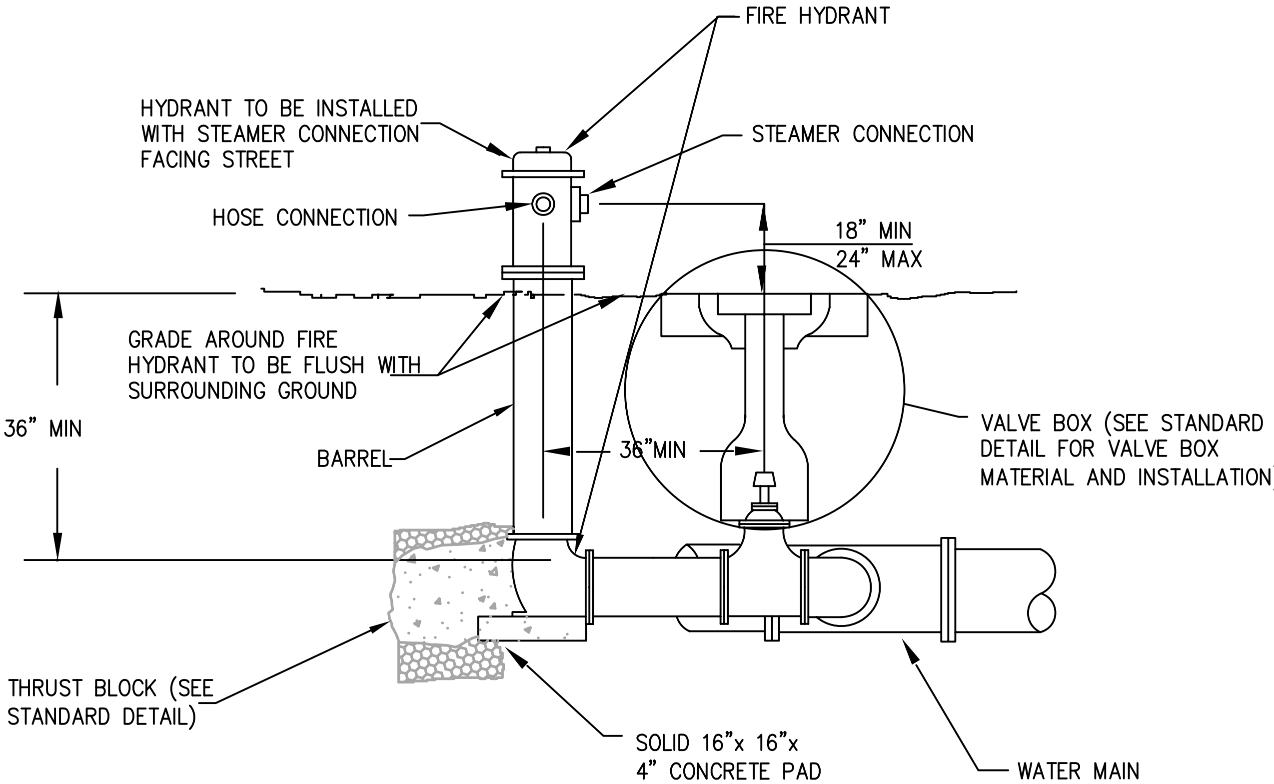
1. NO MORE THAN TWO BARREL SECTIONS SHALL BE ALLOWED WHEN ADJUSTING HYDRANT TO FINISHED GRADE.

CITY OF UMATILLA

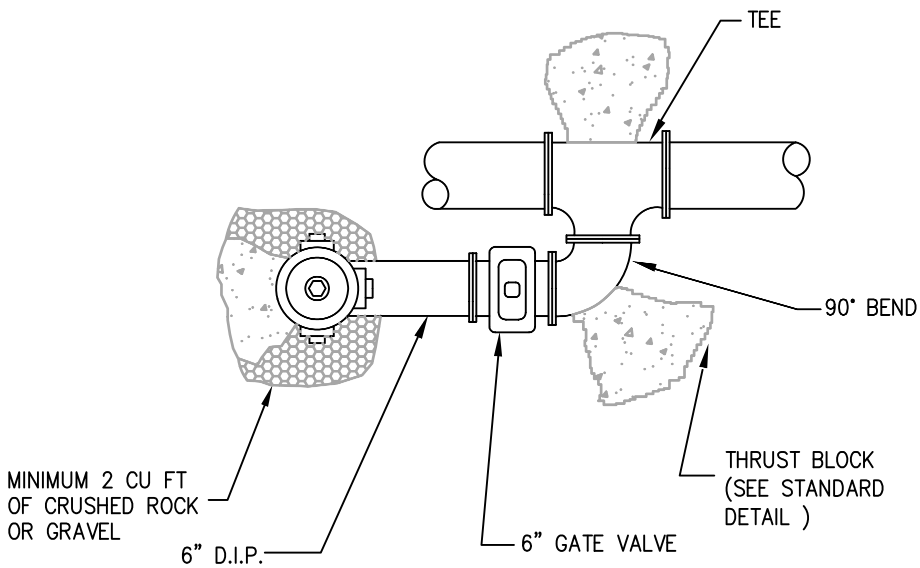
FIRE HYDRANT ASSEMBLY PERPENDICULAR TO MAIN

STANDARD DETAILS

DETAIL W-20



PLAN VIEW



PROFILE VIEW

NOTES:

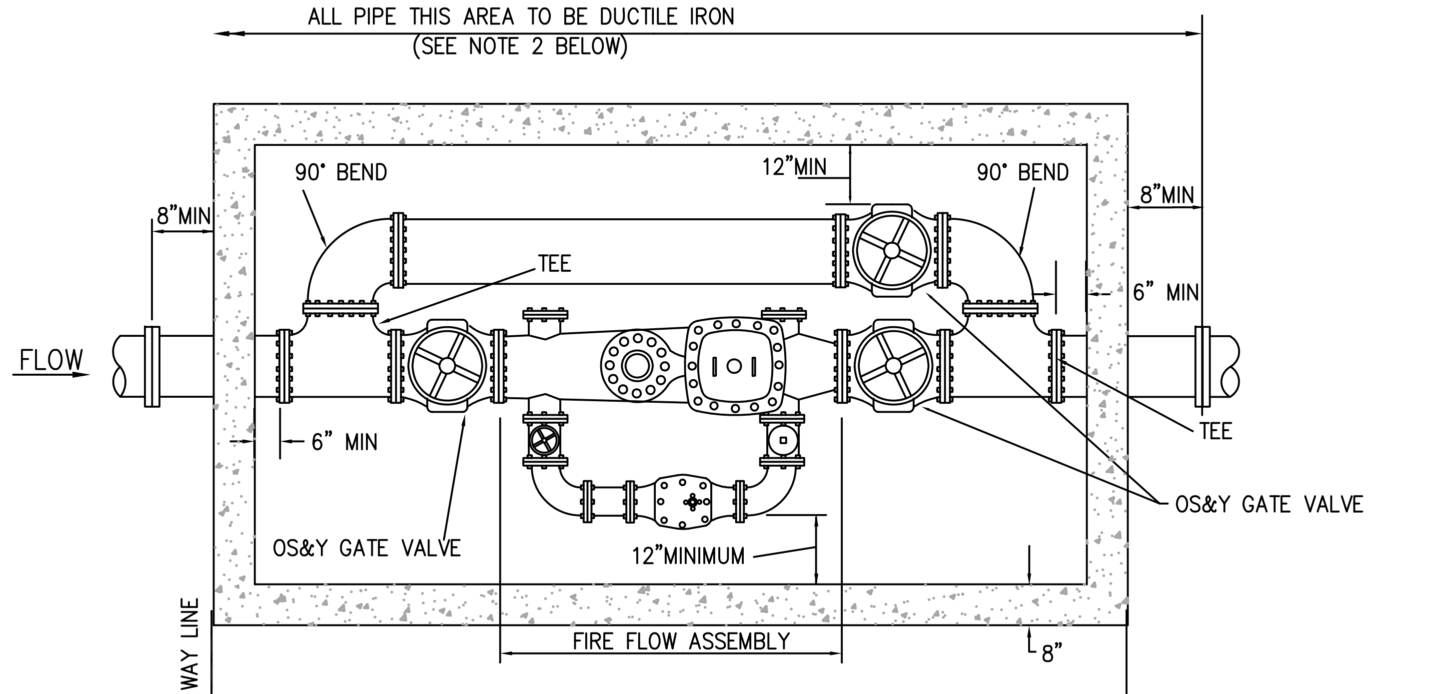
1. NO MORE THAN TWO BARREL SECTIONS SHALL BE ALLOWED WHEN ADJUSTING HYDRANT TO FINISHED GRADE.

CITY OF UMATILLA

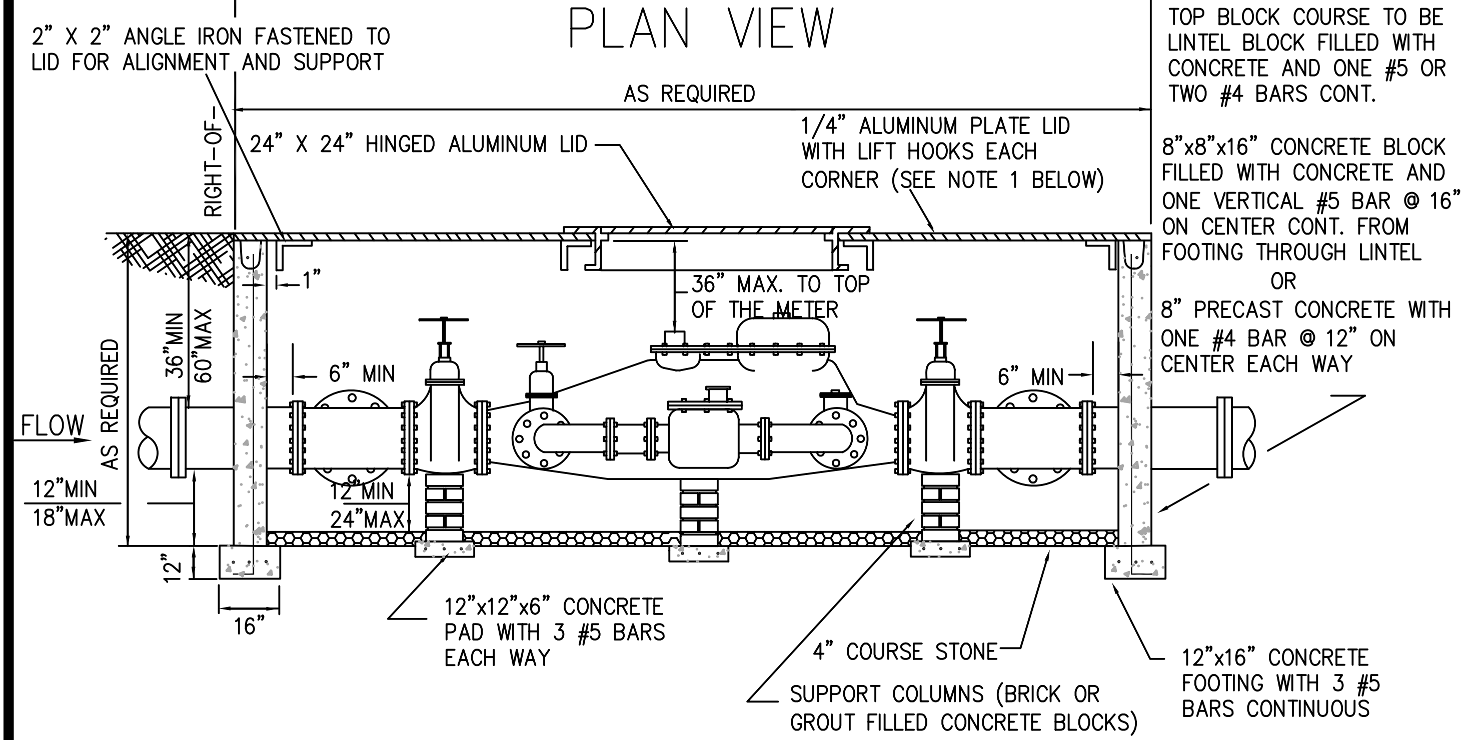
FIRE HYDRANT ASSEMBLY PARALLEL TO MAIN

STANDARD DETAILS

DETAIL W-21



PLAN VIEW

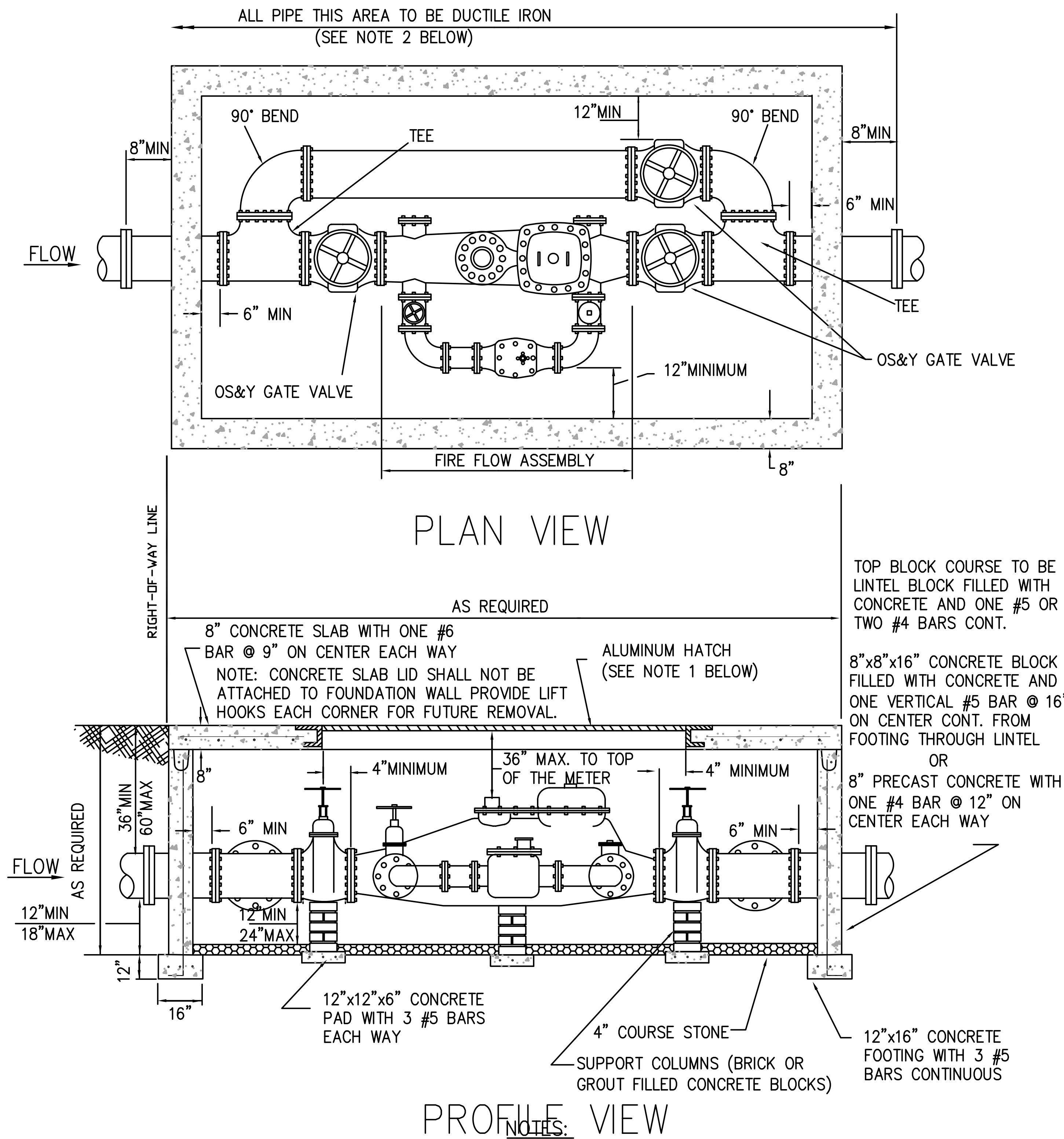


PROFILE VIEW

NOTES:

1. INSTALL BOLTS TO SECURE LID IN EACH CORNER.
2. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
3. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

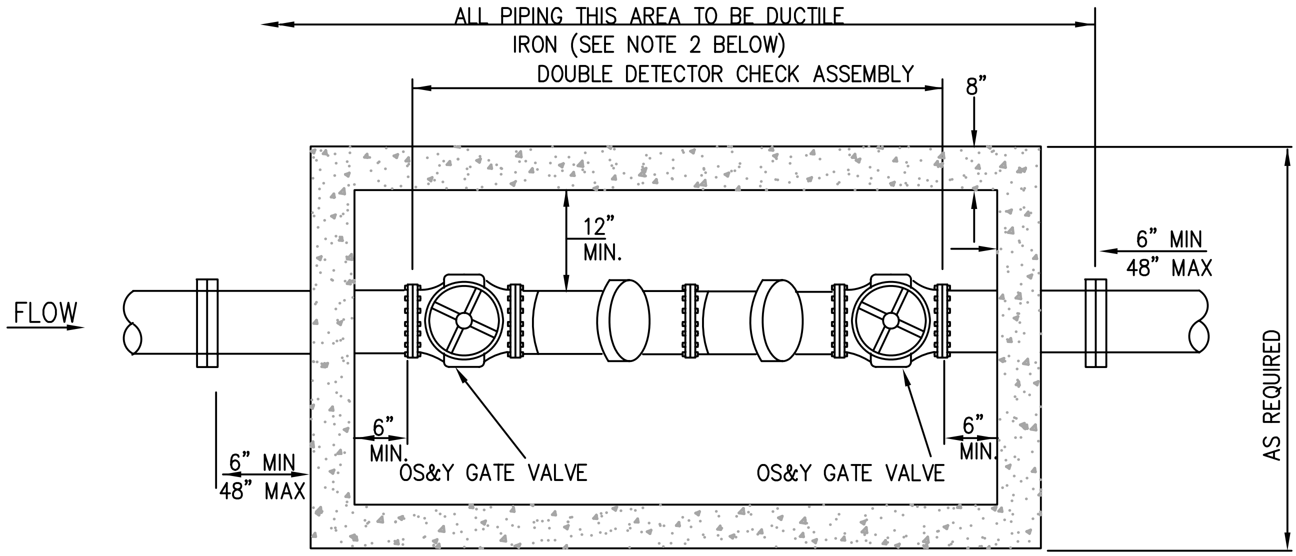
	CITY OF UMATILLA	***FIRE FLOW ASSEMBLY BELOW GROUND WITH NON TRAFFIC LID***	***STANDARD DETAILS*** ***DETAIL W-22***



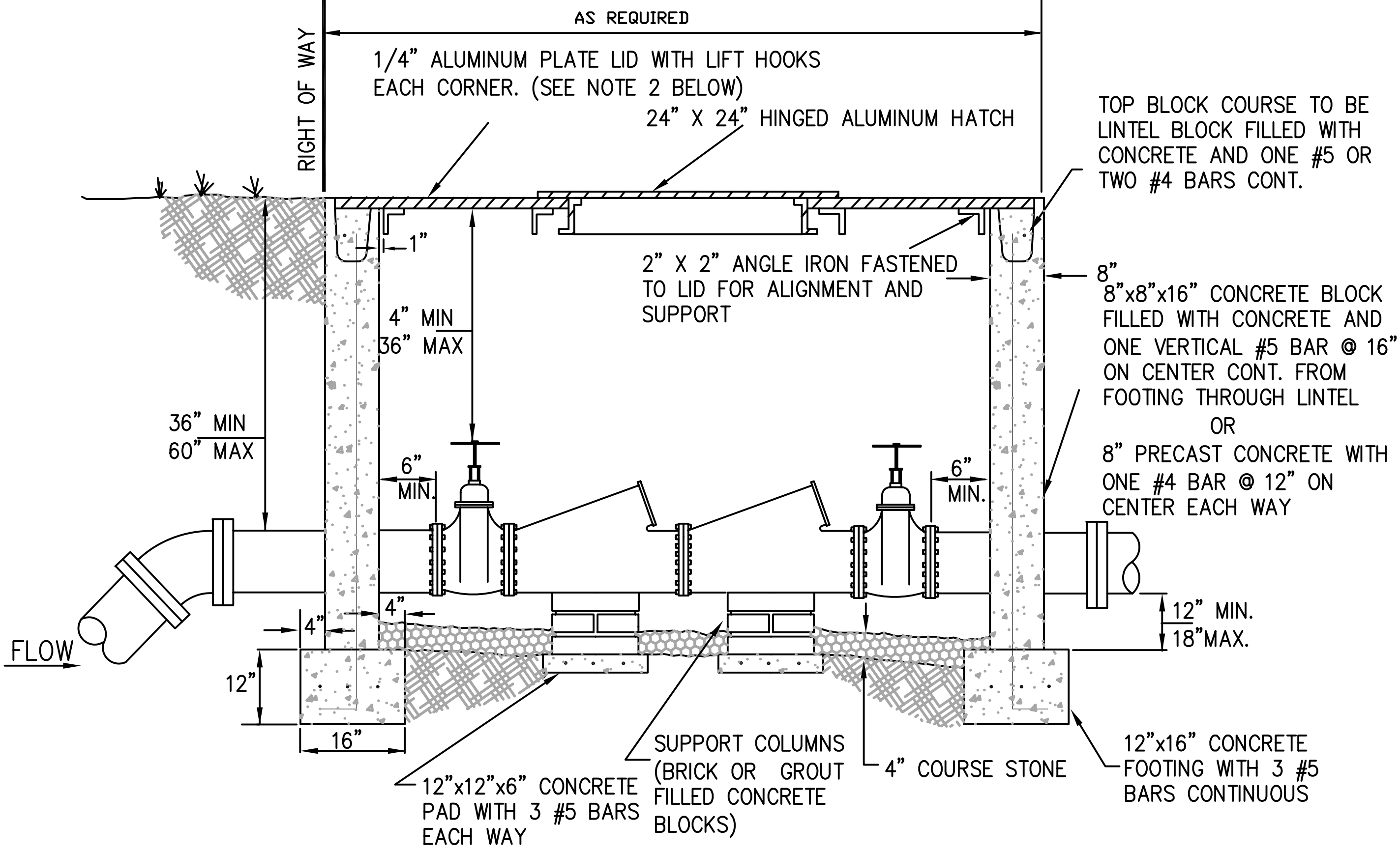
NOTES:

1. ALUMINIUM HATCH TO BE SIZED SO AS TO PROVIDE A MINIMUM OF 4" CLEARANCE ALL SIDES FOR REMOVAL OF THE FIRE FLOW ASSEMBLY FROM THE PIT.
2. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
3. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

	CITY OF UMATILLA	***FIRE FLOW ASSEMBLY BELOW GROUND WITH TRAFFIC LID***	***STANDARD DETAILS*** ***DETAIL W-23***



PLAN VIEW

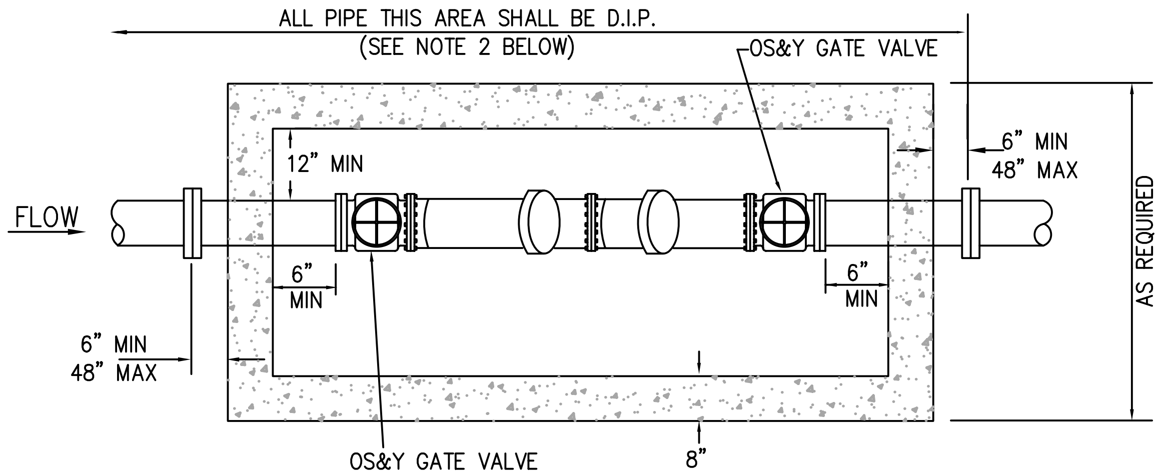


PROFILE VIEW

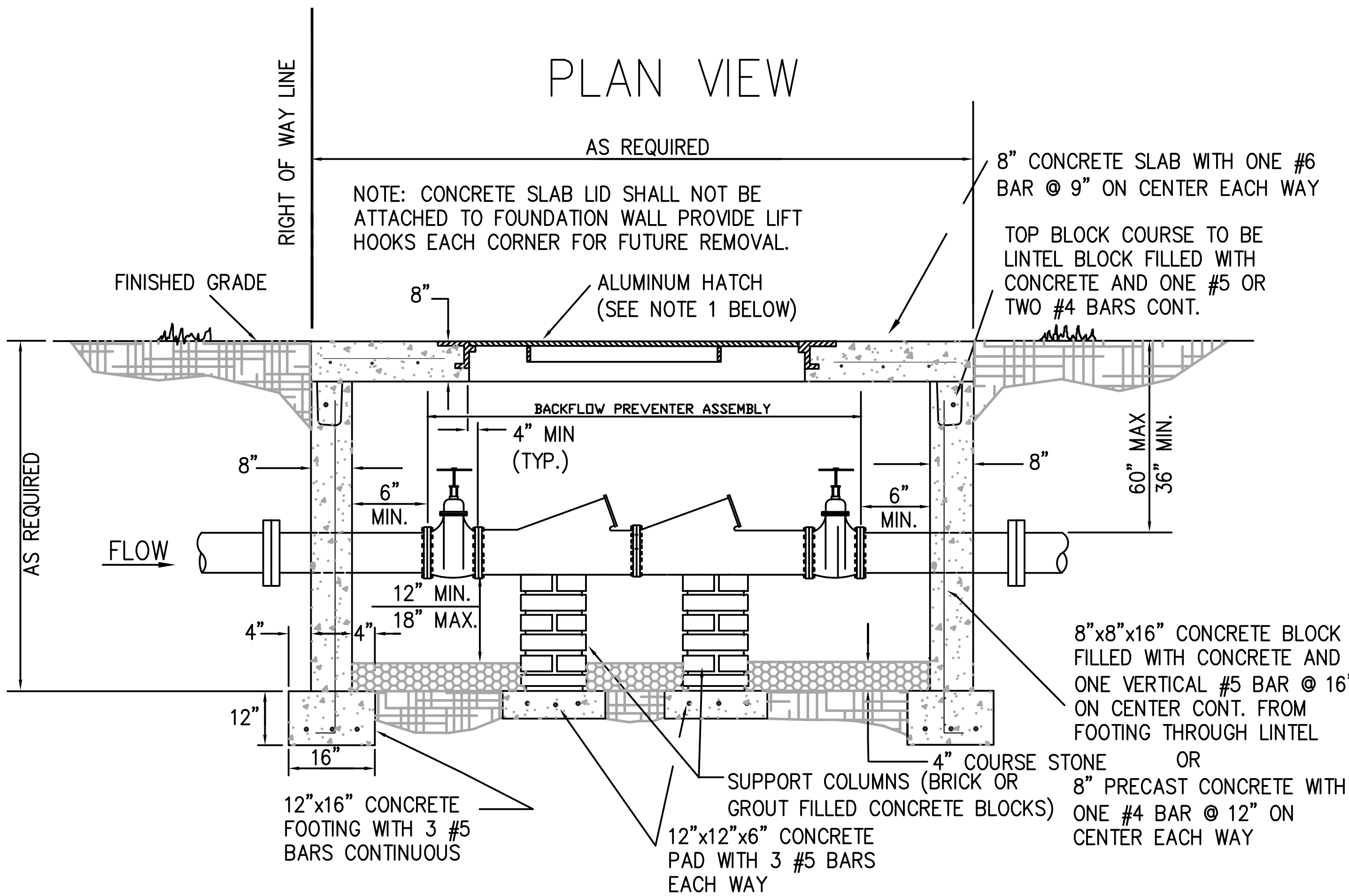
NOTES:

1. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
2. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

CITY OF UMATILLA · Best of All · LAKE COUNTY, FLA.	CITY OF UMATILLA	***BACKFLOW PREVENTER ASSEMBLY BELOW GROUND WITH NON TRAFFIC LID***	***STANDARD DETAILS*** ***DETAIL W-24***



PLAN VIEW



PROFILE VIEW

NOTES:

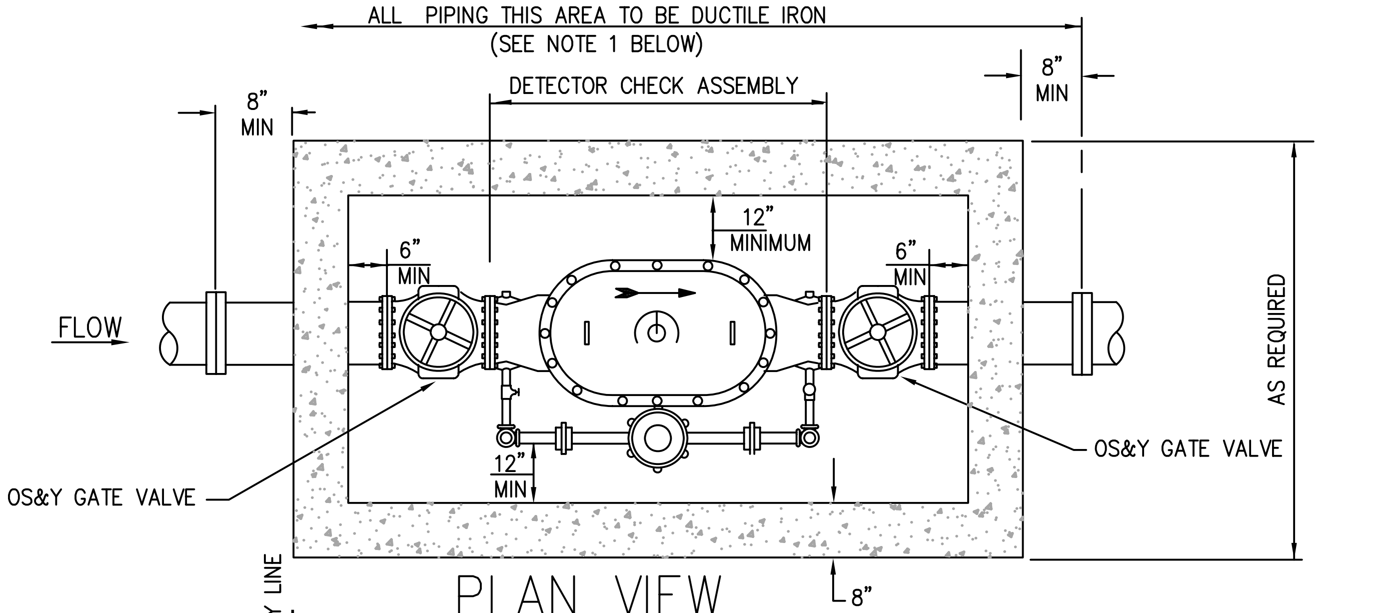
1. ALUMINIUM HATCH TO BE SIZED SO AS TO PROVIDE A MINIMUM OF 4" CLEARANCE ALL SIDES FOR REMOVAL OF THE BACKFLOW ASSEMBLY FROM THE PIT.
2. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
3. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

CITY OF UMATILLA

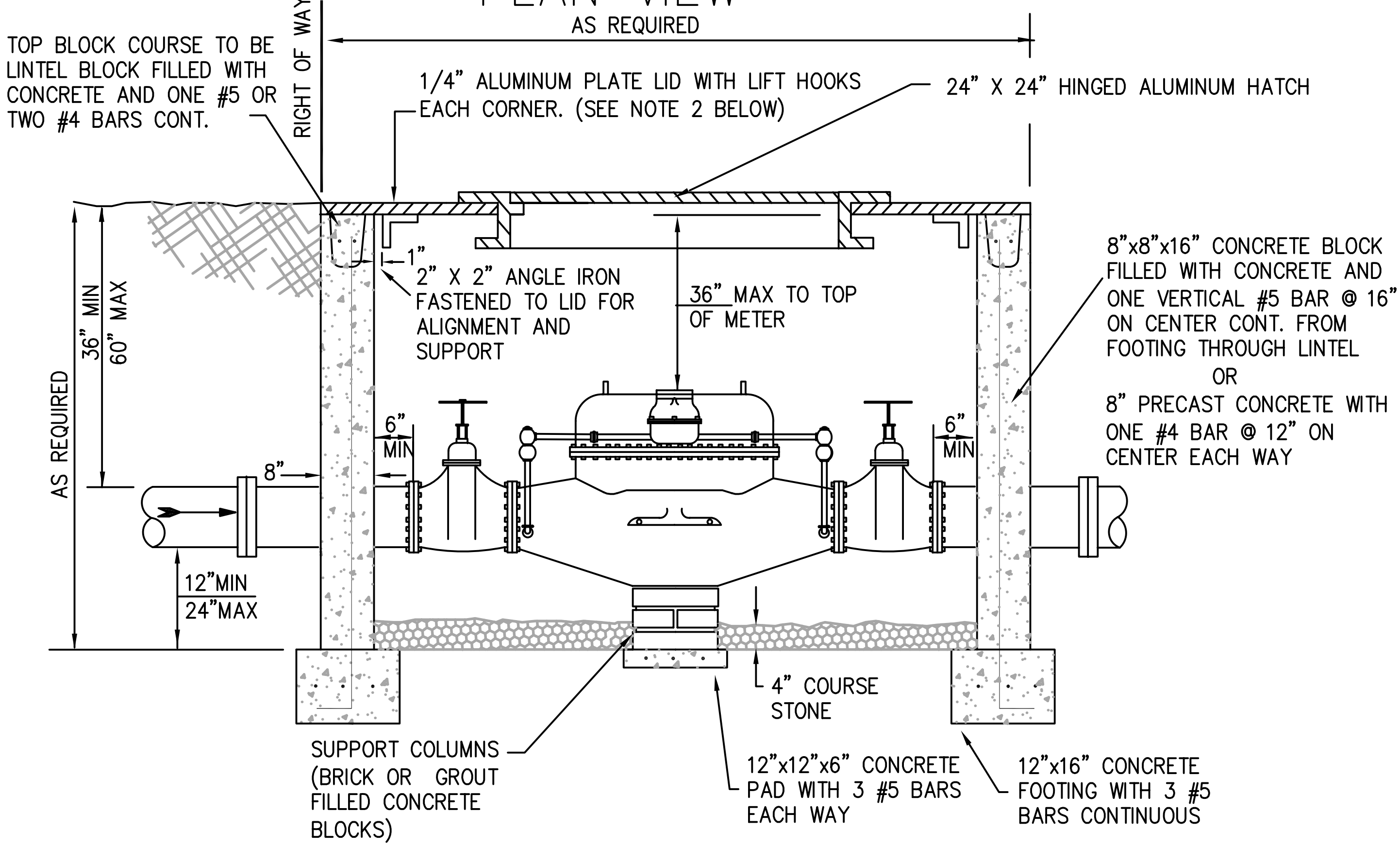
BACKFLOW PREVENTER ASSEMBLY BELOW GROUND WITH TRAFFIC LID

STANDARD DETAILS

DETAIL W-25



PLAN VIEW

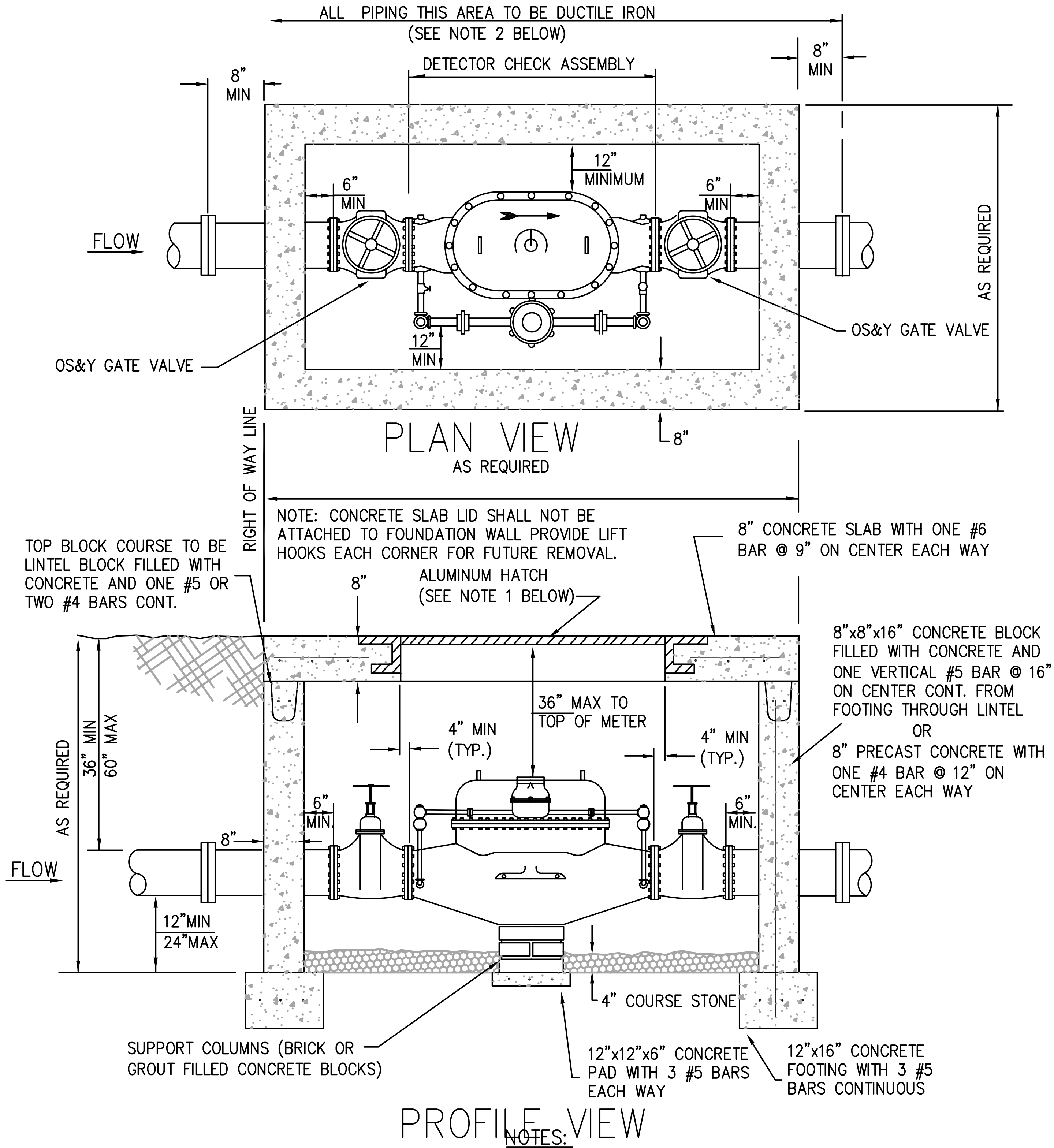


PROFILE VIEW

NOTES:

1. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
2. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.
3. INSTALL BOLTS TO SECURE LID IN EACH CORNER.

CITY OF UMATILLA · Best of All · LAKE COUNTY FLA.	CITY OF UMATILLA	***SINGLE DETECTOR CHECK ASSEMBLY BELOW GROUND WITH NON TRAFFIC LID***	***STANDARD DETAILS*** ***DETAIL W-26***



NOTES:

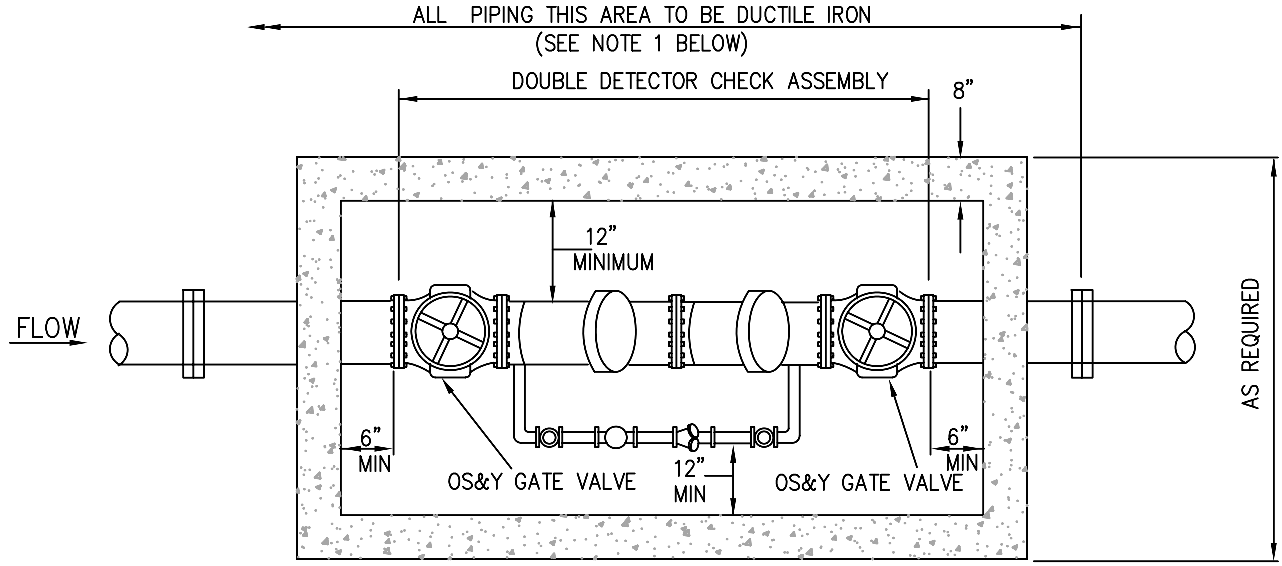
1. ALUMINIUM HATCH TO BE SIZED SO AS TO PROVIDE A MINIMUM OF 4" CLEARANCE ALL SIDES FOR REMOVAL OF THE DETECTOR CHECK ASSEMBLY FROM THE PIT.
2. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
3. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

CITY OF UMATILLA

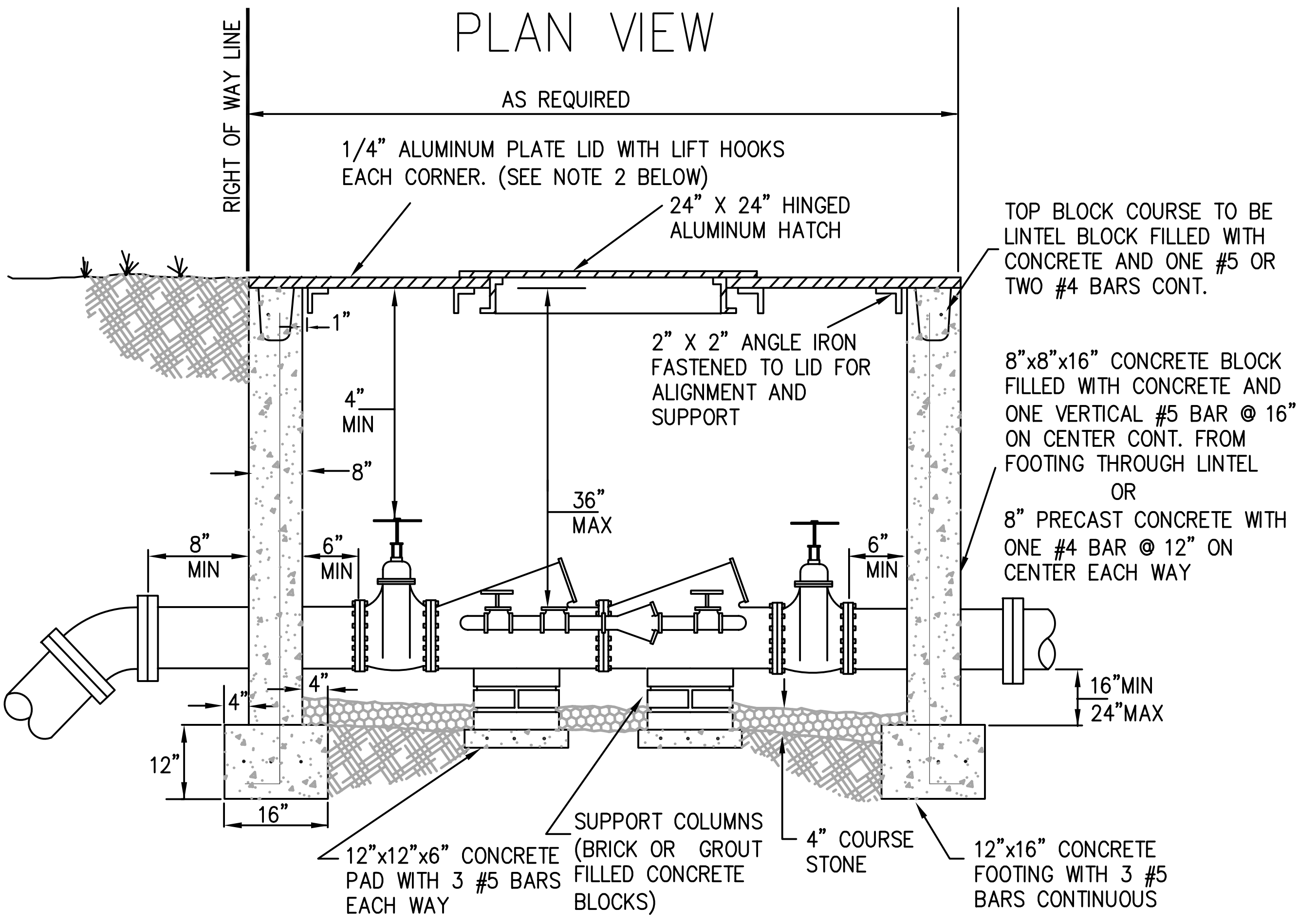
SINGLE DETECTOR CHECK ASSEMBLY BELOW GROUND WITH TRAFFIC LID

STANDARD DETAILS

DETAIL W-27



PLAN VIEW



PROFILE VIEW

NOTES:

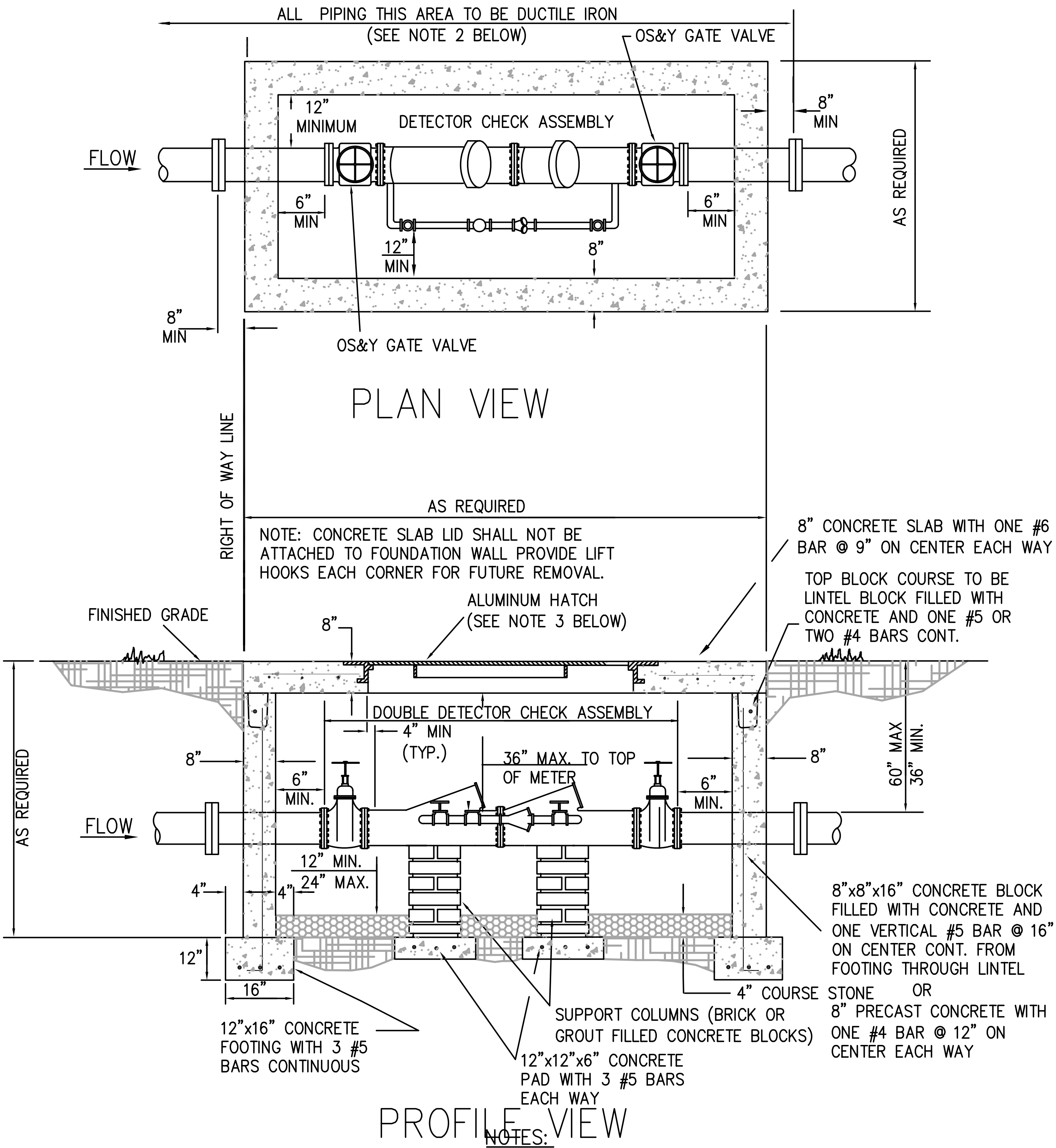
1. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
2. ALUMINUM PLATE SHALL BE PAINTED WITH A TOP QUALITY PRIMER AND FINISH COAT. PAINT SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS. THE PRIMER COAT SHALL BE A TOP QUALITY RED OXIDE PRIMER AS APPROVED BY THE CITY OF UMATILLA. FINISH COAT WILL BE FOREST GREEN NO. F65641 AS MANUFACTURED SHERWIN WILLIAMS.

CITY OF UMATILLA

DOUBLE DETECTOR CHECK ASSEMBLY BELOW GROUND WITH NON TRAFFIC LID

STANDARD DETAILS

DETAIL W-28



NOTES:

1. ALUMINIUM HATCH TO BE SIZED SO AS TO PROVIDE A MINIMUM OF 4" CLEARANCE ALL SIDES FOR REMOVAL OF THE DETECTOR CHECK ASSEMBLY FROM THE PIT.
2. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.
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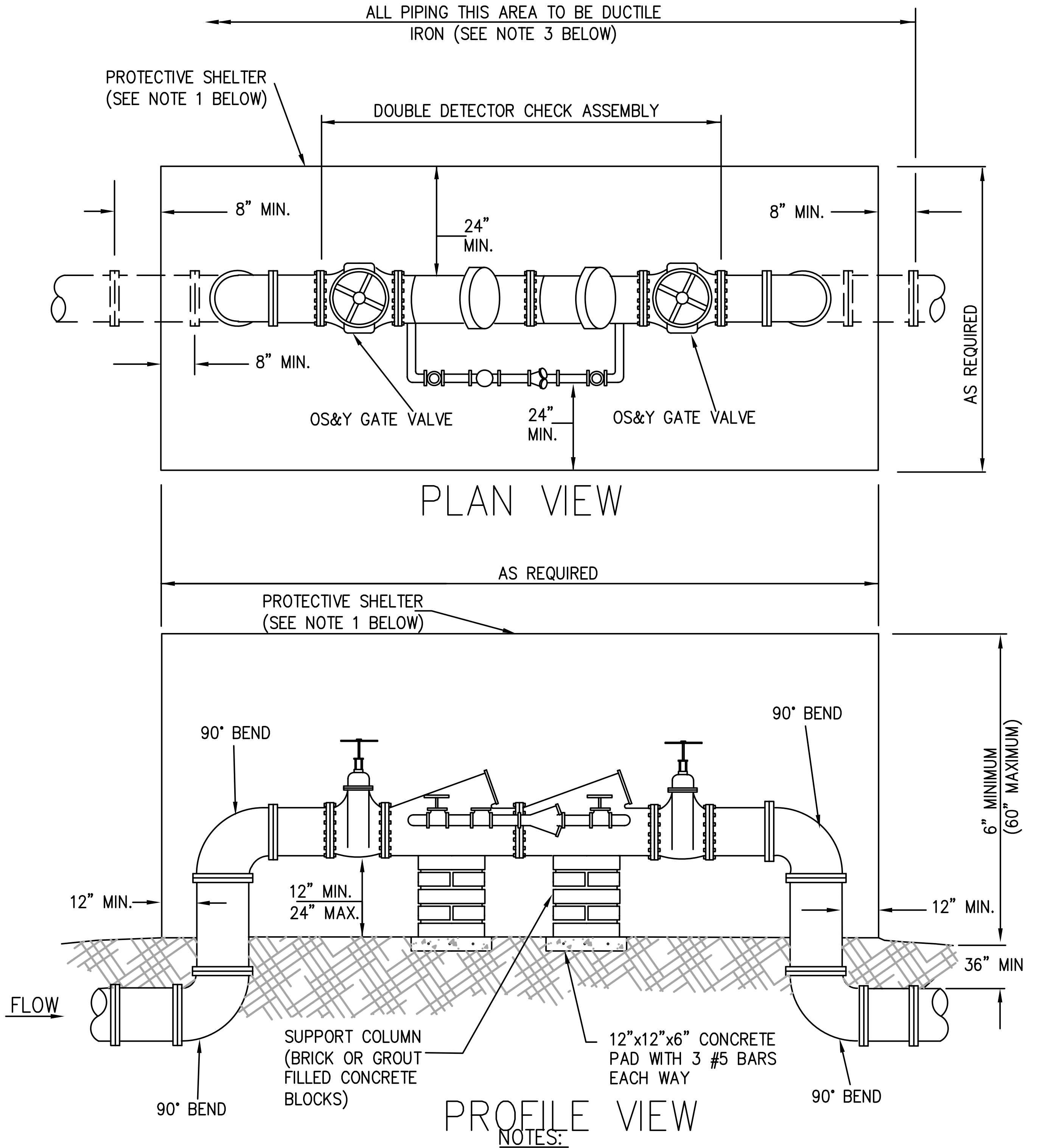
CITY OF UMATILLA · Best of All · LAKE COUNTY FLA	CITY OF UMATILLA	**DOUBLE DETECTOR CHECK ASSEMBLY BELOW GROUND WITH TRAFFIC LID**	**STANDARD DETAILS** **DETAIL W-29**



NOTES:

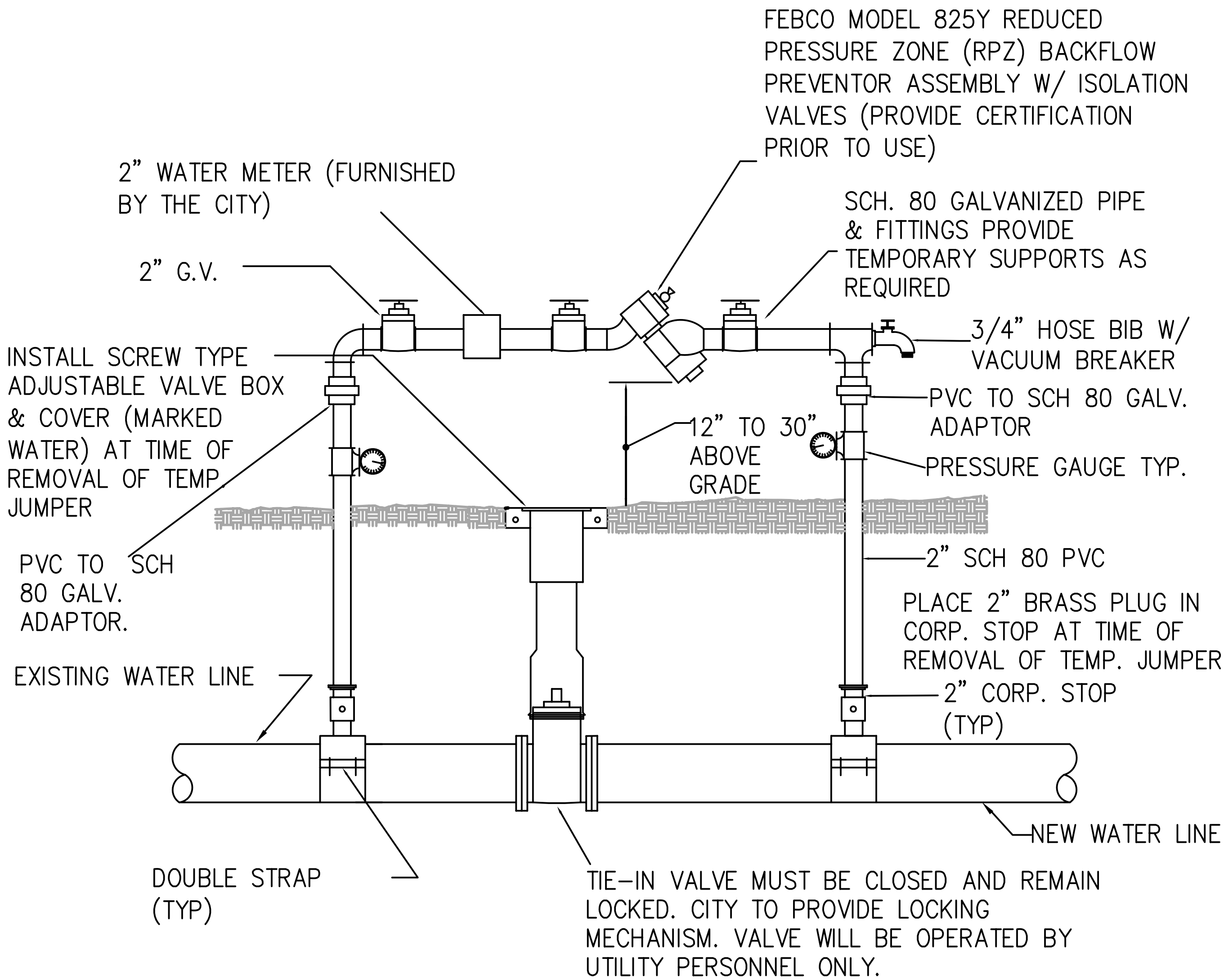
1. PROTECTIVE SHELTER SHALL BE CONSTRUCTED SO AS TO PROVIDE MAXIMUM PROTECTION FROM THE ELEMENTS & VANDALISM. SHELTER SHALL BE PROVIDED WITH SUFFICIENT INTERIOR SPACE TO PROVIDE EASY ACCESS, MAINTENANCE AND SERVICE. A DOOR OR OTHER MEANS OF ACCESS SHALL BE PROVIDED. TYPE & MEANS OF CONSTRUCTION MUST MEET THE APPROVAL OF THE CITY OF UMATILLA. IN ADDITION TO THE SHELTER, A PROTECTIVE ALARM SYSTEM SHALL BE INSTALLED THAT MEETS THE APPROVAL OF THE FIRE MARSHALL.
2. ABOVE GROUND DETECTOR CHECK ASSEMBLIES SHALL ONLY BE INSTALLED WHERE SPECIFICALLY AUTHORIZED, IN WRITING, BY THE CITY OF UMATILLA.
3. UNLESS OTHERWISE NOTED, ALL EXPOSED FITTINGS SHALL BE FLANGED AND ALL BURIED FITTINGS SHALL BE MECHANICAL JOINT.

CITY OF UMATILLA

DOUBLE DETECTOR CHECK ASSEMBLY ABOVE GROUND

STANDARD DETAILS

DETAIL W-30



NOTE: LOCATION TO BE DETERMINED AT TIME OF PRECONSTRUCTION CONFERENCE W/ CITY.

TEMPORARY JUMPER CONNECTION DETAIL

CITY OF UMATILLA

TEMPORARY JUMPER CONNECTION DETAIL

STANDARD DETAILS

DETAIL W-31

APPENDIX A

GENERAL CONSTRUCTION REQUIREMENTS

FOR WATER DISTRIBUTION AND WASTEWATER COLLECTION

1. GENERAL REQUIREMENTS
    - a. Grades, Survey Lines, and Protection of Monuments
        - (1) Grade
        - (2) Surveys
        - (3) Monument Preservation
    - b. Utility Coordination
        - (1) Location of Utilities
        - (2) Deviations Occasioned by Structures or Utilities
        - (3) Test Pits
    - c. Maintenance of Traffic and Closing of Streets
    - d. Protection of Public and Private Property
        - (1) Barricades, Guards and Safety Provisions
        - (2) Protection of Utility Structures
        - (3) Open Excavation
        - (4) Protection of Trees and Shrubs
        - (5) Protection of Lawn Areas
        - (6) Restoration of Fences
        - (7) Protection Against Siltation and Bank Erosion
    - e. Access to the Public Services
    - f. Public Nuisance
    - g. Construction Hours
    - h. Construction in Easements And Rights-of-way
        - (1) Construction in Easements
        - (2) Construction in Florida Department of Transportation Right-of-way
        - (3) Construction in Lake County Right-of-way
        - (4) Construction in City Right-of-way
    - i. Suspension of Work Due to Weather
    - j. Use of Chemicals
    - k. Cooperation with Other Contractors and Forces

5. HORIZONTAL DIRECTIONAL BORES (DIRECTIONAL DRILL)

a. General

b. Pipe Material

c. Qualification Requirements

d. Warranty

e. Submittals

(1) Contractor's Experience Record

(2) Material

(3) Work Plan

(4) Bore Plan

(5) Equipment

f. Horizontal Directional Drilling Equipment

(1) General

(2) Drill Rig

(3) Drill Head

(4) Mud Motors

(5) Drill Pipe

g. Guidance System

(1) General

(2) Components

(3) Operation

h. Drilling Fluid (Mud) System

(1) Mixing System

(2) Drilling Fluid

(3) Delivery System

i. Other Equipment

(1) Pipe Rollers

(2) Restrictions

j. Execution

(1) General

(2) Directional Drilling Operations

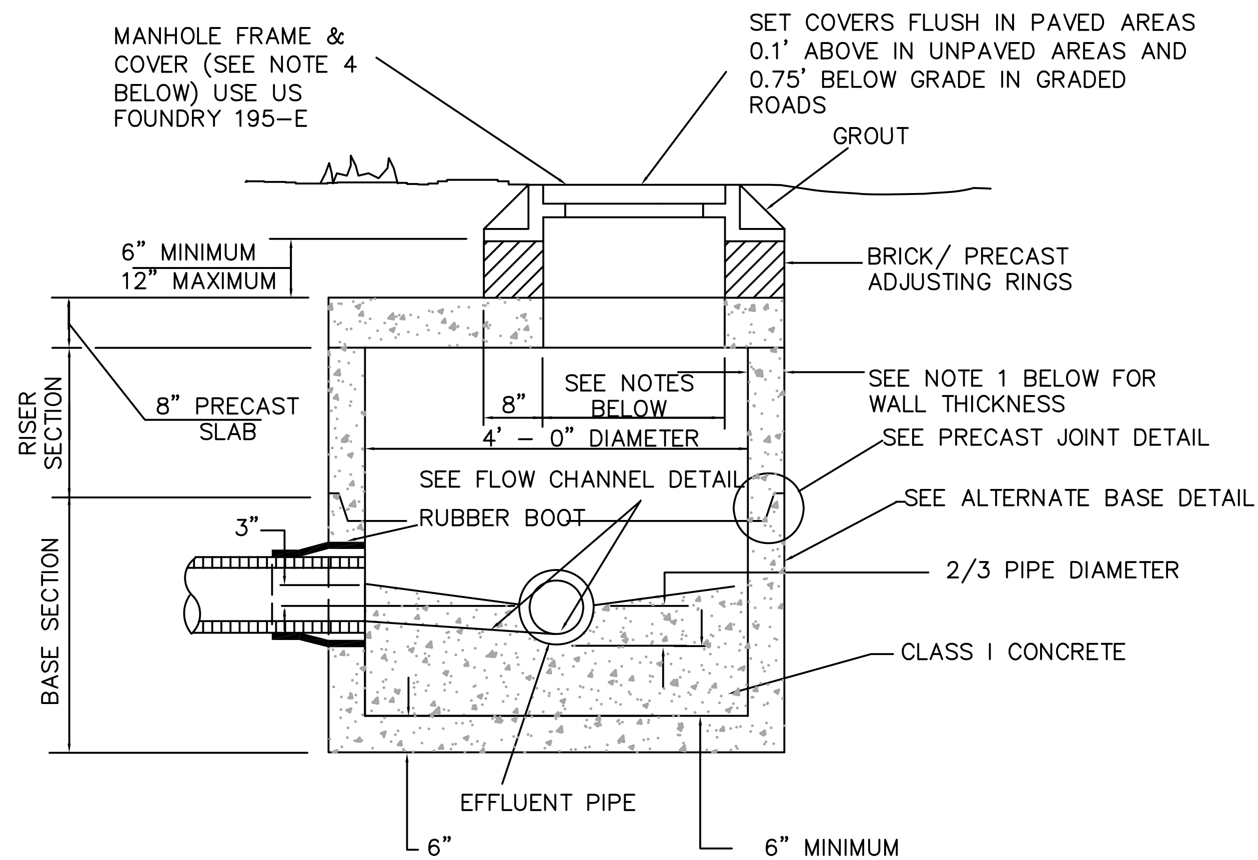
(3) Handling Pipe

(4) Testing

(5) Site Restoration

MINIMUM SLOPE FOR GRAVITY SEWER

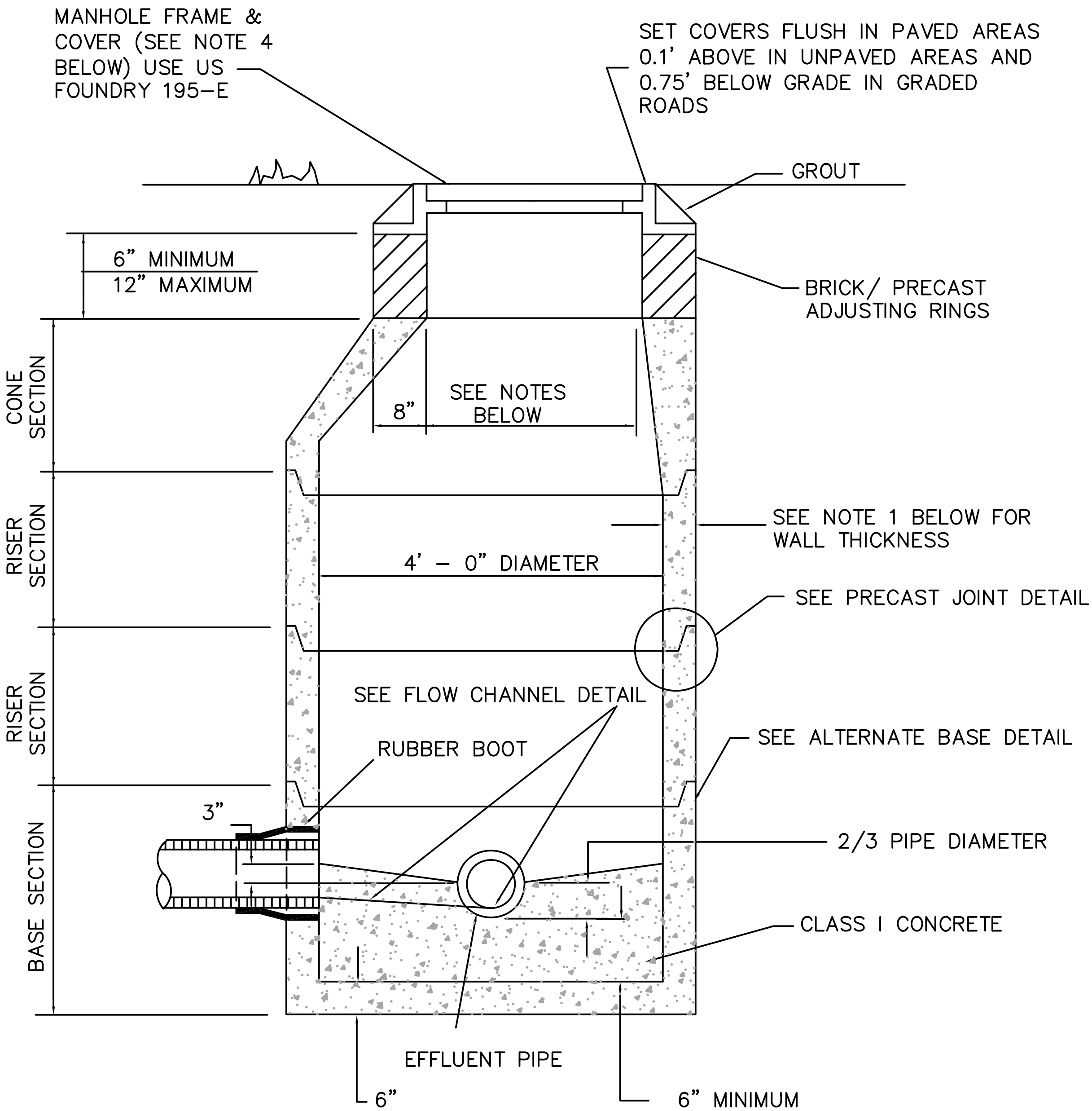
SEWER SIZE	USE	MINIMUM SLOPE
		%
4"	BUILDING SEWER OR SEWER LATERAL	2.08
6"	" "	1.04
8"	GRAVITY SEWER MAIN	0.40
10"	" "	0.28
12"	" "	0.22



NOTES:

1. MINIMUM WALL THICKNESS SHALL BE FIVE INCHES (5") OR 1/12 THE INSIDE DIAMETER, WHICHEVER IS GREATER.
2. THE INTERIOR, EXTERIOR, JOINTS AND GROUTED AREAS SHALL BE COATED WITH TWO (2) COATS OF BITUMASTIC SEALER.
3. MANHOLES SHALL BE FURNISHED WITH FACTORY INSTALLED BOOTS TO CONNECT SEWER PIPES TO MANHOLES.
4. MANHOLE TO BE INSTALLED WITH 22" RING AND COVER.
5. FILL ANNULAR VOID BETWEEN PIPE AND RUBBER BOOT FLUSH TO MANHOLE WALLS WITH GROUT.
6. DROP CONNECTIONS ARE REQUIRED WHENEVER INVERT OF INFLUENT SEWER IS 24" OR MORE ABOVE THE INVERT OF THE MANHOLE. SEE MANHOLE CONNECTION DETAIL.

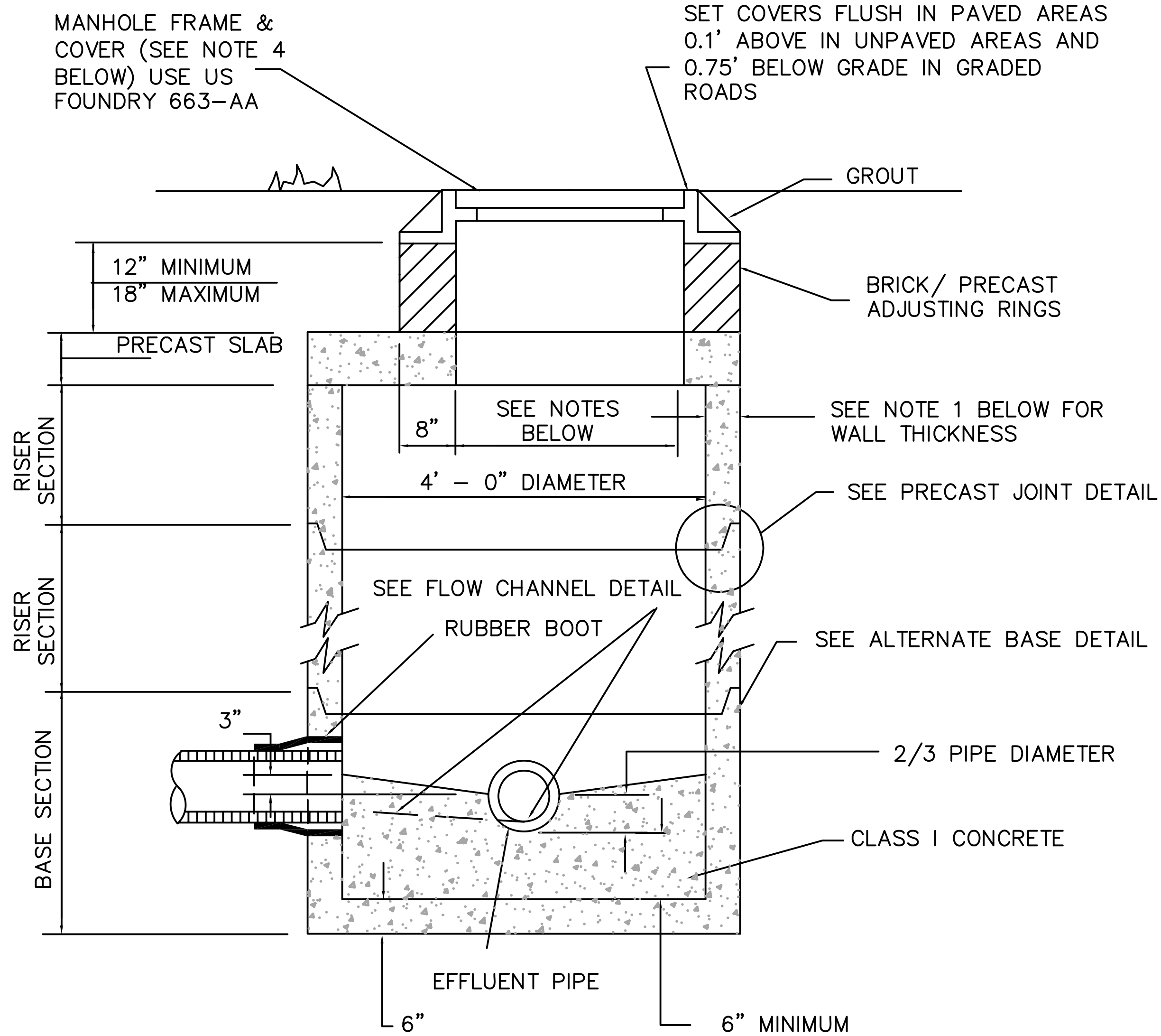
	CITY OF UMATILLA	***PRECAST CONCRETE MANHOLE LESS THAN 5' DEPTH***	***STANDARD DETAILS*** ***DETAIL S-2***



NOTES:

1. MINIMUM WALL THICKNESS SHALL BE FIVE INCHES (5") OR 1/12 THE INSIDE DIAMETER, WHICHEVER IS GREATER.
2. THE INTERIOR, EXTERIOR, JOINTS AND GROUTED AREAS SHALL BE COATED WITH TWO (2) COATS OF BITUMASTIC SEALER.
3. MANHOLES SHALL BE FURNISHED WITH FACTORY INSTALLED BOOTS TO CONNECT SEWER PIPES TO MANHOLES.
4. MANHOLE TO BE INSTALLED WITH 22" RING AND COVER.
5. FILL ANNULAR VOID BETWEEN PIPE AND RUBBER BOOT FLUSH TO MANHOLE WALLS WITH GROUT.
6. DROP CONNECTIONS ARE REQUIRED WHENEVER INVERT OF INFLUENT SEWER IS 24" OR MORE ABOVE THE INVERT OF THE MANHOLE. SEE MANHOLE CONNECTION DETAIL.

	CITY OF UMATILLA	***PRECAST CONCRETE MANHOLE 5' TO 12' DEPTH***	***STANDARD DETAILS*** ***DETAIL S-3***



NOTES:

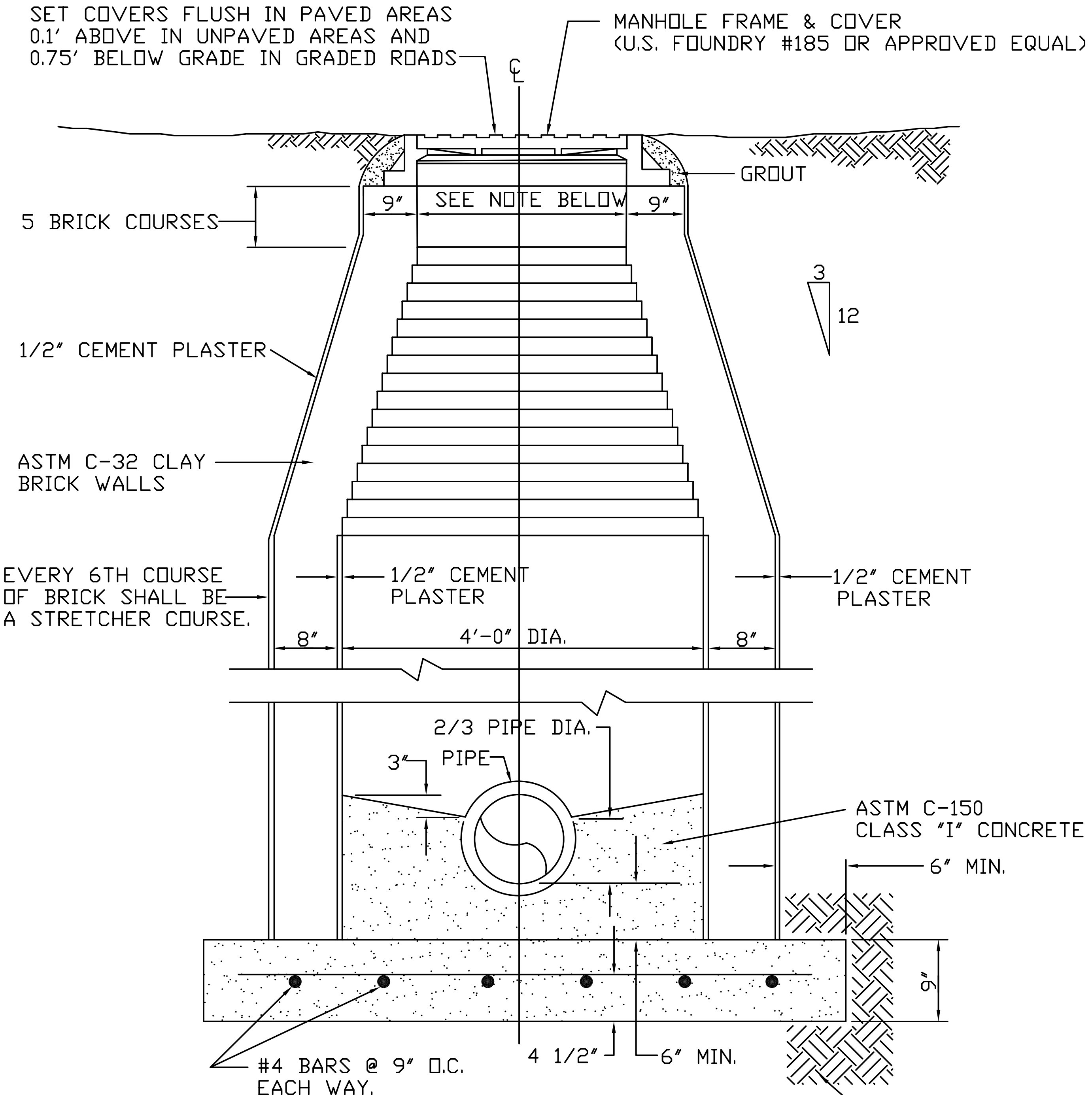
1. MINIMUM WALL THICKNESS SHALL BE FIVE INCHES (5") TO A DEPTH OF TEN FEET (10'). WALL THICKNESS SHALL BE INCREASED TO EIGHT INCHES (8") AT TEN FEET BELOW GRADE.
2. THE INTERIOR, EXTERIOR, JOINTS AND GROUTED AREAS SHALL BE COATED WITH TWO (2) COATS OF BITUMASTIC SEALER.
3. MANHOLES SHALL BE FURNISHED WITH FACTORY INSTALLED BOOTS TO CONNECT SEWER PIPES TO MANHOLES.
4. MANHOLE TO BE INSTALLED WITH 32" RING AND COVER.
5. FILL ANNULAR VOID BETWEEN PIPE AND RUBBER BOOT FLUSH TO MANHOLE WALLS WITH GROUT.
6. DROP CONNECTIONS ARE REQUIRED WHENEVER INVERT OF INFLUENT SEWER IS 24" OR MORE ABOVE THE INVERT OF THE MANHOLE. SEE MANHOLE CONNECTION DETAIL.

CITY OF UMATILLA

PRECAST CONCRETE MANHOLE OVER 12' DEPTH

STANDARD DETAILS

DETAIL S-4



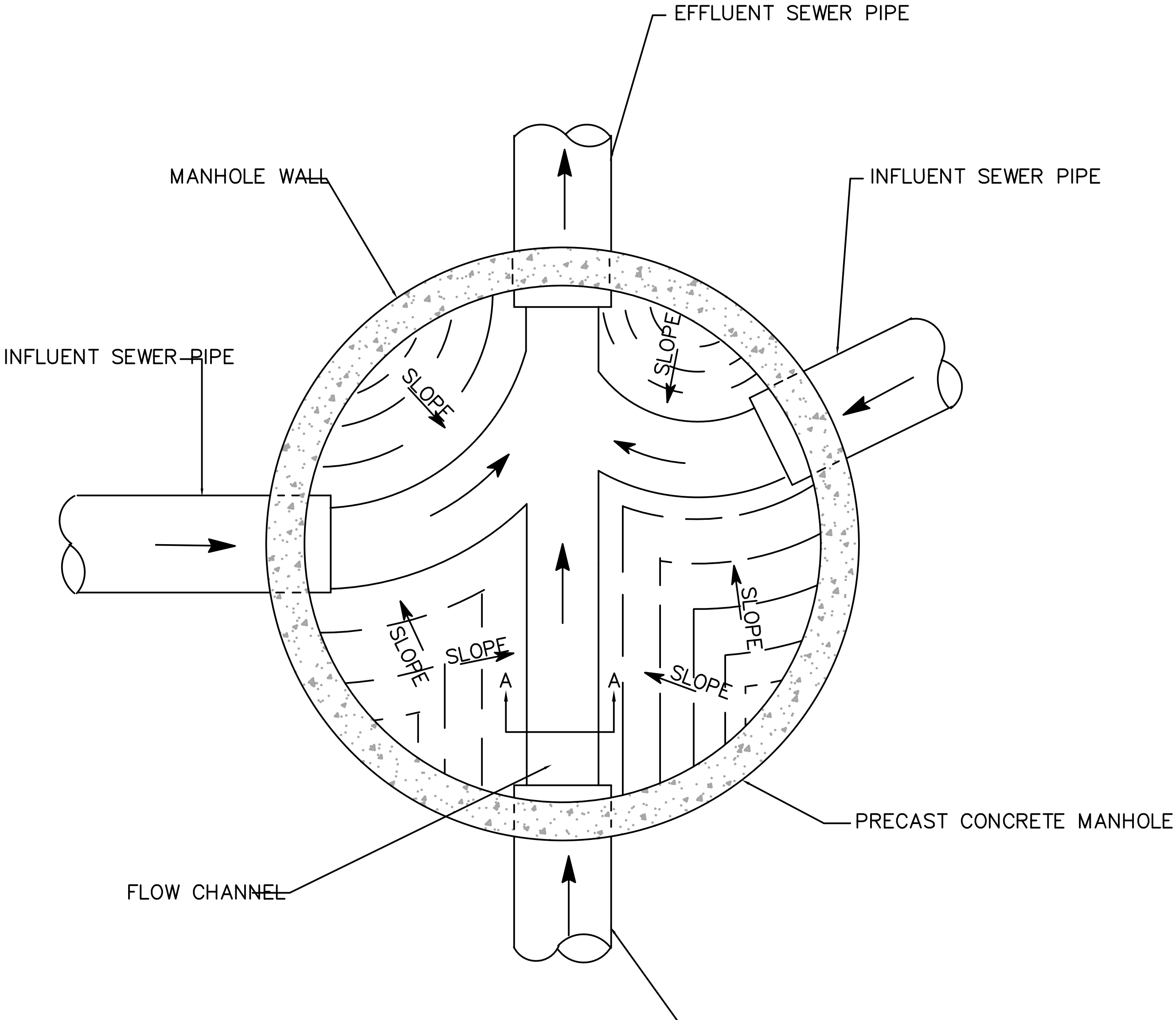
1. ALL INVERTS SHALL FOLLOW THE GRADES OF THE PIPE ENTERING THE MANHOLE.
2. WHERE THE DEPTH OF MANHOLE EXCEEDS 12', THE WALL THICKNESS SHALL BE INCREASED BY 4" AT 10' BELOW GRADE DOWN WITH HORIZONTAL DIMENSION OF SQUARE CONCRETE SLAB BEING INCREASED BY 1'-0".
3. MANHOLE TO BE INSTALLED WITH (22") RING AND COVER FOR MANHOLE UP TO 12' DEEP, MANHOLE TO BE INSTALLED WITH (32") RING AND COVER FOR MANHOLE OVER 12' DEEP.
4. DROP CONNECTIONS ARE REQUIRED WHENEVER INVERT ON INFLUENT SEWER IS 24" OR MORE ABOVE THE INVERT OF THE MANHOLE. SEE MANHOLE CONNECTION DETAIL.

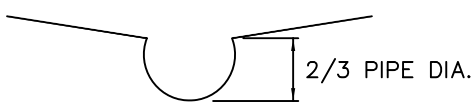
CITY OF UMATILLA

FIBERGLASS MANHOLE

STANDARD DETAILS

DETAIL S-5





SECTION A – A

NOTES:

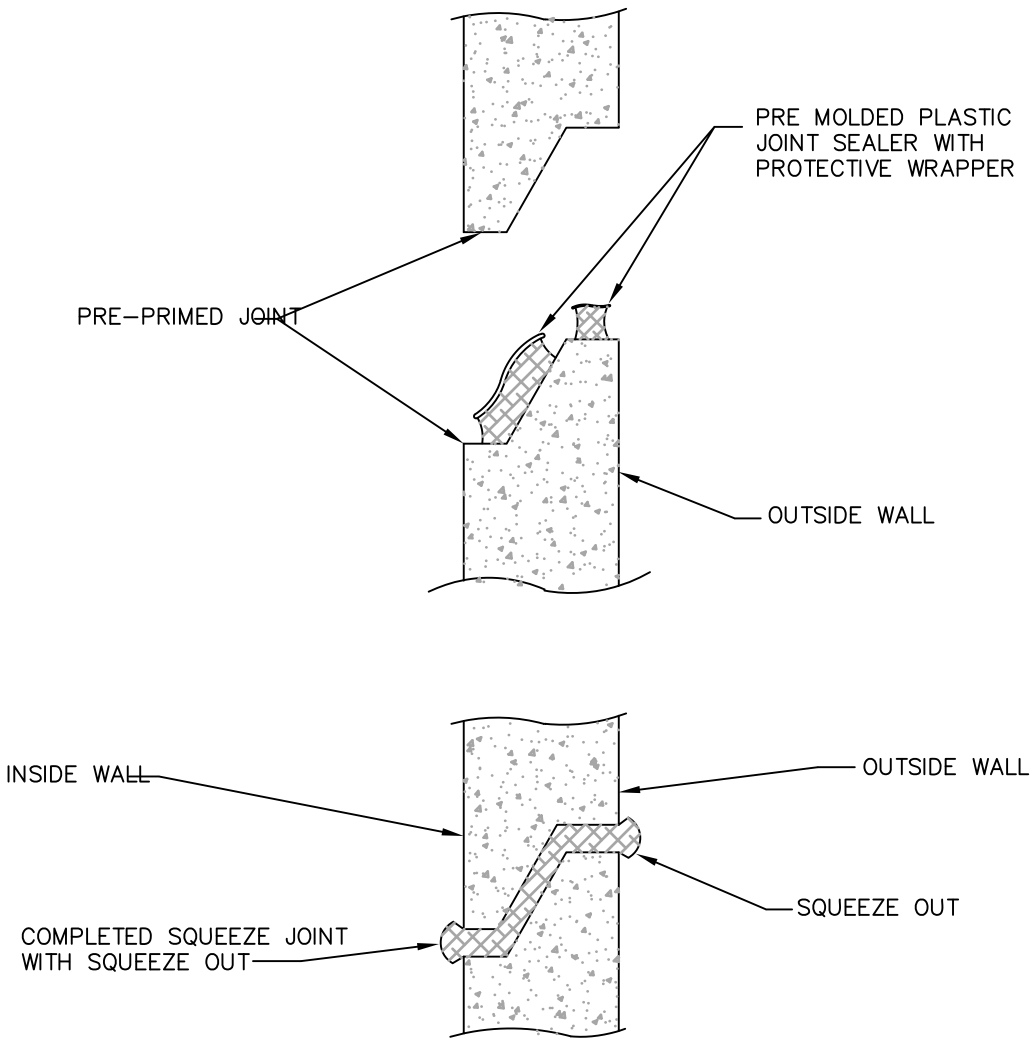
1. FLOW CHANNELS IN MANHOLE BOTTOM SHALL HAVE SAME RADIUS AS EFFLUENT SEWER LINES.
2. FLOW CHANNELS SHALL BE FORMED OF CLASS I CONCRETE. ALL INVERTS SHALL FOLLOW THE GRADES OF THE PIPE ENTERING THE MANHOLE. BRICKS OR OTHER FILL MATERIALS SHALL NOT BE USED WHEN FORMING FLOW CHANNELS.
3. THAT PORTION OF THE FLOW CHANNEL ABOVE THE SLOPED SIDES SHALL BE FREE OF COVERING TO THE LIMITS SHOWN ABOVE.
4. INVERT CHANNELS TO BE CONSTRUCTED FOR SMOOTH FLOW WITH NO OBSTRUCTIONS.
5. SPILLWAYS SHALL BE CONSTRUCTED BETWEEN PIPES WITH DIFFERENT INVERT ELEVATIONS PROVIDING FOR SMOOTH FLOWS.
6. CHANNELS FOR FUTURE CONNECTIONS (STUBS) SHALL BE CONSTRUCTED, FILLED WITH SAND AND COVERED WITH 1" OF MORTAR.

CITY OF UMATILLA

SANITARY SEWER MANHOLE FLOW CHANNEL

STANDARD DETAILS

DETAIL S–6

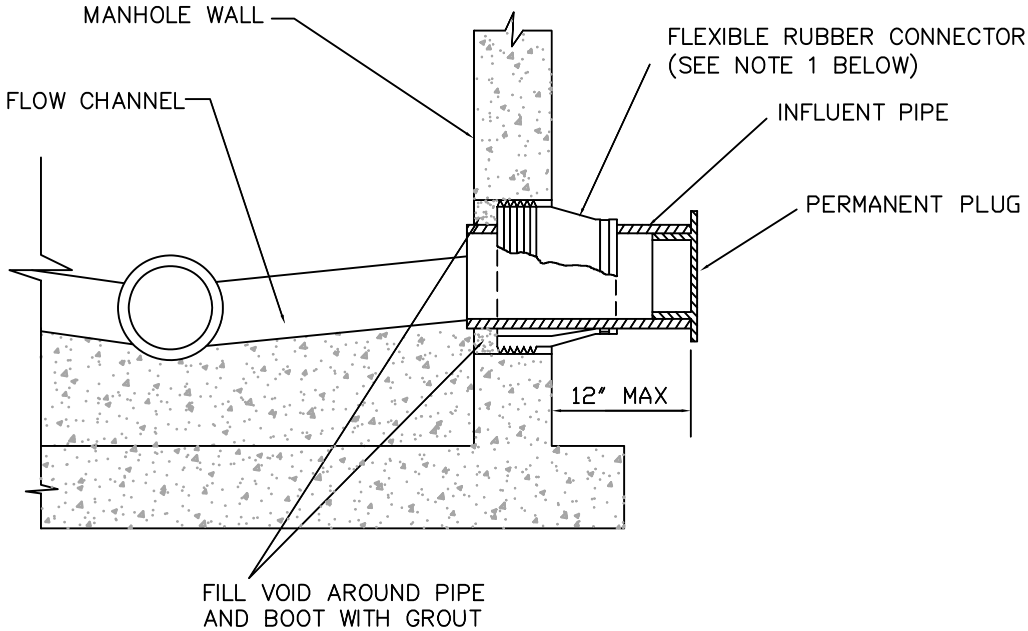


CITY OF UMATILLA

PRECAST CONCRETE MANHOLE JOINT CONSTRUCTION

STANDARD DETAILS

DETAIL S-7



NOTES:

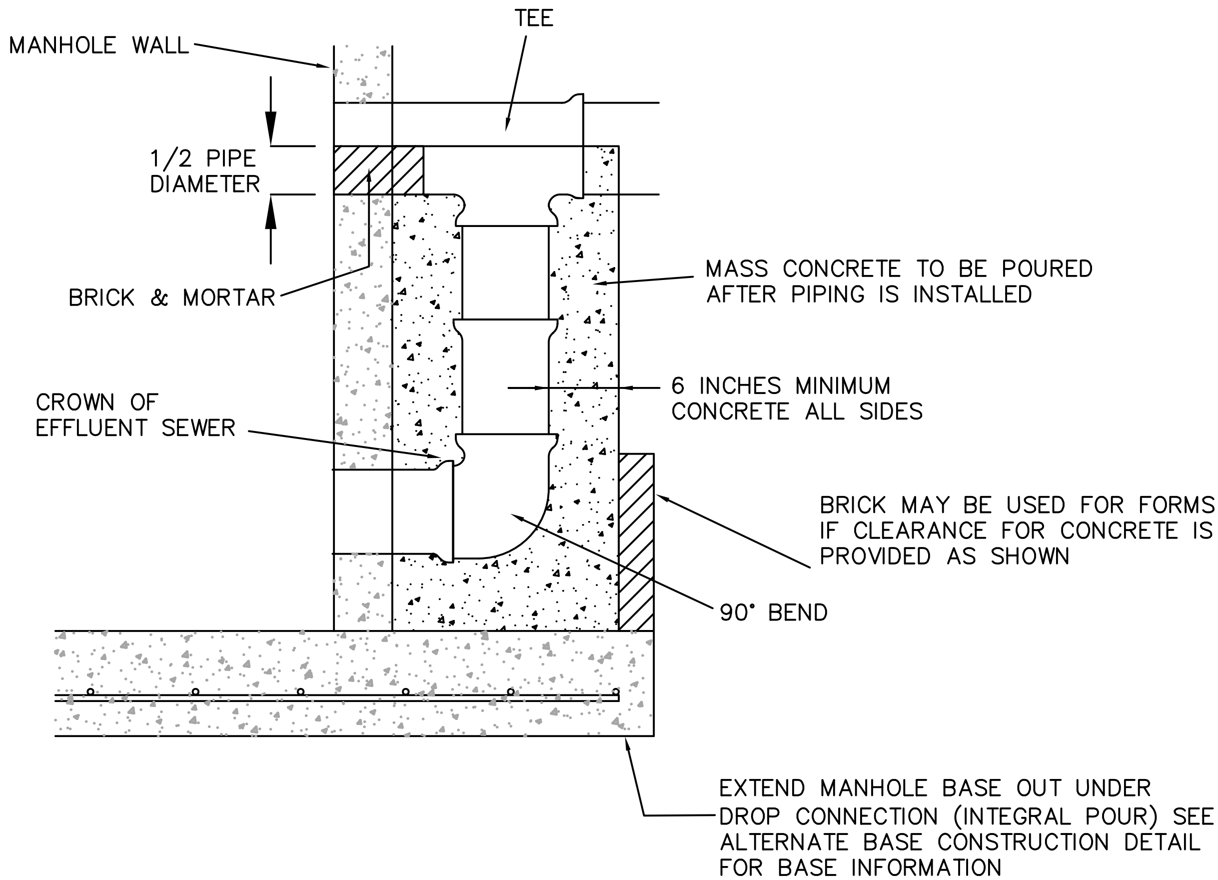
1. BOOTS SHALL BE INSTALLED BY THE MANUFACTURER OF THE PRECAST MANHOLE IN ACCORDANCE WITH THE BOOT MANUFACTURERS INSTRUCTIONS.

CITY OF UMATILLA

SANITARY SEWER MANHOLE STUBOUT

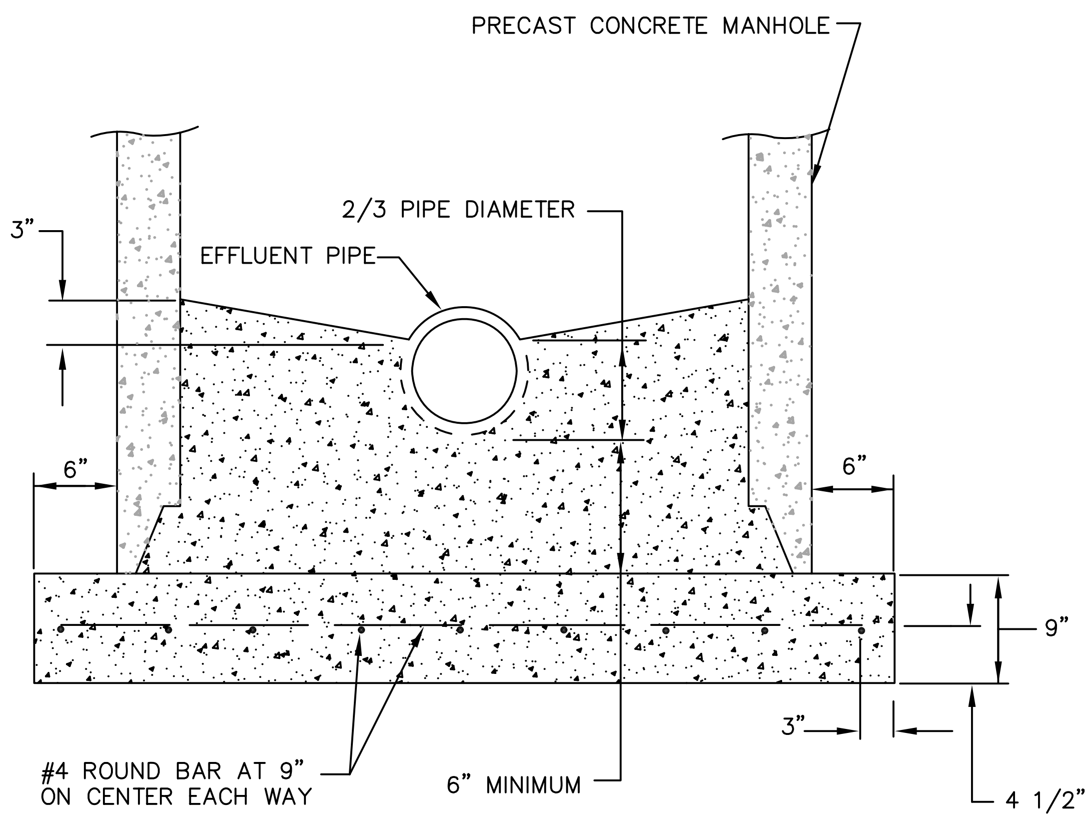
STANDARD DETAILS

DETAIL S-8



NOTES:

1. DROP CONNECTIONS ARE REQUIRED IF INVERT OF INFLUENT SEWER IS 24 INCHES OR MORE FROM THE CROWN OF THE MANHOLE EFFLUENT PIPE. UNLESS DIRECTED OTHERWISE.

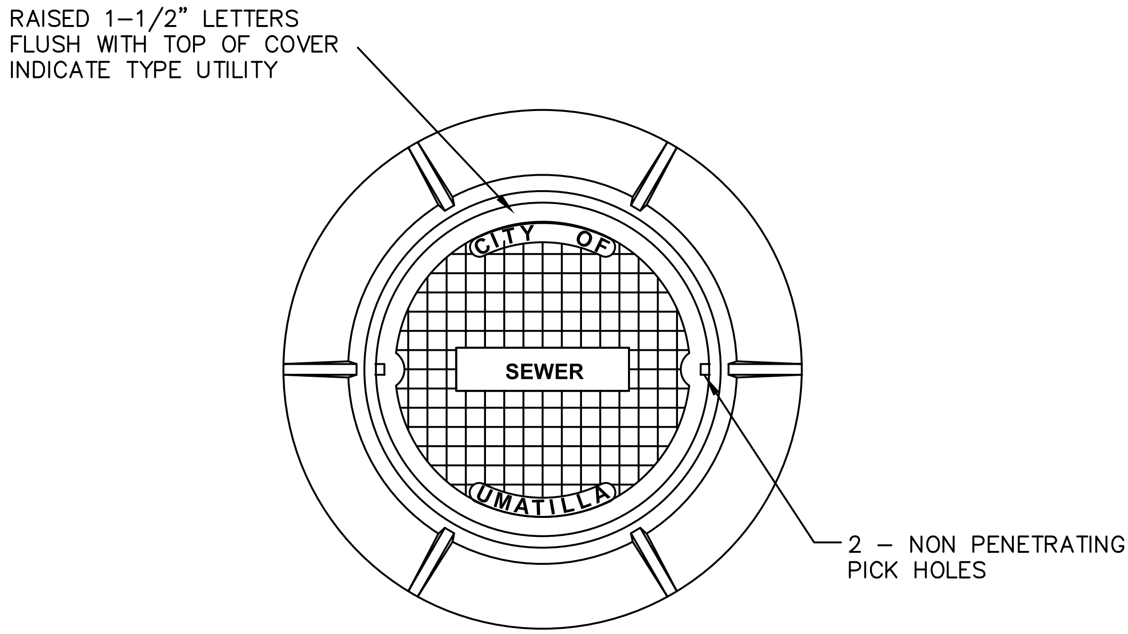


CITY OF UMATILLA

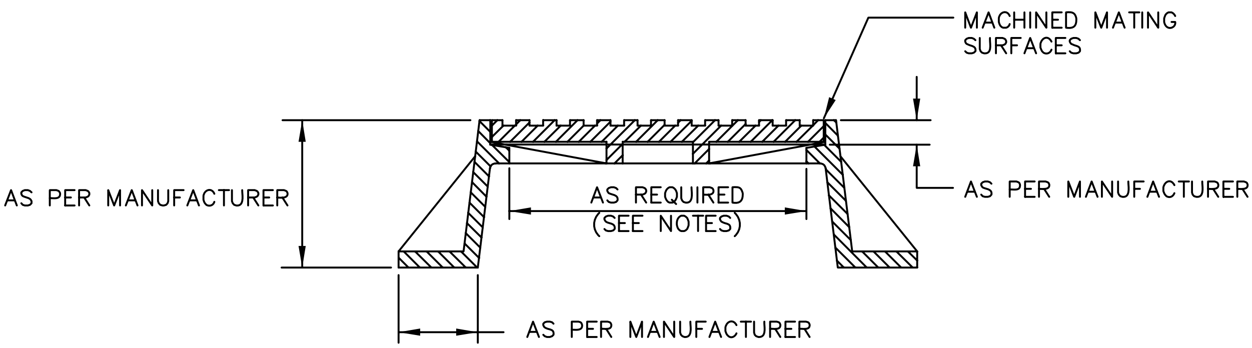
PRECAST CONCRETE MANHOLE ALTERNATE BASE CONSTRUCTION

STANDARD DETAILS

DETAIL S-10



PLAN



ELEVATION

NOTES:

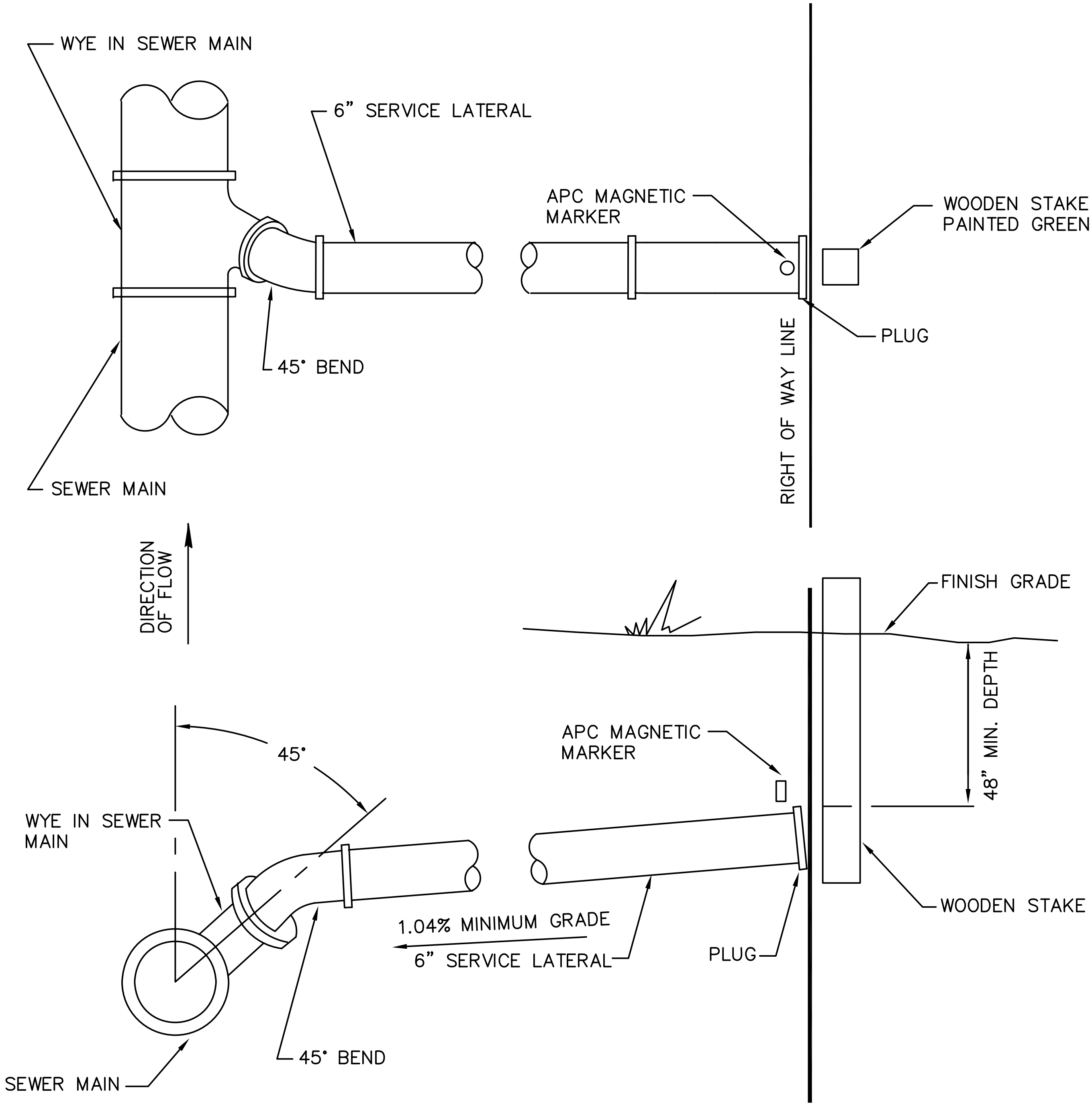
1. MANHOLE COVERS SHALL BE 22" DIAMETER FOR MANHOLES LESS THAN 12' IN DEPTH AND MANUFACTURED BY US FOUNDRY, MODEL NO. 195 RING W/ E COVER.
2. MANHOLE COVERS SHALL BE 32" DIAMETER FOR MANHOLES 32' AND GREATER IN DEPTH AND MANUFACTURED BY US FOUNDRY, MODEL NO. 663 RING W/ AA COVER.

CITY OF UMATILLA

STANDARD MANHOLE FRAME AND COVER

STANDARD DETAILS

DETAIL S-11



NOTES:

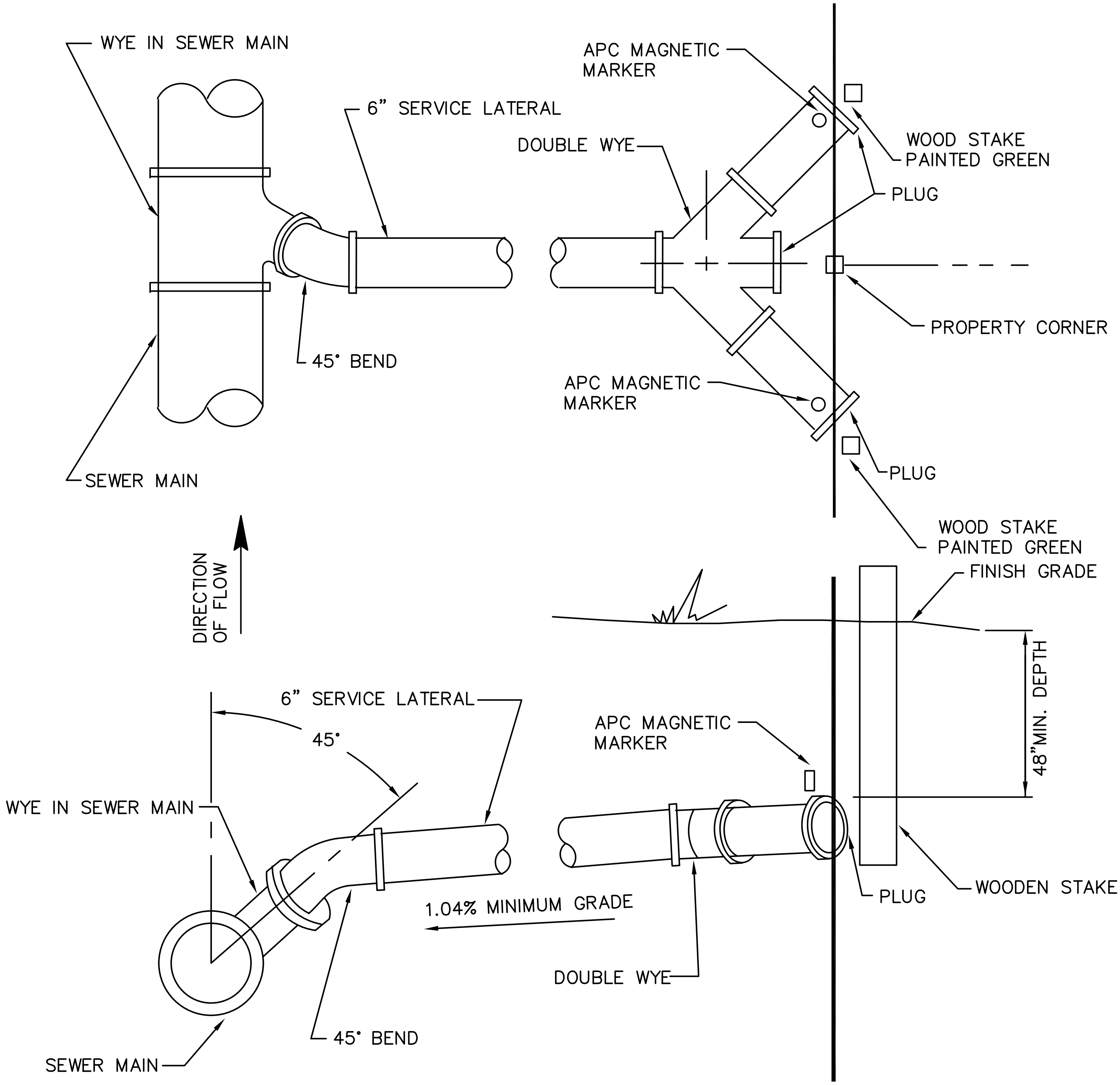
1. INSTALLATION TO INCLUDE APC MAGNETIC MARKER.

CITY OF UMATILLA

SINGLE SANITARY SEWER SERVICE

STANDARD DETAILS

DETAIL S-12



NOTES:

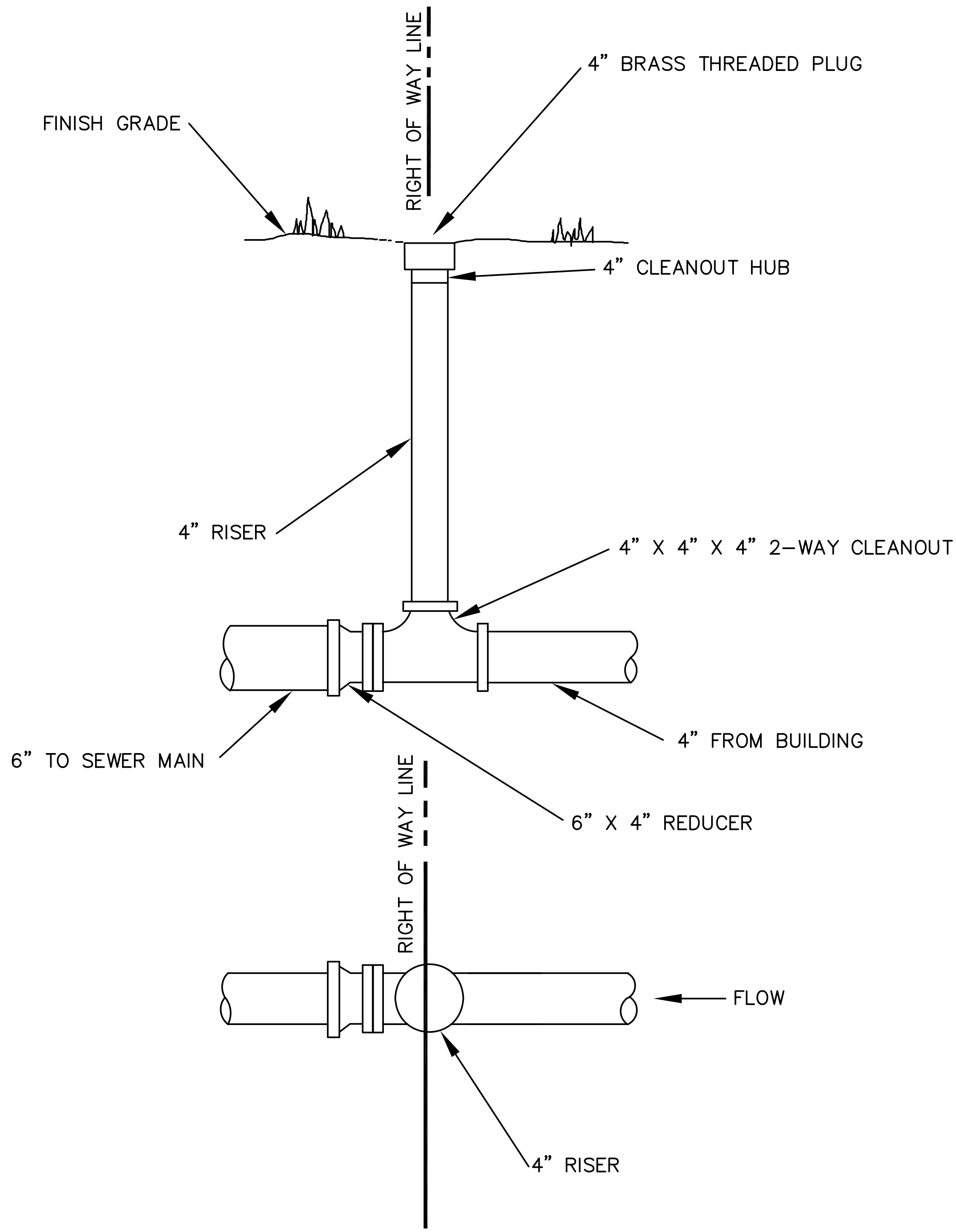
1. INSTALLATION TO INCLUDE APC MAGNETIC MARKER.

CITY OF UMATILLA

DOUBLE SANITARY SEWER SERVICE

STANDARD DETAILS

DETAIL S–13

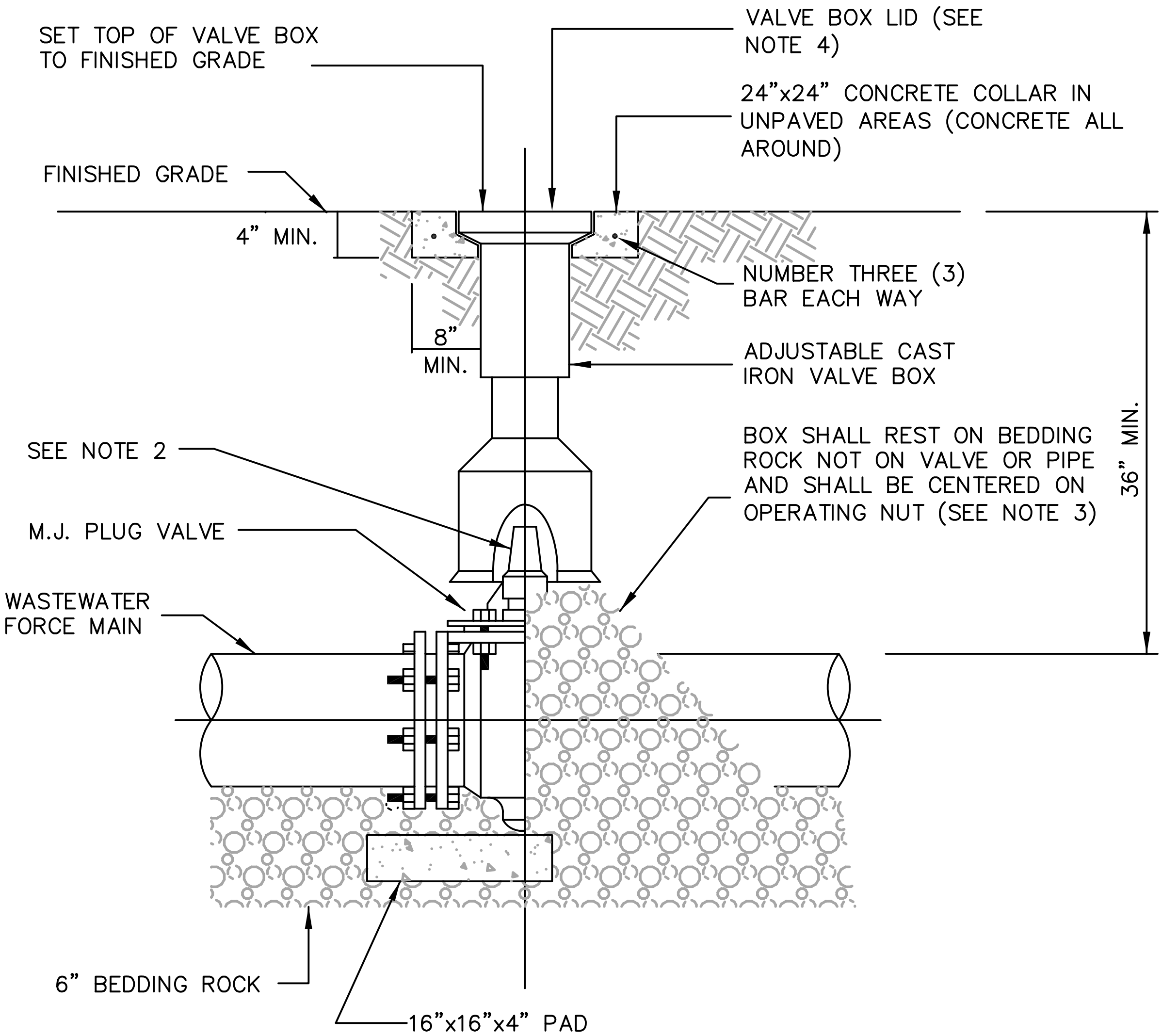


CITY OF UMATILLA

SANITARY SEWER SERVICE RESIDENTIAL CLEANOUT

STANDARD DETAILS

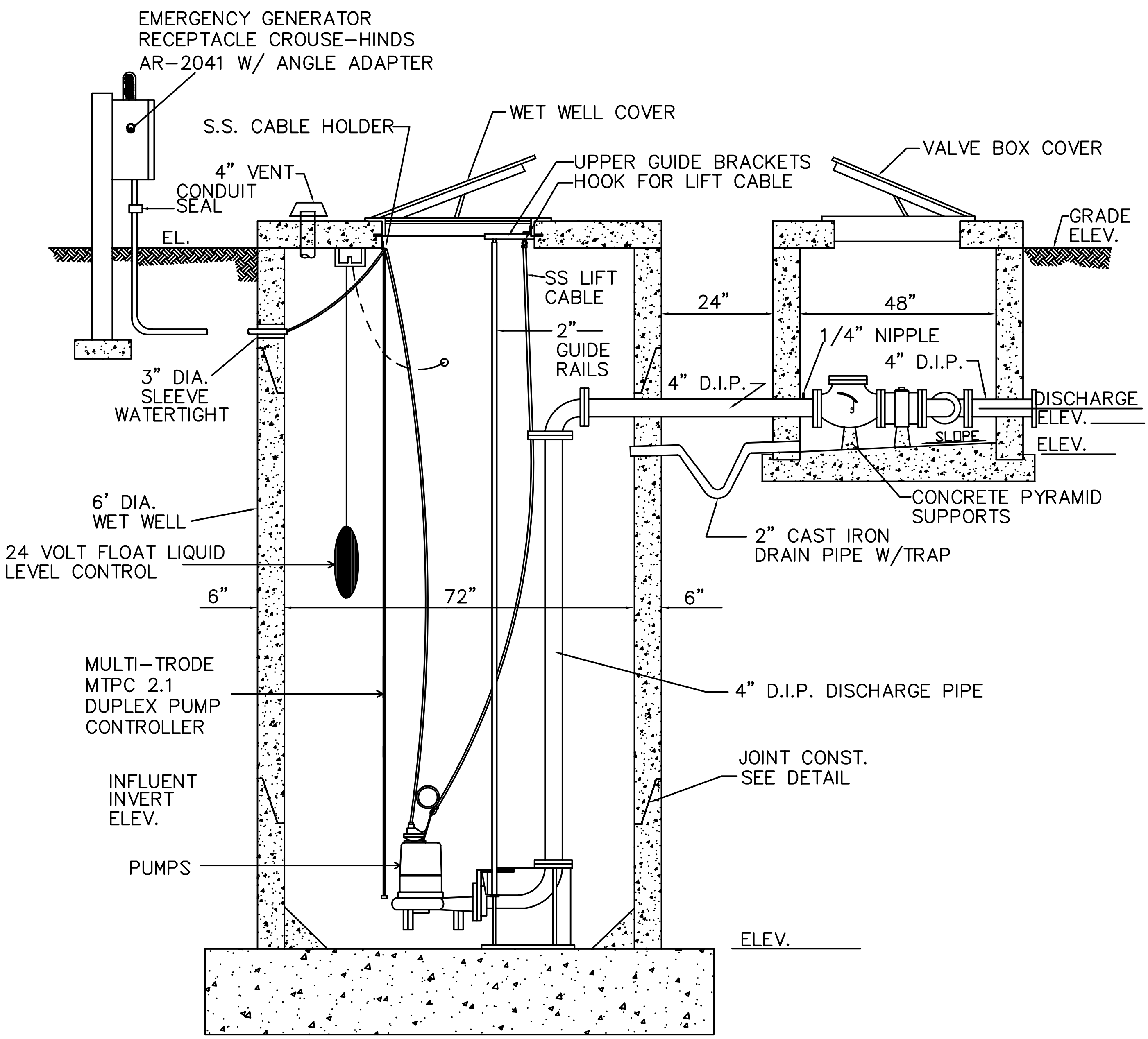
DETAIL S-14



NOTES:

1. PVC EXTENSIONS SHALL NOT BE USED ON VALVE BOX INSTALLATION.
2. THE ACTUATING NUT FOR DEEPER VALVES SHALL BE EXTENDED TO COME UP TO 4 FOOT DEPTH BELOW FINISHED GRADE.
3. WHEN VALVE BOX IS TO BE INSTALLED IN ROADWAY OR OTHER TRAFFIC AREAS SET VALVE BOX ON FIVE (5) SOLID COMMON BRICKS.
4. VALVE BOX LID TO BE LETTERED WITH THE WORD "SEWER".

CITY OF UMATILLA	PLUG VALVE AND BOX DETAIL	STANDARD DETAILS DETAIL S-15



L.S. MANUFACTURER ____________
L.S. MODEL NUMBER ____________
PUMP MODEL NUMBER ____________
PUMP H.P. ____________
PUMP R.P.M. ____________
IMPELLER SIZE ____________

VOLTAGE/PHASE ____________
PUMP RATE – G.P.M. ____________
T.D.H. ____________
F.M. LENGTH ____________
F.M. SIZE ____________
TYPE OF F.M. PIPE ____________

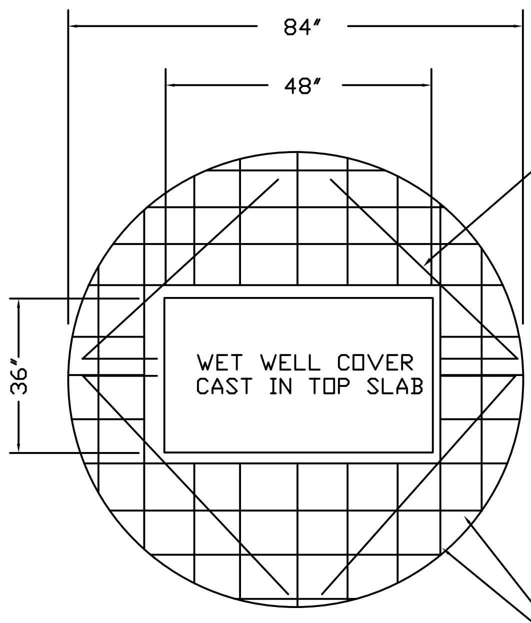
ALARM ______
BOTH PUMPS ON ______
LEAD PUMP ON ______
BOTH PUMPS OFF ______

CITY OF UMATILLA

TYPICAL LIFT STATION AND VALVE VAULT SECTION VIEW

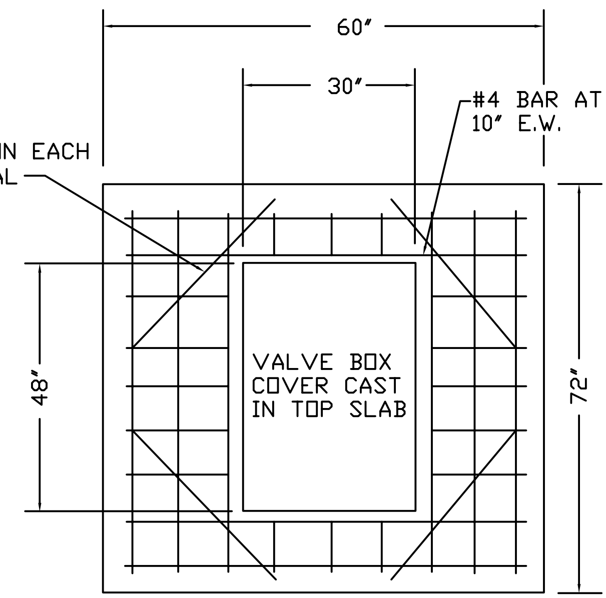
STANDARD DETAILS

DETAIL S–16

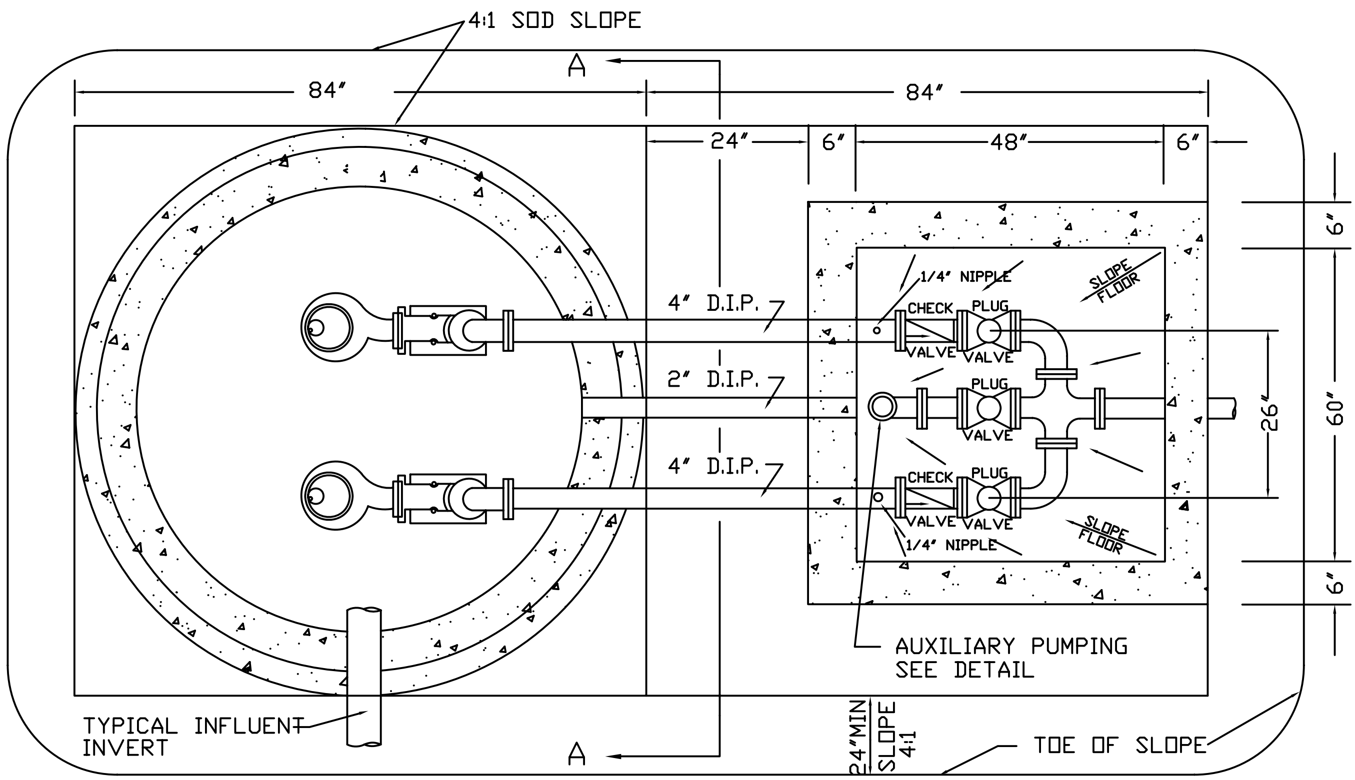


PLAN VIEW A-A
TYPICAL WET WELL COVER

#4 BAR AT 12" E.W. ON EACH SIDE OF HATCH



PLAN VIEW
TYPICAL VALVE VAULT COVER

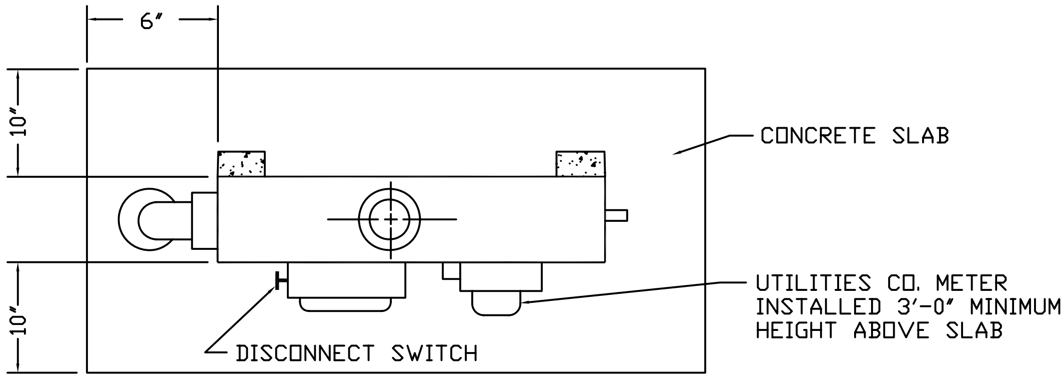


CITY OF UMATILLA

TYPICAL LIFT STATION AND VALVE VAULT PLAN VIEW

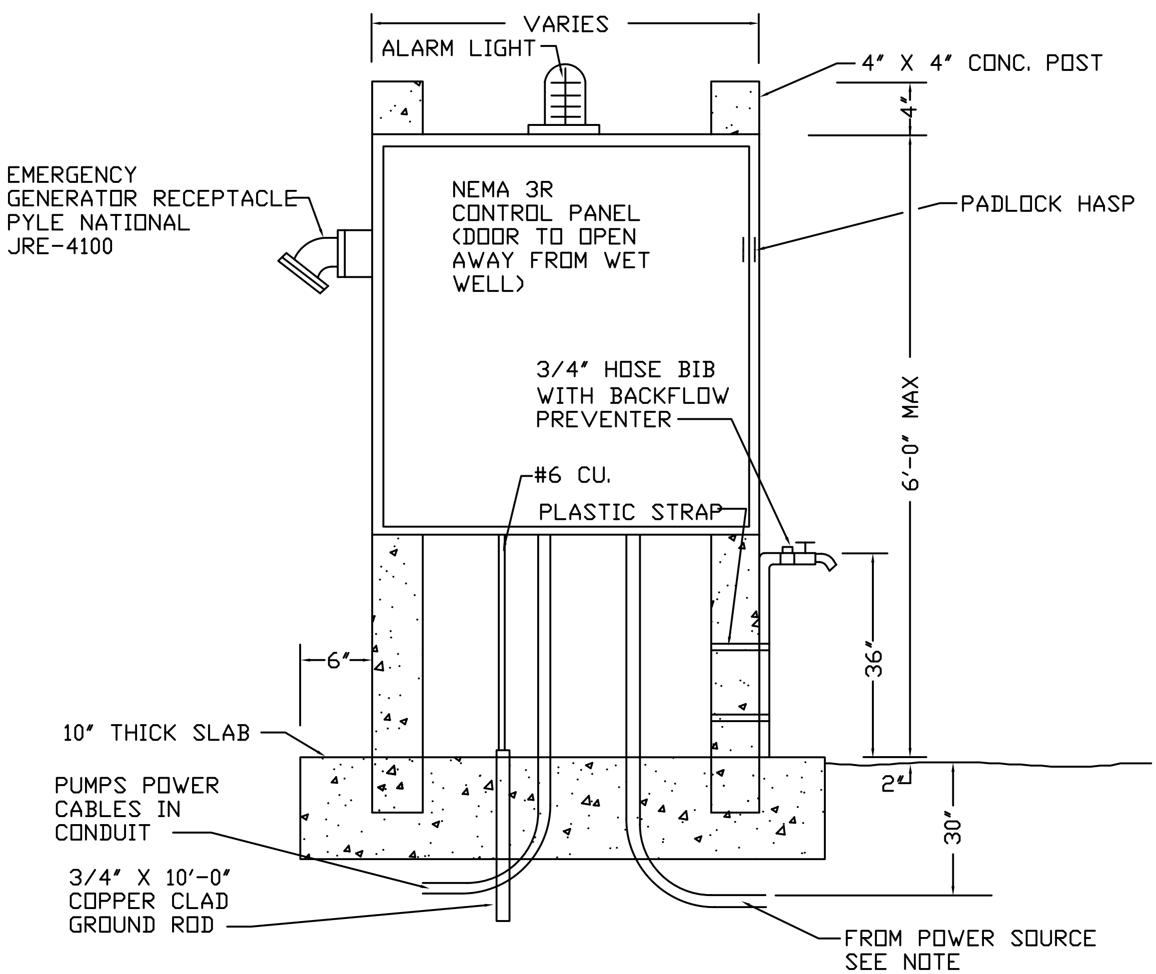
STANDARD DETAILS

DETAIL S-17



PLAN VIEW

FIELD DRILL MOUNTING & WIRE HOLES
SEAL WATERTIGHT AFTER INSTALLATION



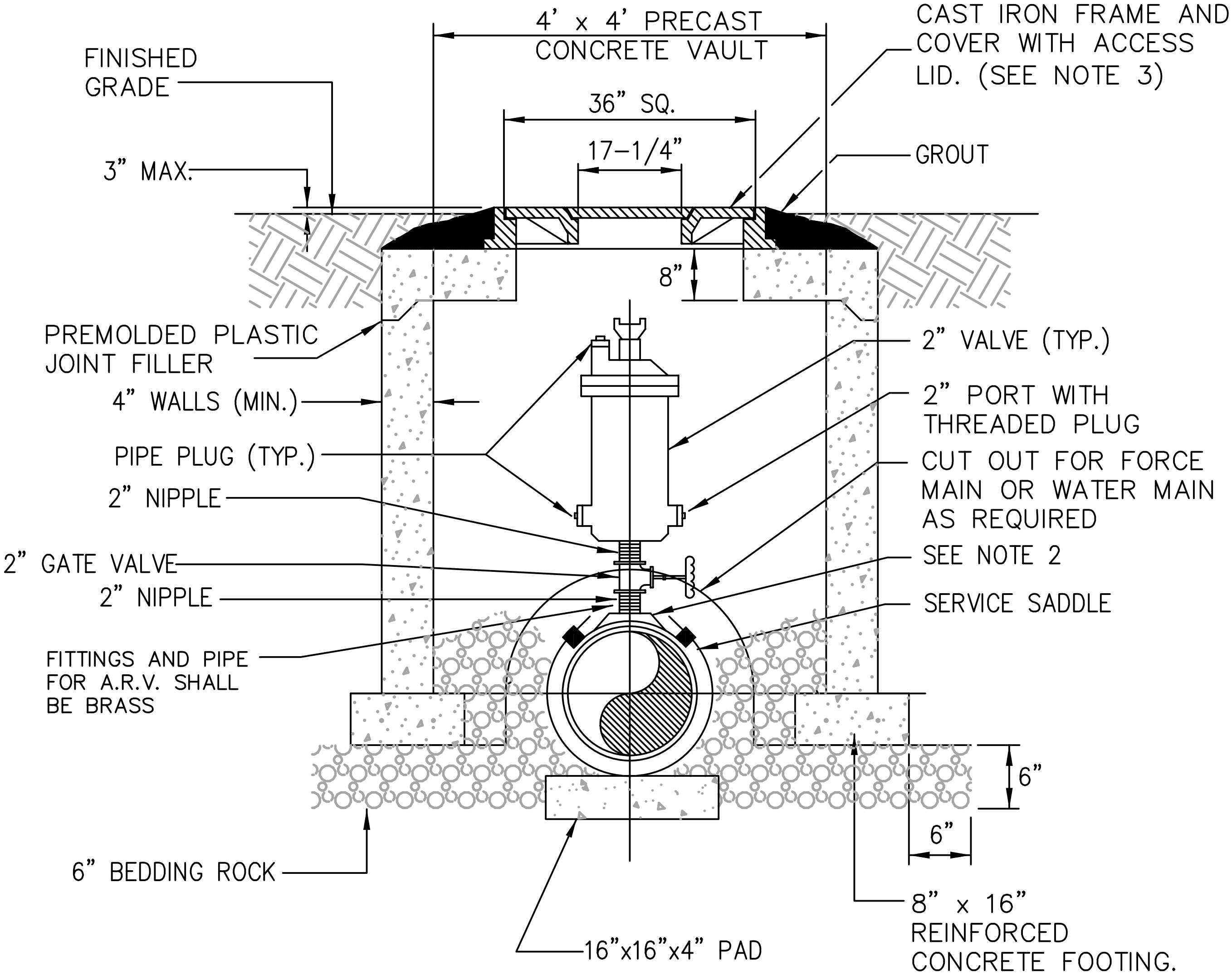
ELEVATION

CITY OF UMATILLA

SERVICE PEDESTAL

STANDARD DETAILS

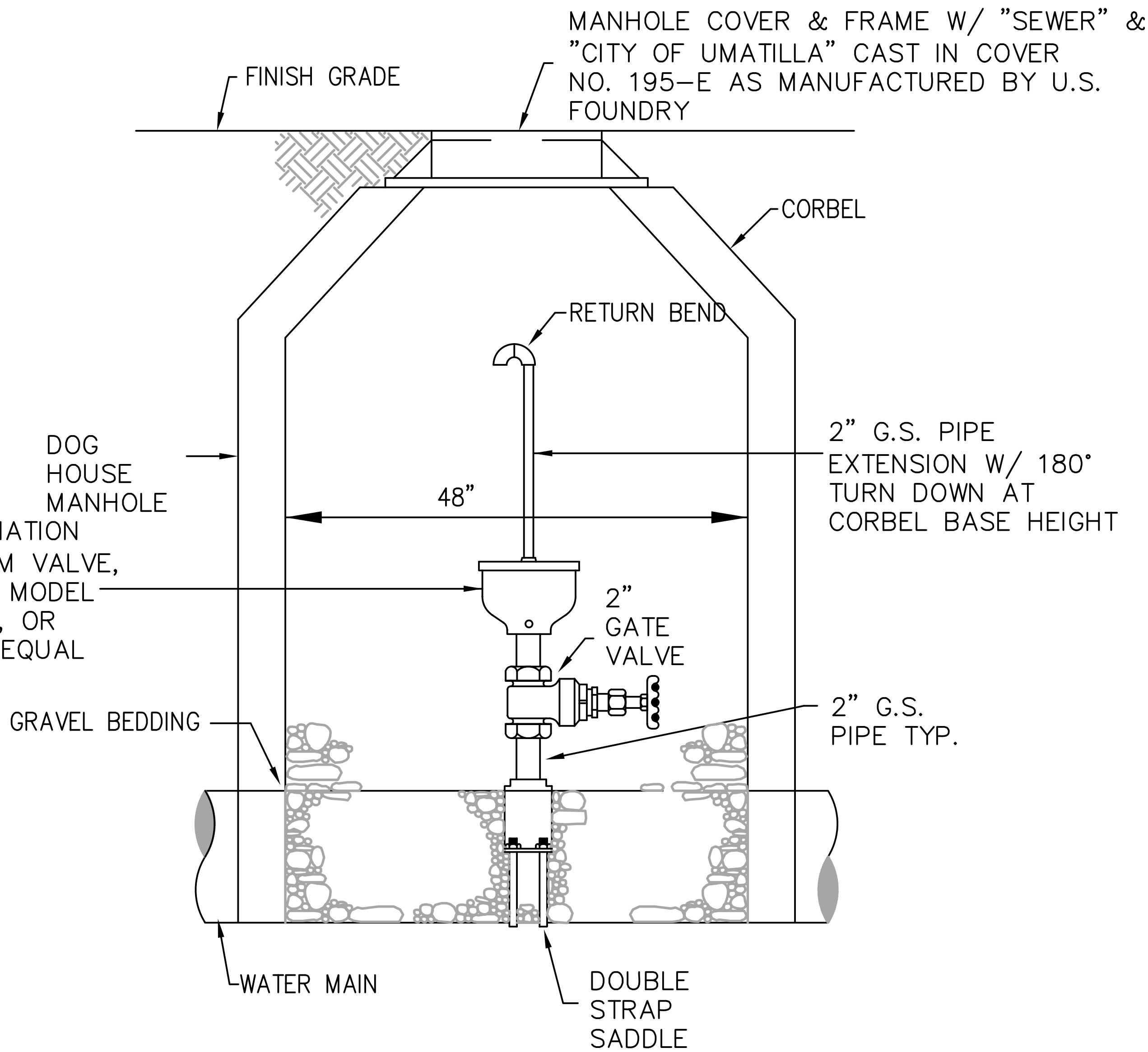
DETAIL S-18



NOTES:

1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE. CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY OF UMATILLA PRIOR TO INSTALLATION.
2. THE MINIMUM DIMENSION FROM TOP OF PIPE TO FINISHED GRADE SHALL BE 3.0 FEET.
3. CAST IRON FRAME AND COVER SHALL BE BY "U.S. FOUNDRY" MODEL 7665, OR APPROVED EQUAL. LID SHALL BE LETTERED WITH THE APPROPRIATE WORD "SEWER" AND "CITY OF UMATILLA".

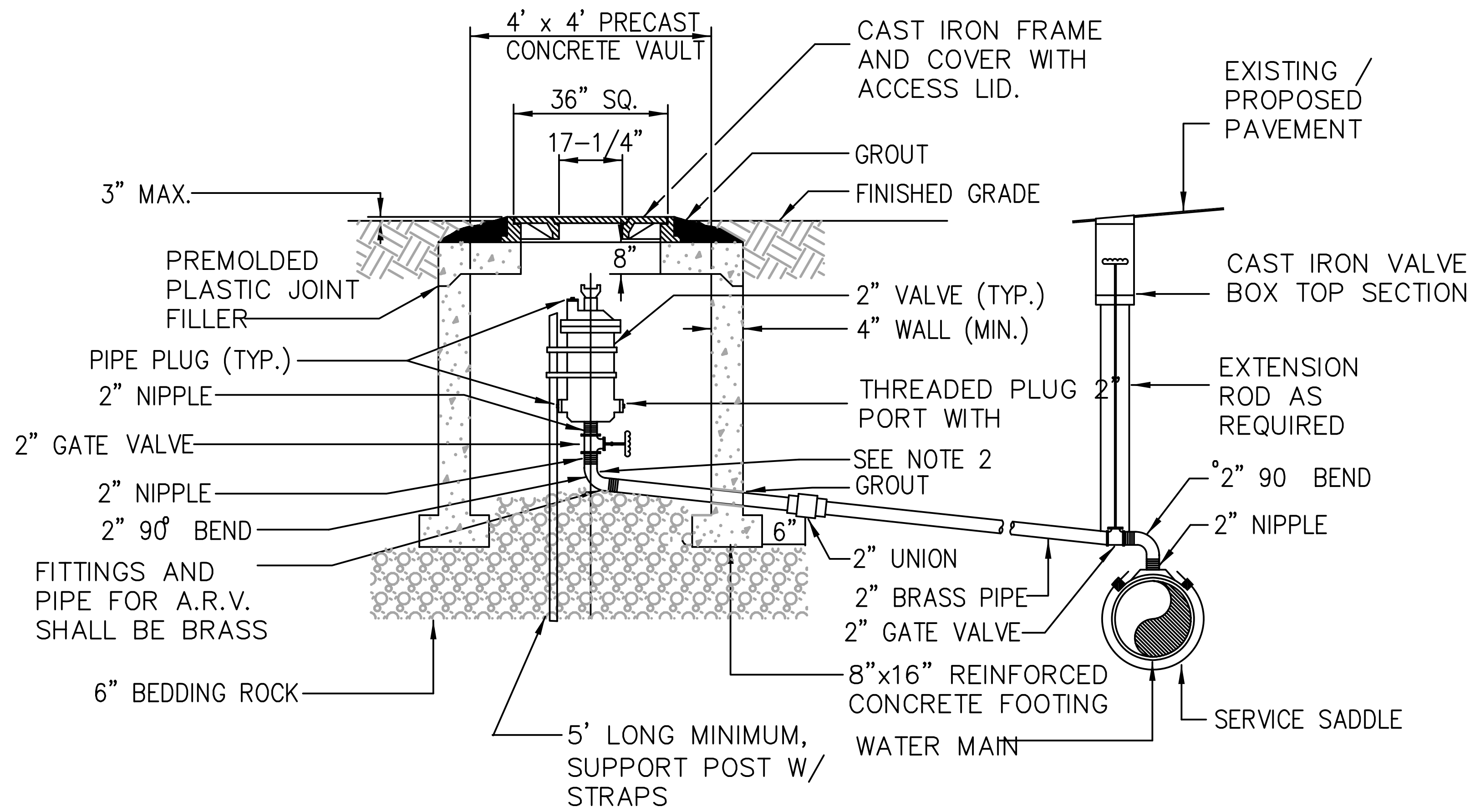
CITY OF UMATILLA · LAKE COUNTY FLA. · Best of All	CITY OF UMATILLA	AIR OR COMBINATION AIR/VACUUM RELEASE VALVE	STANDARD DETAILS DETAIL S-19



NOTES:

1. THE MINIMUM DIMENSION FROM TOP OF PIPE TO FINISHED GRADE SHALL BE 3.0 FEET.
2. DOUBLE STRAP SADDLE AND WRAP WITH TWO LAYERS OF WIDE PLASTIC OR POLY TAPE WITH STAINLESS STEEL STRAP.
3. PIPE INSTALLATION SHALL BE SUCH THAT THE ARV IS LOCATED AT THE HIGHEST POINT IN THE RESPECTIVE SEGMENT.
4. INTERIOR AND EXTERIOR CONCRETE SURFACES SHALL RECEIVE PROTECTIVE COATING AS SPECIFIED FOR STANDARD MANHOLES.
5. CAST IRON FRAME, COVER AND ACCESS LID SHALL BE INSTALLED FLUSH WITH FINISHED GRADE.
6. COVER SHALL READ "SEWER" AND "CITY OF UMATILLA".

CITY OF UMATILLA · Best of All · LAKE COUNTY FLA.	CITY OF UMATILLA	**AIR OR COMBINATION AIR/VACUUM RELEASE VALVE**	**STANDARD DETAILS** **DETAIL S–20**



NOTES:

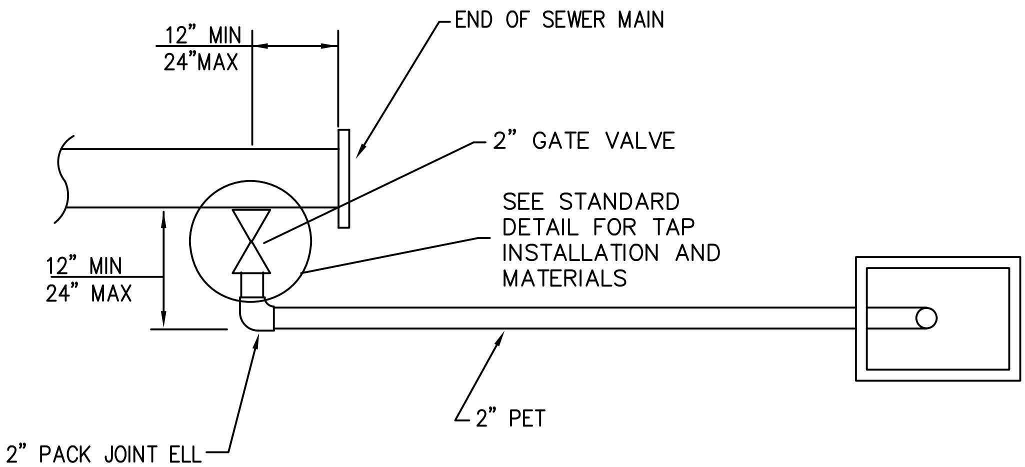
1. ABOVE DETAIL IS BASED ON 2" COMBINATION AIR/VACUUM RELEASE VALVE. CHANGE PIPE AND FITTINGS ACCORDINGLY FOR OTHER VALVE SIZES AND TYPES. VALVE SIZES TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY OF UMATILLA PRIOR TO INSTALLATION.
2. THE MINIMUM DIMENSION FROM ELBOW INVERT TO FINISHED GRADE SHALL BE 2.0 FEET.
3. LID TO BE "U.S. FOUNDRY" MODEL 7665 OR APPROVED EQUAL, LETTERED WITH THE APPROPRIATE WORD "SEWER" AND "CITY OF UMATILLA".

CITY OF UMATILLA

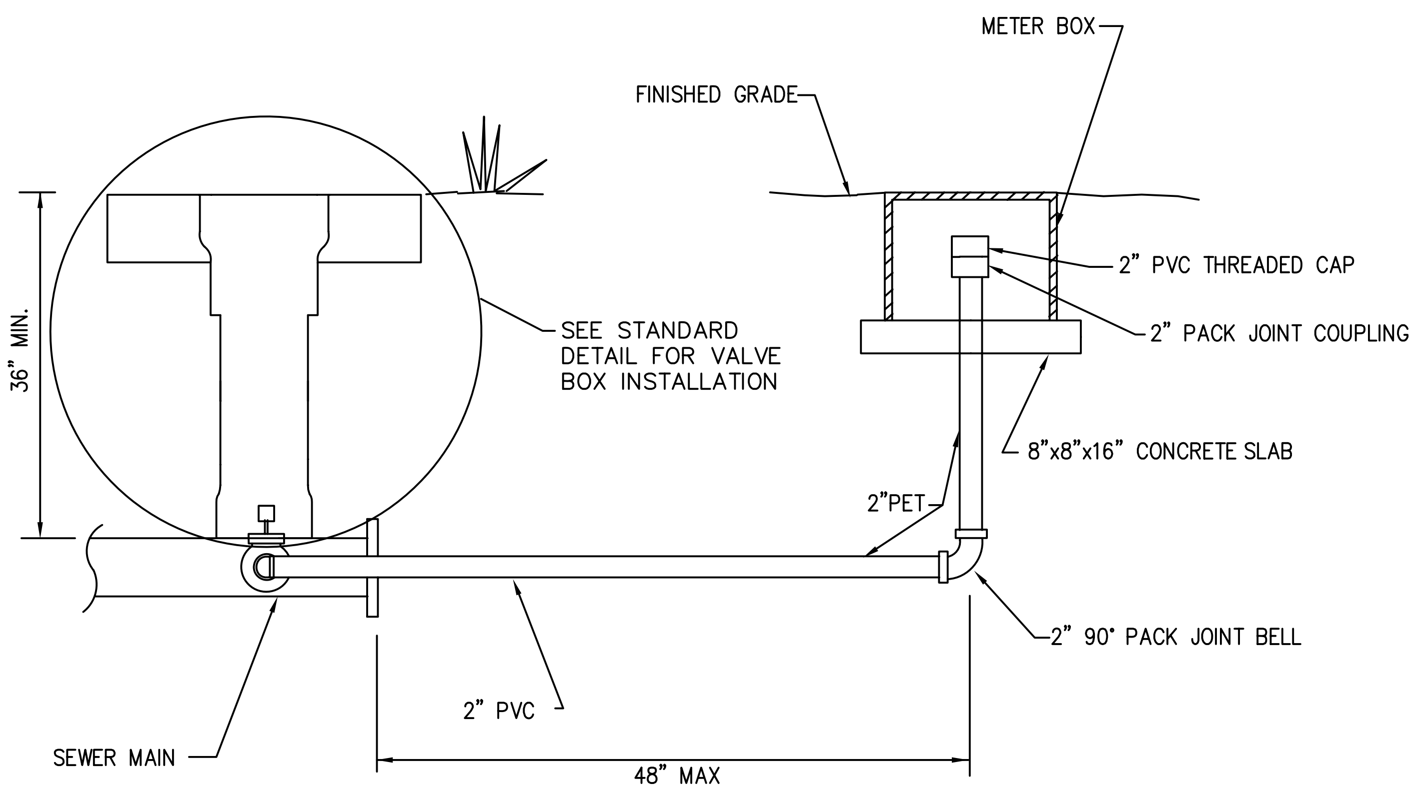
OFFSET AIR OR COMBINATION AIR/VACUUM RELEASE VALVE

STANDARD DETAILS

DETAIL S-21



PLAN VIEW



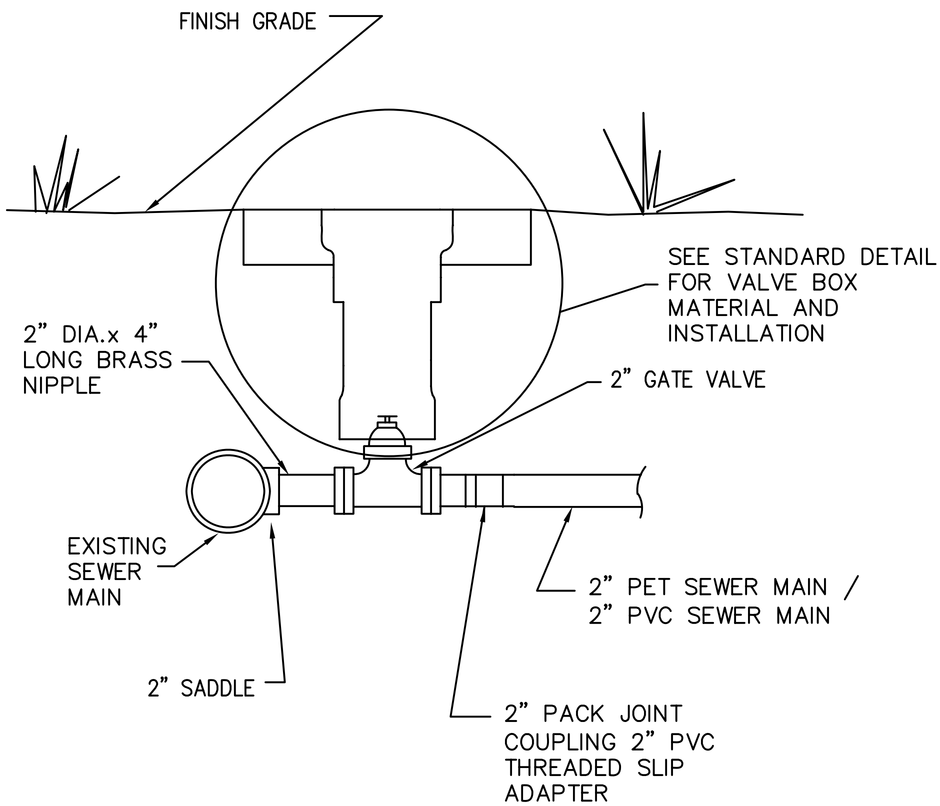
PROFILE VIEW

CITY OF UMATILLA

PERMANENT BLOWOFF ASSEMBLY

STANDARD DETAILS

DETAIL S-22



FOR 2" P.V.C. / P.E.T.

CITY OF UMATILLA

SEWER MAIN TAP

STANDARD DETAILS

DETAIL S-23

APPENDIX A

GENERAL CONSTRUCTION REQUIREMENTS FOR WATER DISTRIBUTION AND WASTEWATER COLLECTION

1. GENERAL REQUIREMENTS

a. Grades, Survey Lines, and Protection of Monuments

(1) Grade

All work shall be constructed in accordance with the lines and grades shown on the Drawings. The full responsibility for keeping alignment and grade shall rest upon the contractor.

Bench marks and base line controlling points shall be established prior to beginning work. Reference marks for lines and grades as the work progresses will be located to cause as little inconvenience to the prosecution of the work as possible. The contractor shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. Contractor shall remove any obstructions placed contrary to this provision.

(2) Surveys

The contractor shall furnish and maintain, at his own expense, stakes and other such materials, and give such assistance, including qualified helpers, for setting reference marks to the satisfaction of the City and the Engineer. The contractor shall check such reference marks by such means as he may deem necessary and, before using this, shall call the City's attention to any inaccuracies. The contractor shall, at his own expense, establish all working or construction lines and grades as required from the reference marks, and shall be solely responsible for the accuracy thereof. The contractor shall, however, be subject to the check and review of the City.

(3) Monument Preservation

Property corners and survey monuments shall be preserved using care not to disturb or destroy them. If a property corner or survey monument is disturbed or destroyed during construction, whether by accident, careless work, or required to be disturbed or destroyed by the construction work, said property corner or survey monument shall be restored by a Professional Surveyor and Mapper registered in the State of Florida. All costs for this work shall be paid for by the contractor.

b. Utility Coordination

(1) Location of Utilities

Prior to proceeding with trench excavation the contractor shall contact all utility companies in the area to aid in locating their underground services. It shall be the contractor's responsibility to contact utility companies or sunshine state one call at least three (3) normal working days before starting construction. The contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground utilities may be determined.

The contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer, underground cable, or other utility, the contractor shall immediately notify the responsible official of the organization operating the interrupted utility. The contractor shall lend all possible assistance in restoring services and shall assume all cost, charges, or claims connected with the interruption and repair of such services.

(2) Deviations Occasioned by Structures or Utilities

Wherever obstructions are encountered during the progress of the work and interfere to such an extent that an alteration in the location shown on the Drawings is required, the City with the concurrence of the engineer of record shall have the authority to order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation or reconstruction of the obstructions. Where gas, water, telephone, electrical, hot water, steam or other existing utilities are an impediment to the vertical or horizontal alignment of the proposed pipe line, the City shall order a change in grade or alignment or shall direct the contractor to arrange with the owners of the utilities for their removal. If a change in line or grade of a gravity sewer is necessary, the City will require the addition of any necessary manholes required to maintain the integrity of the sewer system.

(3) Test Pits

Test pits for the purpose of locating underground pipeline, utilities, or structures in advance of the construction shall be excavated and backfilled by the contractor. Test pits shall be backfilled immediately after their purpose has been satisfied and maintained in a manner satisfactory to the City. The costs for such test pits shall be borne by the contractor.

c. Maintenance of Traffic and Closing of Streets

The contractor shall carry on the work in a manner which will cause a minimum of interruption to traffic. Where traffic must cross open trenches at street intersections and driveways, the contractor shall provide suitable bridges. The contractor shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to the closing of any street the contractor shall notify and obtain the approval of responsible authorities and the City.

Unless permission to close a street is received in writing from the proper authority (City, County, FDOT, etc.), all excavated material shall be placed so that vehicular and pedestrian traffic may be safely maintained at all times. If the Contractor's operations cause traffic hazards, the contractor shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety that are satisfactory to the City.

Detours around construction will be subject to the approval of the authority having jurisdiction and the City. Where detours are permitted, the contractor shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured the contractor shall expedite construction operations. Periods when traffic is being detoured will be strictly controlled by the City.

It shall be the sole responsibility of the contractor to take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. The contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

d. Protection of Public and Private Property

(1) Barricades, Guards and Safety Provisions

The contractor shall be solely responsible for adhering to the rules and regulations of Occupational Safety and Health Administration (OSHA) and appropriate authorities regarding safety provisions. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, lights and guards as required shall be placed and maintained by the contractor at his expense during the progress of the work and until it is safe for traffic to use the roads and streets. All material piles, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor.

All signage and barricades shall be in accordance with the Manual on Uniform Traffic Control Devices and the Traffic Control and Safe Practices Manual.

(2) <u>Protection of Utility Structures</u>

Temporary support, adequate protection and maintenance of all underground and surface utility structures including drains, sewers, manholes, hydrants, valves, valve covers, power poles and miscellaneous other utility structures encountered in the progress of the work shall be furnished by the contractor at his expense. Any such structures which may have been disturbed shall be restored upon completion of the Work.

(3) <u>Open Excavation</u>

All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. The contractor shall, at his own expense, provide suitable and safe bridges with hand railings and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required. The length of open trench will be controlled by the particular surrounding conditions, but shall be limited to 300 feet unless otherwise specifically approved by the City. If the excavation becomes a hazard, or if it excessively restricts the flow of traffic at any point, the City may require special construction procedures such as limiting the length of open trench, fencing, prohibiting excavated material in the street and requiring that the trench shall not remain open overnight. The contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment or other obstacles which could be dangerous to the public shall be well lighted at night.

(4) Protection of Trees and Shrubs

All trees and shrubs not shown to be removed on the Drawings shall be protected by the contractor at his own expense. No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the contractor or his employees shall be replaced by him with new stock of similar size and age at the sole expense of the contractor.

(5) Protection of Lawn Areas

Lawn areas shall be left in as good or better condition as before starting of the Work. Where sod is to be removed it shall be carefully restored with new sod of the same type.

(6) Restoration of Fences

Any fence, or part thereof, that is damaged or removed during the course of the Work shall be replaced or repaired by the contractor and shall be left in as good a condition as before the starting of the Work. The manner in which the fence is repaired or replaced and the materials used shall be subject to the approval of the City.

(7) Protection Against Siltation and Bank Erosion

The contractor shall arrange his operations to minimize siltation and bank erosion on construction sites and on existing or proposed water courses and drainage ditches. The Contractor, at his own expense, shall remove any siltation deposits and restore to original grade.

e. Access to the Public Services

Neither the materials excavated nor the materials or equipment used in the construction of the Work shall be so placed as to prevent free access to public services. All excavated material shall be piled in a manner that will not endanger the Work and that will avoid obstructing streets, sidewalks and driveways. Excavated material suitable for backfilling shall be stockpiled separately on the site. No material shall be placed closer than 2'0" from the edge of an excavation. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, or other utility controls shall be left unobstructed and accessible until the Work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage. Natural water courses shall not be obstructed or polluted. Surplus material and excavated material unsuitable for backfilling shall be transported and disposed of off the site in disposal areas obtained by the contractor.

f. Public Nuisance

The contractor shall not create a public nuisance including but not limited to encroachment on adjacent lands, flooding of adjacent lands, or excessive noise or dust. The contractor shall eliminate noise to as great an extent as practicable at all times.

g. Construction Hours

No Work shall be done between the hours of 7:00 p.m. and 7:00 a.m., or on Saturdays, Sundays and City holidays unless the proper and efficient prosecution of the Work requires operations during the night or weekend. Written notification for proceeding with the Work, during on-working hours, shall be provided to the City a minimum 24 hours before starting such items of the Work.

h. Construction in Easements And Rights-of-way

(1) Construction in Easements

In easements across private property, the contractor shall confine all operations to areas within the easement and shall be responsible and liable for all damage occurring outside of the easement area. Trees, fences, shrubbery or other type of surface improvements located in easements will require protection during construction. Precautions shall be taken by adequate sheeting or other approved method to prevent any cave-in or subsidence beyond the easement limits or damage to existing improvements within the easement. In general, the easement area is intended to provide reasonable access and working area for efficient operation by the contractor. Where easement space for efficient operation is not provided, the contractor shall be responsible for organizing the necessary operations to perform within the restrictions shown on the Drawings.

(2) Construction in Florida Department of Transportation Right-of-way

The contractor shall strictly adhere to the requirements of the Florida Department of Transportation where construction work is in a right-of-way under the jurisdiction of the State of Florida, and shall take care to avoid any unreasonable traffic conflicts due to the Work in road right-of-way.

(3) Construction in Lake County Right-of-way

The contractor shall strictly adhere to the requirements of Lake County where construction work is in right-of-way under the jurisdiction of Lake County, and shall take care to avoid any unreasonable traffic conflicts due to the work in road right-of-way.

(4) Construction in City Right-of-way

Work shall be governed by the requirements in the City of Umatilla Land Development Regulations, Utilities, Pavement Cuts and Right-of-Way Construction.

i. Suspension of Work Due to Weather

During inclement weather, all Work which might be damaged or rendered inferior by such weather conditions shall be suspended. During suspension of the Work from weather or any other cause, the Work shall be suitably covered and protected so as to preserve it from injury.

j. Use of Chemicals

All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of any other classification, must show approval of either United States Environmental Protection Agency or United States Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict conformance with label instructions.

k. Cooperation with Other Contractors and Forces

During construction progress, it may be necessary for other contractors and persons employed by the City to work in or about the site. The City reserves the right to allow such other contractors to work and to afford such access to the construction site and at such times as the City deems proper. The contractor shall not impede or interfere with the work of such other contractors and shall cooperate with the other contractors for proper prosecution of the work.

l. Subsurface Exploration

The contractor shall make such subsurface explorations as he believes necessary to perform the Work.

m. Cleaning

(1) During Construction

During construction the contractor shall, at all times, keep the construction site and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the City, such material, debris, or rubbish constitutes a nuisance or is objectionable.

(2) Final Cleaning

At the conclusion of the Work, all tools, temporary structures and materials belonging to the contractor shall be promptly taken away. The contractor shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances.

n. Salvage

Any existing City owned equipment or material including but not limited to valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction may be designated as "salvage" by the City, and if so, shall be carefully excavated or removed and delivered to the City at a specified location within the City.

o. Shop Drawings and Samples

If requested by the City, prior to commencing construction the contractor shall submit seven (7) copies of all required shop drawings, signed by the Developer's Engineer, to the City. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable review of the information as required.

The contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for analysis and review for any of the materials specified hereafter in this Appendix.

2. SITE, PREPARATION, SURFACE REMOVAL AND RESTORATION

a. General

This Section covers clearing, grubbing, and stripping of the construction sites. The contractor shall clear and grub all of the area within the limits of construction as shown on the Drawings and approved by the City prior to beginning any work. All site work shall conform to the requirements of in the City of Umatilla Land Development Regulations, Landscape Standards and Tree Preservation in the City Land Development Regulations, Utilities, Pavement Cuts and Right-Of-Way Construction.

b. Clearing and Grubbing

(1) Clearing

The surface of the ground for the area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish and all other objectionable obstructions resting on or protruding through the surface of the ground. However, trees and shrubs shall be preserved as specified in Appendix A, paragraph 1.d.(4). Clearing operations shall be conducted so as to prevent damage to existing structures and installations and to those under construction, and so as to provide for the safety of employees and others.

(2) Grubbing

Grubbing shall consist of the complete removal of all stumps, roots larger than 1-1/2" in diameter, matted roots, brush, timber, logs and any other organic or metallic debris not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of 24 " below the subgrade. All depressions excavated below the original ground surface for or by the removal of such objects shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

(3) Stripping

In areas so designated, top soil shall be stripped and stockpiled. Topsoil so stockpiled shall be protected until it is placed as specified. Any topsoil remaining after all work is in place shall be disposed of by the contractor.

(4) Disposal of Cleared and Grubbed Material

The contractor shall at his expense dispose of all material and debris from the clearing and grubbing operation in accordance with all applicable ordinances or codes.

c. Dust Control

Contractor shall control dust resulting from clearing and grubbing operations to prevent nuisance to adjacent property owners and the general public. Contractor shall use dust control methods and materials approved by the City.

d. Surface Removal

Along the proposed pipe lines as indicated on the Drawings, the contractor shall remove the surface materials only to such widths as will permit a trench to be excavated which will afford sufficient room for proper efficiency and proper construction. All applicable City, County and FDOT regulations shall be followed. Where sidewalks, driveways, pavements and curb and gutter are encountered, care shall be taken to protect against fracture or disturbance beyond reasonable working limits. All fractured, broken or disturbed surfaces shall be restored to their original condition prior to completion of the Work.

e. Restoration

Restoration of all surfaces including road subbase, soil cement, limerock base, asphaltic concrete surface, portland cement concrete pavement and driveways, sidewalks and concrete curbs shall be in strict accordance with Road Construction Specifications. All grassing and mulching shall be done as specified in the Road Construction Specifications. Solid sodding shall be placed on all slopes greater than 4:1, within 10 feet of all proposed structures and where existing sod is removed or disturbed during progress of the work. In addition, contractor shall restore all storm drains, culverts, inlets and storm manholes to equal or better condition in accordance with the Road Construction Specifications.

3. EXCAVATION, BACKFILL, COMPACTION AND GRADING

a. General

This section covers excavation, backfill, fill and grading associated with utility trench and structural construction. All such work shall be performed by the contractor concurrently with the work specified herein. The contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfill, fill, compaction, grading and slope protection required to complete the work shown on the drawings and specified herein. The work shall include, but not necessarily be limited to: pump stations, manholes, vaults, conduit, pipe, roadways and paving; all backfilling, fill and required borrow; grading; disposal of surplus and unsuitable materials; and all related work such as sheeting, bracing and water handling.

b. Soil Borings and Subsurface Investigations

The contractor shall carefully examine the site and undertake whatever subsurface investigations, including soil borings, if necessary, before commencing the work. The City will not be responsible for presumed or existing subsurface conditions in the work area.

c. Existing Utilities

Contractor shall locate existing utilities in the areas of work. If utilities are to remain in place, the contractor shall provide adequate means of protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, the contractor shall consult the owner of such piping or utility immediately for directions. Payment for damage and repair to such piping or utilities is the Contractor's responsibility. Refer to Appendix A, paragraph l.b. for utility coordination requirements.

The City shall not be responsible for uncharted or incorrectly charted water and wastewater mains or other utilities. It is the contractor's responsibility to ensure that such facilities exist at the presumed point prior to commencing construction.

d. Materials

All materials used in the backfill and/or grading of utility trenches or structures shall conform to the classification as identified in the Unified Soils Classification System (ASTM D2487-11).

(1) General

Materials for use as bedding and backfill, whether in-situ or borrow, shall be as described under this section. The contractor shall upon request by the City, make an appropriate sample of this material available for testing by the City or its designated representative.

(2) Structural Fill

Materials for structural fill shall be bedding rock or select common fill as specified herein or other suitable material as approved by the City.

(3) Common Fill

Common fill shall consist of mineral soil, substantially free of clay, organic material, loam, wood, trash and other objectionable material which may be compressible or which cannot be compacted properly. Common fill shall not contain stones larger than 6" in any dimension, asphalt, broken concrete, masonry, rubble, or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling. Additionally common fill shall be no more than 12% by weight finer than the No. 200 mesh sieve unless finer material is approved for use in a specific location by the City.Material falling within the above specifications, encountered during the excavation may be stored in segregated stockpiles for reuse. All material which, in the opinion of the City, is not suitable for reuse, shall be spoiled as specified herein for disposal of unsuitable materials.

(4) Select Common Fill

Select common fill shall be as specified above from common fill, except that the material shall contain no stones larger then 1-1/2" in largest dimension, and shall be no more than 5% by weight finer than the No. 200 mesh sieve.

(5) Bedding Rock

Bedding rock shall be 3/16" to 3/4" washed and graded stone (FDOT #67). This stone shall be graded so that 90 to 100% percent will pass a 3/4" screen and 95 to 100% will be retained on a No. 8 screen. No stones larger then 1" in any dimension shall be accepted.

e. Sheeting and Bracing in Excavations

(1) General

If required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction and to protect adjacent structures, existing piping and/or foundation material from disturbance, undermining or other damage, the contractor shall construct, brace and maintain cofferdams consisting of sheeting and bracing. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

(2) Miscellaneous Requirements

For trench sheeting for pipes, no sheeting is to be withdrawn if driven below mid-diameter of any pipe and no wood sheeting shall be cut off at a level lower than one foot above the top of any pipe unless otherwise directed by the City. If during the progress of the Work, the City decides that additional wood sheeting should be left in place, it may direct the contractor to do so. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given by the City for an alternate method of removal. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction of other structures, utilities, existing piping or property. Unless otherwise approved or indicated on the Drawings or in the Specifications, all sheeting and bracing shall be removed after completion of the substructure. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools specially adapted to that purpose, by watering or otherwise compacting as may be directed.

The right of the City to order sheeting and bracing left in place shall not be construed as creating any obligation on its part to issue such orders and its failure to exercise its right to do so shall not relieve the contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

The contractor shall construct the cofferdams and sheeting outside the neat lines of the foundation unless indicated otherwise or to the extent he deems it desirable for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting, bracing and cofferdams shall be adequate to withstand all pressures to which the structure will be subjected. Pumping, bracing and other work within the cofferdam shall be done in a manner to avoid disturbing any construction already performed. Any movement or bulging which may occur shall be corrected by the contractor at his own expense so as to provide the necessary clearances and dimensions.

f. Dewatering, Drainage and Flotation

(1) General

The contractor shall excavate, construct and place all pipelines, concrete work, fill, and bedding rock, in-the-dry. In addition, the contractor shall not make the final 24" of excavation until the water level is a minimum of 1" foot below proposed bottom of excavation. For purposes of these specifications, "in-the-dry" is defined to be within 2% of the optimum moisture content of the soil. The City reserves the right to ask the contractor to demonstrate that the water level is a minimum of one foot below proposed bottom of excavation before allowing the construction to proceed.

Water discharged from the dewatering operations shall be clear, with no visible soil particles. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with the normal drainage of the area in which the Work is being performed, create a public nuisance, or form ponding. The operations shall not cause injury to any portion of the Work completed, or in progress, or to the surface of streets, or to private property. The dewatering operation shall comply with the requirements of appropriate regulatory agencies. Additionally, where private property will be involved, advance permission shall be obtained by the contractor.

(2) Additional Requirements

The contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

It is expected that in some cases, well points will be required for dewatering of the soils prior to final excavation for some of the deeper in-ground structures, or piping and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged. Well points shall be surrounded by suitable filter sand and negligible fines shall be removed by pumping.

The contractor shall furnish all materials and equipment and perform all work required to install and maintain the drainage systems for handling groundwater and surface water encountered during construction of structures, pipelines and compacted fills.

During backfilling and construction, water levels shall be measured in observation wells located as directed by the City.

Continuous pumping will be required as long as water levels are required to be below natural levels.

g. Excavation

(1) <u>General</u>

Excavation consists of removal, storage and disposal of material encountered when establishing required grade elevations and in accordance with the notes shown on the Drawings.

Authorized earth excavation includes removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation. Unauthorized excavation consists of removal of material beyond the limits needed to establish required grade and subgrade elevations without specific direction of the City. Unauthorized excavation, as well as remedial work directed by the City shall be at the Contractor's expense. Such remedial work shall be performed as directed by the City.

If requested by the City, when excavation has reached required subgrade elevations, a Geotechnical/Soils Engineer shall make an inspection of conditions. If the subgrade is unsuitable, contractor shall carry excavation deeper and replace excavated material with select common fill or bedding rock, as directed by the City.

If the contractor excavates below, grade through error or for his own convenience or through failure to properly dewater the excavation or disturbs the subgrade before dewatering is sufficiently complete, the contractor may be directed by the City to excavate below grade and refill the excavation using select common fill or bedding rock.

Slope sides of excavations shall comply with local codes and ordinances, and with OSHA requirements. Contractor shall shore and brace where sloping is not possible due to space restrictions or stability of the material excavated. Sides and slopes shall be maintained in a safe condition until completion of backfilling.

Contractor shall stockpile satisfactory excavated materials at a location approved by the City until required for backfill or fill. When needed in the Work, material shall be located and graded at the direction of a Geotechnical/Soils Engineer.

Stockpiles shall be placed and graded for proper drainage. All soil materials shall be located away from the edge of excavations. All surplus and/or unsuitable excavated material shall be legally disposed of by the contractor. Any permits required for the hauling and disposing of this material shall be obtained by the contractor prior to commencing hauling operations.

(2) Excavation for Structures

All such excavations shall conform to the elevations and dimensions shown on drawing within a tolerance of plus or minus 0.10' and extending a sufficient distance, as shown on the Drawings, from footings and foundations to permit placing and removing form work, installation of services and other construction or inspection. In excavating for footings and foundations, care shall be exercised not to disturb the bottom of the excavation. Bottoms shall be trimmed to required lines and grades to leave a solid base to receive concrete.

(3) Trench Excavation

Excavation for all trenches required for the installation of utility pipes shall be made to the depths indicated on the Drawings and in such manner and to such widths as will give suitable room for laying the pipe within the trenches, for bracing and supporting and for pumping and drainage facilities.

The bottom of the excavations shall be firm and dry and in all respects acceptable to the City.

Excavation shall not exceed normal trench width as specified in the standard drawings. Any excavation which exceeds the normal trench width, shall require special backfill requirements as determined by the City.

Where pipes are to be laid in bedding rock, select common fill or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

Where the pipes are to be laid directly on the trench bottom, the lower part of the trenches shall not be excavated to grade by machinery. The last of the material being excavated shall be done manually in such a manner that will give a shaped bottom, true to grade, so that pipe can be evenly supported on undisturbed material, as specified in the Standard Drawings. Bell holes shall be made as required.

h. Bedding and Backfill

(1) General

Material placed in fill areas under and around structures and pipelines shall be deposited within the lines and to the grades shown on the drawings or as directed by the City, making due allowance for settlement of the material. Fill shall be placed only on properly prepared surfaces which have been inspected and approved by the City. If sufficient select common or common fill material is not available from excavation on site, the contractor shall provide fill as may be required.

Fill shall be brought up in substantially level lifts starting in the deepest portion of the fill. The entire surface of the Work shall be maintained free from ruts and in such condition that construction equipment can readily travel over any section.

Fill shall be placed and spread in layers by a backhoe or other approved method, unless otherwise specified. Prior to the process of placing and spreading, all materials not meeting those specified under Appendix A, paragraph 3.d. shall be removed from the fill areas. The contractor shall assign a sufficient number of employees to this Work to insure satisfactory compliance with these requirements.

If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layer, it shall be loosened by harrowing or by another approved method before the succeeding layer is placed.

All fill materials shall be placed and compacted "in-the-dry". The contractor shall dewater excavated areas as required to perform the work and in such manner as to preserve the undisturbed state of the natural inorganic soils.

Prior to filling, the ground surface shall be prepared by removing vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials. Contractor shall plow strip or break up sloped surfaces steeper than one vertical to four horizontal so that fill material will bond with the existing surface. When existing ground surface has a density less than that specified under Appendix A, paragraph 3.i. for the particular area classification, contractor shall break up the ground surface, pulverize, moisture-condition to the optimum moisture content and compact to required depth and percentage of maximum density.

Before compaction, material shall be moistened or aerated as necessary to provide the optimum moisture content. Material which is too wet shall be spread on the fill area and permitted to dry, assisted by harrowing if necessary, until the moisture content is reduced to allowable limits. If added moisture is required, water shall be applied by sprinkler tanks or other sprinkler systems, which will insure uniform distribution of the water over the area to be treated and give complete and accurate control of the amount of water to be used. If too much water is added, the area shall be permitted to dry before compaction is continued. The contractor shall supply all hose, piping, valves, sprinklers, pumps, sprinkler tanks, hauling equipment and all other materials and equipment necessary to place water in the fill in the manner specified. Contractor shall compact each layer to required percentage of maximum dry density or relative dry density in accordance with Appendix A, paragraph 3.i. Backfill or fill material shall not be placed on surfaces that are muddy, frozen or contain frost or ice.

(2) <u>Bedding and Backfill for Structures</u>

Bedding rock shall be used for bedding under all structures as indicated on the standard drawings. The contractor shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed. Structural fill shall be used as backfill against the exterior walls of the structures. Fill shall be compacted sufficiently in accordance with Appendix A, paragraph 3.i.(2) of these specifications. If compaction is by rolling or ramming, material shall be wet down as required.

Backfilling shall be carried up evenly on all walls of an individual structure. No backfill shall be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength.

In locations where pipes pass through building walls, the contractor shall take precautions to consolidate the fill up to an elevation of at least 1' above the bottom of the pipes. Structural fill in such areas shall be placed for a distance of not less than 3' either side of the center line of the pipe in level layers not exceeding 8" in depth.

The surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the drawings. No soft spots or uncompacted areas will be allowed in the work.

Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against all construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.

(3) Bedding and Backfill for Pipes

Bedding for pipe shall be as shown on the drawings and detailed on the Standard Drawings. The contractor shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed.

Backfilling over and around pipes shall begin as soon as practicable after the pipe has been laid, jointed and inspected. All backfilling shall be prosecuted expeditiously and as detailed on the Standard Drawings.

Any space remaining between the pipe and sides of the trench shall be carefully backfilled and spread by hand or approved mechanical device and thoroughly compacted with a tamper as fast as placed, up to a level of 1' above the top of the pipe. The filling shall be carried up evenly on both sides. Compaction shall be in accordance with the Standard Drawings and Appendix A, paragraph 3.i.

The remainder of the trench above the compacted backfill, as just described above, shall be filled and thoroughly compacted in uniform layers. Compaction shall be in accordance with the Standard Drawings and Appendix A, paragraph 3.i.

i. Compaction

(1) General

The contractor shall control soil compaction during construction to provide the percentage of maximum density specified. The contractor shall provide the City copies of all soils testing reports, prepared by a Geotechnical/Soil Engineer, demonstrating compliance with these specifications.

When existing trench bottom has a density less than that specified under Appendix A, paragraph 3.i.(2) the contractor shall break up the trench bottom surface, pulverize, moisture-condition to the optimum moisture content and compact to required depth and percentage of maximum density.

(2) Percentage of Maximum Density Requirements

Fill or undisturbed soil from the bottom of the pipe trench to 1' above the pipe shall be compacted to a minimum density of 98% of the maximum dry compacted as determined by AASHTO T-180.

Backfill from 1' above utility pipes to grade shall be compacted to a minimum density of 95% of the maximum dry density as determined by AASHTO T-180.

Fill under and around structures, and to the extent of the excavation shall be densified to a minimum density of 95% of the maximum dry density as determined by AASHTO T-180.

(3) Compaction Tests

One compaction test location shall be required for each 300 linear feet of pipe and for every 100 square feet of backfill around structures as a minimum. The City may determine that more compaction tests are required to certify the installation depending on field conditions. The locations of compaction tests within the trench shall be in conformance with the following schedule:

a. One test at the spring line of the pipe.

b. At least one test for each 12" layer of backfill within the pipe bedding zone for pipes 24" and larger.

c. One test at an elevation of one foot above the top of the pipe.

d. One test for each 2' of backfill placed from 1' above the top of the pipe to finished grade elevation.

If based on Geotechnical/Soils Engineer testing reports and inspection, fill which has been placed is below specified density, contractor shall provide additional compaction and testing prior to commencing further construction.

j. Grading

All areas within the limits of construction, including transition areas, shall be uniformly graded to produce a smooth uniform surface. Areas adjacent to structures or paved surfaces shall be graded to drain away from structures and pavement. Ponding shall be prevented. After grading, the area shall be compacted to the specified depth and percentage of maximum density.

No grading shall be done in areas where there are existing pipelines that may be uncovered or damaged until such lines have been relocated.

k. Maintenance

Contractor shall protect newly graded areas from traffic and erosion and keep them free of trash and debris. Contractor shall repair and reestablish grades in settled, eroded and rutted areas.

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, contractor shall scarify surface, and reshape and compact to required density prior to further construction.

l. Inspection and Quality Assurance

(1) Inspection

Contractor shall examine the areas and conditions under which excavating, filling and grading are to be performed, and not proceed with the work until unsatisfactory conditions have been corrected.

Contractor shall examine existing grade prior to commencement of work and report to the City if elevations of existing grade vary from elevations shown on drawings.

(2) Quality Assurance

All work shall be performed in compliance with applicable requirements of governing authorities having jurisdiction.

The contractor, at his own expense, shall engage soil testing and inspection services for quality control testing during earthwork operations. The testing and inspection service shall be subject to the approval of the City.

Quality control testing shall be performed during construction to ensure compliance with these Specifications. Contractor shall allow the testing service to inspect and approve fill materials and fill layers before further construction is performed. The contractor shall give copies of all test results in a report form to the City to demonstrate compliance with compaction requirements stipulated in this Manual.

4. BORING AND JACKING

a. General

Jack and bore shall be required under all state, county and city roads inside the city. Horizontal directional bores may be considered with approval from the city engineer and the city utilities department. (Refer to Section 5 below)

The installation of a casing pipe by the method of boring and jacking is covered herein. The overall work scope shall include, but not be limited to, boring and jacking pits and equipment, sheeting, steel casing pipe, skid, stainless steel straps, coatings, location signs as required, miscellaneous appurtenances to complete the entire work as shown on the Standard Drawings, and restoration. Applicable provisions of these specifications shall apply. Boring and jacking operations shall be performed within the right-of-way and/or easements shown on the drawings.

b. Pipe Material

(1) Steel Casing

Steel casings shall conform to the requirements of ASTM Designation A139 (straight seam pipe only) Grade "B" with a minimum yield strength of 35,000 psi. The casing pipes shall have the minimum nominal diameter and wall thickness as shown on the following table:

Carrier Pipe Nominal Diameter	Casing Outside Diameter	Casing Wall Thickness
4"	16"	0.250"
6"	18"	0.250"
8"	20"	0.250"
10"	24"	0.250"
12"	30"	0.312"
16"	30"	0.312"
20"	36"	0.375"
24"	42"	0.500"
30"	48"	0.500"
36"	54"	0.500"
42"	60"	0.500"

Field and shop welds of the casing pipes shall conform with the American Welding Society (AWS) standard specifications. Field welds shall be complete penetration, single-bevel groove type joints. Welds shall be airtight and continuous over the entire circumference of the pipe and shall not increase the outside pipe diameter by more than 3/4".

(2) Carrier Pipe

The carrier pipe shall be minimum class 250 or 350 ductile iron pipe with restrained joints depending on size of pipe. Refer to following sections. Ductile iron pipe shall comply with the specification outlined in Appendices B, paragraph 1.b.(2), B, paragraph 6.d.(1) and C, paragraph 1.d.(1).

(3) Inspection

All casing pipe to be installed may be subject to be inspected at the site of manufacture for compliance with these Specifications by an independent laboratory selected and paid for by the City. The manufacturer's cooperation shall be required in these inspections.

All casing pipe shall be subjected to a careful inspection prior to being installed. If the pipe fails to meet the specifications it shall be removed and replaced with a satisfactory replacement at no additional expense to the City.

c. Pipe Handling

Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe shall not be dropped. All pipe shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe or coatings shall be repaired to the satisfaction of the City.

d. Construction Requirements

(1) Work Coordination

It shall be the contractor's responsibility to perform the boring and jacking work in strict conformance with the requirements of the agency in whose right of way or easement the work is being performed. Any special requirements of the agency such as insurance, flagmen, etc., shall be strictly adhered to during the performance of work. The special requirements shall be performed by the contractor at no additional cost to the city.

(2) Dewatering

Dewatering through the casing during construction shall not be permitted. All dewatering methods shall be approved by the city before construction work begins.

(3) Carrier Pipe Support

The carrier pipes shall be supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes shall be distributed along the casing by wooden skids or casing spacers. The wooden skids shall be constructed as shown on the Details of Standard Drawings. Casing spacers shall be bolt on style split shells made of either T-304 stainless steel or fusion coated steel (a minimum 0.010" thick coating of PVC shall be provided over the entire band). The shell shall be lined with a PVC liner 0.090" thick with 85-90 Durometer. All nuts and bolts shall be high strength, low alloy meeting AWWA Clll. Runners shall be made of a high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction.

(4) Jacking Pits

Excavation adjacent to the roads shall be performed in a manner to adequately support the roads. Bracing, shoring, sheeting or other supports shall be installed as needed. Contractor shall install suitable reaction blocks for the jacks as required. Jacking operations shall be continuous and precautions shall be taken to avoid interruptions which might cause the casing to "freeze" in place. Upon completion of jacking operations, the reaction blocks, braces, and all other associated construction materials shall be completely removed from the site.

(5) Miscellaneous Requirements

Correct line and grade shall be carefully maintained. Earth within the casing shall not be removed too close to the cutting edge in order to prevent the formation of voids outside the casing. If voids are formed, they shall be satisfactorily filled with grout by pumping.

The sections of steel casing shall be field welded in accordance with the applicable portions of AWWA C206 and AWS D7.0 for field welded pipe joints. Contractor shall wire brush the welded joints and paint with Inertol Quick-Drying Primer 626 by Koppers Company or approved equal. After completion of jacking, contractor shall clean the interior of the casing of all excess material.

The annular space between the carrier pipe and casing shall be filled with clean sand, if required in the Bore and Jack permit. Masonry plugs are to be installed at each open end of the casing. Plugs shall be suitable for restraining the earth load while allowing drainage of the casing.

5. HORIZONTAL DIRECTIONAL BORES (DIRECTIONAL DRILL)

a. General

Horizontal Directional Bores (directional drilling) may be permitted under all state, county, and city roads with approval of the City Engineering Department.

Furnish all labor, materials, tools, and equipment required to install a new water main using the horizontal directional drilling method to the sizes and limits as shown on the drawings, and as specified by these technical specifications herein. Work includes, but not limited to, proper installation, testing, restoration of underground utilities and environmental protection and restoration.

The directional drilling method involves first drilling a pilot hole as shown on the approved pilot bore plan, and then enlarging the pilot hole no larger than 1.5 times the outer diameter of the pull-in pipe, pipe joint coupling and pull back the pipe through the enlarged hole.

b. Pipe Materials

Unless otherwise specified in the plans and/or specifications, one of the following pipes can be considered for horizontal directional drilling contingent upon approval by the Owner:

- Fusible Polyvinylchloride (PVC) Water Pipe as manufactured by Underground Solutions, Inc.
- Restrained Joint Polyvinylchloride (PVC) Water Pipe as manufactured by CertainTeed Corporation

The pipe to be used must be certified for use as a pressure-rated water delivery system and fire protection piping applications conforming to all standards and procedures, and meeting all testing and material properties as described in applicable pipe specifications.

c. Qualification Requirements

All horizontal directional drilling operations shall be performed by a qualified directional drilling company who has at least three (3) years experience involving work of a similar nature. The company must have installed a minimum of 25,000 linear feet of pipe (6-inch diameter or greater) using directional drilling operations or supply a list of project references, prior to job commencement.

- Schedule all work through the City. Notify the City a minimum of ten (10) working days in advance of the start of work.
- Perform all work in the presence of the City, or their representative.
- All applicable permits and applications must be in place prior to start of work.

d. <u>Warranty</u>

A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.

In addition to the standard pipe warranty, the fusing contractor shall provide in writing a warranty for a period of one year for all the fusion joints, including formation, installation, and pressure testing, if applicable.

Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

e. <u>Submittals</u>

The Contractor shall make the following submittals:

(1) <u>Contractor's Experience Record</u>:
Furnish document(s) supporting the directional drilling Contractor's qualifications and experience.

(2) <u>Material</u>:

Submit all applicable pre and post-construction pipe submittals as per applicable technical specifications of the pipe to be used for this project.

(3) <u>Work Plan:</u>

Prior to beginning work, submit a Work Plan detailing the procedure and schedule to be used to execute the project. The Work Plan is to include a description of all equipment to be used, down-hole tools, a list of personnel and their qualification and experience (including backup personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), an environmental protection plan, and contingency plans for possible problems. Work Plan should be comprehensive, realistic and based on actual working conditions for this particular project. The plan should document the thoughtful planning required to successfully complete the project.

(4) Bore Plan:

Prior to beginning work, submit a signed and sealed, scaled drawing of the pilot bore plan for review and approval (Max Vertical Scale 1" = 2' and Max Horizontal Scale 1" = 20'). Show finished grade, deflection and radiuses of the pilot bore, all existing utilities with minimum vertical and horizontal clearances. Address the location of the drill rig setups and for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc. The proposed vertical and horizontal clearances between the bored pipe and any existing/proposed conflicting pipes, conduits or obstructions can not exceed the guidance system accuracy tolerance by a minim of 100%.

(5) Equipment:

Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment is to include but not be limited to: drilling rig, mud system, mud motors (if applicable), down-hole tools, guidance system, and rig safety systems. Include calibration records for guidance equipment. Submit any qualifications for any drilling fluid additives that might be used.

f. Horizontal Directional Drilling Equipment

The Contractor shall provide directional drill equipment as follows:

(1) General:

The directional drilling equipment is to consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling, fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a Magnetic Guidance System (MGS) or "walkover" system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment must be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

(2) Drilling Rig:

The drilling shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. Anchor machine to the ground sufficiently to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system must be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system must be free of leaks. The rig is to have a system to monitor and record maximum pullback pressure during pull-back operations. A system to detect electrical current from the drill string must be in place with an audible alarm that automatically sound when an electrical current is detected.

(3) Drill Head:

The drill head shall be steerable by changing its rotation with the necessary cutting surfaces and drilling fluid jets.

(4) Mud Motors (if required):

The mud motor shall have adequate power to turn the required drilling tools.

(5) Drill Pipe:

The drill pipe shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tools joints should be hardened to 32 – 36 RC.

g. Guidance System

(1) General:

Use an electronic “walkover” tracking system or a Magnetic Guidance System (MGS) probe or proven (non-experimental) gyrospopic probe and interface for a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance system must be capable of tracking at all depths up to fifty feet and in any soil condition, including hard rock. If should enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction) and inclination (vertical direction). The guidance system has to be accurate and calibrated to manufacturer’s specifications of the vertical depth of the borehole at sensing position at depths up to fifty feet and accurate to 2-feet horizontally.

(2) Components:

Supply all components and materials to install, operate, and maintain the guidance system.

(3) Operation:

Set up and operate the Magnetic Guidance System (MGS) with personnel trained and experienced with the system. Be aware of any geo-magnetic anomalies and consider such influences in the operation of the guidance system.

h. Drilling Fluid (Mud) System

(1) Mixing System:

A self-contained, closed, drilling fluid mixing system of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. The mixing system must be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank must be a minimum of 1,000 gallons. Agitate the drilling fluid during drilling operations

(2) Drilling Fluids:

Use drilling fluid composed of potable water and bentonite clay. Supply water from an authorized source with a pH of 8.5-10. Treat any water of a lower pH or with excessive calcium with the appropriate amount of sodium carbonate or equal. No additional material may be used in drilling fluid without prior approval from the Owner. The bentonite mixture used must have the minimum viscosities as measured by a March funnel:

Rocky Clay	60 seconds
Hard Clay	40 seconds
Soft Clay	45 seconds
Sandy Clay	90 seconds
Stable Sand	80 seconds
Loose Sand	110 seconds
Wet Sand	110 seconds

These viscosities may be varied to best fit the soil conditions encountered, or as determined by the operator. No additional fluid shall be used without prior approval from the Owner.

(3) Delivery System:

Fluid pumping system with a minimum capacity of 35-500 GPM and capable of delivering drilling fluid at a constant minimum pressure of 1200 psi. Employ filters on the delivery system in-line to prevent solids from being pumped into drill pipe. Contain all used drilling fluid and drilling fluid spilled during operations convey to the drilling fluid recycling system or remove by vacuum trucks or other methods acceptable to the Owner. Maintain a berm, minimum of 12-inches high, around drill rigs drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills into the surrounding environment. Furnish pumping equipment and/or vacuum truck(s) of sufficient size to convey drilling fluid from containment areas, to storage and recycling facilities or disposal.

i. Other Equipment:

(1) Pipe Rollers:

Use pipe rollers for pipe assembly during final product pull back.

(2) Restrictions:

Do not use other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections unless approved by the Owner prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated by the Owner without undue delay and maintain line and grade within the tolerances prescribed by the particular conditions of the project.

j. Execution

(1) General

Notify the City a minimum of ten (10) working days in advance of starting work. All necessary permits and approvals must be in place prior to commencement of work. Do not begin the directional drilling until the City is present at the job site and agrees that proper preparations for the operation have been made. The City's approval for beginning the installation does not in any way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.

All equipment used on the City's property and right-of-ways may be inspected by the City or their representatives and removed if considered unsatisfactory.

(2) Directional Drilling Operation

Provide all material, equipment, and facilities required for directional drilling. Maintain proper alignment and elevation of the borehole throughout the directional drilling operation. The method used to complete the directional drill must conform to the requirements of all applicable permits.

Survey the entire drill path with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, survey drill path for any surface geo-magnetic variations or anomalies. In addition, open cut, "pothole" or "daylight" areas along the proposed alignment at 200 foot intervals before and during the drilling operation to make sure proper alignment and grade are maintained. It may become necessary, if so determined by the City, to open excavate, "pothole" or "daylight" other areas to determine location of existing facilities and utilities. Costs of open cutting, "potholing" or "daylighting" for the purposes of determining proper alignment and grade are considered incidental to the base bid item for horizontal drill.

Stabilize the open bore hole by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drilling slurry must be in a homogenous/ flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. Calculate the volume of bentonite mud required for each pullback based on soil conditions, largest diameter of the pipe system component, capacity of the bentonite mud pump, and the speed of pullback as recommended by the bentonite drilling fluid manufacturer. Contain the bentonite slurry at the exit or entry side of the directional bore in pits or holding tanks. The slurry may be recycled at this time for reuse in the hole opening operation, or hauled off to an approved dumpsite for proper disposal.

Fuse or join all pipe sections together according to manufacturer's specifications as applicable. The pipe must be free of any chips, scratches, or scrapes. All piping shall be installed with a continuous, insulated TW, THW, THWN, or HMWPE insulated copper, 8 gauge or thicker wire for pipeline location purposes by means of an electronic line tracer:

- The wires must be installed along the entire length of the pipe.
- The insulation color shall match the color of the pipe being installed.
- Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

(3) <u>Handling Pipe</u>

Take care during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

Use ropes, fabrics or rubber protected slings and straps when handling pipes. Do not use chains, cables or hooks inserted into the pipe ends. Use two slings spread apart for lifting each length of pipe. Do not drop pipe or fittings into rocky or unprepared ground.

Store pipe on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Limit the stacking of the pipes to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions store the pipe on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

Place a silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection if required by documents, state, federal, and local regulations. Put in place any additional environmental protection necessary to contain any hydraulic or drilling fluid spills, including berms, liners, turbidity curtains, and other measures.

Record readings after advancement of each successive drill pipe (no more than 10'), and plot on a scaled drawing of 1" - 2' vertical and 1" - 20' horizontal. Make all recorded readings and plan and profile information available at all times. At no time can the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.

Submit a complete list of all drilling fluid additives and mixtures to be used in the directional operation, along with their respective Material Safety Data Sheets. Contain all drilling fluids and loose cuttings in pits or holding tanks for recycling or disposal, no fluids should he allowed to enter any unapproved areas or natural waterways. Dispose of all the drilling mud and cuttings after job completion at an approved dumpsite.

Drill the pilot hole on the bore path with no deviations greater than 5% of depth over the length of the bore unless previously agreed to by the City. In the event that pilot does deviate from the bore path more than 5% of depth over the length of the bore, the pilot must be pulled back and re-drilled from the location along bore path before the deviation. In the event of a drilling fluid fracture, inadvertent returns, or returns loss during pilot hole drilling operations, stop drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and wait another 30 minutes. If mud fracture or returns loss continues, notify the City.

Upon completion of pilot hole phase of the operation, submit a complete set of "as-built" records. Include in these records copies of the pilot bore path plan and profile record drawing, as well as directional survey reports as recorded during the drilling operation.

Upon approval of the pilot hole location, begin the hole opening or enlarging phase. Increase the bore hole diameter to accommodate the pullback operation of the required size of carrier pipe. The type of hole opener or back reamer to be utilized in this phase is to be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. Select the proper reamer type with the final hole opening being a maximum of 1.5 times the largest outside diameter pipe system component to be installed in the bore hole.

Handle assembled pipe in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Position slings for handling at pipe joints. Remove sections of the pipes with cuts and gouges or excessive formation and replace.

(4) Testing

Clean and flush all equipment and the surrounding site after completion. Use only potable water for flushing and pressure testing.

Test directional drilling pipe after pullback. The average pressure should be maintained at 150 psi for two hours. Arrange the test pump and water supply to allow accurate measurements of the water required to maintain the test pressure. Replace any material showing seepage or the slightest leakage as directed by the City at no additional expense to the Contract.

Observe and adhere to the pipe manufacturer's or City (whichever is more stringent) recommendations on pipe stretch allowances, bending radius, tensile strength, allowable test leakage allowance, and magnitude and duration of test pressure.

Test pipeline end to end.

Connect all new service lines and test along with the newly installed main.

Pressure testing the drilled pipe is not necessary if the pipe is intended to be used as a casing for a finished product pipe.

(5) Site Restoration

Following drilling operations de-mobilize equipment and restore the work site to the original conditions or better. Backfill and compact all excavations according to these specifications.

(6) Record Keeping

Maintain a daily project log of drilling operations and a guidance system log with a copy available to the City- at the completion of project.

Record the guidance system data during the actual crossing operation. Furnish "as-built" plan and profile drawings based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. Certify the guidance data to the capability of the guidance System.

6. PRESSURE PIPE RESTRAINT

a. General

Pressure pipe fittings and other items requiring restraint shall be braced with thrust blocks or other restraining assemblies as specified in this Section. Thrust blocks may only be used with specific approval of City Engineer and the Utility Department.

For PVC pipe, 12" and smaller, where thrust blocking is allowed to prevent movement of lines under pressure at bends, tees, caps, valves, hydrants etc., installation shall be by using thrust blocks as specified in Appendix A, paragraph 6.d.

All pressure pipe and fittings 16" and larger shall be restrained as specified in Appendices A, paragraph 6.b. and A, paragraph 6.c. Use of thrust blocks for pressure pipe and fittings 16" and larger shall not be allowed.

Ductile iron pressure pipe and fittings 12" and smaller may be restrained following the criteria established in Appendix A, paragraph 6.c.

b. <u>Restrained Joint Construction</u>

Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "Locked-type" joints manufactured by the pipe and fitting manufacturer and the joints shall be capable of holding against withdrawal for line pressures 50% above the normal working pressure. Mechanical joint ductile iron pipe retainer gland shall not be permitted. Any restrained joints that allow for elongation upon pressurization will not be allowed in those locations where the pipe comes out of the ground.

Restrained pipe joints that achieve restraint by incorporating cut out sections in the wall of the pipe shall have a minimum wall thickness at the point of cut out that corresponds with the minimum specified wall thickness for the rest of the pipe.

The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil.

The required lengths of restrained joint ductile iron pipe shall be determined by the Engineer and shown in a tabular form as depicted on the "Restrained Pipe Table" in the Standard Drawings. All calculations shall be based on the method outlined in the publication entitled "Thrust Restraint Design for Ductile Iron Pipe", latest edition, published by Ductile Iron Pipe Research Association, Birmingham, AL 35244.

Wherever two (2) 45º bends are used in place of a 90º bend and the minimum restrained joints required from one (1) 45º bend extend beyond the other 45º bend, the two (2) 45º bends will be considered as though a 90º bend were located midway between the two (2) 45º bends.

c. Mechanical Restraining Devices

(1) General

Manufacturers Mechanical Restraining Devices as specified herein may be substituted for the restrained "Locked-Type" joints manufactured by the ductile iron pipe and fitting manufacturer. The number of joints to be restrained shall be based on the "Restrained Pipe Table" in the Standard Drawings.

(2) Joint Restraint Device

Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 536. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/A21-53. Twist-off nuts shall be used to insure proper actuating of the restraining devices.

The mechanical joint restraint device shall have a working pressure of at least 250psi with a minimum safety factor of 2:1.

d. Thrust Block Construction

Restraining joints are preferable, however thrust blocks may be provided with specific approval of the City as shown on the drawings. Where undisturbed trench walls are not available for thrust blocking, the contractor shall furnish additional concrete or install suitable pipe harnesses or ties designed and manufactured specifically for this purpose. Additional concrete, harnesses, and/or ties shall be approved by the City Engineer.

Fittings shall be protected by polyethylene film, minimum 8 mil thick, prior to placing concrete thrust block.

Concrete for thrust blocking (where allowed) shall have a minimum compressive strength of 2500psi. Concrete shall be placed against undisturbed material, and shall not cover joints, bolts or nuts, or interfere with the removal of any joint. Wooden side forms shall be provided for thrust blocks where trench conditions require. Thrust blocks shall be properly set and adequately cured prior to pressurizing the system.

7. PRESSURE CONNECTION

a. General

Installations of pressure connections 4" and larger shall be made in accordance with this section.

b. Tapping Sleeves

(1) General

Tapping sleeves shall be mechanical joint sleeves or fabricated steel sleeves as specified below. All pressure connections to existing asbestos cement pipe and all "size on size" taps shall utilize mechanical joint sleeves.

(2) Mechanical Joint Sleeves

Sleeves shall be cast of gray-iron or ductile-iron and have an outlet flange with the dimensions of the Class 125 flanges shown in ANSI B16.1 properly recessed for tapping valve. Glands shall be gray-iron or ductile iron. Gaskets shall be vulcanized natural or synthetic rubber. Bolts and nuts shall comply with ANSI/AWWA C111/A21.11. Sleeves shall be capable of withstanding a 200psi working pressure.

(3) Steel Tapping Sleeves

Sleeves shall be fabricated of minimum 3/8" carbon steel meeting ASTM A285 Grade C. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150 lb. drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength, low alloy steel to AWWA C111 (ANSI A21.11). Gasket shall by vulcanized natural or synthetic rubber. Sleeve shall have manufacturer applied fusion bonded epoxy coating, minimum 12 mil thickness.

(4) Tapping Valves

Tapping valves shall meet the requirements of Appendix C, paragraph 3.b. except that units shall be flange by mechanical joint ends. Valves shall be compatible with tapping sleeves as specified above and specifically designed for pressure connection operations.

c. Notification and Connection to Existing Mains

All connections to existing mains shall be made by the contractor only after the connection procedure and his work scheduling has been reviewed and approved by the city. The contractor shall submit a written request to the city a minimum of five (5) working days prior to scheduling said connections. In his request he shall outline the following:

1. Points of connection, fittings to be used, and method of flushing and disinfection if applicable.

2. Estimated construction time for said connections.

The city shall review the submittal within three (3) working days after receiving it and inform the contractor regarding approval or denial of his request. If his request is rejected by the city, the contractor shall resubmit his request modifying it in a manner acceptable to the city.

All connections shall only be made on the agreed upon date and time. If the contractor does not initiate and complete the connection work in the agreed upon manner, he shall be required to reschedule the said connection by following the procedure outlined above.

The contractor shall not operate any valves in the system.

d. Installation

(1) Excavation, Backfill, Compaction and Grading

The applicable provisions of Appendix A, paragraph 3. shall apply.

(2) Construction Details

Sufficient length of main shall be exposed to allow for installation of the tapping sleeve and valve and the operation of the tapping machinery. The main shall be supported on concrete pedestals or bedding rock at sufficient intervals to properly carry its own weight, plus the weight of the tapping sleeve valve and machinery. Any damage to the main due to improper or insufficient supports shall be repaired at the Contractor's expense.

The inside of the tapping sleeve and valve, the outside of the main, and the tapping machine shall be cleaned and swabbed or sprayed with 10% liquid chlorine prior to beginning installation for water system pressure connections.

After the tapping sleeve has been mounted on the main, the tapping valve shall be bolted to the outlet flange, making a pressure tight connection. Prior to beginning the tapping operation, the sleeve and valve shall be pressure tested at 150psi to ensure that no leakage will occur.

For pressure connections through 12" diameter or less the minimum diameter cut shall be 1/2" less than the nominal diameter of the pipe to be attached. For 14" through 20" installations the minimum diameter shall be 1-1/2" less; for larger taps the allowable minimum diameter shall be 2" to 3" less than the nominal diameter of the pipe being attached. After the tapping procedure is complete the contractor shall submit the coupon to the city.

For pressure connections to wastewater force mains, the tapping valve shall be placed horizontally. After the tapping procedure is complete a plug valve shall be attached to the tapping valve. The tapping valve shall be left in the open position prior to backfilling.

Adequate poured concrete thrust blocks or restrained joint fittings shall be provided to prevent movement of the installation when test pressure is applied. Provisions of Appendix A, paragraph 5. shall apply.

8. GREASE TRAPS

b. Shape

Grease traps shall be rectangular in shape with inside length between two and three times the inside width, or shall be of a shape approved by the Florida Department of Health and Rehabilitative Services.

h. Material of Construction

Grease traps shall be constructed of pre-cast concrete with base and walls poured monolithically. All concrete used in the construction of grease traps shall have a strength of not less than 3,000psi at 28 days. Tests to determine water tightness will be required by the city, and shall be made by filling the tank with water to the overflow point at the time of inspection. Metal, block, brick, fiberglass or sectional tanks of any description shall not be permitted. The interior wall of the grease traps shall be finished smooth and impervious. Voids, pits, or protrusions on or in the inside walls of the grease trap are prohibited.

c. Wall Thickness

Pre-cast concrete grease traps shall have a minimum wall and bottom thickness of 4". Tops shall have a minimum thickness of 4" when installed in non-traffic areas and a minimum of 8" when installed in traffic areas. Pre-cast tanks shall be sufficiently reinforced to resist cracking during handling or installation with a minimum reinforcement of 6 x 6, ten-ten welded wire mesh or equivalent area. Pre-cast grease tanks shall not be located where vehicular traffic or other overburden loads are anticipated unless the design is approved by the City, and the registered engineer certifies that the tank and soil conditions will support the anticipated loads. Where support is provided without bearing on the tank, bearing shall be on the soil independent from the grease tank and reinforced as specified by the engineer.

d. Accessibility

Tanks shall be so located and installed as to provide ready accessibility to the tanks covers, and interior for ease in inspection, operation and maintenance of the tank.

e. Clean Outs

Clean outs shall be provided and installed in conformance with the City's specifications at both the inlet and outlet to the tank(s).

f. Rings & Covers

Access to the tank(s) for cleaning and inspection shall be provided via a minimum of two (2), 24" diameter ring and covers, located at each end (inlet and outlet) of the tank. The cover shall have the words GREASE TRAP cast into it.

g. Minimum Pipe Size

Minimum recommended inlet and outlet pipe size is 4".

h. Minimum Slope

Minimum slope for all tank inlet and outlet piping is 1/8" per foot.

i. Openings

All openings shall be sealed with a waterproof, non-shrinking grout, brushed smooth inside and outside.

j. Manhole Insert

Tanks located in areas of questionable drainage are required to have a waterproof type frame and cover, with a manhole insert.

k. Inspection

Pre-cast structures shall be inspected by the city prior to being set into the ground. Any visible reinforcement wire, steel, or honeycombing shall be cause for rejection.

APPENDIX B

GRAVITY SEWERS, FORCE MAINS, AND PUMP STATIONS

(10) Additional Requirements

(a) Wiring

(b) Terminal Points

(c) Engraved Nameplates

(d) Surge Protector

(e) Elapsed Time Meters.

(f) Convenience Receptacle

(g) Control Terminal Blocks

(h) Control Power Transformers

(I) Control Relay

(j) Electrical Schematic

(k) Phase Monitor

(11) Testing, Service and Warranty

(a) Testing

(b) Service

(c) Warranty

g. Piping, Valves and Accessories

(1) Piping

(2) Plug Valves

(3) Check Valves

(4) Pressure Gauges

h. Standby Power Generator System

(1) General

(2) Generator Set

(a) General

(b) Requirements

(c) Tests

(d) Ratings

(e) Engine

(f) Generator

(g) Engine Generator Control Panel

Control Equipment:

Metering Equipment:

Fault Indicators:

Function Switch:

(h) Battery Charger

(i) Battery

(j) Base and Mounting

(k) Utility Connections

(l) Cooling System

(m) Fuel System

(n) Exhaust System

(o) Weatherproof Enclosure

(p) Automatic Transfer Switch

(q) Warranty

I Flow Monitoring System

(1) General

(2) Acoustic Sensors and Mounting Requirements

(a) For External Sensors (two inch Diameter Meters and Larger).

(b) For "Hot Shot" Sensors (12 inch Diameter and Larger).

(c) For In Stream Wetted Sensors (24 inch Diameter and Larger).

(d) For Fabricated Spool Design.

(3) Transmitter Requirements.

(4) Electronic Recording Receiver

(5) Performance Specifications.

(6) Materials

(7) Flow Meter Maintenance.

(8) Warranty and Service

(a) Warranty

(b) Service.

j. Electrical Grounding System

(1) General

(2) Material and Installation

k. Inspection and Testing

l.. Required Submittals

m. Shop Painting

n. Handling

o. Warranty

p. Tools and Spare Parts

q. Chain Link Fence

APPENDIX B
GRAVITY SEWERS, FORCE MAINS, AND PUMP STATIONS

1. PIPE MATERIAL FOR GRAVITY SEWERS

a. General

Pipe used in gravity sewer construction shall be polyvinyl chloride (PVC) or ductile iron pipe (DIP). Where reference is made to an ASTM, ANSI or AASHTO designation, it shall be the latest revision.

The contractor shall be responsible for all materials furnished and storage of same, until the date of substantial completion. The contractor shall replace at his own expense all materials found to be defective or damaged in handling or storage. The contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified herein. All pipe delivered to project site for installation is subject to random testing for compliance with the designated specifications.

b. Pipe Materials

(1) PVC Gravity Sewer Pipe

PVC Gravity Sewer Pipe (4" - 15") (8’ or less depth), ASTM D3034, Standard Dimension Ratio (SDR) 35. Uniform minimum "pipe stiffness" at 5% deflection shall be 46 psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI-Bell Plastic Pipe Association standard is UNI-B-4.

PVC Gravity Sewer Pipe (4" - 15") (8’ or greater depth), ASTM D3034, Standard Dimension Ratio (SDR) 28. Uniform minimum "pipe stiffness" at 5% deflection shall be 46 psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI-Bell Plastic Pipe Association standard is UNI-B-4.

PVC Gravity Sewer Pipe (18" - 27"), ASTM F679, SDR 35. Uniform minimum "pipe stiffness" at 5% deflection shall be 46 psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI-Bell Plastic Pipe Association standard is UNI-B-7.

All PVC pipe shall bear the NSF-DW seal. The minimum standard length of pipe shall be 13'.

7. <u>DIP Gravity Sewer Pipe</u>

<u>DIP shall only be used with written permission from city engineer and the city utility department</u>
Ductile iron pipe shall conform to ANSI/AWWA A21.51/Cl5l, class thickness designed per ANSI/AWWA A21.50/Cl5O, with mechanical or push on joints. All ductile iron pipe and fittings shall have an interior protective lining of coal tar epoxy with a minimum dry thickness of 30 mils, applied by the pipe manufacturer. The polyethylene lining material shall comply with ASTM D-1248. Additionally, the pipe shall be polyethylene encased (8 mil) where required by the City in accordance with ANSI/AWWA A21.51/C105. The minimum standard length of pipe shall be 18'.

(3) <u>Pipe Markings</u>

All pipe shall have a homing mark on the spigot provided by the manufacturer. On field cut pipe, contractor shall provide homing mark on the spigot in accordance with manufacturers recommendation. Reinforced concrete pipe shall have markings indicating the minor axis of the elliptical reinforcement.

c. <u>Joint Materials</u>

(1) PVC Pipe

PVC sewer pipe joints shall be flexible elastomeric seals per ASTM D 3212.

(2) Ductile Iron Pipe

Ductile iron pipe and fitting joints shall be "push-on" or mechanical joints conforming to ANSI/AWWA A21.11/C110.

(3) Joints for Dissimilar Pipe

Joints between pipes of different materials shall be made with a flexible mechanical compression coupling with No. 304 stainless steel bands.

d. Fittings

Unless otherwise specified, wye branches shall be provided in the gravity sewer main for service lateral connections. Wyes shall be 6" inside diameter, unless otherwise approved by the City. All fittings shall be of the same material as the pipe.

Plugs for stub outs shall be of the same material as the pipe, and gasket with the same gasket material as the pipe joint, or be of material approved by the City. The plug shall be secured to withstand test pressures specified in Appendix B, paragraph 5.of these specifications.

e. Inspection and Testing

(1) General

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the manufacturing plant, and the class or strength classification of the pipe. The markings shall be plainly visible on the pipe barrel. Pipe which is not marked clearly is subject to rejection. All rejected pipe shall be promptly removed from the project site by the contractor.

(2) Miscellaneous Inspection and Testing Requirements

All pipe and accessories to be installed under this Contract shall be inspected and tested at the place of manufacture by the manufacturer as required by the Standard Specifications to which the material is manufactured.

Each length of pipe shall be subject to inspection and approval at the factory, point of delivery, and site of work. If requested by the City, a sample of pipe to be tested shall be selected at random by the City or the testing laboratory hired by the City.

When the specimens tested conform to applicable standards, all pipe represented by such specimens shall be considered acceptable based on the test parameters measured. Copies of test reports shall be available before the pipe is installed in the project.

In the event that any of the test specimens fail to meet the applicable standards, all pipe represented by such tests shall be subjected to rejection. The contractor may furnish two additional test specimens from the same shipment or delivery, for each specimen that failed and the pipe will be considered acceptable if all of these additional specimens meet the requirements of the applicable standards. All such retesting shall be at the Contractor's expense.

Pipe which has been rejected by the City shall be removed from the site of the work by the contractor and replaced with pipe which meets these specifications.

2. GRAVITY SEWER PIPE LAYING, JOINTING, AND MISCELLANEOUS CONSTRUCTION DETAILS

a. Survey Line and Grade

The contractor shall set Temporary Bench Marks (TBM'S) at a maximum 500' interval. The contractor shall constantly check line and grade of the pipe by laser beam method. In the event line and grade do not meet specified limits described hereinafter, the work shall be immediately stopped, the City notified, and the cause remedied before proceeding with the work.

b. Pipe Preparation and Handling

All pipe and fittings shall be inspected prior to lowering into trench to insure no cracked, broken, or otherwise defective materials are being used. The contractor shall clean ends of pipe thoroughly and remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

Proper implements, tools, and facilities shall be used for the safe and proper protection of the work. Pipe shall be lowered into the trench in such a manner as to avoid any physical damage to the pipe. Pipe shall not be dropped or dumped into trenches under any circumstances.

c. Sewer Pipe Laying

Laying of sewer pipe shall be accomplished to line and grade in the trench only after it has been dewatered and the trench has been prepared in accordance with specifications outlined herein. Refer to Appendix B.2.d. for additional bedding requirements. Mud, silt, gravel and other foreign material shall be kept out of the pipe and off the jointing surface.

All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipe shall be laid to conform to the line and grade shown on the drawings.

Variance from established line and grade, at any point along the length of the pipe, shall not be greater than 1/32 inch per inch of pipe diameter and not to exceed 1/2 inch, provided that any such variation does not result in a level or reverse sloping invert.

The sewer pipe, unless otherwise approved by the City, shall be laid up grade from point of connection on the existing sewer or from a designated starting point. The sewer pipe shall be installed with the bell end forward or upgrade. When pipe laying is not in progress the open end of the pipe shall be kept tightly closed with an approved temporary plug.

All PVC pipe shall be installed in accordance with the pipe manufacturer's written recommendations as approved by the City. Laying of Ductile Iron Pipe shall conform to the specifications outlined in Appendix C, paragraph 2.d.(7).

d. <u>Trench Preparation and Pipe Bedding</u>

(1) <u>Trench Excavation, Dewatering, Bedding Material, Backfill, Compaction, Fill and Grading</u>

Applicable provisions of Appendix A, paragraph .3. shall apply. Also refer to Standard Drawings.

(2) <u>Placement of Pipe Bedding Material</u>

Contractor shall hand-grade bedding to proper grade ahead of pipe laying operation. Bedding shall provide a firm, unyielding support along the entire pipe length.

If without direction from the City, the trench has been excavated below the required depth for pipe bedding material placement, contractor shall fill the excess depth with pipe bedding material to the proper grade.

Contractor shall excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.

(3) Depth of Bedding Material

Contractor shall provide pipe bedding material in accordance with the Standard Drawings.

e. Gravity Pipe and Water Main Separation

Gravity sewers that are laid in the vicinity of pipe lines designated to carry potable water shall meet the conditions set forth in Appendix C, paragraph 2.c.

f. Plugs and Connections

Plugs for pipe branches, stubs or other open ends which are not to be immediately connected shall be made of an approved material and shall be secured in place with a joint comparable to the main line joint.

g. Pipe Jointing

All pipe shall be installed to the homing mark on the spigot. The City shall be given an opportunity to check all joints in this manner before backfilling.

Type of joint to be used will conform to the requirements of Appendix B, paragraph 1.c. All pipe and jointing for gravity sewers shall be subject to the tests specified in Appendix B, paragraph 5.

3. MANHOLES

a. General

Manholes shall be leak-tight and constructed of pre-cast concrete units. High density polyethylene or fiberglass manholes may be allowed with the approval of the City Engineer.

b. Pre-Cast Concrete Sections

(1) General

Pre-cast manholes shall conform to specifications for Pre-cast Reinforced Concrete Manhole Sections, ASTM Designation C478, except as otherwise specified below.

(2) Miscellaneous Requirements

The minimum wall thickness shall be 5". Pre-cast manholes shall be constructed with a pre-cast monolithic base structure as shown on the Standard Drawings. The minimum base thickness shall be 8".

Concrete for manholes shall be Type II, 4,000 psi at 28 days. Barrel, top and base sections shall have tongue and groove joints. All jointing material shall be cold adhesive preformed plastic gaskets, conforming with FDOT Article 942-2.

The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on each pre-cast section.

Sections shall be cured by an approved method for at least 28 days prior to painting and shall not be shipped until at least 2 days after having been painted.

Pre-cast concrete top slabs shall be used where cover over the top of the pipe is less than 4'. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the manhole sections.

Concrete surfaces shall have form oil, curing compounds, dust, dirt and other interfering materials removed by brush or sand blasting and shall be fully cured prior to the application of any coatings.

Interior surfaces of manholes shall have a protective epoxy coal tar coating with a minimum dry mil thickness of 16 mils. Exterior surfaces shall have a protective epoxy coal tar coating with a minimum dry mil thickness of 9 mils. Coatings shall be applied in two (2) applications by the manhole manufacturer in strict accordance with the paint manufacturer's recommendations.

(3) Inspection

The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the City. Such inspection may be made at the place of manufacture, or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected and, if already installed, removed and replaced, entirely at the contractor's expense.

At the time of inspection, the sections will be carefully examined for compliance with the specified ASTM designation, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength" blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

c. High Density Polyethylene (HDPE) Manholes

(1) General

HDPE manholes shall conform to the requirements of Type III, Class C, category 5, Grade P34, high density, high molecular weight polyethylene pipe material, as defined in ASTM D-1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

(2) Miscellaneous Requirements

The manhole shall be manufactured by the fabrication of High Density Polyethylene. Walls and stub-out shall be a minimum of Class160 as defined in ASTM F-894.

Manhole sections shall be manufactured with bell and spigot ends. Joining will be accomplished by rubber gasket in accordance with the manufacturer's recommendations.

Rubber gaskets shall meet the physical requirements specified in the non-pressure requirements of ASTM Specification F-477.

Lubricant used for assembly shall have no detrimental effect on the gasket or on the manhole section.

The manhole sections and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The minimum Ring Stiffness Constant for manholes is 160.

The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on each section.

(3) Inspection

The quality of all material, the process of manufacture and the finished sections shall be subject to inspection and approval by the City in accordance with the requirements of Appendix B, paragraph 3.b.(3).

d. Fiberglass Manholes

(1) General

Fiberglass manholes shall conform to the requirements of ASTM Specification D3753 for glass fiber-reinforced polyester manholes, and the requirements of AASHO H-20 Axial Loads.

(2) Miscellaneous Requirements

The manhole shall be constructed of glass fiber-reinforced Isopthalic polyester resin containing chemically enhanced sand. The manholes shall conform to the above design criteria as well as the following: ASTM C-581, ASTM D-2412, ASTM D-695, and ASTM D-2584.

The standard wall thickness shall be 0.50" nominal. The nominal diameter of the manhole shall be 48". The height shall be selected in accordance with project drawings or the design engineer's specifications.

The interior surface of the manhole shall be smooth.

The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on each manhole section.

Manholes shall be installed in accordance with the manufacturer's instructions.

(3) Inspection

The quality of all material, the process of manufacture and finished manhole sections shall be subject to inspection and approval by the City in accordance with the requirements of Appendix B, paragraph 3.b.(3).

e. Castings

Gray iron castings for manhole frames, covers, adjustment rings and other items shall conform to the ASTM Designation A 48, Class 30. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects which would impair their strength, or otherwise make them unfit for the service intended. The seating surfaces between frames and covers shall be machined to fit true. No plugging or filling will be allowed. Lifting or "pick" holes shall be provided, but shall not penetrate the cover. Casting patterns shall conform to those shown or indicated on the Standard Drawings. All manhole frames and covers shall be traffic bearing to meet AASHTO H-20 loadings. Frames shall be suitable for the future addition of a cast iron ring for upward adjustment of top elevation. In certain locations bolt down covers and gasketed covers shall be located as shown on the drawings (ie: flood prone areas).

f. Construction Details

(1) Bedding

Base sections shall be placed on bedding rock conforming to the requirements in Appendix A, paragraph 3.h.(2). The bedding rock shall be firmly tamped and made smooth and level to assure uniform contact and support of the pre-cast element. Refer to Appendix A, paragraph 3.i(2) for density requirements. Refer to the Standard Drawings for additional bedding details.

(2) <u>Cast In Place Bases</u>

Cast in place bases shall be utilized only when specifically approved by the City. Unless otherwise specified, cast-in-place bases shall be at least 8" in thickness and shall extend at least 6" radially outside of the outside dimension of the manholes section. Reinforcement and connection to the riser sections shall be designed by the Developer's Engineer and submitted to the City for approval.

(3) <u>Pre-Cast Manholes</u>

A pre-cast base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and making sure that all entering pipes can be inserted on proper grade.

Pre-cast manhole sections shall be handled by lift rings or non-penetrating lift holes. Such holes shall be filled with non-shrink grout after installation of the manhole.

The first pre-cast section shall be placed and carefully adjusted to true grade and alignment. All inlet pipes shall be properly installed so as to form an integral watertight unit. The sections shall be uniformly supported by the base structure, and shall not bear directly on any of the pipes.

Pre-cast sections shall be placed and aligned to provide vertical alignment with a 1/4" maximum tolerance per 5' of depth. The completed manhole shall be rigid, true to dimensions, and watertight.

(4) Excavation and Backfilling

Requirements of Appendix A, paragraph 3. shall apply.

(5) Placing Castings

Casting shall be fully bedded in mortar with adjustment brick courses placed between the frame and manhole. Bricks shall be a minimum two (2) and maximum four (4) courses. Mortar shall conform to ASTM C-270, type M, and the bricks shall be clay and conform to ASTM C-216, grade SW, size 3-1/2" (w) x 8" (l) x 2-1/4" (h).

Top of manhole castings located in pavement, shouldered areas, and sidewalks shall be set flush with grade. Top of manhole castings located outside these areas shall be placed 2" above grade.

(6) Channels

Manhole flow channels shall be as shown in the Standard Drawings, with smooth and carefully shaped bottoms, built up sides and benching constructed using cement and brick with no voids. Channels shall conform to the dimension of the adjacent pipe and provide for evenly changes in size, grade and alignment. Cement shall be Portland Cement Type II only.

(7) Pipe Connectors

Special care shall be taken to see that the openings through which pipes enter the structure are provided with watertight connections. For ductile iron and PVC pipe, connections shall conform with ASTM C 923, "Standard Specifications for Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes."

(8) Drop Manhole Connections

Drop manhole connections shall conform in all respects to details shown on Details of the Standard Drawings.

g. Cleaning

All newly constructed manholes shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection.

h. Inspection for Acceptance

No visible leakage in the manhole or at pipe connections will be permitted. Manholes shall be hydraulically tested using the method specified in ASTM C969. All manholes shall be inspected by the City prior to acceptance. All manholes failing to meet the specifications set forth above shall be reconstructed or replaced by the contractor to comply with these specifications. Pressure grouting of manholes for repair shall not be accepted.

4. SERVICE LATERALS

a. General

A service lateral is a branch gravity sewer constructed from the main gravity sewer to the right-of-way line or to a point established by the City. A sewer cleanout shall be installed at the property line for each service lateral and a two by two foot,4 inch thick cement pad placed around the top of lateral.

The general requirements for construction of gravity sewers in Appendices B, paragraph 1. and B, paragraph 2. of these Specifications shall apply for service laterals unless they are inconsistent with the provisions of this section.

Service laterals and fittings shall be a minimum of 6" in diameter.

b. Materials

Pipe, fittings & joints shall be PVC or DI pipe and shall conform to the requirement for gravity sewer construction in Appendix B, paragraph 1. of these specifications.

Service laterals shall be connected to the wye, provided in the gravity sewer where such is available, utilizing approved fittings or adapters.

On existing mains where no wye is provided or available, connection shall be made by either a machine-made tap and suitable saddle, or a cast-in-place manhole as referenced in Section 3, paragraph 2.C(4)(e).

c. Construction Details

(1) General

Service lateral connections shall conform to these specifications and Standard Drawings. All necessary approvals for service sewer construction shall be obtained prior to beginning the work.

(2) Excavation and Backfill

Excavation and backfilling for service sewers shall conform to the requirements of Appendices A, paragraph 3. and B, paragraph 2., excepting that no backfill in excess of that required to hold the pipe in true alignment shall be placed prior to inspection.

(3) Pipe Laying and Jointing

Pipe laying and jointing, except as hereinafter provided, shall in general conform to the requirements of Appendix B, paragraph 2. During the pipe laying and jointing, the service lateral shall be kept free of any water, dirt or objectionable matter.

(4) Line and Grade

Pipe shall be laid with a minimum slope of 1' per 100'. The contractor shall establish such alignment and grade control as is necessary to properly install the service sewer. Pipe shall be laid in a straight line at a uniform grade between fittings.

d. Termination of Service Laterals

Service laterals shall terminate at the right-of-way line in accordance with the Standard Drawings. Water-tight factory made plug(s) shall be installed at the end of each service lateral.

e. Inspection

Service sewers shall meet the inspection requirements specified in Appendix B, paragraph 1.e.

f. Restoration, Finishing and Cleanup

The contractor shall restore all paved surfaces, curbing, sidewalks or other surfaces to their original condition in such manner as to meet the requirements established in Appendix B of these specifications. All surplus material and temporary structures, as well as all excess excavation shall be removed and the entire site shall be left in a neat and clean condition.

g. Location

The exact location of the termination point of each installed service lateral shall be marked by etching or cutting an "S" in the concrete curb. Where no curb exists, locations shall be adequately marked by a method approved by the City. Brass or aluminum markers may also be used.

5. TESTING AND INSPECTION FOR ACCEPTANCE OF GRAVITY SEWERS

a. General

All gravity sewers shall be tested for alignment, deflection and integrity prior to acceptance. In addition, a leakage test may be required for gravity sewers, solely at the discretion of the City. The leakage testing shall be performed by the contractor who shall be responsible for furnishing all necessary labor and equipment to conduct such testing. Alignment, deflection and integrity testing shall be performed utilizing television inspection or other methods solely at the discretion of the City.

b. Testing For Leakage

(1) Type of Test

If required by the City, gravity sewers shall be required to pass a leakage test before acceptance. Leakage tests shall be by the low-pressure air test as described below.

(2) Selection of Test Sections

Each test section shall not exceed 400' in length and shall be tested between adjacent manholes.

(3) Preparation and Coordination For Testing

The contractor shall flush all sewers with water sufficient in volume to obtain free flow through each line. Flushing water and debris shall not enter any pump station wet well. Water will be pumped from the sewer system during flushing to an acceptable discharge location. A visual inspection shall be made and all obstructions removed.

The contractor shall notify the City 48 hours prior to performing any leakage testing.

The results of all leakage tests shall be presented by the contractor to the City in neat, legible writing. These written results shall be formatted and adequately labeled so that they are easily understandable.

The contractor shall install sufficient monitoring wells in the representative areas of the gravity system, acceptable to the City, to determine the groundwater elevations. Monitoring wells shall be installed a minimum 24 hours prior to testing.

(4) Leakage Test

Leakage testing shall be conducted in accordance with the procedure for (Recommended Practice For Low Pressure Air Testing of Installed Sewer Pipe) as established by the Uni-Bell PVC Pipe Association and ASTM F1417. Passing this test shall be presumed to establish leakage test limits of 50 gallons per day per inch diameter per mile of sewer.

c. Inspection For Alignment, Deflection and Integrity

Internal video inspection or other testing methods for the gravity sewer shall be performed to check for alignment and deflection. The television inspection may also be used to check for cracked, broken or otherwise defective pipe, and overall pipe integrity.

Prior to inspection, the contractor shall flush all sewers with water sufficient in volume to obtain free flow through each line. Flushing water and debris shall not enter any pump station wet well. Water will be pumped from the sewer system during flushing to an acceptable discharge location. A visual inspection shall be made and all obstructions removed.

The first inspection will be within 30 days after Substantial Completion of the installation of the gravity sewer pipe, provided the road base is in place and the manhole rings and covers are to grade. The requirement of road base being in place shall be waived if the top of the sewer is 12' below the finished grade. In such cases, the video inspection shall be performed once the trench has been compacted up to the road base.

If the video inspection reveals cracked, broken, or defective pipe, or pipe misalignment resulting in vertical sags in excess of 1-1/2" and in the case of PVC pipe a ring deflection in excess of 5%, the contractor shall be required to repair or replace the pipeline. A mandrel deflection test shall be required on all gravity sewer piping..

Successful passage of the leakage test, a mandrel deflection test, and video or visual inspection is required before acceptance of any gravity sewer by the City.

Prior to repair or replacement of failed sewer pipe, the method of repair or replacement shall be submitted to the City for approval. Pressure grouting of pipe or manholes shall not be considered as an acceptable method of repair.

6. WASTEWATER FORCE MAINS

a. General

These specifications cover the pipe, fittings, and accessory items used for wastewater force main systems.

Pipe used in wastewater force main systems shall be either PVC or DIP. HDPE may be used subject to City approval.

The contractor shall be responsible for all materials furnished and storage of same, until the date of project completion. The contractor shall replace at his own expense all materials found to be defective or damaged in handling or storage. The contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified herein. All pipe delivered to project site for installation is subject to random testing for compliance with the designated specifications.

b. Pipe Inspection and Test

Requirements specified in Appendix B, paragraph 1.e. shall apply.

c. PVC Pipe

(1) PVC Pipe

All PVC pipe of nominal diameter 4" through 12" shall be manufactured in accordance with AWWA standard C900. The PVC pipe shall have a minimum working pressure rating of 100 psi and shall have a DR of 25. Pipe shall be the same O.D. as ductile iron pipe.

(2) Joints

PVC pipe shall have integral bell push on type joints conforming to ASTM D3139.

(3) Fittings

Fittings used with PVC pipe shall conform to Appendix B.6.d.

d. Ductile Iron Pipe and Fittings

7. Ductile Iron Pipe

Ductile Iron Pipe - Shall only be used with written permission from city engineer and the city utility department

All ductile iron pipe of nominal diameter 4" through 20" shall be Class 350 and for pipes larger than 20" shall be Class 250 and shall conform to ANSI/AWWA A21.51/Cl5l.

(2) Fittings

All fittings shall be mechanical joint ductile iron or gray iron conforming to ANSI/AWWA A21.10/C110, 250 psi minimum pressure rating, or ductile iron compact fittings in accordance with ANSI/AWWA A21-53/Cl53.

(3) Joints

Joints for ductile iron pipe and fittings shall be push-on or mechanical joints conforming to ANSI/AWWA A21.11/C111, unless otherwise called for on the DRAWINGS. Where called for on the Drawings, restrained or flanged joints shall be provided. Flanged joints shall conform to ANSI Standard B16.1-125 LB. Restrained joints shall conform to Appendices A, paragraph 6.c.

(4) Coatings and Linings

Where ductile iron pipe and fittings are to be below ground or installed in a casing pipe the coating shall be a minimum 1.0 mil thick in accordance with ANSI/AWWA A21.51/Cl5l. Where ductile iron pipe and fittings are to be installed above ground, pipe, fittings and valves shall be thoroughly cleaned and given one field coat (minimum 1.5 mils dry thickness) of rust inhibitor primer. Intermediate and finished field coats of Alkyd shall also be applied by the contractor (minimum 1.5 mils dry thickness each coat).

Primer and field coats shall be compatible and shall be applied in accordance with the manufacturers recommendations. Final field coat color shall be grey for raw wastewater and brown for treated wastewater.

All ductile iron pipe and fittings shall have an interior protective lining of coal tar epoxy or polyethylene with a minimum dry thickness of 30 mils applied by the pipe manufacturer. Polyethylene lining material shall comply with ASTM D-1248 and shall be fused to the interior of the pipe by heat forming a tightly bonded lining.

(5) Polyethylene Encasement

The pipe shall be polyethylene encased (8 mil) where shown on the drawings or required by the City in accordance with ANSI/AWWA A21.51/C105.

e. Pipe Handling

Requirements specified in Appendix C, paragraph 2.b. shall apply.

f. Air and Vacuum Release Valves

(1) General

Wastewater force mains shall be equipped with either air or air/vacuum release valves located as shown on the drawings. Valves shall be located in an enclosure as detailed on the Standard Drawings.

The valves shall be as described below.

(2) Wastewater Air/Vacuum Valve

The valve body shall be of cast iron ASTM A126-B; the floats, float guide and stem shall be of stainless steel Type 304. The resilient seat shall be of Buna N. The valve shall be suitable for 150 psi working pressure. Valve shall have standard 2" NPT inlets and outlet ports unless otherwise shown on the Drawings. Provisions shall be made for back-flushing the valve with clean water.

(3) Wastewater Air Release Valve

The valve body and cover shall be cast iron construction, ASTM A126-B, and all internal working parts shall be of stainless steel Type 304. The venting orifice shall be 3/8" in diameter and the seating material shall be of Viton.

The inlet opening shall be standard 2” NPT screwed connection, unless otherwise shown on the Drawings. The valve shall include a flush out feature for periodic cleaning of the internal mechanism. The overall height of the valve body shall not exceed 21", unless otherwise shown on the Drawings.

g. Notification and Connection to Existing Mains

Pressure connection to existing wastewater force mains shall comply with the requirements of Appendix A, paragraph 7.

h. Plug Valves

(1) General

Only plug valves as specified below shall be used on wastewater force main systems. All plug valves shall be installed so that the direction of flow through the valve is in accordance with the manufacturer's recommendations. Valves shall be eccentric plug valve type.

(2) Valve Construction

Valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the drawings. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard. Mechanical joint ends shall meet AWWA C111, Class B.

Valve bodies shall be of ASTM A126, Class B Semi-steel, 31,000 psi tensil strength minimum in compliance with AWWA C507 and C504. All exposed nuts, bolts, springs, washers, etc. shall be zinc or cadmium plated. Resilient plug facings shall be of Hycar or Neoprene.

Port areas for valves 4" through 20" shall be 80% nominal pipe diameter. Valves 24" and larger shall have a minimum port area of 70% of nominal pipe diameter. All exposed nuts, bolts, springs, washers, etc., shall be zinc or cadmium plated. Resilient plug facings shall be of Hycar or Neoprene.

Valves shall be furnished with permanently lubricated stainless steel or oil-impregnated bronze upper and lower plug stem bushings. These bearings shall comply with AWWA C507 and C504.

Seats in 4" and larger valves shall have a welded-in overlay of a high nickel content on all surfaces contacting the plug face which comply with AWWA C507 and C504.

Valve shaft seals shall be adjustable and comply with AWWA C507.

(3) Valve Testing

Plug valves shall be tested in accordance with AWWA C504. Each valve shall meet the performance, leakage, and hydrostatic tests described in AWWA C504. The leakage test shall be applied to the face of the plug tending to unseat the valve. The manufacturer shall furnish certified copies of reports covering proof of design testing as described in AWWA C504.

(4) Actuators

Manual valves shall have lever or gear actuators and tee wrenches, extension stems, floor stands, etc. as indicated on the drawings. All valves 6" and larger shall be equipped with gear actuators. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. All actuator shafts shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be zinc or cadmium plated. Valve packing adjustment shall be accessible without disassembly of the actuator.

i. Valve Boxes

Requirements specified in Appendix C, paragraph 3.e. shall apply, except that covers shall have "sewer" cast into the top.

j. Separation of Force Mains, Water Mains and Reclaimed Water Mains

Requirements specified in Appendix C, paragraph 2.c. shall apply.

k. Force Main Construction

Requirements specified in Appendix C, paragraph 3. shall apply.

l. Hydrostatic Tests

Requirements specified in Appendix C, paragraph 2.e. shall apply except that all pipe sections to be tested shall be subjected to a hydrostatic pressure of 100 psi.

m. Final Cleaning

Prior to final inspection and acceptance of the force main by the City, contractor shall flush and clean all parts of the system. Flushing and cleaning shall remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the downstream end.

Upon the City's final inspection of the pressure pipe systems, if any foreign matter is still present in the system, contractor shall clean the sections and portions of the lines as required.

n. Location and Identification

All non-metallic force mains shall be installed with a continuous, insulated 14 gauge copper wire installed directly on top of the pipe for location purposes. Detectable tape shall be placed 1' above the top of the pipe. See Standard Drawings. In addition, all PVC force mains shall be either a solid green. All lettering shall appear legibly on the pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use.

All ductile iron force mains shall be marked with a continuous stripe located within the top 90º of the pipe. Said stripe shall be a minimum 2" in width and shall be green in color. Backfill shall not be placed for 30 minutes following paint application.

7. WASTEWATER PUMP STATIONS

a. General

This section includes the specifications for equipment, materials, site work, fences and appurtenances for the installation of wastewater pump stations.

b. Wet Well and Valve Vault

The wet wells shall be lined or coated as approved by the City. Wet well and valve vault shall be constructed as shown on the Standard Drawings and in conformance with the specifications outlined in Appendix B, paragraph 3.

c. Access Frames and Covers

Both the wet well and the valve vault shall be furnished with an access frame and cover. Equipment furnished shall include the necessary aluminum access frames, complete with hinged and slide bar equipped covers, stainless steel upper guide holder and level sensor cable holder. The frames shall be securely mounted above the pumps. Doors shall be of aluminum checker plate. The access cover and frame with stainless steel hardware shall be sized as shown on the drawings.

d. Pumps and Controls

Pumps and miscellaneous accessories shall be as specified in Appendix B, paragraph 7.e. Controls and miscellaneous accessories shall be as specified in Appendix B, paragraph 7.f.

e. Submersible Wastewater Pumps

(1) General

The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by a reputable firm having at least five (5) years experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods, and shall operate satisfactorily when installed as shown on the drawings.

All parts shall be so designed and proportioned as to have liberal strength, and stiffness and to be especially adapted for the work to be done. Ample space shall be provided for inspection, repairs, and adjustment. The stator casing and oil casing shall be of gray iron construction, with all parts coming into contact with sewage protected by a PVC epoxy primer with a chloric rubber paint finish. All necessary foundation bolts, plates, nuts, and washers shall be furnished by the equipment manufacturer, and shall be of Type 304 stainless steel. Brass or stainless steel nameplates giving the name of the manufacturer, voltage, phase, rated horsepower, speed, and any other pertinent data shall be attached to each pump. The nameplate rating of the motors shall not be exceeded.

The pumps shall be capable of handling raw unscreened domestic wastewater and minimum 3" diameter solid spheres. Pump operation shall be controlled automatically by means of a liquid level sensors in the wet well with a supplemental float type backup control. Alternate or approved equal are subject to City review and approval. Pumps shall be mounted in the wet well as shown on the Drawings.

(2) Pump Construction Details

(a) Shaft

The pump shaft shall be of Series 300 or 400 stainless steel or carbon steel. When a carbon steel shaft is provided, the manufacturer shall demonstrate that any part of the shaft which will normally come in contact with the wastewater has proven to be corrosion resistant in this application. The shaft and bearings shall be adequately designed to meet the maximum torque required for any start-up or operating condition and to minimize vibration and shaft deflection. As a minimum, the pump shaft shall rotate on two (2) permanently lubricated bearings. The upper bearing shall be a single row ball bearing. The lower bearing shall be a two (2) row angular contact ball bearing, if required to minimize vibration and provide maximum bearing life.

(b) Impeller

The impeller shall be constructed of gray cast iron, ASTM A-48, class 30. All external bolts and nuts shall be of Type 304 stainless steel. Each pump shall be provided with a replaceable metallic wear ring system to maintain pump efficiency. As a minimum one (1) stationary wear ring provided in the pump volute or one (1) rotating wear ring provided on the pump impeller shall be required. A two-part system is acceptable.

(c) Mechanical Seal

Each pump shall be provided with a tandem double mechanical seal running in an oil reservoir, composed of two (2) separate lapped face seals, each consisting of one (1) stationary and one (1) rotating tungsten carbide ring with each pair held in contact by a separate spring, so that the outside pressure assists spring compression in preventing the seal faces from opening. The compression spring shall be protected against exposure to the pumped liquid. Silicone carbide may be used in place of tungsten carbide for the lower seal. The pumped liquid shall be sealed from the oil reservoir by one (1) face seal and the oil reservoir from the air-filled motor chamber by the other. The seals shall require neither maintenance nor adjustment, and shall be easily replaced. Conventional double mechanical seals with a single spring between the rotating faces, requiring constant differential pressure to effect sealing and subject to openings and penetration by pumping forces shall not be considered equal to tandem seal specified and required.

(d) Guides

A sliding guide bracket shall be an integral part of the pump casing and shall have a machined connecting flange to connect with the cast iron discharge connection, which shall be bolted to the floor of the wet well with stainless steel anchor bolts and so designed as to receive the pump discharge flange without the need of any bolts or nuts. Sealing of the pumps to the discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided by no less than two (2) Type 316 seamless tubular stainless steel guides which will press it tightly against the discharge connection. No portion of the pump shall bear directly on the floor of the wet well and no rotary motion of the pump shall be required for sealing. Sealing at the discharge connection by means of a diaphragm or similar method of sealing will not be accepted as an equal to a metal to metal contact of the pump discharge and mating discharge connection specified and required. Approved pump manufacturers, if necessary to meet the above specification, shall provide a sliding guide bracket adapter. The design shall be such that the pumps shall be automatically connected to the discharge piping when lowered into place on the discharge connection. The pumps shall be easily removable for inspection or service, requiring no bolts, nuts or fastenings to be removed for this purpose, and no need for personnel to enter the wet well. Each pump shall be fitted with a Type 304 stainless steel, 3/4" lifting chain of adequate strength. A 1/4" Type 304, stainless steel cable, air craft rating, shall be provided between the cable holder and the lifting chain.

(3) Motors

(a) General Requirements

All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA Standards where applicable. Pump motors shall be housed in an air-filled, water-tight casing and shall have Class F insulated windings which shall be moisture resistant. The motor shall be provided with over temperature sensors set at 125º Centigrade (C) and shall be NEMA Design B, rated 155º C maximum. Pump motors shall have cooling characteristics suitable to permit continuous operation, in a totally, partially or non-submerged condition. The pump shall be capable of running continuously in a non-submerged condition under full load without damage, for extended periods. The motor shall be capable of a minimum of 10 starts per hour. If required by the City, before final acceptance, a field running test demonstrating this ability, with 24 hours of continuous operation under the above conditions, shall be performed for all pumps being supplied. Motors 25 horsepower and below shall be rated 230/460 volt, 3 phase. Motors greater than 25 horsepower shall be 460 volt, 3 phase. All motors shall be designed with a 1.15 service factor and shall not be less than 5 horsepower unless approved by the City. Pumps shall be capable of meeting all pump curve conditions without exceeding the motors rated horsepower.

(b) Heat and Moisture Sensors

Each motor shall incorporate a minimum of one (1) ambient temperature compensated overheat sensing device and one (1) moisture sensing device. These protective devices shall be wired into the pump controls in such a way that if excessive temperature or moisture is detected the pump will shut down. These devices shall be self-resetting.

In lieu of moisture and temperature sensors, each pump motor shall have its motor winding insulation resistance monitored automatically by an automatic megger solid state electronics module. Each automatic megger must have an individual disconnect terminal plug, manual shut off switch, three lights to indicate 10 M ohm, 5 M ohm, and 1 M ohm, resistance values, two (2) output circuits for external alarms, and two (2) switches for manual testing. The power source shall be 110 VAC fused at 0. 24 AMP. The test voltage shall be 500-700 volts d.c. The automatic megger shall monitor the motor resistance only when the motor is off and shall activate an alarm system when the motor resistance drops to 1 M ohm.

(c) Cables

Cables shall be designed specifically for submersible pump applications and shall be properly sealed. A type CGB water-tight connector with a neoprene gland shall be furnished with each pump to seal the cable entry at the control panel. The pump cable entry seal design shall preclude specific torque requirements to insure a water-tight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top. Secondary sealing systems utilizing epoxy- potting compounds may be used. When this type of sealing system is used the manufacturers shall supply a cable cap as part of the spare parts for each pump. All cables shall be continuous, without splices from the motor to the control panel, unless otherwise approved by the City.

The junction chamber, containing the terminal board, shall be perfectly leak proof.

f. <u>Pump Station Electrical Power and Control System</u>

(1) <u>General</u>

This section specifies the electrical power and control system requirements for wastewater pump stations. These requirements apply to duplex pump panels. Similar requirements shall apply when more than two (2) pumps are involved except for the quantity of control equipment and panel size shall be increased accordingly. The manufacturer of the control panel shall provide data to indicate that the manufacturer has a minimum of three (3) years experience in the building of pump control panels.

A pump station control panel shall be provided for each wastewater pump station. The control panel shall respond to liquid level switches to automatically start and stop pumps as well as sound an alarm upon high or low wet well levels. The control panel shall operate two (2) electrical submersible pumps at the power characteristics stipulated. The control function shall provide for the operation of the lead pump under normal conditions. If the incoming flow exceeds the pumping capacity of the lead pump, the lag pump shall automatically start to handle this increased flow. As the flow decreases, pumps shall be cut off at elevation as shown on the drawings. Pumps shall alternate positions as lead pump at the end of each cycle. A failure of the alternator shall not disable the pumping system. The alternator shall include a safe, convenient method of manual alternation and also have provisions to prevent automatic alternation without disturbing any wiring. Should the "pump off" regulator fail, the system shall keep the station in operation and provide a visual indication of the regulator failure.

The control panel shall consist of main circuit breakers, a circuit breaker and magnetic starter for each pump motor, and 15 ampere, 120-volt circuit breakers as required. All pump control operations shall be accomplished by a float type liquid level control system with all control components mounted in one common enclosure. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually select or automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle. A liquid level control system shall continuously monitor wet well liquid level and control operation of the low-level cutoff for the pumps and shall operate off a 24-volt circuit.

(2) <u>Panel Construction</u>

The duplex pump panel shall be housed in a NEMA 3R, Type 304, 14 Gauge stainless steel enclosure with 30% extra mounting space for additional equipment. Enclosure shall have provisions for padlocking the door and a dead front inner door unit for mounting controls. All exterior hardware and hinges shall be stainless steel.

There shall be permanently affixed to the interior side of the exterior enclosure door both a nameplate and a 10" x 12" pocket for log sheet storage. The nameplate shall contain the following information, voltage, phase, rated horsepower, speed, date manufactured and pump and control panel manufacturer's name, address and telephone number, pump data, including impeller data, operating point and head, KW input, and amps at the operating point and at least two other points on the pump curve.

The control panel enclosure shall be Underwriters Laboratories (UL) 50,Type 3R listed.

(3) Power Supply and Main Disconnect

Power supply to the control panel shall be either 240 volt, 3 phase, 4 wire or 480 volt, 3 phase, 4 wire. Minimum service shall be 100 AMP. Single-phase power shall not be accepted.

Non-fusible safety service main disconnects shall be installed at all stations. In all 240 volt systems, disconnects should be installed between the meter and the panel and on all 480 volt systems, disconnect should be installed ahead of the meter. LED power available indicators shall be supplied on all legs.

7. Circuit Breakers

All circuit breakers shall be heavy duty molded case breakers. The handle on the circuit breakers shall be operational through the inner door. All breakers shall be Square D or equal.

(5) Motor Circuit Protectors

Each pump motor shall be protected by a 3-pole motor circuit protector. The Motor Circuit Protector shall be operated by a toggle-type handle and shall have a quick-make, quick-break over center switching mechanism that is mechanically trip-free from the handle so that the contacts cannot be held closed against a short circuit and abnormal currents which cause the Motor Circuit Protector to trip. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the normal ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously. Motor Circuit Protector must be completely enclosed in a high-strength glass polyester molded case. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. A manual push-to-trip button shall be provided for manual exercising of the trip mechanism. Each pole of these Motor Circuit Protector's shall provide instantaneous short circuit protection by means of an adjustable magnetic-only element.

(6) Motor Starter and Selector Switches

The panel shall contain two (2) motor starters. The motor starter shall be across the line magnetic starter with individual overload protection on each power leg with reset installed through the inner door unit. Local Power Company Regulations shall govern.

Selector switches shall be installed on the face of the inner door unit. Selector switch shall be a heavy duty oil tight "Hand-Off-Auto" three (3) position switch to control the operation mode of each pump motor starter.

(7) Pump Alternator

An eight (8) pin plug-in solid state alternator (see approved manufacturers' list in Appendix F) shall be provided to change the pump starting sequence on each pumping cycle. A three (3) position alternator test switch shall be provided to control the alternation operation. Switch positions to include the "Auto" to provide normal automatic sequence, "Off" position to disable alternator, and "test" position with a spring return to allow the alternating of the pump sequence to check alternator operation.

(8) Lights and Alarms

(a) Indicator Lights

There shall be installed on the face of the inner door unit, heavy duty oil tight indicator lights as shown on the Standard Drawings.

(b) High Level Alarm

A vapor proof red light and horn shall be mounted on top of the panel for high level alarm. Also, there shall be an alarm silence push button on the inner door and a silence relay which will silence the horn and automatically reset when these signals are restored to normal. The push button shall be heavy duty oil tight. The red globe shall be the screw-on type.

(9) Emergency Generator

The city shall require permanent standby generator power at all lift stations. The generator shall be sized to the full capacity of any up grades that can be made to the lift station.

(10) Additional Requirements

(a) Wiring

All power wires shall be THW or THWN 75º C insulated stranded copper conductors and shall be appropriately sized for the given load application. All control circuit wire shall be type THW; Size 14, stranded type. All wiring within the enclosure shall be neatly routed by the use of slotted type wiring duct with snap on type covers. Wiring on the rear of the inner door shall be neatly bundled with nylon ties and include sufficient loop across the hinges to prevent wire damage, with each end of conductor marked (I.D.), Color: Red, 24 volt; white, neutral; black, 120 volts

(b) Terminal Points

Terminal points of all terminal strips shall be permanently identified. All terminal numbers and identifying nomenclature shall correspond to and be shown on electrical diagrams. All wiring shall be permanently shown on electrical schematic diagrams.

(c) Engraved Nameplates

All circuit breakers, control switches, indicator pilot lights and other control devices shall be identified with permanently affixed legend plates and lamicoid-type engraved nameplates where applicable.

(d) Surge Protector

A surge protector shall be included and wired to protect motors and control equipment from lightning induced line surges. All surge protectors shall be U.L. approved and installed per respective power company requirements and manufacturers' specifications. Surge protectors shall be attached to the main disconnects.

(e) Elapsed Time Meters.

Elapsed time meters shall be 115-volt not-reset type and shall totalize pump running time in hours and tenths of hours to 99999.9 hours.

(f) Convenience Receptacle

On the face of the inner door unit, there shall be installed a 15 AMP 120 volt, duplex convenience receptacle. It shall be provided with it's own single pole, 15 AMP circuit breaker for protection. Ground fault interrupt type shall be required.

(g) Control Terminal Blocks

Control terminal blocks shall be of the clamp screw type, rated for 600 volts. Amperage rating shall accommodate the control circuit amperage. An additional 30 space terminal strip shall be installed in the cabinet for future use, with RTU equipment.

(h) Control Power Transformers

There shall be a control power transformer with a minimum size of 500VA to provide 120VAC power for: coils for starters, 15A duplex receptacle, indicator pilot lights, alarm horn, alarm light, pump alternator, elapsed time meters etc. The secondary side shall have one (1) leg fused and the other grounded. This control power transformer is required only on 480 volt control panels.

The signal required by the float switches and relays shall be 24VAC. This shall be provided by a 24VAC control power transformer properly sized with a fused secondary.

(i) Control Relay

The level control relays shall operate from 24VAC. They shall be enclosed, plug-in (8) pin type with octal-style screw terminal sockets.

(j) Electrical Schematic

There shall be permanently affixed to the interior side of the exterior enclosure door an electrical schematic diagram and a copy supplied to City personnel at start-up. The schematic diagram shall include the rated amperage and voltage for all components.

(k) Phase Monitor

For all 240 volt stations an eleven (11) pin plug-in type phase monitor shall be provided for protection of electrical components due to phase loss. Adequate dummy pin protection shall be provided to prevent accidental interchanging of the eleven (11) pin phase monitor with the eleven (11) pin alternator. All 480 volt stations shall have surface mount type phase monitors.

(11) Testing, Service and Warranty

(a) Testing

After fabrication in the control panel manufacturer's plant, an operational test shall be performed to check out the entire panel before delivery. Three phase source voltage for which the panel is intended , shall be used for the testing.

(b) Service

The control panel manufacturer shall maintain a customer service organization that is available for service.

(c) Warranty

The manufacturer shall furnish a five (5) year warranty against defects in materials and workmanship covering parts and labor on all items supplied under this section.

g. Piping, Valves and Accessories

(1) Piping

Influent piping to the wet well shall meet the requirements of Appendices B, paragraph 1.and B, paragraph 6.except that the influent pipe to the wet well shall be a minimum 18" section of Ductile Iron Pipe. All pipe inside the wet well and the valve vault shall be as shown on the Standard Drawings.

(2) Plug Valves

Plug valves shall meet the requirements of Appendix B, paragraph 6.h.

(3) Check Valves

Check valves for ductile iron pipelines shall be swing type and shall meet the material requirements of AWWA C500. The valves shall be iron body, bronze mounted, single disc, 150 Psi working water pressure, non-shock, and hydrostatically tested at 300 psi. Ends shall be 125 pound ANSI B16.1 flanges.

When there is no flow through the line the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.

Check valves shall have bronze seat and body rings, extended bronze hinge pins and stainless steel nuts on the bolts of bolted covers.

Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight. If pump shut off head exceeds 77 feet, then an air cushioned assembly shall be installed.

(4) Pressure Gauges

Pressure gauges shall be installed on each discharge pipe as indicated on the Standard Drawings. Each pressure gauge shall be direct mounted, stainless steel case, stainless steel sensing element, liquid filled, with a 4-1/2" diameter dial and furnished with a clear glass crystal window, 1/4" shut-off (isolation) valve. All gauges shall be weatherproofed. The face dial shall be white finished aluminum with jet-black graduations and figures. The face dial shall indicate the units of pressure measured in psi, with a 0-60 psi range.

Pressure gauges shall not be installed until after the substantial completion date unless otherwise requested by the City.

h. Standby Power Generator System

(1) General

A standby power generator system shall be installed at all pump stations as required by Section 3.2.E.5. Emergency Operations, for electrical power during the loss of normal power.

(2) Generator Set

(a) General

The generator set shall consist of a diesel or alternate fuel engine directly coupled to an electric generator, together with the necessary controls and accessories to provide continuous electric power to the lift station for the minimum duration of 72 hours failure of the normal power supply.

A complete engine generator system shall be furnished and installed with fuel transfer pump, fuel day tank, battery, battery charger, muffler, radiator, control panel, remotely mounted automatic transfer switch (part of the control panel), and all other accessories required for an operational system. All materials and parts of the generator set shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. The set shall be of a standard model in regular production at the manufacturer's place of business. Units and components offered under the Specifications shall be covered by the manufacturer's standard warranty on new machines.

(b) Requirements

The emergency generator set and accessories shall be of a type that complies with the latest edition of the National Electrical Code and all applicable state and local building codes.

The material and workmanship used in the manufacture of this equipment shall be of the highest quality consistent with the current standards for like equipment, and the equipment shall be manufactured in such a manner so as to conform to the latest applicable IEEE, ANSI, ISA, NEMA, and EEIA Standards.

The equipment supplier shall be liable for any latent defects due to faulty materials or workmanship in the equipment which may appear within one (1) year from the date of equipment start-up.

(c) Tests

Equipment shall be completely assembled and tested at the factory prior to shipment. Certified copies of the data obtained during these tests shall be submitted to the City.

Final tests shall be conducted at the site, after installation has been completed, in the presence of the City's representative. The emergency generator manufacturer shall furnish a service representative to operate the engine during the tests, to check all details of the installation and to instruct the City's representatives in proper equipment operation.

Field tests shall include operating the diesel generating set for eight (8) hours, carrying normal lift station loads. The contractor shall refill the main fuel tank at the completion of the tests.

(d) Ratings

The rating of the generator shall be as shown on the drawings. These ratings must be substantiated by the manufacturer's standard published curves. Special ratings shall not be acceptable. The diesel generating set shall be capable of supplying the specified usable KW for the specified duration, including the power required for both pump start-up and run. With time delay so both pumps will not start at same time, without exceeding its safe operating temperature.

(e) Engine

The engine shall be water cooled, four stroke cycle, compression ignition diesel. It shall meet specifications when operating on No. 2 domestic burner oil. The engine shall be equipped with fuel, lube oil and intake air filters; lube oil coolers, fuel transfer pump, fuel priming pump, and gear-driven water pump.

The engine and generator shall be torsionally compatible to prevent damage to either engine or generator.

An engine instrument panel shall be installed on the generator set in an approved location. The panel shall include oil and fuel pressure and water temperature gauges. A mechanically driven engine hour meter shall also be provided.

The engine governor shall be of the isochronous electronic type. Frequency regulation shall not exceed plus/minus 0.25% under steady state conditions. The engine shall start and assume its rated load within 10 seconds, including transfer time.

(f) <u>Generator</u>

The generator shall be a three-phase, 60 hertz, single bearing, synchronous type, built to NEMA Standards. Epoxy impregnated Class F insulation shall be used on the stator and the rotor.

The excitation system shall employ a generator-mounted volts per hertz type regulator. Voltage regulation shall be plus/minus 2% from no load to full load. Readily accessible voltage drop, voltage level and voltage gain controls shall be provided. Voltage level adjustment shall be a minimum of plus/minus 5%.

(g) <u>Engine Generator Control Panel</u>

A generator mounted NEMA 3R Type 304, vibration isolated, 14 gauge stainless steel control panel shall be provided. Panel shall contain, but not be limited to, the following equipment:

<u>Control Equipment:</u>

Control equipment shall consist of all necessary exciter control equipment, generator voltage regulators, voltage adjusting rheostat, and speed control equipment and automatic starting controls, as required to satisfactorily control the engine/generator set. In addition an automatic safety shut down shall be provided for low oil pressure and/or high temperature conditions in the engine. An emergency shut down lever switch shall be provided on the air intake.

Metering Equipment:

Metering equipment shall include 3-1/2" meters (dial or digital type frequency meter, 2% accuracy voltmeter, and ammeter and ammeter-voltmeter phase selector switch). The control panel shall also include the engine water temperature, lube oil pressure and hour meter.

Fault Indicators:

Individual press-to-test fault indicator lights for low oil pressure, high water temperature, low water level, over-speed, over crank, and for fuel tank high and low level shall be provided.

Function Switch:

A four position function switch marked "Auto," "Manual," "Off/Reset," and "Stop" shall be provided.

(h) Battery Charger

The battery charger shall be so designed that it shall not be damaged and shall not trip its circuit protective device during engine cranking or it shall be automatically disconnected from battery during cranking period. The charger shall be mounted in the emergency generator control panel. The charger shall have a 7 day/24 hour timer control.

(i) Battery

The battery shall be lead-acid type with sufficient capacity to provide 90 seconds total cranking time without recharging. The battery shall be adequately rated for the specific generator set. The battery shall be encased in hard rubber or plastic and shall be furnished with proper cables and connectors, together with rack and standard maintenance accessories. The battery shall be provided with a 48 month warranty for the replacement of the battery if found to be defective.

(j) Base and Mounting

A suitable number of spring-type vibration isolators with a noise isolation pad shall be provided to support the set and its liquids.

(k) Utility Connections

All connections to the generator set shall be flexible.

(l) Cooling System

The generator set shall be equipped with an engine mounted radiator sized to maintain safe operation at 110 degree F maximum ambient at the pump station altitude. A blower type fan shall be used directing the air flow from the engine through the radiator. The entire cooling system shall be filled with 50% glycol-water solution.

(m) Fuel System

An above ground, main fuel oil storage tank with float switch and fuel level indication or <u>approved equivalent</u> shall be furnished and installed. The emergency system shall include low fuel level contacts for remote alarm. If necessary to guard against loss of prime to pump, a check valve shall be mounted on pump intake. The emergency system shall include a float switch, fuel level gauge and standard control panel.

A fuel containment system shall be provided to prevent the accidental release of fuel to the environment. The containment area shall be of sufficient size to contain 110% the volume of the largest fuel tank. A minimum 2" drain and valve shall be provided for drainage of the containment area. An approved epoxy coating shall be applied to any concrete area.

Fuel oil piping, including mounting of any required fuel tanks, shall be furnished and installed by the contractor.

(n) <u>Exhaust System</u>

The generator set supplier shall provide a critical-type silencer, with flexible exhaust fittings, properly sized and installed, according to the manufacturer's recommendation. The silencer shall be mounted so that its weight is not supported by the engine.

Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed the maximum limitations specified by the generator set manufacturer. The exhaust system shall include a flexible, seamless, stainless steel connection between the engine exhaust outlet and the rest of the exhaust system. The exhaust system shall be a part of generator enclosure.

(o) <u>Weatherproof Enclosure</u>

For generator installation in the outdoors, the weatherproof enclosure and all other items shall be designed and built by the engine manufacturer as an integral part of the entire generator set and shall be designed to perform without overheating in the ambient temperature specified. The city may require noise reduction enclosures

Enclosure shall be constructed of 14 or 16 gauge sheet metal suitably reinforced to be vibration free in the operating mode.

Four hinged doors shall be provided to allow complete access without their removal.

Each door shall have at least two satch-bearing points.

Side and rear panels shall be completely and simply removable for major service access.

Roof shall be peaked to allow drainage of rain water.

Baked enamel finish with primer and finish coat shall be painted before assembly. All fasteners shall be rust resistant.

Unit shall have sufficient guards to prevent entrance by small animals. Padlocks shall be provided.

Batteries shall be designed to fit inside enclosure and alongside the engine. Batteries under the generator are not acceptable.

Unit shall have coolant and oil drains outside the unit to facilitate maintenance. Each drain line shall have a high quality valve located near the fluid source.

Fuel filter shall be inside the base perimeter and located so spilled fuel cannot fall on hot parts of engine or generator. A cleanable primary fuel strainer shall be used to collect water and sediment between tank and main engine fuel filter.

Crankcase fumes disposal shall terminate in front of the radiator to prevent oil from collecting on the radiator core and reducing cooling capacity.

(p) Automatic Transfer Switch

The automatic transfer switch shall be part of the control panel described in Appendix B.7.f.

The transfer switch shall be provided with the following features:

Complete protection, close differential voltage sensing relays monitoring all three phases (pick-up set for 95% of nominal voltage, drop-out set for 85% nominal voltage).

Voltage sensing relay on emergency source (pick-up set for 95% of nominal frequency).

Time delay on engine starting--adjustable from 1 second to 300 seconds (factory set at 3 seconds.) Time delay normal to emergency transfer--adjustable from zero second to 300 seconds (factory set at 1 second). The contractor shall request time delay settings in accordance with the priority rating or their respective loads.

Time delay emergency to normal transfer--adjustable 30 seconds to 30 minutes (factory set at 5 minutes), and time delay bypass switch shall be provided on door of the switch cabinet.

Unload running time delay for emergency engine generator cooling down-adjustable from 0 to 5 minutes (factory set at 5 minutes) unless the engine generator control panel includes the cool down timer.

Automatic exercise control so as to exercise the generator (under full load) at a day, time and length of exercise as needed.

(q) <u>Warranty</u>

Products shall be guaranteed to be free from defects in material and workmanship under normal use and service for a period of one (1) year after start-up.

I <u>Flow Monitoring System</u>

(1) <u>General</u>

When indicated on the drawings or as required by Section 3.2.E.4, a flow monitoring system capable of indicating, recording, and totalizing wastewater flows shall be provided. The system shall include magnetic flow meter / transmitter, electronic recording receiver, and miscellaneous related accessories as specified herein. It shall be the Contractor's responsibility to provide and install such equipment resulting in a completely operational flow monitoring system.

(2) <u>Acoustic Sensors and Mounting Requirements</u>

Two flow sensors shall be permanently mounted to the pipe to ensure accurate and stable measurements of flow. The sensors shall be positioned in accordance with the manufacturer’s specifications and factory approved methods. Mounting templates and /or fixtures for sensor attachments shall be provided by manufacturer. The mounting hardware and transducers shall have sufficient integrity to maintain accurate sensor placement withstanding normal pipe vibration and shall be capable of operating over a temperature range of (-) 30 to 150 degrees F. In addition, the sensor shall be so designed as to operate under submerged conditions indefinitely. The acoustic sensors shall alternately transmit and receive acoustic energy pulses propagated along the centerline of the fluid. Only transmit – time method of operation will be accepted.

(a) For External Sensors (two inch Diameter Meters and Larger).

The integrity of the pipe shall be maintained during installation and operation. Cutting into the pipe to install the sensors or holders shall not be allowed. Stainless steel mounting bands shall be placed around the pipe circumference to secure the sensor brackets. The mounting bands shall have sufficient strength to maintain accurate sensor position. Positioning of the sensor mounting brackets shall be in accordance with manufacturer's specifications. The acoustic sensors shall be securely held in the sensor brackets and shall transmit acoustic energy through the pipe wall for measurement of flow. The sensors shall be designed as to be operated directly buried in accordance with the manufacturer's recommendations or underwater.

(b) For "Hot Shot" Sensors (12 inch Diameter and Larger).

Two acoustic sensors of the "hot shot" style shall be mounted on the piping at the position shown on the drawings. Valve assemblies shall be supplied to allow the insertion or withdrawal of the sensors without dewatering the conduit.

(c) For In Stream Wetted Sensors (24 inch Diameter and Larger).

The sensor design and mounting hardware shall be such as to allow mounting against the inside of the pipe wall. Installation shall be in accordance with the manufacturer's specifications.

(d) For Fabricated Spool Design.

The meter body shall be constructed from material, conforming to AWWA Class 150#, carbon steel for plain end connections. The design shall incorporate externally mounted sensors that are field replaceable factory mounted on the meter body. The design will be in accordance with ASME pressure vessel code.

(3) Transmitter Requirements.

The transmitter shall contain all the circuitry necessary to produce a (4-20 MA DC) signal linear with the flow rate. The transmitter shall be capable of measuring and totalizing forward and reverse flow. It shall be microprocessor controlled. The microprocessor shall be of a single chip design. The transmitter shall be housed in foam molded polycarbonate enclosure suitable for wall or panel mounting rated NEMA 4X. The display on the enclosure will be a 24 character, 2- line alpha numeric LCD clearly indicating instantaneous flow rate and totalized flow information. The transmitter shall utilize menu-driven sequencing of the internal functions from the front panel switches without the need or use of external equipment. The functions shall include: rate indication, totalization, on-line meter status, self-test, meter identification and tag number, 4-20 MA span adjustment, flow damping, 4-20 MA zero adjustment, meter re-scale and meter recalibration. Meter output shall be isolated 4-20 MA signal linearly proportional to the flow rate operating into a maximum of 1,000 ohms. The power requirements for the meter shall be a maximum of five watts operating on 117 VAC 50 /60 HZ. It shall be capable of operating on 12 VDC continuous or battery back up. The temperature range of the transmitter shall be 32-140 degrees F. For installations at wastewater treatment plant, the installation shall also include a remote chart recorder to be located in the operations building.

(4) Electronic Recording Receiver

The electronic recording receiver shall be of the solid state, null-balance, servo operated potentiometer type.

The instrument shall contain a differential amplifier, a TORQ-ER driving motor to position the pin, and a Flux Bridge contact-less solid state position feedback device for balancing. The instrument shall be capable of receiving one process variable input. Inputs shall be provided with electrical isolation. The instrument shall accept an input signal of 4 to 20 ADC. Electrical zero and span adjustments shall be provided. Power requirements shall be 120 VAC + 10%, 60 Hz. A power supply shall be provided for two-wire transmitters. Accuracy shall be + 0.5% of span, with repeatability of + 0.2% of span.

The Receiver shall be provided with an indicating 5 inch segmental scale.

The electronic recording receiver shall be housed in a cast aluminum case suitable for panel mounting. The case shall have a door with gasket and glass window. A 12 inch circular chart shall be provided, with 7 day/rev. and chart rotation. An eight (8) digit electronic totalizing counter shall also be provided.

(5) Performance Specifications.

The meter shall measure, indicate, totalize and record the flow within the following parameters:
Accuracy: 1% +/ - of actual flow above 1 foot per second
Linearity of the units: 0. 5% + / -
Repeatability: to within 0. 25 % + / -
Sensitivity: 0.005 feet per second

(6) Materials

Sensors: PVC
Strap-on Hardware: 304 stainless steel
Hot-Shot Valve Hardware: brass
Sensor Cable: Triax Beldon 9222
Sensor Cable Length: 1,000 feet maximum

(7) Flow Meter Maintenance.

The flow meter manufacturer shall incorporate trouble shooting guides with the instruction manuals. In addition the meter shall be designed to provide a continuous on line indication of meter status via the LCD display. The front panel shall have a menu with user operated self test program which can be activated to check signal strength, transmission status as well as electronic circuitry to assure reliable operation of the motor.

(8) Warranty and Service

(a) Warranty

Products shall be guaranteed to be free from defects in material and workmanship under normal use and service for a period of one (1) year after start-up.

(b) Service.

Service shall be available for instrument repair of the products. Manufacturer's service personal shall be based in Florida to insure a reasonable response time of not more than two working days.

j. Electrical Grounding System

(1) General

A grounding system shall be installed as per National Electrical Code, Local Codes and Ordinances. The drawings shall clearly show the Electrical Grounding System. An underground perimeter cable grounding system shall be installed with connections to at least the following equipment:

1. Wet Well Cover
2. Valve Vault Cover
3. Control Panels
4. Generator
5. Utility Company Transformer
6. Main Disconnect Switch
7. Fence

(2) <u>Material and Installation</u>

The drawings shall show details of material and installation to construct a completely functional and operational Electrical Grounding System.

k. <u>Inspection and Testing</u>

A factory representative knowledgeable in pump operation and maintenance shall inspect and supervise a test run at the pumping station covered by this Manual. A minimum of one (1) working day shall be provided for the inspections. Additional time made necessary by faulty or incomplete work or equipment malfunctions shall be provided as necessary to meet the requirements in this Manual at no additional cost to the City. Upon satisfactory completion of the test run, the factory representative shall issue the required manufacturer's certificate.

The test run shall demonstrate that all items of this Manual have been met by the equipment as installed and shall include, but not be limited to, the following tests:

1. That all units have been properly installed.

2. That the units operate without overheating or overloading any parts and without objectional vibration.

3. That there are no mechanical defects in any of the parts.

4. That the pumps can deliver the specified pressure and quantity.

5. That the pumps are capable of pumping the specified material.

6. That the pump controls perform satisfactorily.

l.. Required Submittals

Submittals shall be provided to the City in triplicate and include the following:

- Shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

- Descriptive literature, bulletins, and/or catalogs of the equipment.

- Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, submergence and horsepower. Curves shall be submitted on 8- 1/2" by 11" sheets, at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to maximum manufacturer recommended pump capacity. Catalog sheets showing a family of curves will not be acceptable.

- Complete layouts, wiring diagrams, elementary or control schematics, including coordination with other electrical control devices operating in conjunction with the pump control system. Suitable outline drawings shall be furnished for approval before proceeding with manufacture of any equipment. Standard preprinted sheets or drawings simply marked to indicate applicability will not be acceptable.

- A drawing showing the layout of the pump control panel shall be furnished. The layout shall indicate all devices mounted on the door and in the panel shall be completely identified.

- The weight of each pump.

- Complete motor data shall be submitted including:

  - Name plate identification
  - No-load current
  - Full load current
  - Full load efficiency
  - Locked rotor current
  - High potential test data
  - Bearing Inspection Report

m. Shop Painting

Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter. All pumps and motors shall be shop coated with a corrosion resistant paint proven to withstand an environment of raw wastewater. All nameplates shall be properly protected during painting.

Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to the City up to the time of the final acceptance test.

n. Handling

All parts and equipment shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation. Finished surfaces of all exposed pump openings shall be protected by wooden planks, strongly built and securely bolted thereto. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

o. Warranty

The pump manufacturer shall warrant the units being supplied to the City against defects in workmanship and material for a period of five (5) years or 10,000 hours.

p. Tools and Spare Parts

One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

The manufacturer shall have in stock the following spare parts for each size pump supplied:

1. One (1) upper bearing.
2. One (1) lower bearing.
3. One (1) set of upper and lower shaft seals.
4. One (1) set of "O-Rings" or gaskets required for replacement of bearings and seals.
5. One (1) set impeller wear ring, and impeller bolt and key
6. One (1) shaft sleeve (if applicable).
7. One (1) cable cap (if applicable).
8. One (1) motor cable and cable entry washer/grommet.
9. One (1) set of inspection plug washers.

The pump supplier shall have a guaranteed parts stock program in the State of Florida.

q. Chain Link Fence

(1) General

The contractor shall furnish and erect the chain link fence and gate in accordance with these specifications and in conformity with the lines, grades, notes and typical sections shown on the drawings and Details of the Standard Drawings.

(2) Materials

The fence, posts, fastenings, fittings and other accessories for chain link fence shall meet the requirements of AASHTO M 181 with the following changes:

1. The weight of coating of wire fabric shall be 1.2 ounces of zinc per square foot (Class B).

2. The galvanizing of steel materials shall be hot-dipped galvanized.

3. The weight of coating on posts and braces shall be 1.8 ounces of zinc per square foot, both inside and outside to meet the requirements of AASHTO M 111.

The base metal of the fence shall be a good commercial quality 9 Gage Steel wire. The fabric shall be of uniform quality, and shall be 6' high with a 2" mesh size.

All posts and rails shall be in accordance with the following schedule:

End, corner and pull posts 2-3/8"
O.D., Schedule 40.

Line posts and gate frames 2" O.D.,

Schedule 40.

Gate Posts - 3" O.D., Schedule 40.

Post braces and top rail - 1-5/8" O.D.,
Schedule 20.

Tension wire shall be 0.177" coiled spring wire tensioned along the bottom of the fabric and shall be coated similarly to the wire fence.

Miscellaneous fittings and hardware shall be zinc coated commercial quality or better steel or zinc coated cast or malleable iron as appropriate for the article.

Post caps, designed to provide a drive fit over the top of the tubular post to exclude moisture, shall be provided.

(3) Installation

(a) Post Setting

All posts shall be set 3' deep in concrete footings, 18" diameter for line posts, gate and corner posts.

After the post has been set, aligned and plumbed, the hole shall be filled with 2500 p.s.i. concrete. The concrete shall be thoroughly worked into the hole so as to leave no voids. The exposed surface of the concrete shall be crowned to shed water.

End, corner, pull and gate posts shall be braced to the nearest post with horizontal brace used as a compression member and a galvanized 3/8" steel truss rod and truss tightener used as a tension member. Corner posts and corner bracing shall be constructed at all changes of fence alignment of 30º or more. All chain link fence shall be constructed with a top rail and bottom tension wire.

(b) Gates

Swing gates shall be two (2), 6' wide double hung gates as indicated on the Details of the Standard Drawings and hinged to swing through 180º from closed to open and shall be complete with latches, locking device, stops keeper, hinges, fabric and braces. Gates shall be the same height as the fence and the gate fence shall be of the gage and quality as the fence.

Gate leaves less than 8' wide shall have truss rods or intermediate braces and gate leaves 8' or more in width shall have intermediate braces and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist.

(c) Placing Fence

The fence shall not be placed until the posts have been permanently positioned and concrete foundations have attained adequate strength. The fence shall be placed by securing one end and applying sufficient tension to remove all slack before making permanent attachments at intermediate points. The fence shall be fastened to all corner, end and pull posts by substantial and approved means. Tension for stretching the fence shall be applied by mechanical fence stretchers.

r <u>Wet Well Entrance</u>

The wet well entrance shall be paved from the street to the double gates. Pavement shall be at least ten feet wide.

g <u>Wet Well Grounds</u>

The grounds inside the fence shall be rock. Before the fence is installed three inches of ground around all pads and panel box stands shall be removed, weed control fiber put down and brought back to ground level with rock.

APPENDIX C

WATER DISTRIBUTION

1. Pipe material for water mains and service connections.

   a. General
   b. Pipe Inspection and Testing.
   c. PVC Pipe
      (1) PVC PIPE
      (2) Joints.
      (3) Fittings.
   d. Ductile Iron Pipe and Fittings
      (1) Ductile Iron Pipe
      (2) Fittings.
      (3) Joints.
      (4) Coatings and Linings.
      (5) Polyethylene Encasement.
   e. Service Pipe, Stops, Fittings, and Service Saddles
      (1) Service Pipe.
      (2) Stops
      (3) Fittings.
      (4) Service Saddles

2, Pipe installation for water mains.

   a. General
   b. Pipe Handling.
   c. Separation of Water Mains, Sewers and Reclaimed Water
      (1) General
      (2) Horizontal Separation
      (3) Vertical Separation
      (4). Crossing of Water Mains and Sewers.
   d. Trench Preparation and Pipe Bedding
      (1) Trench Preparation and Pipe Bedding.
      (2) Pipe Preparation and Handling.
      (3) Trench Dewatering and Drainage Control.
      (4) Survey Line and Grade.
      (5) Pipe Laying in Trench. 6
      (6) Laying PVC Pipe.
      (7) Laying Ductile Iron Pipe.
      (8) Laying of Pipes on Curves
      (9) Pipe Restraining and Thrust Block.
      (10) Bedding and Backfill for Pipes.

APPENDIX C

WATER DISTRIBUTION

1. Pipe material for water mains and service connections.

a. General

These specifications cover the pipe, fittings, and accessory items used for water distribution systems. Pipe used in water distribution systems shall be either standard PVC, fusible PVC, or DIP. The contractor shall be responsible for all materials furnished and storage of same, until the date of substantial completion. The contractor shall replace at his own expense all materials found to be defective or damaged in handling or storage. The contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified herein. All pipe delivered to project site for installation is subject to random testing for compliance with the designated specifications.

b. Pipe Inspection and Testing.

Requirements specified in Appendix B, paragraph 1 e. shall apply

.

c. PVC Pipe

(1) Standard PVC PIPE

PVC Pipe of nominal diameter, four inches through 12 inches, shall be manufactured in accordance with AWWA Standard C900, latest edition. All PVC pipe shall be DR of 18. Pipe shall be the same O.D. as ductile iron pipe. Pipe of 14 inch diameter and larger shall be manufactured in accordance with AWWA Standard C905, latest edition, and shall have a DR of 18. PVC pipe shall be blue in color. All PVC pipe under pavement must be sleeved, refer to Appendix A.4 b. for sleeve materials.

(2) Joints.

PVC pipe shall have integral bell push on type joints conforming to ASTM D3139

.
(3) Fittings.

Fittings used with PVC pipe shall conform to Appendix B, paragraph

d. Ductile Iron Pipe and Fittings

(1) Ductile Iron Pipe.

D I P shall only be used with written permission of city engineer and utility Department

All ductile iron pipe of nominal diameter four inches through 20 inches shall be Class 350 and for pipe sizes larger than 20 inches shall be Class 250 and shall conform to ANSI/AWWA A21.51/Cl5l

.
(2) Fittings.

Any fittings required shall be mechanical joint ductile iron or gray iron conforming to ANSI/AWWA A21.10/C110, 250 Psi minimum pressure rating, or ductile iron compact fittings in accordance with ANSI/AWWA A21.53/C153

.
(3) Joints.

Joints for ductile iron pipe and fittings shall be push- on or mechanical joints conforming to ANSI/AWWA A21.11/C111. Where called for on the drawings, restrained or flanged joints shall be provided. Flanged joints shall conform to ANSI Standard B 16.1-125 LB. Restrained joints shall conform to Appendix A, paragraph 6. b. and paragraph 6.c.

(4) Coatings and Linings**.**

Where ductile iron pipe and fittings are to be below ground or installed in a casing pipe the coating shall be a minimum 1.0 mil thick in accordance with ANSI/AWWA A21.51/C151. Where ductile iron pipe and fittings are to be installed above ground, pipe, fittings and valves shall be thoroughly cleaned and given one field coat (minimum 1.5 mils dry thickness) of rust inhibitor primer. Intermediate and finished field coats of Alkyd shall also be applied by the contractor (minimum 1.5 mils dry thickness each coat). Primer and field coats shall be compatible and shall be applied in accordance with the manufacturers recommendations. Final field coat shall be green for raw water and blue for finished water. All ductile iron pipe and fittings shall have an interior protective lining of cement-mortar with a seal coat of asphalt material in accordance with ANSI/AWWA A21.4/C104.

(5) Polyethylene Encasement.

The pipe shall be polyethylene encased (8 mil) where shown on the drawings or required by the City in accordance with ANSI/AWWA A21.51/C105.

e. Service Pipe, Stops, Fittings, and Service Saddles

(1) Service Pipe.

All service lines shall be one inch, one and one-half inch or two inch polyethylene tubing conforming to specifications in AWWA C800 and AWWA C901

.

(2) Stops.

Corporation stops shall be one inch, one and one-half inch or two inch brass, equipped with connections compatible with the polyethylene tubing and threaded in accordance with specifications in AWWA C800 and AWWA C901. Curb stops shall be sized to match the meter size and conform to the specifications in AWWA C800 and AWWA C901

.

(3) Fittings.

Fittings shall be brass, cast and machined in accordance with specifications in AWWA C800 and AWWA C901, with compatible polyethylene tubing connections

.

(4) Service Saddles

A service saddle shall be used for all service line taps. Service saddles shall be double strap, anchored by a minimum four bolt pattern on a ductile iron saddle body. Service saddles for PVC pipe shall have the double strap sized exactly to the pipe outside diameter. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel. The City may require a stainless steel strap and fusion epoxy or nylon coated ductile iron body with stainless steel hardware in areas designated as corrosive.

2, Pipe installation for water mains.

a. General

Pipe shall be installed in accordance with the manufacturer's specifications and instructions for the type of pipe used and applicable AWWA standards, such as C900 and C903, unless otherwise stated in these specifications.

b. Pipe Handling.

All types of pipe shall be handled in such manner as will prevent damage to the pipe or coating. Accidental damage to pipe or coating shall be repaired to the satisfaction of the City or be removed from the job. When not being handled, the pipe shall be supported on timber cradles or on properly prepared ground, graded to eliminate all rock points and to provide uniform support along the full length. When being transported, the pipe shall be supported at all times in a manner which will not permit distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the City, is damaged beyond repair by the contractor shall be removed from the site of the work and replaced with another unit. Joint gaskets shall be stored in clean, dark, dry location until immediately before use. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and relaid. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a water-tight plug or by other means approved by the City to ensure absolute cleanliness inside the pipe

.

c. Separation of Water Mains, Sewers and Reclaimed Water

(1) General

Water mains that are laid in the vicinity of pipe lines designated to carry raw wastewater or reclaimed water (wastewater effluent) shall meet the horizontal and vertical separations specified below.

(2) Horizontal Separation

Normal conditions: water mains shall be located at least 10' horizontally from pipes carrying raw wastewater, and 3' horizontally from pipes carrying reclaimed water, whenever possible. The distance shall be measured from inside edge of pipe to inside edge of pipe.

Unusual conditions: When local conditions prevent a horizontal separation of ten feet, a water main may be laid closer to a pipe carrying raw wastewater provided that the bottom of the water main is at least 18 inches above the top of the sewer pipe and the water main is laid in a separate trench or on an undisturbed earth shelf. All Florida Department of Environmental Protection (FDEP) regulations regarding separation between water and sewer mains shall apply and in the case of a discrepancy between the City and FDEP requirements, the stricter shall prevail. However, in no circumstance shall a reclaimed water pipe be installed closer than three feet from a water main.

(3) Vertical Separation

Normal conditions: water mains shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer or reclaimed water pipe.
Unusual conditions: When construction conditions prevent a vertical separation of 18 inches as described herein above, the sewer or reclaimed water pipe shall be constructed of ductile iron pipe with mechanical joints.

(4). Crossing of Water Mains and Sewers.

Water mains shall be above the sewer or reclaimed water pipe whenever they cross. A vertical separation of at least 18 inches shall be maintained between the top of the sewer or reclaimed water pipe, and the bottom of the water main. Adequate structural support for both the water main and sewers shall be provided to prevent excessive deflection of joints and settling. Sewer or reclaimed water mains shall be constructed of PVC or ductile iron pipe with mechanical joints and the length of PVC or ductile iron pipe shall be minimum 18 feet and centered at the point of crossing so that the joints will be equidistant and as far as possible from the water main.

d. Trench Preparation and Pipe Bedding

(1) Trench Preparation and Pipe Bedding.

Provisions of Appendix A, paragraph 3.h. shall apply. Also refer to Standard Drawings.

(2) Pipe Preparation and Handling.

All pipe and fittings shall be inspected prior to lowering into trench to insure no cracked, broken, or otherwise defective materials are being used. Contractor shall clean ends of pipe thoroughly and remove foreign matter and dirt from inside of pipe and keep clean during and after laying. Contractor shall use proper implements, tools, and facilities for the safe and proper protection of the work. Contractor shall lower pipe into the trench in such a manner as to avoid any physical damage to the pipe and shall remove all damaged pipe from the job site. Care shall be taken to not drop or dump pipe into trenches under any circumstances.

(3) Trench Dewatering and Drainage Control.

Specifications from Appendix A-3.f shall apply. Contractor shall prevent water from entering the trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water.

(4) Survey Line and Grade.

Pipe shall be laid to the lines and grades shown on the plans. The contractor shall provide line and grade stakes at a 100’ maximum spacing and at all line or grade change locations. Contractor shall provide Temporary Bench Marks at maximum 1,000’ intervals in compliance with state statutes. The minimum pipe depth shall be 3’ feet below the finished grade surface or 3’ below the elevation of the edge of pavement of the road surface whichever is greater.

(5) Pipe Laying in Trench.

Contractor shall prevent foreign material from entering the pipe while it is being placed in the trench. Contractor shall remove all foreign material from the pipe or joint ring before the next pipe is placed. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into the pipe, the City may require that snugly-fitted, tightly-woven canvas bags be placed over each end before lowering the pipe. The bags shall be left in place until the connection is to be made to the adjacent pipe. During laying operations, contractor shall keep debris, tools, clothing, or other materials out of the pipe.

(6) Laying PVC Pipe.

All PVC pipe shall be installed in accordance with standards set forth in the UNI-BELL “ Handbook of PVC pipe design and construction” unless such standards conflict with this Code in which case this Code shall apply.

(7) Laying Ductile Iron Pipe.

All ductile iron pipe shall be installed in accordance with AWWA C600 unless such standards conflict with this Code in which case this Code shall apply. Contractor shall cut pipe only as necessary to comply with alignment shown on the plans. Flame cutting of pipe shall not be allowed. Contractor shall provide special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes shall be permitted under any circumstances. The pipe shall be polyethylene encased (8 mil) where shown on the drawings in accordance with ANSI/AWWA A21.51/C105

(8) Laying of Pipes on Curves

Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflections at the joints. Maximum deflections at pipe joints and laying radius for the various pipe lengths shall be as recommended by the pipe manufacturer.

(9) Pipe Restraining and Thrust Block.

Requirements specified in Appendix A, paragraph 6.b., 6.c., and 6.d. shall apply.

(10) Bedding and Backfill for Pipes.

Requirements specified in Appendix A, paragraph 3.h. shall apply.

e. Hydrostatic Tests

(1) General.

Hydrostatic tests shall consist of pressure test and leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints and valves including all service lines to the curb stops. Air testing of pressure pipes will not be permitted under any circumstance. Tests may be made on sections not exceeding 2,000’, when this procedure is acceptable to the City. Contractor shall furnish all necessary equipment and material, make all taps, and furnish all closure pieces in the pipe as required. Equipment to be furnished by the contractor shall include graduated containers, pressure gauges, hydraulic force pumps, and suitable hoses and piping. The City will monitor and approve a satisfactory test. The contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified. Where any section of pipe is provided with concrete thrust blocking, pressure test will not be made until at least five days have elapsed after the thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be reduced to 24 hours if the City concurs that the concrete has cured and reached adequate strength.

(2) Testing Criteria.

All pipe sections to be pressure tested shall be subjected to a hydrostatic pressure of 150 psi. The duration of each pressure test shall be for a period of 2 hours. If during the test, the integrity of the tested line is in question, the City may require a 6 hour pressure test. The basic provisions of AWWA C600 for Ductile Iron Pipe or C605 for PVC Pipe shall be applicable.

(3) Procedure for Pressure Test.

Each section of pipe to be tested, as determined by the City, shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered in consequence of this pressure test, all such items shall be removed and replaced by the contractor with sound material and the test shall be repeated until satisfactory results are obtained. Provisions of AWWA C600 or C605, where applicable, shall apply

.

(4) Procedure for Leakage Test.

After completion of the pressure test, a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Applicable provisions of AWWA C600 for Ductile Iron Pipe and C605 for PVC Pipe shall apply. Allowable leakage in gallons per hour for pipeline shall not be greater than that determined by the formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

Note:

L = Allowable leakage in gallons per hour.
S = Length of pipe tested, in feet.
D = Nominal diameter of the pipe in inches.

P = Average test pressure during leakage test in pounds per square inch gauge.

Leakage is defined as the quantity of water to be supplied in the newly laid pipe or any valved section under test, which is necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. Should any test of pipe laid disclose leakage greater than that allowed, contractor shall locate and replace or repair the defective joints, pipe or valve until the leakage from subsequent testing is within the specified allowance.

f. Disinfection of Water Mains

(1) General.

Before being placed in service, all new water mains shall be chlorinated in accordance with the specifications below and the procedures outlined in AWWA C651 “Standard Procedure for Disinfecting Water Mains”

(2) Flushing.

Sections of pipe to be disinfected shall first be flushed (full diameter) to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a blow-off valve shall be provided large enough to develop a velo of at least 2.5 feet per second in the main. All taps required for chlorination or flushing purpose, or for temporary or permanent release of air shall be provided for by the contractor as a part of the construction of water mains. After the disinfection, all such taps shall be sealed to the satisfaction of the City

.

(3) Disinfection Criteria**.**

Before being placed into service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that the initial chlorine residual is not less than 50 mg/l and that a chlorine residual of not less than 25 mg/l remains in the water after standing 24 hours in the pipe.

(4) Form of Applied Chlorine.

Chlorine may be applied as a liquid chlorine (gas-water mixture as specified in AWWA B300. Contractor shall assume responsibility for safe handling of chlorine and shall meet requirements of OSHA and other regulatory agencies for safe handling of chlorine.

(5) Point of Application.

The preferred point of application of the chlorinating agent is at the beginning of the pipeline extension or any valved section of it, and through a corporation stop inserted in the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of applications may be used when approved or directed by the City

.

(6) Operation of City Valves.

Valves shall be manipulated by the City personnel so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

(7) Retention Period.

Treated water shall be retained in the pipe at least 24 hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 25 mg/l.

(8) Chlorinating Valves and Hydrants.

In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent and under normal operating pressure.

(9) Final Flushing and Testing.

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its lengths shows upon test, a free chlorine residual not in excess of that normally carried in the system. After flushing, water samples collected on 2 successive days from the treated piping system, as directed by the City, shall show acceptable, bacteriological results. All bacteriological testing shall be performed by the Contractor. However, in order to expedite testing, the Developer may request testing by a private laboratory. All such bacteriological analysis must be performed by a laboratory certified by the State of Florida. Proper chain of custody procedures must be followed. Copies of testing results and all related correspondence with the FDEP shall be submitted to the City.

(10) Repetition of Flushing and Testing.

Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the contractor until satisfactory results are obtained.

g. Notification and Connection to Existing Mains.

Requirements specified in Appendix A, paragraph 7. shall apply.

h. Water Service Piping and Connection.

Water service piping and connection shall be installed as indicated in the Standard Drawings. The location of all service lines shall be as shown on the drawings and shall be either single or dual service. On curbed streets the exact location for each installed service shall be marked by etching or cutting a “W” in the concrete curb. Where no curb exists, locations shall be adequately marked by a method approved by the City. Brass or aluminum markers may also be used.

i. Location and Identification.

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All non-metallic water mains shall be installed with a continuous, insulated 14 gauge copper wire installed directly on top of the pipe for location purposes. Detectable tape shall be placed 1’ above the top of the pipe. See Standard Drawings. In addition, all PVC water mains shall be either a solid blue color or white with blue lettering. All lettering shall appear legibly on pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use. As an alternate to the above requirements metallic tape shall be installed 12” above the pipe. All ductile iron water mains shall be marked with a continuous stripe located within the top 90° of the pipe. Said stripe shall be a minimum 2” in width and shall be blue in color. Backfill shall not be placed for 30 minutes following paint application.

3. Valves, hydrants and accessories for water mains.

a. General.

All valves and appurtenances shall be products of well established firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

b. Resilient Seat Gate Valves

(1) General.

All gate valves 12” and smaller shall be resilient seat gate valves. Such valves shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509, latest revision, and in accordance with the following specifications. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.

(2) Material.

The valve body, bonnet, and bonnet cover shall be cast iron ASTM A126, Class B. All ferrous surface inside and outside shall have a fusion-bonded epoxy coating. A 2” wrench nut shall be provided for operating the valve. All valves are to be tested in strict accordance with AWWA C509

(3) Miscellaneous Requirements.

The valves shall be non-rising stem with the stem made of cast, forged, or rolled bronze as specified in AWWA C509. Two stem seals shall be provided and shall be of the O-ring type. The stem nut must be independent of the gate. The resilient sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.

c. Butterfly Valves

(1) General.

All shut-off valves 16” and larger shall be Butterfly valves. Butterfly valves and operators shall conform to the AWWA Standard Specifications for Rubber Seated Butterfly Valves, Designation C504, except as hereinafter specified. Valves, except as specified hereinafter, shall be Class 150A or B.

(2) Material.

The valve body shall be constructed of close grain cast iron per ASTM A126, Class B or equivalent material. All retaining segments and adjusting devices shall be of corrosion resistant material. Valve seats shall be a natural rubber or synthetic rubber compound. Valve seats 30” and larger shall be field adjustable and replaceable without dismounting operator disc or shaft and without removing the valve from the line. All retaining segments and adjusting devices shall be of corrosion resistant material. Valves 24” and smaller shall have bonded or mechanically restrained seats as outlined in AWWA C504.

(3) Face to Face Dimension.

The face-to-face dimensions of valves shall be in accordance with above mentioned AWWA Specification for short-body valve.

(4) Valve Shaft.

The valve shaft shall be turned, ground, and polished, constructed of 18-8 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. Shaft shall be of either a one piece unit extending full size through the valve disc and valve bearing or it may be of a stub shaft design

(5) Valve Operator.

In general, the butterfly valve operators shall conform to the requirements of AWWA Standard Specifications for Rubber Seated Butterfly Valves, Designation C504, in so far as applicable.

d. Valve Installation.

All valves shall be inspected upon delivery in the field to insure proper working order before installation. They shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connection ends furnished. All valves and appurtenances shall be installed true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the City before they are installed. Valves shall be installed in a vertical position and be provided with a standard valve box so arranged that no shock will be transmitted to the valve. The box shall be vertically centered over the operating nut, and the cast iron box cover shall be set flush with the road bed or finished surface. After installation, all valves shall be subjected to the field test for piping as outlined in Appendix A 2. E. of these specifications. Should any defects in materials or workmanship appear during these tests, the contractor shall correct such defects to the satisfaction of the City. Flanged joints shall be made with hot dipped galvanized bolts, nuts and washers. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts. All exposed bolts shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two coats of bituminous paint.

e. Valve Boxes.

All buried valves shall have cast-iron three piece valve boxes. Valve boxes shall be provided with suitable heavy bonnets and shall extend to such elevation at or slightly above the finished grade surface as directed by the City. The barrel shall be two-piece, sliding type, having 5-1/4" shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with cast iron covers. Covers shall have "Water" cast into the top for all water mains. The actuating nuts for deeper valves shall be extended to come up to 4' depth below finished grade. Care shall be taken while constructing valve boxes to ensure that valve stems are vertical and the cast iron box has been placed over the stem with base bearing on compacted fill and top flush with final grade. Boxes shall have sufficient bracing to maintain alignment during backfilling. Contractor shall remove any sand or undesirable fill from valve box prior to final inspection. Each valve box shall have a 2' x 2' concrete pad 4" thick. Etched in the pad will be arrows to indicate the direction of flow the valve will control and the size of the valve.

f. Air Release Valves.

The air release valves for use in water mains shall be installed as shown on the Standard Drawings. The valves shall have a cast iron body, cover and baffle, stainless steel float, bronze water diffuser, Buna-N or Viton seat and stainless steel trim. Valves shall be provided with a vacuum check to prevent air from reentering the line. The fittings shall be threaded.

g. Fire Hydrants.

(1) Material.

Fire hydrants shall have 5-1/4" valve opening and shall comply with AWWA Standard C502 for fire hydrants for water works service, unless in conflict with this Code in which case this Code shall apply. Each hydrant Shall have 6" mechanical joints ends with harnessing lugs (dog ears) and shall open by turning to the left (counter clockwise).Fire hydrants shall be of ample length for 42" depth of bury. It shall be provided with two 2-1/2" hose nozzles and one 4-1/2" pumper nozzle, all having National Standard hose threads. Nozzles shall have caps attached by chains. Operating nuts shall be AWWA Standard (pentagonal, measuring 1-1/2" point to flat). Fire hydrants shall be equipped with "O-Ring" packing.

(2) Painting.

All iron parts of the hydrant both inside and outside shall be painted, in accordance with AWWA C502. All inside surfaces and the outside surfaces below the ground line shall be coated with asphalt varnish in accordance with AWWA C550. They shall be covered with two coats, the first having dried thoroughly before the second is applied. The outside of the hydrant above the finished ground line shall be thoroughly cleaned and there after painted with one coat of paint of a durable composition, and one additional coat of red paint.

(3) Construction Details.

Hydrants shall be plumb and shall be set so that the lowest hose connection is at least 18” above the surrounding finished grade. All hydrants shall be inspected in the field upon delivery to the job to insure proper operation before installation. The resetting of existing hydrants and moving and reconnecting of existing hydrants shall be handled in a manner similar to a new installation. (Fire flows shall be done on each hydrant and a copy of the results submitted to the City). Hydrant shall be constructed in accordance with the Standard Drawings.

(4) Location.

Fire hydrants shall be located in the general location as shown on the drawings. Final field location of all hydrants shall be as approved by the City. All hydrants shall be located no less than 5’ and no more than 10’ from the edge of pavement of the adjacent roadway and no less than 5’ from any physical feature which may obstruct access or view of any hydrant unless otherwise approved by the City

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h. Water Meters.

All water meters 4” and less shall be the positive displacement type with brass bodies. Water meters greater than 4” shall be either the compound or turbine type. Turbine types will be used for irrigation only. All meters shall register in gallons per minute (gpm) with leak indicator, shall have oil filled hermetically sealed dial and shall be programmed to read in thousands. All meters shall be compatible with all Neptune meter reading equipment and billing software.

i Backflow Preventer.

All potable water lines shall have a backflow preventer. The type shall be determined by the city.

APPENDIX D

RECLAIMED WATER TRANSMISSION/DISTRIBUTION

3. <u>VALVES, HYDRANTS AND ACCESSORIES FOR RECLAIMED WATER MAINS</u>

   a. <u>General</u>

   b. <u>Resilient Seat Gate Valves</u>

   c. <u>Butterfly Valves</u>

   d. <u>Valve Installation</u>

   e. <u>Valve Boxes</u>

   f. <u>Air Release Valves</u>

   g. <u>Fire Hydrants</u>

APPENDIX D
RECLAIMED WATER TRANSMISSION/DISTRIBUTION

1. PIPE MATERIAL FOR RECLAIMED WATER MAINS

a. General

These specifications cover the pipe, fittings, and accessory items used for reclaimed water transmission and distribution systems.

Pipe used in reclaimed water transmission and distribution systems shall either be PVC or DIP.

The contractor shall be responsible for all materials furnished and storage of same, until the date of substantial completion. The contractor shall replace at his own expense all materials found to be defective or damaged in handling or storage. The contractor shall, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified herein. All pipe delivered to the project site for installation is subject to random testing for compliance with the designated specifications.

b. Pipe Inspection and Testing

The reclaimed water pipe shall be inspected and tested as required in Appendix B, Section 1.e.

c. PVC Pipe

(1) PVC Pipe

All PVC pipe of nominal diameter 4" through 12" shall be manufactured in accordance with AWWA standard C900, latest edition, and shall have a DR of 18. Pipe of 14" diameter and larger shall be manufactured in accordance with AWWA C905, latest edition, and shall have a DR of 18. Pipe shall have the same O.D as DIP. Pipe shall be lavender color.

(2) Joints

PVC pipe shall have integral bell push on type joints conforming to ASTM D3139.

(3) Fittings

Fittings used with PVC pipe shall conform to Appendix C, Section 1.d.

d. Ductile Iron Pipe and Fittings

(1) Ductile Iron Pipe

DIP shall only be used with written permission from the city engineer and the city utility department.

All DIP of nominal diameter 4" through 20" shall be Class 350 and for pipe larger than 20" shall be Class 250 and shall conform to ANSI/AWWA A21.51/C151.

(2) Fittings

Any fittings required shall be mechanical joint ductile iron or gray iron conforming to ANSI/AWWA A21.10/C110, 250 psi minimum working pressure rating, or ductile iron compact fittings in accordance with ANSI/AWWA A21.53/C153.

(3) Joints

Joints for DIP and fittings shall be push-on or mechanical joints conforming to ANSI/AWWA A21.11/C111. Where called for on the drawings, restrained or flanged joints shall be provided. Flanged joints shall conform to ANSI Standard B16.1-125 lb. Restrained joints shall conform to Appendx A, Sections 6.b. and 6.c.

(4) Coatings and Linings

Where DIP and fittings are to be below ground or installed in a casing pipe the coating shall be a minimum of 1.0 mil thick in accordance with ANSI/AWWA A21.51/C151. Where DIP and fittings are to be installed above ground, pipe, fittings and valves shall be thoroughly cleaned and given one (1) coat (minimum 1.5 mil dry thickness) of rust inhibitor primer. Immediate and finished field coats of Alkyd shall also be applied by the contractor (minimum 1.5 mils dry thickness each coat). Primer and field coats shall be compatible and shall be applied in accordance with the manufacturers recommendations. Final field coat shall be lavender.

All DIP and fittings shall have an interior protective lining of cement - mortar with a seal coat of asphaltic material in accordance with ANSI/AWWA A21.4/C104.

(5) Polyethylene Encasement

The DIP shall be polyethylene encased (8 mil) where shown on the drawings or required by the City in accordance with ANSI/AWWA A21.51/C105.

e. Service Pipe, Stops, Fittings and Service Saddles

(1) Service Pipe

Service pipe shall be 1", 1-1/2" or 2" polyethylene tubing conforming to specifications in AWWA C800 and AWWA C901. Larger size service pipe, 3" and above shall be PVC pipe conforming to paragraph c.(1) above. All service pipe shall be lavender in color.

(2) Stops

Corporation stops shall be 1", 1-1/2" or 2" brass, equipped with connections compatible with the polyethylene tubing and threaded in accordance with specifications in AWWA C800 and AWWA C901. Curb stops shall be sized to match the meter size and conform to the specifications in AWWA C800 and AWWA C901.

(3) Fittings

Fittings shall be brass, cast and machined in accordance with specifications in AWWA C800 and AWWA C901, with compatible polyethylene connections.

(4) Service Saddles

A service saddle shall be used for all service line taps. Service saddles shall be double strap, anchored by a minimum four (4) bolt pattern on a ductile iron saddle body. Service saddles for PVC pipe shall have the double strap sized exactly to the pipe outside diameter. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel.

The City may require stainless steel straps and fusion epoxy or nylon coated ductile iron body with stainless steel hardware in areas designated as corrosive.

2. PIPE INSTALLATION FOR RECLAIMED WATER MAINS

a. General

Pipe shall be installed in accordance with the manufacturer's specifications and instructions for the type of pipe used and applicable AWWA standards, such as AWWA C600 and C605, unless otherwise stated in these specifications.

b. Pipe Handling

All pipe, fittings and appurtenances shall be handled in such a manner as will prevent damage as specified in Appendix C, Section 2.b.

c. Separation of Reclaimed Water Mains, Sewers and Water Mains

When reclaimed water mains are laid in the vicinity of pipe lines designated to carry potable water or raw wastewater they shall meet horizontal and vertical separation distance requirements specified in Appendix C, Section 2.c.

d. Trench Preparation and Pipe Bedding

The trench preparation and bedding for the reclaimed water main shall meet the requirements specified in Appendix C, Section 2.d.

e. Hydrostatic Tests

Hydrostatic testing of the reclaimed water mains shall comply with the requirements specified in Appendix C, Section 2.e.

f. Disinfection Reclaimed Water Mains

Before being placed into service, all new reclaimed water mains shall be chlorinated in accordance with Appendix C, Section 2.f. However, bacteriological tests as specified in Appendix C, Section 2.f.(9) will not be required.

g. Notification and Connection to Existing Reclaimed Water Main

Connections to the existing reclaimed water main shall comply with the requirements specified in Appendix A, Section 7.

h. Reclaimed Water Service Piping and Connection

Reclaimed water service piping and connection shall be installed as indicated in the Standard Drawings for a water service connection. The location of all serve lines shall be as shown on the drawings and shall be either single or dual service. On curbed streets the exact location for each installed service shall be marked by etching or cutting a "RW" in the concrete curb. Where no curb exists, locations shall be adequately marked by a method approved by the City.

i. Location and Identification

All non-metallic reclaimed water mains shall be installed with a continuous, insulated 14 gauge copper wire installed directly on top of the pipe for location purposes. Detectable tape shall be placed 1' above the top of the pipe. See Standard Drawings. In addition, all PVC reclaimed water mains shall be a solid lavender color. All lettering shall appear legibly on pipe and shall run the entire length of the pipe. Lettering shall read as is acceptable for the intended use.

All DIP reclaimed water mains shall be marked with a continuous stripe located within the top 90º of the pipe. Said stripe shall be a minimum 2" in width and shall be lavender in color. Backfill shall not be placed for 30 minutes following paint application.

3. VALVES, HYDRANTS AND ACCESSORIES FOR RECLAIMED WATER MAINS

a. General

All valves and appurtenances shall be products of well established firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed with the best practices and methods and shall comply with these specifications as applicable.

b. Resilient Seat Gate Valves

The resilient seat gate valves shall meet the requirements of AWWA C509 and the Appendix C, Section 3.b. of these Specifications.

c. Butterfly Valves

All shut-off valves 16" and larger shall be butterfly valves and shall conform to the AWWA C504 and Appendix C, Section 3.c. of these Specifications.

d. Valve Installation

All valves shall be inspected and installed in accordance with the AWWA Standards for the type of valve and connection and shall comply with the requirements specified in Appendix C, Section 3.d.

e. Valve Boxes

All buried valves shall have cast-iron three (3) piece valve boxes and shall comply with the requirements specified in Appendix C, Section 3.e., except that covers shall have "Reclaimed Water" cast into the top.

f. Air Release Valves

The air release valves for use in the reclaimed water mains shall be installed as shown on the Standard Drawings and shall comply with the requirements specified in Appendix C, Section 3.f.

g. Fire Hydrants

Fire hydrants installed on the reclaimed water mains shall meet the requirements specified in Appendix C.3.g., except that the final exterior coat shall be lavender.

APPENDIX E

INTERIM PACKAGE AND SUBREGIONAL WASTEWATER TREATMENT FACILITIES DESIGN CRITERIA

APPENDIX E

INTERIM PACKAGE AND SUBREGIONAL WASTEWATER TREATMENT FACILITIES DESIGN CRITERIA

1. ENGINEERING

a. Scope and Intent

The scope of this Design Criteria for Interim Package and Subregional Wastewater Treatment Facilities (WWTF) for City of Umatilla, Florida include guidelines for engineering, general aspects for design, influent pumping stations, preliminary, secondary and advanced treatment facilities, disinfection, sludge treatment and management, treated effluent disposal, and instrumentation and power systems. This design criteria is not a facility specification or a facility design; rather this section provides criteria guidelines for future design activities in the City. At this juncture, some technical areas may not have been considered or may have been considered not favorable for the present "state of the art" in wastewater treatment. The intent of this section is to state the present guidelines of design criteria for interim package and subregional WWTFs which are intended to be owned or operated by the City or to be connected to the City system. Moreover, this section is not intended to preclude innovative designs, alternate designs or other process trains which the City's design engineer may consider more appropriate. Rather, this design criteria permits the City staff to recognize deviations from the criteria and discuss justifications for the deviations with a sound design basis for comparison.

b. Purpose

The purpose of this section is to provide guidance for the selection of wastewater treatment processes equipment and materials which will produce a final effluent which will meet the requirements established by the Florida Department of Environmental Protection (FDEP). Some of the problems associated with the design and operations of an adequate WWTF are:

(1) Variation: The wide variation which occurs in the composition of the municipal wastewater. While generated mainly in residential and commercial areas, municipal wastewater may contain some storm water discharge, infiltration, and minor amount of miscellaneous industrial wastes. The wide range of organic and inorganic compounds contained in these flows impose serious problems in the selection of the treatment process and on the effective operation of the plant.

(2) Quantity: The quantity of the influent flow varies widely. Significant changes in the flow rate may occur over a relatively short period of time. These surges impose serious problems for both the system's hydraulic balance and treatment processes.

(3) Effluent Standards: High effluent standards promulgated by the State and/or Federal agencies having jurisdiction in the area frequently require a quality of treatment which necessitates the use of a sophisticated, involved and expensive process.

(4) Technical Design: Appropriate technical design data is frequently unavailable or inadequate, impairing confidence in and the reliability of the performance of a specific system or subsystem.

(5) Inherent Problems: The inherent problems associated with odor, noise, traffic, and plant operation demand that aesthetic considerations be a prime factor in site selection, design, construction and plant operation.

(6) Design & Operational Data: Design and operation data available from recent research in many areas of wastewater treatment have not been correlated to the point of acceptable engineering practice.

c. Facility Designations

(1) Size

The facility guidelines are stipulated with respect to flow capacity throughout this manual. These flow designations are intended to be guidelines for design. Such flow capacities assume that the average 5-day carbonacious biochemical oxygen demand (BOD_5) and total suspended solids (TSS) loadings are as presented in Section E.2. As the BOD_5 and TSS loadings are defined for a specific facility, then an adjustment of the applicable wastewater flow capacity guidelines may be appropriate.

The minimum initial phase of a subregional WWTF shall be 0.1 million gallons per day (MGD). The primary flow categories shall be as follows:

- From 0.1 MGD to 0.5 MGD.
- Greater than 0.5 MGD to 2.0 MGD.
- Greater than 2.0 MGD.

Other flow distinctions are made in this section and are not to be precluded by the above general category delineations. The maximum capacity facility provided for herein is 10.0 MGD.

All WWTFs with an average daily flow of less than 0.10 MGD in capacity will be considered package WWTFs. Interim package WWTFs must:

i. Include provisions for interconnection (i.e., manifold force main, gravity, etc.) to a sub-regional or City sub-regional facility. Such provisions must be approved by the City, and be consistent with the City's Comprehensive Land Use Plan and City Utility System Master Plan for the area.

ii. Include the investigation and rationale why an interim package WWTF is being proposed versus an interconnection.

iii. Include an agreement to connect to a sub-regional system once such system is available and decommission the interim package WWTF.

(2) Facility Description

Throughout this section facility descriptions are presented with regard to process, equipment and material. Moreover, annual capital, operation and maintenance (O&M) costs for the WWTF shall be provided to the City for budgeting purposes.

d. Submittals

Reports, plans, and specifications for interim package and sub-regional WWTF's in the City should conform with the design criteria and other provisions presented herein, unless otherwise justified. All work shall be conducted under the supervision of a professional engineer registered in the State of Florida. All work shall be in conformance with the requirements and provisions of all state regulations including but not limited to Chapter 62-4, 62-600, 62-610 and 62-640, Florida Administrative Code (FAC), shall be of accepted engineering practice and shall conform to the Land Development Regulations and the building and zoning codes of the City.

All reports, plans and specifications shall be submitted at least 60-days prior to the date set by the City. The documents submitted for formal approval shall include the engineer's report, plans and specifications. It is suggested that preliminary plans be submitted with the engineer's report for review prior to the preparation of the final plans. No approval for construction can be issued until final, detailed plans and specifications have been submitted to the City and judged satisfactory. All submittals will be subject to an operation and maintenance review by the City. All revisions shall be completed prior to approval.

e. Engineer's Report

The purpose of this report is to present to the City in a clear, concise form a description of the problem, alternative solutions examined, rejected and recommended; their technical and financial feasibility; and their environmental impact within the area of the proposed project. The report should be written for easy public understanding, and serve as a convenient and permanent summary of the principal information required by regulatory and funding agencies to support the recommended project. Controlling assumptions made and factors used in the functional design of the systems should be summarized for convenient and permanent reference.

1. <u>Contents</u>

The contents of the Engineer's report shall be in conformance with the requirements and provisions of 62-600, FAC, and shall include, but not be limited to the following:

(a) A description of the project, including a statement of need.

(b) Pertinent data regarding relevant existing permits, orders, etc. issued by the approving authority.

(c) Describe the geographic location of the project, with reference to maps, exhibits. Provide specific locations of existing and proposed transmission systems, lift stations, and WWTFs.

(d) Describe the topography and include a contour map of the general area with specific reference to the area involved in the project.

(e) Provide an estimated population growth with time for the proposed project.

(f) Discuss potential or planned improvements which would impact future water use or wastewater flow projections.

(g) Address the possibility of increased or decreased wastewater concentrations due to the use of gray water systems, industrial wastes, etc.

2. Field Data

Where there are existing sewers, the volume and strength of wastewater flows shall be determined. The design engineer shall confer with the City to establish the scope of the necessary data. These data shall be obtained from actual flow measurements, preferably during both dry and wet weather periods. If a public water supply is already in use, give approximate maximum, minimum and average daily consumptions and, where appropriate, analysis of the water as it might affect the character of the wastewater.

3. Laboratory Analyses

Laboratory analyses should be made on samples collected with consideration of quantity and quality variations in a 24-hour period. These data should include composite samples for the maximum significant period of sewage and industrial waste discharge and should cover a sufficient period of time to be representative of actual conditions. The design engineer shall confer with the City for details concerning the collection and analysis of samples.

4. Existing Establishments

(a) All establishments producing non-domestic wastes shall be listed, and include the quantity, producing periods, and character of industrial wastes insofar as they may affect the sewer system or WWTF. The quantity and character of the wastes shall be based on flow gauging and laboratory analysis of composite samples. Additionally, the characteristics and volume of the industrial wastes should be determined for the foreseeable future.

(b) The expected amounts of septic tank and grease trap cleanings discharged into the system, and their seasonal variations should be provided, if applicable.

5. Soil Investigations

The extent of soil investigations shall be provided, including but not limited to, geologic regimes and unusual conditions likely to be encountered. Soil borings shall indicate depth, nature of soil encountered, existing and anticipated high groundwater levels, etc.

6. Inflow/Infiltration

The quantity of infiltration/inflow (I/I) shall be measured in the existing sewer systems and a comparison made to determine if the I/I can be most economically eliminated by reconstruction or repair of the sewer system, or treated at the proposed interim package or subregional WWTF.

7. 100 Year Flood

If any part or parts of the project will be subject to upland flooding of a 100-year or less frequency, the extent and effects of such flooding shall be discussed. The precautions against flooding that shall be incorporated in the design, with respect to flooding of the sewer collection system, lift stations, and WWTF shall be discussed.

8. Land Application of Effluent

The report shall incorporate the technical feasibility of public access and non-public access land treatment and disposal systems. For all projects the report shall comply with the most recent FDEP requirements on evaluation of land application. The report should present a summary survey of alternative land treatment and disposal sites considered, and state the reasons for rejecting the least favorable ones. The most favorable sites shall be studied in depth and a thorough exposition of technical feasibility shall be presented. Additionally, the report shall present a detailed discussion of the site requirements, soil conditions, etc. of the most favorable sites for land treatment and disposal.

9. Solids Handling

A complete solids handling system shall be described, per unit process, with respect to the total pounds of solids, percent solids, and volume. Some preliminary determinations shall be made for the organic and inorganic content of the sludge. The report shall assess the technical feasibility and cost, as well as, the long-term reliability of the sludge treatment system.

10. Contributing Area

The extent of the existing and proposed contributory area to the proposed interim package or subregional WWTF with reference to a map or exhibit shall be provided. The areas of probable future expansions of the sewer system contributory to the interim package or subregional WWTF shall be provided. The location of the WWTF and effluent disposal sites shall be described.

11. Site Selection

The various sites available for the interim package or subregional WWTF, and the reasons for choosing the site recommended shall be discussed. The proximity of residences or developed areas to the site shall be indicated, and discuss the accessibility of the WWTF site. Include a sketch of the property to be used for the WWTF on which shall be indicated the topography and the arrangement of present and future treatment works.

12. Treatment Process

The type of treatment processes evaluated and reasons for choosing the recommended wastewater treatment alternative shall be discussed. Included in this discussion shall be considerations for industrial flows, septage loading, ability to handle shock loads from failing industrial pretreatment facilities, ease of operation, energy consumptions, capital and operating costs, level of operator's skill and effort required, and expandability.

13. Existing WWTF

If there is an existing WWTF, the limitations of the overall WWTF or of individual units that require additions, modifications, or expansions shall be discussed.

The basis of design shall include, but not be limited to the following:

(a) The ultimate design period shall be 30-years, unless otherwise justified. The phasing procedure of the facilities shall be described in detail, as it relates to this WWTF.

(b) The resident and nonresident sewered and unsewered population and industrial wastes population equivalent where appropriate for the design period shall be provided.

(c) The strength of the BOD_5 and TSS for domestic wastewater and for industrial wastewater shall be described. Allowances should be made for contributions from septic tank cleanout wastes. Other wastewater constituents should be listed as appropriate (e.g., nitrogen, phosphorus, metals, organic chemicals, temperature, chlorides, color, etc.).

(d) The total per capita and total daily flows, including I/I allowances shall be provided.

(e) The minimum, average, maximum flow rates for both the 24-hour period and the maximum hourly period for wet and dry weather conditions shall be indicated. Additionally, the peak instantaneous wet and dry weather flows should be provided.

(f) The major units of the interim package or subregional WWTF with capacities, size, equipment, and operation factors under varying conditions and methods of operation, including emergencies and major maintenance periods shall be described.

14. Future Expansions

The recommendations should be discussed in detail concerning the proposed project and future expansion thereof, including:

(a) Alternate plans should be discussed where two (2) or more solutions exist for a particular problem, each of which is feasible and practical, and provide the reasons for selecting the one (1) recommended.

(b) The area and extent to which the plans provide sewerage facilities for future development should be described. A description should be provided together with information as to the probability of future development, and how this area can be served.

(c) The degree and type of wastewater treatment, reasons for adopting the proposed method, the adequacy for present and future needs should be discussed. A general layout and quantitative flow diagram should be provided.

(d) Preliminary project cost estimates should be provided for the integral parts of the system and a detailed estimated annual cost of maintenance and operation.

(e) Where pretreatment of industrial wastes is necessary or where they are of such a character that they should be excluded from the sewers, pertinent information shall be provided.

f. Engineering Drawings

All drawings for the interim package and subregional WWTFs shall bear an appropriate title showing the name, scale in feet, a graphical scale, the north arrow, date, and the name of the engineer and imprint of his registration seal. The drawings shall be clear, legible, and drawn to scale which will permit all necessary information to be plainly displayed. The size of the drawings should not be larger that 24" by 36". Datum used and its relation to mean sea level datum should be indicated. Locations and logs of test borings, when made, shall also be shown on the drawings. Detail drawings shall consist of plan views, elevations, sections and supplementary views which, together with the specifications and general layouts, provide the working information for the contract and construction of the project. Dimensions and relative elevations of structures, the location and outline form of equipment, location and size of piping, water levels, and ground elevations shall also be included.

A location plan shall also be submitted showing the subregional WWTF in relation to other elements of the system. Sufficient topographic features shall be included to indicate its location with relation to water bodies and to the proposed effluent disposal system.

Layouts of the proposed interim package or subregional WWTF provided on the drawings shall show the following:

1. <u>Topography</u>

   Topography of the site. Property corners of the site shall be tied to the state plane coordinate system NAD 83 (1990 Adjustment).

2. <u>Structures</u>

   Size and location of the WWTF structures and buildings.

3. <u>Schematic</u>

   Schematic flow diagram showing the flow through various process units.

4. Piping

Piping, including any arrangements for by-passing individual units. Materials handled and direction of flow through pipes shall be indicated. Also, a complete schematic diagram of all sludge and chemical piping systems.

5. Hydraulic Profile

Hydraulic profiles showing the flow of wastewater, supernatant and sludge for average, minimum and maximum conditions.

6. Test Borings

Test borings and groundwater elevations.

7. Proposed Facilities

Location, dimensions, and elevations of all existing and proposed facilities.

8. Expansions

All future plant expansions shall be shown on the drawings including all major yard piping, unit locations and areas reserved for the expansion.

9. Miscellaneous

Adequate descriptions of any features not otherwise covered by the specifications.

g. Specifications

Complete technical specifications for the construction of the interim package or subregional WWTF, and all appurtenances, shall comply with the drawings. The design engineer shall review all equipment selections with the City. The specifications accompanying the construction drawings shall include, but are not limited to, all construction information not provided on the drawings which is necessary to inform the builder in detail of the design requirements as to the quality of materials, workmanship and fabrication of the project. The specifications shall include:

- The type, size, pertinent features, operating characteristics and features, piping and manufacturer's rated capacity of all pumps, blowers, motors and other mechanical equipment.
- Allowable infiltration including allowable methods of measuring infiltration.
- The complete requirements for all electrical and mechanical apparatus, wiring, and meters.
- Laboratory fixtures and equipment.
- Operating tools.
- Construction materials, installation specifications, etc.
- Miscellaneous appurtenances.
- Chemicals when used.
- Testing materials and equipment as necessary to meet design standards.
- Operating tests for the completed works and component units.

The use of the Construction Specifications Institute (CSI) format is preferred.

h. Cost Estimates

Final design cost estimates shall be submitted to the City by the design engineer 15-days prior to advertisement of the project or negotiations with potential contractors. A detailed capital cost estimate shall be submitted by the design engineer with the design drawing submittal. This estimate shall detail the costs of the project and break-out unit process/facility costs. Comparison with at least three (3) similar projects constructed in the past 5-years shall be required.

Additionally, detailed O&M cost estimate shall be submitted by the design engineer. This work task shall include estimates for the first 5-years of operations. Moreover, an annual renewal and replacement (R & R) cost estimate shall be submitted with the design projecting the design life of all major facilities and equipment.

i. Revisions to Approved Drawings

Any proposed or requested deviations from the approved drawings or specifications shall be approved in writing by the City before such changes are made. Drawings 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. The "As-Built/Record Drawings" clearly showing such alterations shall be submitted to the City within 90-days of acceptance by the City.

j. Operation During Construction

If required, specifications shall contain a program for keeping existing treatment plant units in operation during construction of plant additions. Should it be necessary to take plant units out of operation, a shutdown schedule agreed to by the FDEP shall be adhered to and shall minimize pollution effects on the receiving waters.

2. GENERAL

a. Site Selection

The engineer shall confer with the City before proceeding with the design of the detailed drawings. Subregional WWTF design should take into consideration the estimated population and flows from start-up through the design life span at least 30-years after start-up. Complete consideration of facility phasing shall be provided. An interim package WWTF shall include an expected schedule for interconnection with a City subregional WWTF.

The site selection for the WWTF is left to the discretion of the City, the design engineer, and the FDEP. However, new facilities unprotected from the 100-year flood will not be approved for construction. The effluent disposal system shall be determined by the City, the design engineer, and the FDEP. Sufficient land shall be acquired for all projected future plant expansions.

The following items shall be considered when selecting a WWTF site:

(1) Proximity to residential area.

(2) Direction of prevailing winds.

(3) Accessibility by all-weather roads.

(4) Area available for expansion.

(5) City zoning requirements

(6) Local soil characteristics, geology, hydrogeology, and topography available to minimize pumping.

(7) Access to effluent disposal system.

(8) Capacity and treatment requirements for effluent disposal system through the design life of the WWTF.

(9) Compatibility of treatment processes with the present and planned future land use, including noise, potential odors, air quality, and anticipated sludge processing and disposal techniques.

(10) Facility phasing and expansion program.

(11) Availability of land for future effluent disposal.

b. <u>Design</u>

The accepted methods of treatment are provided in Subsections E.4, 5, 6, 7, and 8. Careful consideration should be given to the type of treatment prior to making a final decision. Important factors which should influence the type of treatment are:

(1) Flow, character, and effluent disposal system.

(2) Location and topography of the site.

(3) Present and future effluent limits.

(4) The effect of industrial wastes likely to be encountered.

(5) Ultimate method of sludge disposal.

(6) Operating costs.

(7) Probable type of supervision and operation which the WWTF will have.

Additionally, the WWTF design should achieve the longest possible useful life, incorporate flexibility and convenience of operation, require minimum energy expenditures, minimum maintenance effort, and minimum capital and operating costs.

Where significant amounts of industrial wastes are involved, the quantity and character of the wastes should be determined by analysis and provision made in the design for the raw waste or waste after pretreatment. The engineer shall provide, to the extent feasible, the flexibility to handle shock loads resulting from pretreatment failure.

The treatment units shall be designed on the basis of hydraulic loading, BOD_5 and TSS in accordance with the requirements outlined in Subsections E.4, 5, 6, and 7. The design flow for the WWTFs servicing of new sewer systems should be determined in a manner consistent with:

(a) Planned future improvements to the potable water system which may increase or decrease flows.

(b) Future use of water conservation devices.

(c) The trend of increasing or decreasing water usage within the geographic area.

An allowance shall be made for industrial and commercial /institutional flows, and I/I. The design flow shall allow for future growth of domestic, industrial and commercial flows and shall take into consideration increasing I/I as sewers deteriorate with age.

Design flow for WWTFs servicing existing sewers should be based on actual flow measurements, initial reductions of I/I achieved by rehabilitation, and shall otherwise consider all the factors provided above.

Where such information cannot be obtained, new systems shall be designed on the basis of average daily flow of the wastewater as indicated in Table E-1.

Unless satisfactory justification can be given for using different values for strength of wastes, plans for the WWTF to serve a new sewer system will be examined on the basis of an average daily concentration of 220 milligrams per liter (mg/l) for both BOD_5 and TSS, exclusive of industrial wastes or unusual commercial wastes. Consideration should be given to 2-times the average to treatment units caused by influent pumping, industrial flows and/or diurnal variations and its impact on unit process performance.

TABLE E-1
WASTEWATER TREATMENT FACILITY
WASTEWATER FLOW DESIGN BASIS

Description	Flow
1. Residential	
a. Single Family	**300 GPD**
b. Multi-Family and Duplex (1 and 2 bedrooms)	**250 GPD**
c. Multi-Family and Duplex (3 and 4 bedrooms)	**300 GPD**
d. Mobile Homes	**300 GPD**
2. Peak flow rates should be determined in accordance with actual field data or under the ratio method presented in Figure E-1.	
3. Data from similar projects, in the case of new systems.	
4. Wet weather flows.	
5. Recirculation.	
6. Pumping rates.	
7. Consideration should be given to the hydraulic surge loading to treatment units caused by influent pumping, industrial flow or diurnal variations. The design should minimize effects by flow equalization, or other means.	
8. Consideration should be given to the seasonal hydraulic loading to treatment units.	

Piping and channels shall be designed to carry the maximum future flows. The incoming sewer shall be designed for free discharge. Bottom corners of channels should be filleted and pockets and corners where solids can accumulate shall be eliminated. Suitable gates should be placed in channels to seal off unused sections which may accumulate solids. The use of shear gates or stop gates is permitted where they may be used in place of gate valves or sluice gates. Channels which may not be in use for considerable periods shall be provided with valved drains.

The size and number of WWTF units should be selected to provide flexibility to meet varying flows and facilitate emergency treatment with some units when a unit is out of service for maintenance or other reasons. Component parts of the plant should be arranged for greatest operation convenience, flexibility and economy, and in such a manner as to facilitate addition of future treatment units.

c. WWTF Details

(1) General

The specifications should be written such that the installation and initial operation of the major items of mechanical equipment will be supervised by a representative of the manufacturer.

Except where duplicate units are available, properly located and arranged bypass structures should be provided so that each major unit of the WWTF can be removed from service independently. Under certain circumstances, bypasses may be required even though duplicate units are provided. The design should provide for maximum treatment and convenient operation with any given unit out of operation. Particular attention should be given to solids retention, sludge handling and disinfection during such periods.

Additionally, means should be provided to dewater each process unit preferably by a gravity drain. Consideration should also be given to protection of tanks from flotation.

(2) Construction Materials

Consideration should be given to the selection of materials which are to be used in wastewater treatment works because of the possible presence of hydrogen sulfide (H_2S) and other corrosive gases, greases, oils and similar constituents frequently present in wastewater. This is particularly important in the selection of metals and paints. Dissimilar metals should be avoided to minimize galvanic action.

An approved coating system with an approved thickness shall be applied to all treatment unit surfaces. In concrete facilities, as a minimum, the top 3' below the water level are an exception to this requirement. Secondary clarifiers and filtration units are excluded from this requirement.

(3) Structural Materials

The major types of properly designed structural materials are summarized below:

(a) Influent pumping station and flow equalization facilities: Concrete.

(b) Grit removal facilities: Concrete.

(c) Process treatment trains: The structural material selected for each treatment unit shall be reviewed by the City prior to final design.

(d) Effluent storage: The structural material selected for effluent storage shall be reviewed by the City prior to final design.

All walls shall be designed to contain the maximum hydrostatic pressure which could be experienced due to operational practices.

The use of paints containing lead or mercury shall not be used. In order to facilitate identification of piping, particularly in the large plants, it is suggested that the different pipes have contrasting colors, and the contents and direction of flow indicated. The recommended color scheme and labels for the purposes of standardization are presented in Table E-2.

(4) Operating Equipment

The specifications shall include a set of tools, accessories for adequate maintenance and spare parts for the WWTF. Readily accessible storage space and work bench facilities shall be provided, and consideration given to provision of a garage for large equipment storage, maintenance and repair.

TABLE E-2
RECOMMENDED COLOR CODING OF PROCESS PIPING

Piping Description	Recommended Color
Raw sewage	**Dark gray**
Return and waste sludge	**Dark brown**
Potable water	**Light blue**
Raw water	**Olive green**
Non-potable water	**Bright orange**
Reclaimed water	**Purple**
Gas or fuel oil	**Red**
Compressed air	**Dark green**
Chlorine gas	**Yellow**
Chlorine solution	**Yellow with 2" red bands spaced 24" apart**
Other coding	**As directed by the City Utilities Department**

(5) Grading, Landscaping and Irrigation Minimum Requirements

Upon completion of the WWTF, the ground should be graded and seeded. Sod shall be provided 10-feet around each structure, building or walkway. An irrigation system utilizing reuse water shall be installed. Paved or gravel walkways should be provided for access to all treatment units.

Where possible, steep slopes should be avoided to prevent erosion. Surface water shall not be permitted to drain into any unit. In small or interim package WWTFs receiving part-time operation, consideration should be given to minimizing the need for landscape/grounds maintenance. Provisions should be made for landscaping, particularly when a WWTF must be located close to residential areas; however, the operator's view of the units should not be obstructed. The City's Land Development Regulations regarding grading, landscaping and irrigation requirements shall be adhered to.

d. Essential Facilities

An adequate supply of potable water under pressure shall be provided for general cleaning around the WWTF, operator use, fire protection and laboratory requirements. No piping or other connections shall exist in any part of the WWTF which, under any conditions, might cause the contamination of the potable water supply. Potable water from a municipal or separate supply may be used directly at points above grade and installed in accordance with the "Southern Standard Plumbing Code" specifications and backflow prevention for the following hot and cold supplies:

(1) Water closet and shower.

(2) Drinking fountain.

(3) Laboratory sink, if protected against back siphonage.

(4) Outside hydrants, if protected against back siphonage.

(5) Slop sink, if protected against back siphonage.

Hot water for any of the above units shall not be taken directly from a boiler used for supplying hot water to a treatment unit. Hot water to the above units shall be supplied by a hot water heater separated from the boiler.

Where potable water is to be used for any purpose in the WWTF other than those listed above, a reduced pressure type backflow prevention device shall separate the potable water supply from all sources of possible toxic or non-toxic contamination caused by back siphonage or back pressure. Where it is not possible to provide potable water from a public water supply, a separate well may be provided. Location and construction of the well should comply with the requirements of the State and City's Land Development Regulations. Where a separate non-potable water supply is to be provided, a backflow prevention device will not be necessary but all sill cocks and hose bibs shall be posted with a permanent sign indicating that the water is not safe for drinking.

The sanitary facilities at the WWTF shall consist of a toilet, shower, lavatory and locker for the convenient use of the projected number of operators for WWTFs with design capacities over 0.5 MGD. Slop sinks for general cleaning shall be provided. A minimum of 150 square feet shall be allocated for the sanitary facilities. Additional areas shall be provided as deemed appropriate by the City.

All WWTFs with a design capacity over 2.0 MGD shall include a laboratory for making the necessary analytical determinations and operating control tests. The laboratory shall have sufficient size, bench space, equipment and supplies to perform all self-monitoring analytical work required by the permits, and to perform the process control tests necessary for good management of each treatment process included in the design. Fume hoods should be used where odors or hazardous vapors are present during testing. The laboratory size and arrangement must be sufficiently flexible and adaptable to accomplish all required assignments. The layout should consider future needs for expansion in the event that more analytical work is required.

The laboratory should be located on ground level, easily accessible to all sampling points, with environmental control as an important consideration. It shall be located away from vibrating equipment which may have adverse effects on the performance of laboratory equipment. A minimum of 300 square feet of floor space shall be allocated for the laboratory. If more than two (2) persons will be working in the laboratory at any given time, an additional 100 square feet shall be provided for each additional person. Bench-top working surface should occupy a minimum of 35% of the total floor space. The minimum ceiling height shall be 8'- 6". If possible, this height should be increased to provide for the installation of wall-mounted water stills, distillation racks, and other equipment with extended height requirements. The laboratory should be equipped with the necessary equipment to test and analyze at a minimum for BOD_5, TSS, pH, total solids, settleable solids, dissolved oxygen (DO), chorine residual and sludge index.

All WWTFs shall have suitable facilities for measuring, recording and totaling the flow of the wastewater at the influent to the facility. The principal flow equipment should generally be installed at the pretreatment structure. Additionally, metering should be provided on the effluent from the WWTF, the return and waste sludge pumps, sludge loading pumps for ultimate disposal and other locations as deemed appropriate.

Flow splitting facilities shall be provide in all WWTFs with a design capacity of over 0.5 MGD. Flow splitting devices shall be easily adjustable by the operator. Generally, they should be preceded by relatively long, straight channels of uniform cross-section and provide for only a 2-way division. Flow splitting devices should be visible and accessible for the operator to verify the quantity or flow issuing from each leg of the split.

Stairways shall be installed wherever possible in lieu of ladders. Spiral or winding stairs are permitted only for secondary access where dual means of egress are provided. Stairways shall have slopes between 50º and 30º from horizontal to facilitate carrying samples, tools, etc. Each tread and riser shall be of uniform dimension in each flight. Minimum tread riser shall not be less than 8". The sum of the tread run and riser shall not be less than 17" nor more than 18". A flight of stairs shall consist of not more than a 12 foot continuous rise without a platform.

All WWTFs with a design capacity of greater than 0.5 MGD shall include an office/control area for keeping necessary records and monitoring/recording necessary plant functions. This area shall be located away from vibrating machinery or equipment which may have an adverse effect on recording equipment. A minimum of 250 square feet of floor space shall be allocated for the office/control area, with minimum ceiling heights of 8'-6". Additional space shall be provided as deemed appropriate.

All WWTFs with design capacities greater than 2.0 MGD shall include a covered and enclosed maintenance/storage area for on-site maintenance functions. This maintenance/storage area shall have a minimum of 300 square feet and a minimum ceiling height of 11'. Additional space shall be provided as deemed appropriate.

All WWTFs shall include a covered and enclosed chemical storage area. The location and size shall be determined by the design engineer.

e. Effluent Disposal

The effluent disposal for the WWTP shall be accomplished by methods acceptable to both the City and FDEP as indicated in Subsection E.9. All WWTFs shall be designed to consistently produce the quality of effluent required in the applicable WWTF operations permit. The design basis shall include all industrial wastes which will enter the sanitary sewerage system. The engineering report shall state the average and peak flows, and strengths of all industrial wastes and shall discuss the aspect of hazardous and/or toxic materials that may enter the system. All WWTF bypass structures/systems shall be indicated on the drawings, and the need for such facilities shall be described in the engineering report. The piping within all WWTFs shall be arranged so that when one (1) unit is out of service for repairs, the operation of the WWTF will continue and emergency treatment can be accomplished.

f. Safety

Adequate provisions shall be made to effectively protect the operator and visitors from hazards. The following shall be provided to fulfill the particular need of each WWTF:

- Enclosure of the WWTF site with a fence designed to discourage the entrance of unauthorized persons and animals.
- Installation of handrails and guards where necessary and per the United States Department of Labor, Occupational Safety and Health Administration (OSHA) standards. Vertical ladders over 6' shall have cages. Kickplates shall be required in liquid tankage areas.
- Provisions for first aid equipment and MSA Foille Burn Kit.
- Posting of "No Smoking" signs in hazardous areas.
- Provisions of protective clothing and equipment such as gas masks, self-contained air packs, goggles, gloves, safety belts, oxygen deficiency, H_2S and combustible gas indicators, and suitable fire extinguishers.
- Portable blowers, and portable "mud hog" type pump and sufficient hose.
- Portable non-flammable lighting equipment.
- Appropriately placed warning signs for slippery areas, non-potable water fixtures, low head clearance areas, open service manhole, hazardous chemical storage areas, flammable fuel storage areas, etc.
- The design of the WWTF shall incorporate all necessary facilities to assure safe working conditions including all appropriate requirements of OSHA.

The electrical design shall conform to local and State building codes. Nonsparking electrical equipment shall be utilized where flammable gas may exist. The equipment shall bear the seal of the Underwriters Laboratory, Inc. (UL) and comply with the National Electrical Code (NEC). Adequate lighting must be provided in the buildings, as well as, on the grounds, especially around treatment units to be serviced by personnel on duty during hours of darkness.

With regard to process/equipment the following should be provided or considered:

- Where frequent movement of equipment and material is required, consideration should be given to the use of ramps with non-skid treads, to supplement stairs, wherever feasible.

- Provisions of "Panic" hardware on all doors leading from hazardous areas. Ensure that the hardware selected for all other doors will permit opening from the inside.

- Monorail and lifting hoist systems located in potentially explosive gas areas shall be electrically explosion-proof and have one (1) sparkproof hook and cable chain (i.e., brass hook and stainless steel cable/chain), and two (2) brass monorail track wheels.

- Air flow switches and associated common alarms in Heating, Ventilation and Air Conditioning (HVAC) ductwork in hazardous process areas shall be provided to ensure positive air flow for the safety of operational personnel.

- Local isolation switches shall be provided on all process equipment.

- Safety guards on all exposed moving parts of machinery.

- Evaluate the effects on noise produced by equipment and limit such noise to 85 dBA within 3' of the equipment. Never locate roof leader piping over motor control centers (MCC) or other electrical equipment.

- All areas designated hazardous, must be truly isolated and made explosion proof, including all motors on process equipment, ventilation systems, and overhead doors, as well as, all lighting fixtures. Check details on all wall, floor, sky lighting and ceiling penetrations for sealing.

- Provide H_2S and combustible monitoring and alarm systems, in areas subjected to direct exposure to raw wastewater. The system should include a warning light over the entrance doors, to indicate no entry without special equipment.

- For areas where insects could be a nuisance (e.g., pretreatment structure, sludge storage, etc.) electric insect killer units should be considered.

g. Plant Performance

All WWTFs shall provide the required level of performance for the method of effluent disposal utilized. Adequate performance shall be provided for all design flow and quality conditions.

h. Energy Requirements

The most cost effective and energy efficient system is desired. The design engineer shall illustrate the energy aspects of the facility design. Where payback is achieved within 5-years, power factor correction shall be provided. The energy requirements of the proposed facility shall be estimated by the design engineer from initial start-up through attainment of design capability of the WWTF. These estimates shall be submitted to the City for review.

i. Chemicals, Chemical Storage and Handling

(1) General

The following items shall be provided in all chemical storage and feed systems installed at the WWTF:

(a) Acid resistant stainless steel floor drains in chemical areas subjected to vehicular traffic.

(b) Isolation valve adjacent to all tank level transmitters to permit their removal for maintenance and calibration.

(c) Chemical delivery truck doorways shall be a minimum of 13'-6" high to permit trailer truck entrance.

(d) Baffles in chemical mixing tanks to prevent vortexing and ensure proper operation of the mixer.

(e) Review the need for a permanent water supply at all chemical facilities.

(f) Unions at all chemical pumps, tanks and diffusers.

(g) Adequate piping supports and thrust anchorages for all chemical lines.

(h) Chemical lines shall be designed to be flush-cleaned or replaced without draining the process or chemical tanks.

(i) Pipe outlets from pressure relief valves on chemical feed lines to drain to floor drainage systems, if resistant to chemicals, or, if possible, back into the chemical tanks.

(2) <u>Chemical Storage</u>

All chemical storage tanks shall be located within containment curbing to control spillage. Containment curbing shall be designed to contain at least one (1) tank rupture until it can be safely transferred to alternate storage or released to the wastewater at controlled rates which will not damage facilities or inhibit the treatment processes. Additionally, ramps on curbing for chemical deliveries should be provided where possible. The chemical storage tanks must have a sufficiently large screen and weather protected vent pipe, vented to a safe area, to eliminate problems with rapid filling from a delivery truck. For facilities using large quantities of liquid polymer, bulk storage facilities should be considered as opposed to drums. If drums are used, provide sufficient drum racks storage area. All storage tanks shall be provided with a level-indicating device, minimum 12" diameter access hole, and easily accessible drain valve. The use of translucent panels for level detection will not be permitted. Similarly, if external sight glasses are utilized, valves and clean-out drains for maintenance shall be provided. Sulfuric acid storage tank suction piping drain lines shall be installed at a level above the tank bottom to avoid clogging from sediment accumulation. Adequately size inlet and outlet pipes on chemical storage tanks, especially those containing concentrated polymers with high viscositys. The inlet pipes shall be compatible with delivery truck discharge facilities. Lime storage silos must be provided with a vibrator, to facilitate easy removal of the lime and to be compatible with the type of lime stored. The lime storage silo and feed hopper sides shall be sloped a minimum of 60º to the horizontal. Bag feeders for lime systems, with dust exhaust units can be utilized if the facility is not greater than 1.0 MGD.

(3) Chemical Handling

A diaphragm pump shall be used for pumping ferric chloride ($FeCl_3$), sodium hypochlorite (NaCl), alum, and dilute polymers. A progressive cavity pump shall be used for concentrated polymers. For pipelines carrying alum, hot water flushing facilities shall be provided, to keep these lines from clogging because of crystallization.

Dry polymer and/or lime systems should have provisions for handling and emptying bagged lime or polymer to the storage and mixing tanks.

For lime slurry systems, a strainer shall be installed on the suction limes of the slurry pumps to remove grit. Where practical, gravity flow efficiency can be improved on slaker systems employing dilution chambers by increasing the size of the grit outlet insert. A diaphragm, plunger, or abrasion resistant rubber-lined centrifugal pump which has been specially designed for lime slurry service shall be used. Additionally, an adequate supply of flushing water to the suction and discharge pipes of the lime pumps shall be provided.

Bulk chemical delivery connections shall be located over a bermed area of the service road, to allow for clean-up of normal spillage's during delivery. Provide a hose bib in this area together with a drain pipe into the nearest suitable disposal point. Additionally, good access shall be provided for deliveries of bagged hydrated lime, liquid chemical drums, etc.

(4) Chemical Safety

The materials utilized for the storage, piping, valves, pumping, metering, splash guards, etc., shall be specially selected, considering the physical and chemical characteristics of each chemical utilized at the WWTF. Eye-wash fountains and safety showers utilizing potable water shall be provided in the laboratory and on each floor or work location involving hazardous or corrosive chemical storage, mixing, pumping, metering, or transportation unloading. These facilities are to be as close as practical to possible chemical exposure sites and are to be fully useful during all weather conditions. The eye-wash fountains shall be supplied with water of moderate temperature (50º to 90º Fahrenheit), separate from the hot water supply, and suitable to provide 15 to 30 minutes of continuous irrigation of the eyes. The emergency showers shall be capable of discharging 30 to 50 gallons per minute (gpm) of water at a moderate temperature and pressures of 20 to 50 pounds per square inch (psi). The eye-wash fountains and showers shall be no more than 25' from points of hazardous chemical exposure.

All pumps and feeders for hazardous or corrosive chemicals shall have splash guards which will effectively prevent the spray of chemicals into space occupied by personnel. The splash guards are in addition to the guards to prevent injury from moving or rotating parts.

All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10' with at least two (2) labels in each hood, closet, or pipe chase. Color-coding may also be used, but is not an adequate substitute for labeling. All connections (Flanged or other type), except those adjacent to storage or feeder areas, shall have guards which will direct any leakage away from space occupied by personnel. Pipes containing hazardous or corrosive chemicals should not be located above shoulder level except where continuous drip collection trays, double walled pipe, and coupling guards will eliminate chemical spray or dripping onto personnel.

The following items of protective clothing or equipment shall be available and utilized for all operations or procedures where their use will minimize injury hazard to personnel:

(a) Respirators, air supply type recommended for protection against chlorine.

(b) Chemical worker's goggles or other suitable goggles (safety glasses are not sufficient).

(c) Face masks or shields for use over goggles.

(d) Rubber gloves, aprons with leg straps, and boots.

(e) Safety harness and line.

Facilities shall be provided with automatic shutdown of pumps and sounding of alarms when failure occurs in a pressurized chemical discharge line. Additionally, warning signs requiring the use of goggles shall be located near chemical unloading stations, pumps, and other points of frequent hazard.

Dust control equipment shall be provided to protect personnel from dust injurious to the lungs or skin and to prevent chemical dust from settling on walkways. The latter is to minimize slick floors which result when a chemical covered floor becomes wet.

j. Preventive Maintenance Program

The contractor shall supply a manual containing each manufacturer's preventive maintenance suggestions. These items shall be integrated into a bound booklet comprising the preventive maintenance program.

k. Operation and Maintenance Manual

Prior to completing the construction of a new package or subregional WWTF or facility expansion and effluent disposal system, an O&M manual covering the recommended operating procedures for the entire facility shall be furnished to the City. The O&M manual shall include the following contents:

(1) Description of unit processes and component parts. Functional, normal operating characteristics and limiting conditions. Performance curves, engineering data and tests. Complete nomenclature and commercial number of replaceable parts.

(2) Operating procedures. Start-up, break-in, routine and normal operating instructions. Regulation, control, sequences required, stopping, shut-down and emergency instructions. Summer, winter and special operating instructions.

(3) Maintenance procedures. Guide to "troubleshooting". Disassembly, repair and reassembly, alignment, adjusting and checking.

(4) Servicing and lubrication.

(5) Manufacturer's printed operating and maintenance instructions.

(6) Description of sequence of operation by control manufacturer.

(7) Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance. Predicted life of parts subject to wear. Items recommended to be stocked as spare parts.

(8) As-installed control diagrams by controls manufacturer.

(9) As-installed color coded piping and wiring diagrams.

(10) Charts of valve tag numbers, with location and function of each valve.

(11) Circuit directories and panel boards for electrical service, controls and communication.

(12) List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.

(13) Other data as required under pertinent specifications.

l. Spare Parts

Sufficient spare parts shall be provided by the contractor at start-up of the WWTF for a projected 3-year operating period as stipulated by the design engineer.

m. System/Facility Reliability

The design of the package and subregional WWTF shall include provisions for system back-up and reliability, as required by FDEP for the size of the WWTF and type of effluent disposal, as presented in the United States Environmental Protection Agency (USEPA) Manual MCD-05, Design Criteria for Mechanical and Fluid System and Component Reliability. The design of the following requirements for system back-up and reliability shall be considered during the design phases of the WWTF.

(1) Pretreatment

All pretreatment structures will be designed with dual channels each sized to handle the anticipated peak hour flow rate. Mechanically cleaned bar screens shall be installed on all facilities 1.5 MGD and larger. A second bar screen shall be provided. It is permissible that this back up bar screen be designed for manual cleaning only. WWTFs with only two (2) bar screens shall have at least one (1) bar screen designed to permit manual cleaning.

For grit removal facilities only hydraulically induced or mechanically induced vortex type units will be acceptable. The grit removal units shall be designed to treat the maximum day flow. No secondary treatment unit will be required for grit removal. The grit removal units shall consist of isolation gates that can be closed in case of maintenance.

(2) Pumps

Standby pumps shall be provided for each set of pumps which perform the same function. The capacity of the pumps shall be such that with any one (1) pump out of service, the remaining pump(s) will have capacity to handle the peak flow requirements. It is permissible for one (1) pump to serve as backup to more than one (1) set of pumps.

(3) Aeration Facilities

A backup aeration basin shall not be required; however, at least two (2) compartments of equal volume basins shall be provided within the basin. There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest unit out of service. It is permissible for the backup unit to be out of service. Additionally, it is permissible for the backup unit to be an uninstalled unit, provided that the installed unit can be easily removed and replaced. At least two (2) units shall be installed. The air diffusion system for each aeration basin shall be designed such that the largest section of diffusers can be isolated without impairing the oxygen transfer capability of the system.

(4) Secondary Clarifiers

There shall be a sufficient number of units of a size, such that with the largest unit out of service, the remaining unit(s) shall have a design capacity equal to 75-percent of the total design to that unit operation. The secondary clarifier shall be designed around the maximum daily flow conditions.

(5) Effluent Filtration

There shall be a sufficient number of filters of a size, such that with the largest unit out of service, the remaining unit(s) shall have a design capacity equal to 75-percent of the total design to that unit operation. The filtration facilities shall be designed around the maximum daily flow conditions. The filters shall be designed for operating at an average hydraulic loading rate of 2 gpm/square foot or a peak loading rate not exceeding 5 gpm/square foot.

(6) Disinfection

There shall be a sufficient number of units of a size, such that with the largest unit out of service, the remaining unit(s) shall be capable of treating 50-percent of the design basis flow to that unit operation. Additionally, there shall be complete backup disinfection facilities in the event one (1) unit should be out of service.

(7) Miscellaneous Components

At least two (2) chemical feed systems (e.g., pumps, mixing basins, etc.) or a back-up means for adding and mixing chemicals, separate from the basin, shall be provided. If only one (1) system is provided, at least a second uninstalled unit or bypass around the basin shall be provided.

n. Facility Expansion

The size and number of treatment units should be selected to provide the flexibility to meet varying flows and facilitate emergency treatments with some units when a unit is out of service for maintenance or other reason. Component parts of the plant should be arranged for greatest operating convenience, flexibility, and economy and in such a manner as to facilitate possible future treatment units. The City shall review the preliminary engineering provisions for facility expansions and comment on conceptual design prior to proceeding with final design as specified in Subsection E.1.

Additionally, the land area acquired for the WWTF shall be of sufficient size to accommodate all projected treatment plant expansions, not necessarily including land for effluent disposal.

3. INFLUENT PUMPING STATION

a. General

The design engineer shall comply with the criteria listed herein and Appendix A. Unless justification is given by the design engineer, all WWTFs with capacities greater than 0.5 MGD shall be provided with an influent pumping station, including equalization storage. WWTFs with capacities less than 0.5 MGD and not requiring an influent pumping station shall be provided with equalization storage. Pumping stations shall be preferably of the submersible type. The wet well-dry well type may be considered when justified by the design engineer. Such stations shall preferably minimize the head differential between the station and the treatment units in order to minimize the energy requirements.

b. Design Parameters

(1) General

The design flows shall be the total ultimate development flow from all tributary areas. The tributary area shall include existing development, planned developments, and projected future developments. The maximum influent flow shall be the product of the average daily flow and the selected peak factors computed as set forth in Subsection E.1. However, due to the sensitivity of various process units to excessive surges in hydraulic flows, the pump station shall be designed for a maximum capacity of 2.0 times the average estimated flows. The flow differential between the maximum peak hourly flow and the maximum design capacity of the pump station shall flow into equalization storage.

No single method for sizing wet wells applies to all design situations. Proper wet well sizing considers three (3) critical factors:

(a) Pump cycle time.

(b) Detention time.

(c) Turbulence at the pump intake.

Pump cycle time refers to the elapsed time between successive motor starts. It has been determined that excessive motor wear and shortened service lives result from cycle times less than the manufacturer's recommendation. Therefore minimum cycle times shall range from about 10-minutes up to 30-minutes. The design engineer shall consult with the motor manufacturer for minimum cycle time recommendations or special motor designs. The minimum cycle time recommendations of the motor manufacturer shall be obtained in all cases. In the absence of other information, summarized in Table E-3 are the minimum cycle times for full voltage starting that can be used.

The minimum wet well volume required to control cycle times shall be sized according to the following equation:

$$V = t(Q_p)/4N$$

where: V = the minimum wet well volume in gallons.

Q_p = Capacity of one (1) pump in gpm.

N = Number of pumps in the lift station.

t = Minimum pump cycle time in minutes.

For constant speed pumps, the minimum cycle time results if the influent flow equals 50% of the rated pump capacity. In multiple pump installations, alternating the lead pump after each pumping cycle effectively doubles the cycle time and reduces the wet well volume accordingly. Consideration will also be given to strategic "on" and "off" settings to optimize the wet well volumes. Wet wells for variable speed pumping systems can be significantly smaller than for comparably sized constant speed stations. However, the cycle time for variable speed pump stations will still be the limiting factor if the influent flow is 50% of the pumping capacity at the minimum pump speed. If multiple variable speed installations are used, the wet well capacity required is the sum of the wet well capacities required for the individual pumps.

Wet wells shall also provide sufficient space for installed equipment and required suction pipe submergence and spacing. When determining the pump operating levels in the wet well, the design engineer will need to consider the net positive suction head (NSPH) requirements of the pumps. Wet well designs should allow adequate submergence and clearance between the pump intakes to prevent eddy currents, air binding, vortexes and other design considerations that could otherwise reduce pump efficiency or capacity. In general, the normal operating water level shall provide a positive suction head for the pumps. Operational, maximum, or high water levels shall not exceed the invert elevation of the lower influent pipe, with the high water alarm no higher than the 0.8 point of said pipe.

TABLE E-3
WASTEWATER MASTER LIFT STATION
MINIMUM CYCLE TIMES

Motor Size	Minimum Cycle Time
15 Hp and smaller	10-minutes
20 Hp through 50 Hp	15-minutes
60 Hp and larger	30-minutes

A minimum size hopper bottom shall be provided, with the wet well floor sloping to said bottom at a slope of not less than one to one (1:1).

Sufficient volume shall be provided in the wet well or in an auxiliary basin to store flows in excess of the pump station peak design flow. The volume shall be calculated based upon a 2 hour sustained flow rate. If an auxiliary basin is used for equalization storage, it shall be aerated with diffused air and provisions shall be made for gravity drainage to the wet well. Odor control shall be provided, if necessary.

The size of wet well-dry well systems will depend on the number and type of pumps selected and piping arrangement. A minimum of 3' from each of the outboard pumps to the nearest side wall and a minimum of 4' between each pump discharge casing shall be required. Additionally, sufficient space between the pumps shall be provided to remove the pumps from their base with ample remaining clearance between the suction and discharge piping in the room for on-site repairs, inspection, or removal from the pit to the surface for repairs. The installation of monorails, lifting eyes in ceiling, and A-frames for the attachment of portable hoists, cranes, and other devices should be considered. Additionally, all doorways and openings in the dry well shall have sufficient width and headroom for installation and removal of equipment.

Other wet well design considerations include:

(a) Arranging the influent pipe inlet in the wet well so that any splashing or eddy current is directed away from the pump intakes to prevent air entrainment and pump air locks.

(b) Dividing the wet well into two (2) sections that are properly interconnected to ease repairs, cleaning, and expansion if the pump station must operate continuously or future flows will substantially exceed existing flows.

(c) Providing for a well lighted wet well with vapor-proof and explosion proof fixtures.

(d) Odor control.

(2) Pump Capacity

The selected pumping system shall have a minimum capability of pumping at the design peak flow rate with the largest pumping unit out of service (firm pumping capacity). The peak flow rate from the pumping system shall not be greater than 2-times the average daily flow. In order to dampen any surge effect of the pumping system on the WWTF, the pumping station shall be provided with either three (3) or more constant speed pumps or an automatic control variable speed system.

Head capacity curves shall be prepared for the proposed pumping system and shall include system curves and pump head capacity curves (modified for piping system losses) illustrating the performance of the pumps operating alone and in combination with one another at the anticipated wet well water levels. Hydraulic computations shall be based upon the Hazen-Williams formula at a friction factor, "C-Factor", equal to 110. In addition, system curves shall be calculated at a "C-Factor" equal to 140 in order to protect against runout conditions. Finally, the pumping system should be analyzed to determine the validity for providing 2-speed motors or variable speed devices.

(3) Piping Systems

Piping material, sizes and arrangements are very important. Suction and discharge piping, valves and fittings should be adequately supported by the pump flanges. Pipe sizes should be selected on the basis of sustaining a reasonable head loss with substantially reducing the velocity.

Suction piping for wet well-dry well stations should not include any elevated sections where air or gas could accumulate. Each pump shall have a separate suction pipe with a turn down bell and shutoff plug valve prior to the pump. Additionally the suction piping shall be as short and straight as possible to minimize suction lift requirements. If reducers are required, the eccentric type shall be installed so that the top of the suction pipe profile is level. Suction piping shall be sized to produce a velocity of not greater than 4.0 feet per second (fps). Additionally, suction pipe lines shall have a valved hose connection so that the pipeline can be backflushed periodically with water.

The velocity in the discharge piping shall not exceed 6.0 fps. A check valve, followed by a plug valve shall be provided on the discharge side of each pump.

The design velocity in the force main piping shall be a minimum of 2.0 fps with the smallest pump operating, unless facilities are provided for periodic flushing or when a flushing velocity of 5.0 fps or more will occur one (1) or more times per day. If the force main is to be sized for future flows, and current flows will not achieve flushing velocities, the use of multiple force mains should be considered. The force main and piping of the discharge side of the pump will need to be pressure rated to withstand the maximum hydraulic head on the system, including abnormal pressures that may be produced by hydraulic transients, such as water hammer and surge pressures.

(4) <u>Future Expansion</u>

When designing a pump station, the engineer shall allow for required future capacities. One (1) option that can be utilized includes modifying the original pump by installing a new impeller with a larger diameter. This option may also require installing larger motors, starters, controls, or electrical systems. A second option is by installing an additional pump if the structure and the piping are designed initially to accept additional units that are identical to the existing pumps that are installed in the pump station. A third option consists of replacing the pumps and motors with larger units. However, it should be noted that this option must also account for the existing pipe sizes, electrical capacity and other elements.

c. <u>Facilities and Equipment</u>

The site of the pump station shall not be subject to flooding, and shall be accessible to maintenance personnel and equipment during all types of weather. In addition, the site shall be provided with pavement and walkways, and shall be on or as close as practical to the WWTF site.

Where buildings and/or structures are constructed, the relevant provisions of Appendix A shall apply with special design considerations for the following where applicable:

(1) Combined pumping station structures shall provide complete separation between wet and dry wells, including their superstructures. Separation by common-wall construction is acceptable, provided that interconnecting pipes, ducts, etc. are designed to preclude unwarranted or detrimental passage of fluids or gases.

(2) Pumping station structures shall be of adequate size to allow easy access to all operating equipment for service and maintenance.

(3) Structural openings shall be provided to facilitate equipment removal, including pumps and motors, stand-by generators, bar screens and other large items.

(4) Well designed stairways shall be provided for all dry well access and to the service landings for wet wells when regular inspection or maintenance is required therein. Removal ladders may be provided in small stations where it is impractical to install stairways. Manhole steps or fixed ladders are not acceptable in wet wells.

(5) All floor and stairway surfaces shall be sloped to an adequate point of drainage. The pump room floor shall be provided with a small channel against the divider wall for pump seal drainage.

(6) All access openings, stair wells or other abrupt drops in traffic areas shall be covered by protected gratings, checkerplates, handrails, or other applicable methods. Stairways into wet well areas shall be constructed of non-corrosive materials.

(7) Structural provisions shall be made for future pumping station expansion.

(8) Should hoisting equipment be required for initial or future installation, adequate ceiling height and structural consideration shall be provided.

(9) Wet wells and dry wells shall be separated by at least a water and gas-tight wall with separate entrances provided to each. Equipment requiring regular or routine maintenance and inspection shall not be located in the wet well, unless the maintenance can be accomplished without entering the wet well.

The raw sewage pumps shall be of the non-clog type design and be capable of passing 2-1/2" diameter solids and the suction and discharge shall be a minimum of 3" diameter and shall be either submersible or vertical dry well mounted. The maximum rotational speed of any pump shall not exceed 1,800 revolutions per minute (rpm). The dry well mounted pumps shall have an inspection and cleanout plates on the body of the pump or a hand hole in the suction elbow to provide for clearing stoppages. All pumps shall be equipped with stainless steel wearing rings and mechanical seals for dry well mounted pumps. Protected potable water or chlorinated plant effluent shall be used for sealing. Grease seals will not be allowed. Seal water drainage shall be piped to the drainage receptacle or sump. Safety guards shall be provided on all exposed rotating shafts and couplings. Vertical shafting and couplings must have safety guards up to 7' above the floor. All dry well mounted pumps shall be provided with pet cocks on the top of the volute at the discharge to facilitate removal of air from the pump and placement of pressure gauges. The submersible pumps installation shall be equipped with stainless steel guides for raising and lowering the pumps. Additionally, submersible pumps shall be capable of running for extended periods without damage under full load in a totally dry condition.

All interior piping and fittings shall be ductile iron with interior bituminous coating and ANSI 125 pound (lb) standard flange. At least one (1) grooved coupling on the suction and on the discharge piping shall be provided to expedite removal and replacement for equipment. The wall penetration below the water table or below the wet well operating level shall be by wall pipes with 2" water stops. Wall sleeves with rubber link-seal arrangements shall be used in lieu of wall pipes. Caulking below water elevations shall not be acceptable. Where the pipes extend through the exterior walls, a flexible connection (mechanical joint or push-on-type joint) shall be provided at the exterior wall face. The face of the bell shall not be more than 2' from the outside face of the wall. Additionally, restrained joints shall be provided on all discharge lines as necessary.

Shut off valves on the suction and discharge piping shall be non-lubricated plug valves. The plug valves located more than 6' off the floor shall be provided with chain wheel operators. Additionally, check valves shall be installed in the horizontal piping only.

The pump control systems shall be of the encapsulated float type and shall be located in areas unaffected by flow currents in the wet well. Provisions shall be made to prevent grease and other floating materials and rags in the wet well from interfering with the operation of the controls. Additionally, provisions shall be made to automatically alternate the pumps. Alarm systems shall be provided on all pumping stations. The alarm shall be activated for high or low water levels in the wet well, loss of power, high water level in pump room sump (wet well-dry well system), loss of alarm transmission line and failure of pump to start. The alarm system shall be provided with an independent battery power source with continuous charge. Finally, each pump shall be provided with an elapsed time meter.

For all wet wells and pump rooms below grade, continuous ventilation is required with a minimum of six (6) air changes per hour. In rooms where motors are located, ventilation must be provided to also dissipate the heat from the electric motors. Intake ducts in below grade rooms shall extend to within 2' of the floor level. Separate ventilation systems shall be provided for the wet well and dry well. Wet wells for submersible installations, without free access, shall be ventilated with not less than one (1) 4" diameter open vent pipe.

Two (2) separate submersible non-clog sump pumps shall be provided for the removal of leakage or other water from the dry well floor. Each sump pump shall be provided with a double check valve system, a shut off valve, and a minimum of 2" diameter discharge piping and shall be capable of passing a 1-1/2" solid. Additionally, an alarm shall be provided for high water level in the sump. The sump pumps piping discharge should be as high as possible in the wet well and above the design high water level.

The pump motors shall meet the requirements for the NEC for Class I, Division 2 locations. Motors mounted on the pump in the dry well areas shall be totally enclosed fan-cooled squirrel-cage induction with Class F insulation limited to a Class B temperature rise. The motors that are mounted above grade in the motor control areas shall be open-dripproof squirrel-cage induction with Class F insulation limited to a Class B temperature rise. Motors mounted outside and exposed to the environment shall be weather protected type II squirrel-cage induction motors with epoxy encapsulated windings or approved equal. All electrical equipment (e.g., lights, cables, conduits, switch boxes, control circuits, etc.) located in the raw sewage wet well or enclosed spaces where hazardous gasses may be present, shall comply with the NEC requirements for Class I, Group D, Division I locations.

The submersible motors shall be housed in an air-filled watertight casing and shall have Class F insulated windings which shall be moisture resistant. The motors shall be NEMA Design B rated to 155 degrees Fahrenheit (ºF) maximum. The pump motors shall have cooling characteristics suitable to permit continuous operation, in a totally, partially, or non-submerged condition.

All motors shall be non-overloading at all points on the pump characteristic curve and shall be provided with a 1.15 service factor. Two (2) or more RTD's imbedded at various depths in the motor winding shall be provided to shut-off power and initiate an alarm for motor over-heating conditions.

Consideration shall be given in large installations to providing variable speed drive equipment of either the eddy-current coupling type or the liquid rheostat type. The eddy-current couplings, if supplied, should not be mounted in dry well areas, but connected by extended shafting from the motor control area to the pump in the dry well. Slip loss shall not exceed 3% of the full motor load. The wound-motor for the liquid rheostat variable speed system mounted in dry well areas shall be suitable for mounting in Class I, Division 2 locations with the slip rings in an explosion proof enclosure. The slip loss at full load shall not exceed 6-percent of the motor's synchronous speed.

Odor control shall be provided as appropriate.

4. PRELIMINARY TREATMENT

a. <u>General</u>

Screening equipment shall be provided at all WWTFs. The screens shall be preferably provided at the pretreatment structure, prior to discharging to either the grit removal facilities or to the aeration basins. Comminutors will not be considered an alternative to screening. Coarse screens shall be considered as units with openings that are 3/8" and larger, whereas, fine screens shall have openings

1/4" and less. The purpose of the screening units is to remove solids and trash that could otherwise damage or interfere with the downstream operations of the wastewater treatment equipment and processes. Manually cleaned bar screens shall be required for all WWTFs with a design capacity of less than 1.5 MGD, and mechanically cleaned bar screens shall be installed in all WWTFs with design capacities 1.5 MGD and greater.

Grit removal facilities may be omitted from WWTFs that have an initial capacity or 0.25 MGD or less. In larger facilities the initial grit removal facility shall be designed for the initial design flow or 50% the ultimate plant design capacity, whichever is greater. Grit removal shall be installed immediately after screening and prior to discharging to the aeration basins. The method of grit removal shall be a vortex type system, either hydraulically or mechanically induced system. The use of horizontal non-aerated grit chambers, aerated grit chambers, or detritus tanks will not be an accepted method.

Odor control facilities shall be provided as appropriate. However, at a minimum, provisions for odor control shall be provided in the initial design, so that if required, the necessary odor control facilities can be simply added to the system.

b. Bar Screening Facilities

Either manually or mechanically cleaned bar screens shall be provided at the WWTF to remove the larger objects which may damage mechanical equipment installed, form obstructions in the pipes or channels, or interfere with the normal operation of the WWTF. The bar screens may be divided into two (2) categories according to size as noted above. Design parameters used in the design of a bar screen shall include the following:

- Bar spacing, material of construction and dimensions.

- Channel depth, width and approach velocity.

- Discharge height to accommodate screenings conveying units.

- Angle of screen.

- Headloss through the unit.

- For mechanically cleaned bar screens, provisions for a redundant screen or bypass manually cleaned unit should be considered.

- For mechanically cleaned bar screens, the motor size and enclosure, service factor etc. should be considered.

- Odor control.

Location of the bar screen is an important aspect of the overall effectiveness of the unit. When locating the screen, the design engineer needs to consider the effects of the backwater caused by the headloss through the screen. Additionally, an overflow weir shall be provided to a bypass channel to prevent upstream surcharging if the screen becomes "blinded". If the screen is enclosed in a structure, ventilation shall be required to reduce the accumulation of moisture and odors.

The velocity distribution in the approach channel has an important influence on the operation of the bar screen. A straight channel is required ahead of the screen to ensure that a good approach velocity is attained across the screen. Additionally, the design engineer must ensure that the wastewater's approach velocity to the screen does not fall below a self-cleaning value or rise enough to dislodge screenings. The minimum approach velocity to the screen shall be 1.0 fps and the maximum approach velocity shall be 4 fps.

The method of cleaning the screens, manual or mechanical, relates to the method of removing and transporting screenings from the screens to a disposal site. For manually cleaned bar screens, the screenings shall be deposited onto a drainage plate to allow the drainage from the screenings to discharge into the influent channel prior to depositing the screenings to a dumpster or some other method of disposal. For mechanically cleaned units, the screenings can either be discharged directly to a dumpster or to a conveyor system with ultimate disposal to a dumpster. Prior to being discharged onto the conveyor system or directly to the dumpster, the screenings shall be dewatered using a compactor system. The basis of design for the screening facilities are summarized in Table E-4.

(1) Facilities and Equipment

All screening facilities shall be provided with at least dual channels each sized to carry the anticipated peak flows. Gates shall be provided to isolate the flow from any channel to facilitate dewatering and cleaning. The approach channels shall be designed to prevent the deposition of solids and provided with velocity control devices to limit the maximum approach velocities to the unit. All grating and handrails shall be aluminum. All bar screens shall be installed prior to the grit chambers.

(2) Manually Cleaned Bar Screens

Manually cleaned bar screens shall typically have openings ranging from 3/8" to 1.5" with the bars set at 30º to 45º angles from the vertical to facilitate cleaning. The bars shall be constructed of either aluminum or 316 Type stainless steel and shall consist of bars that are 3/8" thick by 2-1/2" wide. The bar screen shall be readily removed from the channel. The screen shall be provided with an accessible perforated platform where the screenings that are manually removed from the screen can be deposited where they can drain before removal for disposal.

(3) Mechanically Cleaned Bar Screens

Mechanically cleaned bar screens shall have clear openings that are less than 1/4", with the unit set at 0 to 30º from the vertical. Acceptable types of mechanically cleaned bar screens consist of reciprocating rake and continuous screens. The materials of construction shall be 316 Type stainless steel, and if acceptable the element of the screen itself may be plastic. The screen unit shall be readily accessible for maintenance and shall be capable of being removed from the influent channel. The bypass channel as a minimum shall be equipped with a manually cleaned bar screen. The controls shall operate the screen based on a time interval with auxiliary controls which will start the mechanism in operation at a preset high water level. Additionally, a screen failure alarm shall be included in the design. Manual overrides shall be provided. If a conveyor system is used then the controls for the screening system shall be interlocked into the auxiliary equipment of the screen, such as spray wash, conveyors, compactors or other equipment associated with the operation of the screen. The electrical fixtures and controls housed in the screening areas where hazardous gases may accumulate shall meet the requirements of the NEC for Class 1, Group D, Division 1 locations.

TABLE E-4
TYPICAL DESIGN CRITERIA FOR
BAR SCREENS

Item	Range	Comments
Manual screen		**Used in facilities with design capacities less than 1.5 MGD or in bypass channels**
Openings	**0.375" to 1.5"**	
Approach Velocity	**1.0 to 2.0 fps**	
Bar depth	**1" to 3"**	
Slope from vertical	**30º to 45º**	
Allowable headloss	**6"**	
Mechanically cleaned bar screen		**Used in facilities with design capacities greater**
Openings	**0.25" to 0.5"**	**than 1.5 MGD**
Approach Velocity (maximum)	**2.0 to 4.0 fps**	**Maximum approach velocity based on headloss through the screen**
Minimum Velocity	**1.0 to 2.0 fps**	**Minimum velocity required to prevent grit accumulation**
Slope from vertical	**0º to 30º**	
Allowable headloss	**6"**	

(4) Grit Removal Facilities

The removal of grit, sand, and other inert debris from the waste flow is considered a protective process and does not materially reduce the pollutant load. This inert material causes wear on the pumps and other mechanical downstream equipment. Additionally, this material settles in tanks, clogs pipes and channels and reduces the effective treatment volume of the individual treatment units, thereby, increasing the O & M costs.

While the quantity and characteristics of the grit and its potential impact on downstream processes are important considerations in selecting a grit removal process, other factors should be considered. These factors include:

- Headloss requirements.
- Space requirements.
- Grit removal efficiency.
- Organic content.
- Economics.

A number of grit removal processes may be utilized, however, only mechanically or hydraulically induced vortex type units will be considered. The grit removal system shall be capable of removing at least 95% of the grit that is 150 micron (μ) and larger, having a specific gravity of 2.65.

The vortex grit removal system relies on a mechanically or hydraulically induced vortex to capture grit solids in the center hopper of a circular tank. For the mechanically induced unit a rotating turbine maintains a constant flow velocity, and its adjustable pitch blades promote separation of the organics from the grit. The action of the turbine shall produce a toroidalflow path for the grit particles. Generally the headloss through this type of unit is 1/4". These units are generally effective in removing grit that is 150 micron (µ) and larger. The mechanically induced vortex unit shall be constructed of concrete. Carbon or galvanized steel, fiberglass or other materials will not be acceptable.

In the second type of unit, a hydraulic or "free" vortex is generated by the flow entering tangentially at the top of the unit. The effluent exits the center of the top of the unit from a rotating cylinder or "eye" of the fluid. Gravitational forces within this cylinder minimize the release of particles with densities greater than water. Grit settles by gravity to the bottom of the unit, while organics, including those separated from the grit particles exit principally with the effluent. Headloss through this type of unit is a function of the size of the particle removed, and can in some cases exceed 48". However, these units will remove particles less than 64" in diameter. The free vortex tankage shall be constructed of at least 304 Type stainless steel. Carbon or galvanized steel, fiberglass or other materials will not be acceptable.

Ideally, the flow to the unit shall be straight, smooth, and streamlined. Generally, the influent channel length is 7-times the width of the influent channel, or 15', whichever is greater. However, the length and overall dimensions of the influent channel to the grit removal unit shall be in accordance with the manufacturer's recommendation. The approach velocity in the influent channel shall range from 2.0 to 3.0 fps. The ideal range shall be 40% and 80% of the peak flow experienced. The minimum acceptable approach velocity is 0.5 fps, since lower velocities will not carry grit into the unit.

Sizing of the units shall be based on manufacturer's recommendations. Typical detention times for these units at peak design flows range between 20 and 30-seconds. Deviations from the recommended dimensions without the manufacturer's prior approval, may be considered by the City if it is in the best interest of the WWTF.

Grit shall be removed from the unit utilizing either an air lift or other type pump or gravity. Air lift and pumping methods for removal of the grit shall be considered for the mechanically induced vortex grit removal units, whereas, gravity is most commonly used for the free vortex unit. If gravity is utilized a flushing system to pump water at a high pressure to loosen the grit prior to the solenoid valve opening for discharge of grit from the unit is required.

Vortex or recessed impeller type pumps, and air lifts shall be utilized to pump the grit slurry to the grit washing unit. The pump casing and impeller shall be constructed of abrasive resistant ni-hard material. The piping shall be a minimum of 4" in diameter and the configuration utilized shall minimize the horizontal and vertical bends to reduce plugging. Cleanouts shall be provided at bends to readily clear any blockages. The minimum velocity through the pipes shall be maintained at 2.0 fps. Additionally, check valves shall be placed in the horizontal section of the grit discharge line. Pump controls shall be provided which will allow for manual initiation of operation, timed interval operation, and continuous operation.

After the grit is removed from the unit, it shall be washed to remove putrescible organic material that may be present in the grit. To wash the grit, a cyclone type unit shall be used prior to classifying. The cyclone separator shall have a minimum of 4" diameter inlet and discharge selected to meet the requirements of the expected grit load. The separator shall be provided with replaceable rubber liner, adjustable apex and pressure gauge. The constant feed rate to the units generally shall operate within a range of 200 to 500 gpm, depending upon the size of the unit, and shall be based upon the manufacturer's recommendations. The discharge from the cyclone shall than discharge into a grit classifier. The grit classifier shall consist of either an inclined screw or cleated belt system. For a target particle size the design engineer shall select a minimum pool area and overflow weir length to ensure the proper removal of the grit.

c. Flow Equalization

Accommodating wide variations in flow rates and organic mass loadings is one of the major challenges faced in the design of WWTFs. Because of the naturally occurring variations in the generation of wastewater and the related effects of I/I, all municipal WWTFs must process unsteady wastewater flows. Efficiency, reliability, and control of the unit process operations within the WWTF can be adversely affected by the cyclic nature of waste generation. Equalization of the influent flow can dampen the diurnal variations and the variations caused by I/I to achieve a relatively constant loading of downstream treatment processes.

Two (2) types of equalization on influent flows may be used:

- Hydraulic Flow equalization.
- Waste strength equalization.

The primary objective of hydraulic flow equalization is simply to dampen the diurnal flow variation and thus achieve a constant or nearly constant rate of flow through the downstream processes. Waste strength equalization, commonly using industrial applications dampens the variability of the strength of the waste by blending the wastewater in the equalization basin. For this purpose the volume of wastewater in the equalization basin normally remains constant.

Equalization may be used to minimize the effects of loading variations and can be used to reduce the required size of downstream facilities. However, the design engineer shall perform an economic and operational analysis to determine the feasibility of utilizing equalization basins versus the required size of the downstream treatment units.

If feasible, the equalization basins shall be located immediately following the pretreatment structure. The equalization basins shall be designed as either in-line or off-line systems. For the in-line system all of the wastewater passes through the equalization basin. Whereas, for the off-line system only the portion of the flow that exceeds the average daily demand is diverted to the basin.

The equalization basins shall be constructed of concrete, and if necessary, covered for odor control purposes. Steel tanks shall not be acceptable. Either diffused air or floating mechanical aerators can be used to adequately mix and aerate the wastewater. The design of the mixing equipment shall provide for blending of the contents of the tank and preventing the deposition of solids in the basin. Whereas, aeration will be necessary to prevent the wastewater from becoming septic. Mixing requirements will be based on a wastewater with a TSS concentration of 200 mg/l, and shall range from 0.02 to 0.04 horsepower (HP) per 1,000 gallons of storage. To maintain aerobic conditions, the air should be supplied at a rate of 1.25 to 2.0 cubic feet (cf) per 1,000 gallons of storage. Mechanical aerators can be used as one method of providing both mixing and aeration and shall have oxygen transfer capabilities varying from 1.0 to 1.5 pounds of oxygen per Hp/hour. The minimum operating depth of the equalization basin shall be 5 feet. Low level shut-off controls shall be required to protect the mixing and aeration units. Baffling should be provided to prevent short circuiting and ensure proper mixing. Additionally, if diffused aeration systems are used, then coarse or intermediate bubble diffusers shall be used. Other operational appurtenances that should be considered by the design engineer include:

- Facilities for flushing any solids and grease that may tend to accumulate on the basin walls.

- An emergency overflow in case of pump failure.

- A high-water takeoff for the removal of floating material and foam.

- Water sprays to prevent the accumulation of foam on the sides of the basin, if foam is a problem.

d. Odor Control

Wastewaters entering the WWTF may contain odorous compounds that can escape from open channels and tanks in the preliminary treatment systems, particularly at points of turbulence. Prevention and control of odors shall be required to prevent complaints from nearby residents, to provide a reasonable working environment for WWTF operators, and to reduce the corrosive effects of the gases on the equipment. The malodorous gases emanated from municipal wastewater may contain numerous components, including H_2S, indoles, skatoles, amines, ammonia (NH_3), carbon dioxide (CO_2), methane (CH_4), and others. The acceptable methods for odor control shall include:

- Prevention, which entails minimizing the formation of anaerobic conditions, largely through good housekeeping.

- Chemical treatment in the wastewater ahead of the pretreatment structure can help minimize the formation and release of odorous substances. Some of the common chemicals used to control odors include chlorine and chlorine compounds, hydrogen peroxide, metal salts, and caustics or alkalis.

- Preaeration to replenish the DO in the influent wastewater, thereby reducing the septicity and odor. However, preaeration will strip the H_2S and volatile organics from the wastewater and, hence may require a cover and air scrubbing system.

- Air scrubbing of gas streams collected from covered treatment processes can provide effective and economical odor control. Odor scrubbers remove odorous compounds from the air stream by many methods, including activated carbon, biological towers, dissolution in liquids containing oxidants using packed towers or aerosol contact vessels, and ozonation.

All WWTFs shall be designed with the provisions to add an odor control system should conditions warrant after start-up of the facilities.

5. SECONDARY TREATMENT

a. Activated Sludge

An activated sludge process cultivates large populations of the soil bacteria and other microorganisms commonly found in the aquatic environment. The microorganisms utilize the soluble organic material found in wastewater as a source of food and energy. The soluble material is thus converted to a form which can be readily separated from the liquid phase by sedimentation. The growth of the desired microbial populations are encouraged by maintaining aerobic conditions and by controlling pH and temperature. The growth of microorganisms and their settleability can be enhanced by selecting a proper ratio between the available food (F) and the quantity of available microorganisms (M_V). Although a reduction in the F/M_V ratio will result in a reduction in the quantity of waste activated sludge, the power costs required to enhance this auto-oxidation process will increase.

Mechanical aerators or diffused air systems are used to mix the biological solids in the wastewater and to provide a source of air from which the oxygen required for the biological process can be obtained. The wastewater and biological solids mixture, mixed-liquor-suspended-solids (MLSS), are transferred from the aeration basins to the secondary clarifiers to separate the treated effluent and remove the heavier, biological solids by sedimentation. The treated effluent is then chlorinated prior to discharge. A major portion of the settled biological solids are returned to the aeration basins for continued removal of organic waste material. The remaining solids are wasted to the solids treatment stream.

Activated sludge plants have been shown to be very effective in the nitrification of ammonia to nitrate under proper loading conditions and with an adequate source of oxygen. The oxygen required to nitrify one pound of ammonia is more than four (4) times the oxygen required to oxidize 1-pound of organic matter (BOD_5). Thus the required aerator or blower capacity and the resultant power consumption for a nitrifying activated sludge plant are sharply increased.

(1) Processes to be Considered

The following activated sludge processes shall be considered:

(a) Conventional activated sludge with plug flow and tapered aeration. This modification consists of a primary settling tank, two (2) or more long, narrow aeration tanks, secondary clarifiers, and a sludge recycle system consisting of a pumping unit and a sludge recycle line.

The effluent from the primary tank is mixed with the settled activated sludge from the secondary settling basin and discharged into the aeration tank. Air is supplied to the tank for aeration either using mechanical aerators and/or diffused aeration. The oxygen demand decreases as the waste moves along the tank in a plug flow fashion, and more air is needed at the inlet end. Thus the air flow is tapered with about 40% being supplied to the inlet quarter and about 10% to the outlet quarter. The detention time in the aeration tank may vary from 4 to 10 hours with 6 being average. During this period, the microorganisms in the returned activated sludge adsorb or absorb the organic material in the waste stream converting it from a colloidal and dissolved form to a settleable material. The waste flow is allowed to settle and the biological cell mass is removed. A portion of this cell mass is returned to the inlet end of the aeration tank and the process repeated. In order to maintain a balance between the food supply in the waste stream and the cell mass in the return sludge, it is necessary to waste some of the activated sludge.

(b) Step-feed activated sludge system. In this modification of the conventional activated sludge system, the effluent from the pretreatment structure is discharged into the aeration tank at several points rather than at the tank inlet.

This equalizes the food-to-microorganisms ratio thereby lowering the peak oxygen demand which occurs at the tank inlet in the conventional system and spreads it more uniformly over the tank length. Thus, higher BOD_5 loadings are possible per unit of aeration tank volume.

(c) Contact stabilization. It has been found that removal of BOD in the activated sludge process occurs in two (2) stages. The first is the adsorptive and absorptive stage where the colloidal material is adsorbed and the dissolved material is absorbed into the cell itself. The second phase is the utilization of the organic material by the cell mass and its conversion into energy, new cell mass, and waste products. The first phase is generally accomplished in less than an hour whereas the second phase requires 4 to 8-hours. The settling characteristics of the waste at the end of the first phase is excellent and by separating the two phases and aerating the smaller volume of the recycled sludge for the longer period of time the plant capacity may be increased substantially.

This method of treatment is particularly adaptable to those situations where a high percentage of the organic waste load is in colloidal form. In such cases, the primary settling basin may be omitted.

However, because the residence time in the contact tank is relatively short, some of the dissolved organics may not be absorbed thus this method is not as efficient as can be achieved by the conventional method. Therefore, this method is not recommended, nor will it be acceptable to the City.

(d) Complete mix process. In this modification of the activated sludge process, the recycled sludge and the waste stream are mixed together and fed into the aeration tank at several points. Using some means of aeration, the waste stream and the tank volume are mixed almost instantaneously. This evens out the oxygen demand and supply throughout the tank.

(e) Extended aeration. The extended aeration system is an attempt to totally oxidize the organic fraction in the waste by extending the aeration time from the 4 to 10 hours common in the conventional system to 20 to 36 hours and increasing the concentration of (MLSS) in the aeration tank. This additional residence time and MLSS concentration allows almost complete oxidation of the organic material and therefore minimizes the volume of waste sludge.

Because of the required increase in tank volume extended aeration is required for relatively small installations. With capacities of less than 0.10 MGD, the extended aeration process is required. The units are particularly adaptable to situations where the flow into the plant is intermittent as would be expected from small installations.

Due to the long detention time provided and the high MLSS concentration, the raw waste may be discharged directly into the aeration tank from the pretreatment facility. When good operating conditions exist, excellent reduction in BOD_5 can by achieved. When the operating conditions are poor or when high hydraulic loadings are received, the quality of the effluent will degenerate dramatically. This is true because of a washout of the settling activated sludge from the settling basin by the surge in flow.

(f) Oxidation Ditch (See Section E.5.b)

(g) Carrousel Process (See Section E.5.c)

(2) Process Design Parameters

The size of the aeration tank for any modification of the activated sludge process shall be determined by rational calculations based upon the F/M_V, MLSS level and sludge retention times (SRT). In addition, the following items will be considered:

(a) Degree of treatment required.

(b) Wastewater temperature.

(c) pH.

(d) Dissolved solids.

(e) Organic load variations.

The basis for sizing of the aeration basins relates to the sludge production rate as determined by the influent BOD_5 load. The sludge production determines the size of the aeration basin when the values for the mixed liquor volatile suspended solids and the SRT are established.

The basic relationship normally used for calculating sludge production is:

$$S_v = aF - bM_v$$

where:

S_v = Total volatile solids produced and wasted (either deliberately
or in the final effluent) in lbs/day.

M_v = Total mass of volatile solids in the aeration system (usually only the solids in the aeration basin are considered) in lbs.

F = lbs. of BOD_5; removed in the activated sludge process in lbs/days.

a = The cell yield coefficient in terms of lbs of volatile suspended solids, produced per lb. of BOD_5, removed. For unsettled domestic wastewater, this value will be taken as 1.10. For settled domestic wastewater this value will be taken as 0.70.

b = Endogenous respiration coefficient. For unsettled domestic wastewater this value will be taken as 0.08. For settled domestic wastewater this value will be taken as 0.075.

The entire analyses shall be based upon volatile solids since any inert solids, either entering or precipitated by chemical addition, are not involved in the biological process. Their amounts must, of course, be added to S_V in order to determine the total amount of sludge to be wasted, but they need not be considered with the relationship for calculating sludge age.

By transposing the above equation, a more useful form results:

$$S_V/M_V = a(F/M_V) - b$$

The value of S_V/M_V is the reciprocal of the SRT. Therefore,

$$1/SRT = a(F/M_V) - b$$

The overall design parameters for a WWTF required to remove only carbonaceous BOD_5 are as shown in Table E-5.

For the removal of carbonaceous plus nitrogenous BOD, the use of the sludge age parameter shall be required. As has been demonstrated the. growth rate of nitrifying organisms is much slower than those organisms needed to metabolize the carbonaceous matter and is very dependent upon temperature. The theoretical relationship, as developed by Downing, for nitrification in domestic wastewater is:

$$1/SRT = (0.18)\,(1.128)^{T-15}$$

This means that in any activated sludge system requiring nitrification at a given design temperature, the sludge age, (SRT) must be greater than the value obtained from the above equation. If the operation sludge age is less than the value obtained, the slow-growing nitrifiers will be washed out of the system.

In designing aeration basins for nitrification the value of the SRT shall be determined using a wastewater temperature of 18 degrees Celsius (°C). This results in a minimum SRT of approximately 4 days. Furthermore, because of the unpredictable variations and the possibility of some inhibition of the growth rate of nitrifying organisms, a safety factor of 2.0 for sludge age based an the average BOD load shall be used providing that at the maximum day BOD load the SRT is not less than the minimum of 4 days.

The value of the MLSS must be projected on the basis of what can normally be carried for any particular activated sludge system and method of aeration. With diffused air systems, the range of MLSS for normally loaded plants is 2,000 to 3,500 mg/l, with higher values being for treatment of unsettled domestic wastewater. For mechanical surface aerators the MLSS ranges up to 4,500 mg/l. Because the solids become somewhat densified in plants operating in or very close to the endogenous phase (F/M_V, less than 0.15) MLSS values of up to 5,000 mg/l can be used.

The F/M_V is based upon MLVSS which is 75% to 80% of the MLSS for settled domestic wastewater, and 65% to 70% for unsettled wastewater.

The oxygen input requirement for the removal of carbonaceous BOD_5 shall be determined by the following equation:

$$O_r = cF + dM_v$$

where:

O_r = lbs/day of oxygen required.

c = 0.55 lb 02/lb BOD5 Applied.

d = 0.15 lb 02/lb MLVSS.

In those plants where nitrification is needed, an additional requirement of 4.6 lb. O_2/lb. total kjeldahl nitrogen (TKN) applied shall be used. A DO concentration of 2.0 mg/l or higher shall be maintained in the aeration tanks. The oxygen requirements shall be based upon the maximum day BOD_5 and TKN applied.

(3) Aeration Facilities and Equipment

The method for transferring oxygen to the mixed liquor shall be by either a diffused aeration system or by low speed mechanical aerators. Pure oxygen systems will not be considered for use in the City due to their complexity and labor intensive requirements.

TABLE E-5

TYPICAL ACTIVATED SLUDGE DESIGN PARAMETERS

Process Modification	Sludge Retention Time (days)	F/M lbs BOD_5/MLVSS/ day	Aeration Loading lbs BOD_5/1,000 cf of tank volume	MLSS (mg/l)	Detention Time (hours)
Conventional	5 to 15	0.2 to 0.4	20 to 40	1,500 to 3,000	4 to 8
Complete Mix	5 to 15	0.2 to 0.4	40 to 60	3,000 to 3,500	3 to 5
Step Aeration	5 to 15	0.2 to 0.4	40 to 60	2,000 to 3,500	3 to 5
Contact Stabilization (not recommended)	5 to 15	0.2 to 0.6	30 to 75	1,000 to 4,000[1] 4,000 to 10,000[2]	0.5 to 1.5[1]
Extended Aeration	20 to 30	0.05 to 0.15	10 to 15	2,000 to 5,000	24

Notes: 1. Contact unit.

2. Stabilization unit.

Air requirements for a diffused air system shall be determined by incorporating such factors as:

- Tank depth, not less than 12.0'.
- Alpha factor of waste; 0.4 for fine bubble diffusers; 0.7 for coarse bubble diffusers.
- Beta factor of 0.95.
- Certification of aeration device transfer efficiency.
- Minimum aeration tank DO concentration at 2.0 mg/l.
- Minimum wastewater temperature of 18° C.
- Minimum mixing intensity required of 0.75 to 1.0 HP per 1000 cf. of volume.

To the air requirements shall be added air required for channels, pumps, aerobic digesters, or other plant air use demands. Diffuser efficiencies shall be as recommended by the manufacturer but shall in all cases exceed 10% for coarse bubbler diffusers and 25% for fine bubble diffusers in clean water tests at a power density in excess of 1.0 HP per 1000 cf. Documentation from the manufacturer shall be provided for all proposed diffuser efficiencies. The installed diffuser system shall be tested in clean water and corrected to standard conditions to determine conformance with the stated efficiencies. Dissolved oxygen probes shall be used and determination of DO content by the Winkler method shall not be allowed.

The specified capacity of blowers should take into account that the air intake temperature may reach 40° C and the pressure may be less than normal. The specified capacity of the motor drive should also take into account that the intake air may be 0° C (32° F) and may require oversizing of the motor or a means of reducing the rate of air delivery to prevent overheating or damage to the motor. The blowers shall be provided in multiple units to meet the maximum air demand with the single largest unit out of service. Centrifugal blowers shall be equipped with intake and exhaust silencer's and shall be equipped with inlet control butterfly valves. The design shall also provide for varying the volume of air delivered in proportion to the load demand of the WWTF.

Aeration equipment shall be easily adjustable in increments and shall maintain solids suspension within these limits. The spacing of diffusers should be in accordance with the oxygen requirements through the length of the channel or tank, and should be designed to facilitate adjustment of their air flow rate without major revisions to air header piping. All WWTFs employing less than four (4) independent aeration tanks shall be designed to incorporate removal diffusers that can be serviced and/or replaced without dewatering the tank. Air piping for fine bubble diffusers shall be stainless steel to prevent accumulation of scale and eventual clogging of the diffuser. Individual assembly of units of diffusers shall be equipped with control valves, preferably with indicator markings for throttling or for complete shutoff. Diffusers in any single assembly shall have substantially uniform pressure loss. Air filters shall be provided in numbers, arrangements, and capacities to furnish at all times an air supply sufficiently free from dust to prevent damage to blowers and clogging of the diffuser system used.

For low speed mechanical aerators, the equipment shall be standard mechanical surface aeration equipment capable of transferring the required atmospheric oxygen into the mixed liquor. The aerators shall maintain the activated sludge solids in suspension throughout the aeration tank while maintaining a minimum of 2.0 mg/l DO in the mixed liquor at all times. Adjustable outlet weirs for controlling the aeration tank's liquid level and thereby controlling the amount of atmospheric oxygen transferred shall be provided. Alpha factor for mechanical aeration shall be taken as 0.90.

The aerator blades shall be sized based on the following conditions:

The coefficient, P_c, as calculated below, at maximum design speed and power input,not being less than 0.0045.

$$P_c = P/(N^3)(D^5)$$

where:

P = motor electrical input HP at maximum speed of aerator.

N = maximum rotational speed of aerator impeller in revolutions/second.

D = Diameter of the aerator impeller in feet.

At maximum design speed of the aerator, the tip or peripheral speed of the impeller shall not exceed 20 fps. Transfer efficiencies of mechanical surface aerators shall not be less than 2.75 lbs. O_2 per electrical input HP under standard conditions. Proposed transfer rates shall be based upon the manufacturers recommendation where consideration is given to the geometric shape, area and volume of the basin. Transfer efficiency tests shall be conducted on the installed system to determine conformance with the specifications.

The aerator drives shall be either of the lower extended bearing type or of the independent bearing support construction with a speed reducer. The minimum AGMA Service Factor shall be 2.3 for speed reducers and for gear motors. Gear reducers shall be provided with bearings having a minimum rating life expectancy (B-10) of 100,000 hours, except those bearings attached directly to the output shaft which shall have a rating-life expectancy (B-10) of 300,000 hours.

Gear reducers shall have a reliable lubrication system incorporating a pressure, flow or temperature switch device to stop the motor in the event of insufficient lubrication. Motors shall be TEFC type suitable for outdoor operation having NEMA Class F insulation and B temperature rise. The motor shall have encapsulated or vacuum pressure impregnated windings capable of passing a mist/spray and direct wash down test.

(4) Aeration Basins

All aeration basins shall be of reinforced concrete design either above or below grade as dictated by site constraints. In addition, all aeration basins shall be provided with:

- A minimum of 1.5' freeboard.
- Sufficient units of a size to enable proper operation of the WWTF in its initial years.
- Visible return sludge discharges for each tank, particularly when the sludge flow to each tank is not metered.
- Floor slopes and gravity drain piping to facilitate periodic flushing of solids from the tank bottom.
- Strategically located yard hydrants for easier clean-up operations.
- Adequately sized influent and effluent channels to prevent deposition of MLSS.
- Foam control water sprays for channels.
- Bitumastic coating in channel areas and in the tank interior to 3' below the nominal water surface elevation.
- All grating, entrance hatches and handrailing shall be aluminum or fiberglass.

The aeration basins using diffused air system shall also be provided with the following:

(a) Gravity drains where air header galleries are used.

(b) An adequate froth or foam control water spray system.

(c) Swing arm diffusers with air measuring and shut-off features.

(d) Main butterfly valve controls at each basin to enable the air flow to each basin to be independently controlled depending on flow pattern and demand.

The aeration basins using low speed mechanical aerators shall be provided, in addition to that listed above, with the following:

(a) Stilling baffles in front of outlet weirs to ensure even flow distribution and prevent surging.

(b) Means of removal of the aerator's motor and/or gear units.

(c) Access manholes in aerator platform.

(d) Aeration platforms shall be a minimum of 5' above the water surface.

(e) Provisions for aerosol and splash control.

(5) Return Activated Sludge

The basic relationship for the quantity of return sludge is developed from the mass balance around the clarifier and is as follows:

$$(Q + Qr)Ca = QrCr + QCe + QwCr$$

where:

Q = plant influent flow rate.

Qr = sludge recycle flow rate.

Qw = sludge wasting rate.

Ca = required MLSS concentration in the aeration tank.

Ce = plant effluent concentration.

Cr = sludge recycle concentration.

For the purposes of calculating the return sludge rate the two (2) terms QCe and QwCr are relatively small in comparison to the other terms and are normally taken as zero. Thus the following form of the equation results:

$$Qr = (Q)(Ca)/(Cr - Ca)$$

The return sludge concentration (Cr) for those plants removing only carbonaceous BOD_5 may be taken at a maximum value of 8,000 mg/l. For those WWTFs which are nitrifying the effluent or operating in the endogenous phase, the value of Cr shall take a maximum of 6,000 mg/l. The rate of sludge return expressed as a percentage of the average plant design flow should generally be variable between the limits set forth in Table E-6.

The maximum return sludge capacity shall be obtained with the largest pump out of service. A positive head shall be provided on pump suctions. Pumps should have at least 3" suction and discharge openings. When possible, each group of aeration tanks and clarifiers shall have separate return and waste sludge removal capabilities. Additionally, the capability to return and waste sludge concurrently shall be provided. Automatic proportioning of return sludge flow to influent flow should be provided at larger facilities.

The pumps shall be equipped with mechanical seals (grease stuffing boxes will not be considered). The seal water may be either clean potable water after it has passed through a reduced pressure backflow preventer or strained plant effluent. Seal water pressure must be 10 psi greater than maximum pump discharge pressure. Automatic solenoid shut off valves, manual isolation valves, and rotometer shall be required for seal water installations. Pumps shall be equipped with replaceable stainless steel wearing rings.

Suction and discharge piping should be at least 4" in diameter and should be designed to maintain a velocity of not less than 2-fps when return sludge facilities are operating at normal return sludge rates. Suitable devices for observing sampling, and controlling return activated sludge flow from each settling tank shall be provided. It is recommended that return sludge piping be terminated above the aeration tank liquid level to allow for observation and sampling.

TABLE E-6
RETURN ACTIVATED SLUDGE RATES
AS A PERCENTAGE TO AVERAGE WWTF FLOW

Type of Process	Minimum Percentage	Maximum Percentage
Processes without nitrification	15	100
Processes with nitrification	50	125
Extended Aeration	50	150

b. Oxidation Ditch

The oxidation ditch is essentially an extended aeration modification of the activated sludge process. The system consists of a "racetrack" shape basin and a large brush type rotor. The rotor is placed across the ditch to provide the air required and to move the liquid around the basin.

(1) Design Parameters

All design parameters shall be equivalent to the extended aeration process design parameters as given in Subsection E.5.a.

(2) Facilities and Equipment

There shall be at least two (2) ditches of equal volume. Each rotor shall be sized so that its oxygen capacity is equal to the total oxygen demand of the plant. The rotor shall provide at least a 1 fps velocity to the mixed liquor. Provisions shall be made to easily vary the liquid level in the ditch to control immersion depth on the rotor. The rotor bearing should have grease fittings that are readily accessible to maintenance personnel. Bearing shall have a minimum B-10 life rating of 300,000 hours. The gear reduction limit shall have a minimum service factor at 2.5. Gear housing and outboard bearings shall be shielded from rotor splash. The oxidation ditch may be trapezoidal and lined with reinforced concrete or as approved by the City.

c. Carrousel Process

The carrousel process is a patented modification to the activated sludge process. It utilizes a plug flow regime with the mixed liquor continually circulating in a "racetrack" shaped basin. The mechanical surface aerator is used in this process to supply the energy required to maintain a sufficient velocity in the channel and to supply the oxygen required for the biological process. The zone of aeration is a relatively small volume where the mixed liquor is intensely mixed with the influent flow and the oxygen transferred from the atmosphere.

(1) Process Design Parameters

The design of a carrousel process shall conform to the requirements as set forth in Section E.5.a.

(2) Facilities and Equipment

The facilities and equipment shall conform to the requirements as set forth in Section E.5.a.

d. Secondary Clarification

Inlets shall be designed to dissipate the inlet velocity, to distribute the flow equally and to prevent short circuiting. Scum baffles shall be provided ahead of all effluent weirs. Outlet weirs shall be adjustable for leveling. Multiple units are required. In plants where two (2) units are furnished, each unit shall be sized for 75% of the total design capacity.

All secondary clarifiers shall be designed to provide easy access for maintenance and protection to the operator. Such features shall include stairways, walkways, and handrails.

Sludge removal shall be as dictated by the particular process utilized.

(1) Process Design Parameters

Since the rate of recirculation of return sludge from the secondary settling tanks to the aeration or reaeration tanks is quite high in activated sludge processes, the detention time, surface settling rate and weir overflow rate should be adjusted for the various processes to minimize the problems with sludge loadings, density currents, inlet hydraulic turbulence, and occasional poor sludge settleability. The design parameters shown in Table E-7 should be observed in the design of secondary settling tanks for the various activated sludge processes. Consideration must be given to the flow duration.

The minimum sidewater depth for secondary clarifiers shall be a function of tank diameter as shown Table E-8.

TABLE E-7
DESIGN PARAMETERS FOR SECONDARY CLARIFIERS

Type of Treatment	Hydraulic Loading Rates (gpd/sf)		Solids Loading Rates (lbs./day/sf)	
	Average	**Peak**	**Average**	**Peak**
Extended aeration and nitrification processes	**200 to 400**	**600 to 800**	**10 to 20**	**30 to 35**
All other activated sludge processes	**400 to 600**	**1,000 to 1,200**	**8 to 30**	**40 to 45**

TABLE E-8
SECONDARY CLARIFICATION
RECOMMENDED SIDEWATER DEPTHS

Diameter	Minimum Sidewater Depth
up to 70'	**12'**
71' to 100'	**13'**
101' to 140'	**14'**
Greater than 140'	**15'**

The bottom slope for clarifiers following an activated sludge process, which are preceded by primary clarification, shall not be less than 0.5' in 12'. The bottom slope for units following fixed film reactors and activated processes, not preceded by primary clarification shall not be less than 1' in 12'.

(2) Equipment and Facilities

Clarifiers following the activated sludge processes, that are less than 100' in diameter shall be the scraper/rake sludge collection mechanism type which continually moves the settled solid toward a centrally located hopper. Whereas clarifiers greater than 100' in diameter should be of the rapid sludge return type incorporating a suction type removal system with suction nozzle attached to the moving sludge collection arms. For clarifiers that incorporate suction type removal systems, the sludge is continuously withdrawn from the clarifier bottom by a hydrostatic differential head between the water surface level in the clarifier and the discharge elevation in the sludge well of the suction pipe. The discharge of the suction pipe shall be equipped so that the discharge elevation can be raised or lowered to adjust the return sludge flow.

The sludge collection equipment shall not have chains, bearings, or operating mechanisms below the liquid surface. The maximum allowable stresses on structural steel members when the full stall torque is applied shall not exceed those permitted by the latest AISC Specifications. The entire drive assembly shall be designed on the basis of maximum continuous working output torque and shall be designed for a stalled torque of twice the maximum continuous working output torque. Overload device assemblies of either the worm shaft thrust actuated type or the ampere measuring type shall be provided. The overload alarm device shall show a value indicating impending overload and further shut the unit down if this value is exceeded.

e. Waste Activated Sludge Facilities

Waste sludge facility design is highly dependent on the sludge handling system to which the sludge will be discharged. Wasting will be accomplished either continuously or in a very definite time span based on the downstream sludge handling units and the plant's operating schedule. Continuous wasting should be the goal of larger facilities, and in this case the wasting system should be designed to function in the range of 0.5% to 5.0% of the average wastewater flow expected (initial and design). In systems where continuous wasting cannot take place, waste sludge control facilities should have a maximum capacity of not less than 25% of the average rate of wastewater flow and function satisfactorily at rates of 0.5% of average wastewater flow.

The abrasive nature of sludges, especially those containing grit, must be considered in the selection of pump type and materials of construction. The pump capacity shall be adequate to cover the full range of solids concentrations and sludge reproduction. Variable speed or other rate control systems are desirable. Maximum operating pressure should be calculated to account for the high friction factor when pumping sludges. Duplicate pumping units shall be provided where failure of one unit would seriously hamper plant operation. Interconnection of pump suction and discharge manifolds is recommended, so that one pump discharge can be used to backflush other suction piping. A minimum positive head of 24" shall be provided at the suction side of centrifugal type pumps and is desirable for all types of sludge pumps. Plunger pumps, screw feed pumps, recessed impeller-type centrifugal pumps, progressive cavity pumps, or other types of pumps with demonstrated solids handling capability shall be provided for handling raw sludge. Plunger pump backup for centrifugal pumps is recommended.

Sludge withdrawal piping should have a minimum diameter of 8" for gravity withdrawal and 6" for pump suction and discharge lines. Where withdrawal is by gravity, available head shall be adequate to provide a velocity of at least 3 fps. Gravity piping should be laid on a uniform grade and alignment. The slope of gravity discharge lines should not be less than 3%. Provisions should be made for cleaning, draining, and flushing sludge piping. Flanges, tees and crosses, and cleanouts to allow rodding of suction lines are desirable. Provisions for back flushing with positive displacement pump discharge is desirable. Provisions for cleaning by hot water, steam injection, or chemical degreasing should be considered in long lines containing raw sludge or scum.

Flow meters should be provided on all essential lines. Provisions should be made for metering equipment isolation, cleaning, and calibrating. Variable timer equipment should be provided for sludge pumps used in intermittent withdrawal service. Unless sludge sampling facilities are otherwise provided, quick-closing sampling valves shall be installed at the sludge pump. The size of the valve and piping shall be at least 1-1/2".

Aerated sludge holding tanks should be sized on the basis of 2 cf per capita. Chemical conditioning facilities that would allow chemical addition prior to discharge to sludge conditioning should be installed. The holding tanks should be provided with devices such as telescoping valves and multiple suction lines to allow supernatant to be returned to the main flow pattern of the plant.

6. ADVANCED WASTE TREATMENT

a. General

Advanced waste treatment includes those physical, chemical or biological processes or any combination thereof designed specifically to reduce the concentration of any pollutant not adequately reduced by conventional preliminary, primary, and secondary wastewater treatment processes. These pollutants may include BOD_5, TSS, nitrogen, phosphorus, toxic materials, dissolved salts, and any other material considered to be detrimental to the environment. The advance treatment needs may be addressed as an integral part of the new WWTF flowsheet or an add-on to the existing secondary treatment train.

This Subsection will deal specifically with selected processes which may have application in the area. These include:

- Phosphorus removal
- Suspended solids removal by filtration
- Nitrogen removal
- Activated carbon adsorption of trace organics

Each unit process added to a conventional secondary WWTF process flowsheet to achieve enhanced degrees of treatment has certain design objects and capabilities that, in light of the treated effluent limits, provide the basis for process selection. In general, as a minimum, the following factors should be considered:

- Effluent goals.
- Process capabilities and compatibility with the overall treatment flowsheet.
- Operational factors.
- Process control.

- Sidestreams and recycle flows.
- Solids production and air emissions.
- Energy requirements.
- Economics.
- Other factors (e.g., space requirements, worker health and safety, etc.).

Many advanced waste treatment processes are still in the experimental stage and design criteria based on years of proven results are unavailable. Therefore, it may be necessary that pilot plant studies be conducted to establish design criteria for the specific installation.

b. Phosphorus Removal

Phosphorus can be removed from wastewater biologically or by chemical precipitation using lime, alum, or ferric chloride. Conventional secondary biological treatment systems take up phosphorus from solution for biomass synthesis during BOD oxidation. Since phosphorus is required in intracellular energy transfer, it becomes an essential cell component. For this reason, phosphorus is taken up in an amount related to the stoichiometric requirement for biosynthesis. Generally, for biological phosphorus removal the most common method of phosphorus removal is the addition of an anaerobic basin prior to the aeration basin. Generally, the anaerobic and aerobic stages are each divided into a number of equally sized, completely mixed compartments, and the RAS is returned to the first compartment of the anaerobic zone. The process can be adapted for nitrification by allowing the necessary detention time in the aerobic zone. This process is commonly called the A/O™ process. Other processes for biological phosphorus removal include the use of sequential batch reactors (SBR's), and the PhoStrip™ and the OWASA™ process both of which are sidestream type treatment processes. Typical design parameters for the A/O™, SBR and the PhoStrip™ processes are presented in Table E-9. The OWASA™ process is a relatively new process and firm design data is not available at this time.

For chemical precipitation of the phosphorus, the chemicals, as a slurry, are mixed with the waste usually ahead of the primary settling tank. Precipitation takes place in the tank where the compounds settle out and are removed together with the normal organic sludges. Modifications of the process allow the chemicals to be added either to the aeration tank or following the secondary settling tank. In the latter case, a second settling tank is necessary. Approximately 90% to 95% of the phosphorus compounds can be removed by chemical precipitation. However, the chemical costs add substantially to the operating costs and significantly increase sludge volume to be disposed of.

TABLE E-9
TYPICAL DESIGN PARAMETERS FOR BIOLOGICAL PHOSPHORUS REMOVAL PROCESSES

		Process		
Design Parameter	**Units**	**A/O**	**PhoStrip**	**SBR**
F/M Ratio	**lbs. BOD/lbs. MLVSS-day**	**0.2 to 0.7**	**0.1 to 0.5**	**0.15 to 0.5**
Solids Retention Time	**days**	**2 to 25**	**10 to 30**	**N/A**
MLSS	**mg/l**	**2,000 to 4,000**	**600 to 5,000**	**2,000 to 3,000**
Hydraulic Retention Time_hours__				
Anaerobic Zone__0.5 to 1.5				
Aerobic Zone__1 to 3				
Return Activated Sludge_% of influent_25 to 40				
Internal Recycle_% of influent_N/A				
UUDesign Parameter_Units_A2/O_5-Stage	**UCT_VIP**			
F/M Ratio_lbs. BOD/lbs. MLVSS-day_0.15 to 0.25_0.1 to 0.2				
Solids retention time_days_4 to 27_10 to 40				
MLSS_mg/l_3,000 to 5,000_2,000 to 4,000				
Hydraulic retention time				
UU2.0	**1.5**			
4.0	**3.0**			
6.0	**4.5**			
8.0	**7.5**			
10.0	**14.0**			

When designing a sludge stabilization process the design engineer shall consider the sludge quantity to be treated, the integration of the stabilization process with the other treatment units. and the objectives of the stabilization process. The objectives of the stabilization process will be affected by the existing state and federal regulations.

While there are many methods to stabilize the sludge generated from a WWTF, only a few are truly applicable to the City's present needs, based on the size of the regional WWTFs. Therefore, the City will primarily consider lime stabilization, aerobic digestion and anaerobic digestion, and also will consider other viable processes on a case by case basis (e.g., auto thermal digestion, composting, etc.).

(1) Aerobic Digestion

The purpose of aerobic digestion is to reduce the volume of organic factions, to improve the dewatering characteristics and to destroy and/or reduce the putrescible portion in the sludge. This can be accomplished by subjecting the sludge to long-term times under aeration. Generally this is accomplished in two (2) or more tanks with air supplied by either diffused air or by mechanical aeration.

This process is usually used to treat WAS. In some cases the process has been used to treat a mixture of waste activated sludge or trickling filter sludge.

The aerobic sludge digestion process reduces the volatile solids to a level that is approximately equal to that of anaerobic digestion. However, this process produces a lower BOD_5 concentration in the supernatant that is returned to the head of the WWTF for treatment. Additionally this process produces a superior end product that can be disposed of easily and has excellent sludge dewatering characteristics. Moreover, the aerobically digested sludge has higher fertilizer values than other sludge stabilization processes. The design parameters for aerobic digestion facilities are provided in Table E-13.

Consideration should be given to either following a thickening process with an aerobic digestion process to increase the SRT in the aerobic digester and thereby reducing the overall digester volume. Additionally, multiple tanks should be considered so that the aerobic digestion facilities can either be operated in a batch mode or in series. Moreover, multiple tanks allow continuous wasting, draining one (1) tank for repairs or maintenance, and alternate treatment modes of operation.

Aeration equipment shall conform to that outlined in Section E.5.a. "Activated Sludge." Methods for aeration and mixing include mechanical aerators, diffused aeration or combined systems. Air rates to the aerobic digester should range from 20 to 40 cfm/1,000 cf to ensure adequate mixing. Whereas, air flow rates necessary to meet oxygen transfer requirements depend on digester loading. If mechanical surface aerators are used, pontoon-mounted devices of either low- or high-speed design should be considered. Additionally, mechanical submerged turbine aerators combined with diffused air systems can be utilized for mixing and aeration.

The tank should have a bottom slope ranging from 1' in 12' to 3' in 12' or greater. Additionally, provisions shall be provided to drain the tank. Side water depths are similar to those used in activated sludge systems and will depend on factors such a available space limitations, type of oxygenation and mixing system, and other considerations. Generally, aerobic digester side water depths range from 10' to 25' and a freeboard of at least 4' should be provided to allow for foaming.

Specific piping requirements for aerobic digesters shall include provisions for feeding sludge, decanting the supernatant, withdrawing the digested sludge and supplying air for aeration. Additionally, if multiple tanks are used then provisions should be provided for flexibility in feeding and withdrawing the sludge. It is recommended that a minimum of two (2) supernatant withdrawal lines located a different elevations in the basin shall be incorporated into the tank design. Additionally, an emergency overflow should be provided if the potential for overfilling exists.

Sludge removal from the aerobic digester shall be by means of a progressive cavity pump. Other types of pumps will not be acceptable.

Supernatant from the process shall be returned to either the primary (pretreatment) or secondary (aeration) treatment process. The respective treatment process shall be capable of handling the additional hydraulic flow resulting from the return of supernatant.

The operational control of the aerobic digester shall be manual. However, operating variables that currently lend themselves to automatic control are DO and tank level. Therefore, the DO signal can be used to maintain an optimum DO level and provide energy conservation. However, DO changes in an aerobic digester are generally minimal and maintenance of the DO equipment may be time consuming. Therefore, it is recommended that a tank level signal, indicating high levels be the only monitoring control required.

TABLE E-13
DESIGN PARAMTERS FOR AEROBIC DIGESTERS

Parameter	Value
Hydraulic Detention Time at 20 C	
Waste activated sludge only	15 to 40 days
Activated sludge from WWTF without primary clarifiers	18 to 40 days
Solids loading	0.3 to 1.0 lbs. VSS/cf/day
Oxygen requirements	
lbs. O_2/lb. cell tissue destroyed	2.3 lbs. O_2
Energy requirements for mixing	
Mechanical aerators	1.0 to 1.5 HP/1,000 cf
Air mixing	20 to 40 cfm/1,000 cf
Dissolved oxygen level in liquid	1 to 2 mg/l
Volatile solids reduction	40% to 50%

(2) Lime Stabilization

In the lime stabilization process, lime is added to untreated sludge in sufficient quantities to raise the pH to 12 or higher. The high pH creates an environment that is not conducive to the survival of microorganisms. Consequently, the sludge will not purify, create odors, or pose a health hazard, so long as the pH is maintained at this level.

Process design of the lime stabilization process is based on selecting a suitable chemical dose to achieve and maintain an elevated pH for a sufficient time to accomplish microbial inactivation. The pH must remain high, in excess of 12.0 for 2 hours and 11.5 for 22 hours, at which time the sludge can be disposed of at an approved site. However, it should be noted that the required chemical dose depends on an variety of factors, including:

- Chemical characteristics of the lime.
- Chemical characteristics of the sludge, including both the organic and inorganic constituents.
- Physical characteristics of the sludge, including moisture content and viscosity.
- Adequacy and speed of mixing the sludge and the lime.

The effectiveness of the lime stabilization process is a function of the pH and the contact time, the pH of the sludge and the lime mixture must be maintained at an adequate level for a specific time period to reduce pathogens and achieve other stabilization objectives.

The lime stabilization process consists of two (2) main components:

- Lime handling, inclusive of receiving, storing, transferring, and delivering lime to a lime and sludge blending tank.

- Mixing of the lime and sludge.

The required design features of lime-handling facilities depend on the type of lime to be used. Quicklime (CaO) and hydrated lime ($Ca(OH)_2$) are the two (2) most commonly used types of lime used in lime stabilization of domestic sludges and are available in varying quality. However, lime is available in bags or bulk as well as in a premixed slurry. Additionally, quicklime is converted to hydrated lime through a slaking process on-site, or hydrated lime can be slaked by the supplier and delivered to the facility.

Bagged lime is generally delivered to the site loose on pallets. Delivery of bulk lime is shipped by truck or rail and is unloaded using a pneumatic or mechanical conveyance systems. Storage requirements are an important aspect to the overall design of the system. Generally, hydrated lime can be stored for approximately 1-year, whereas, quicklime has a 3 to 6-month storage period. Bagged-lime should be stored in a covered area to prevent the rain from wetting the bags, and should not be stored near combustible materials. Steel silos are used for the bulk storage of dry lime. The silo must be watertight and airtight. A height to diameter ratio for the silo of approximately 2.5 to 4 is suggested. Additionally, a steep coned (60º or greater) bottom is necessary for the discharge of the lime. Vibrators, commonly used for pulverized quicklime, shall be installed on the hopper and operated during discharge of the lime.

The dry lime, when delivered in bulk, must be transferred from the storage silos to the point of mixing with the sludge or to the point at which water is added to form a slurry. Dry chemical feeders are typically located on the bottom of the silo hopper, and are either volumetric or gravimetric types. The volumetric type supplies a constant proportional delivery of lime by volume and will not recognize a change in material density. As a result, this type of feeder will need to be calibrated for the type of lime being used. However, a gravimetric type feeder supplies a constant weight of lime over a given time, and compensates for changes in form, type, size, and density.

Dry lime may be made into a wet suspension or slurry before being mixed with the sludge. In small systems, bagged hydrated lime may be mixed with water in a batch tank. In larger systems, a volumetric feeder or gravimetric feeder supplies the lime to a dilution tank. The dilution tank shall be mixed with a mechanical mixer. The batch or dilution slurry tank can be constructed of either steel or fiberglass.

The lime slurry is generally the most troublesome step in the lime-handling operation. The slurry feed equipment should be located as close as possible to the lime and sludge mixing tank to minimize plugging problems. Additionally, the lime slurry may be pumped or flow by gravity to the lime and sludge mixing basins. Due to the characteristics of the lime slurry, heavy duty rubber hoses, quick-disconnect fittings, and an acid cleaning system should all be considered in the design. However, if the acid cleaning system is used then the piping, valves and appurtenances must be constructed of suitable material.

The lime sludge mixing/holding tank shall be constructed of concrete and shall consist of a minimum of three (3) basins. The geometric configuration of the tank can either be circular or square. However, in either case, baffling of the tank may be necessary to enhance the mixing characteristics of the lime sludge mixture. Mixing of the tank contents shall be accomplished using mechanical mixers and shall be based on the bulk velocity and impeller.

Since lime is a caustic material that can cause burns. Safety considerations should include having operations and maintenance personnel wear protective clothing and be trained to use proper handling procedures. Additionally, eyewash stations and safety showers will need to be installed.

(3) Anaerobic Digestion

Anaerobic digestion is a process which biologically converts volatile solids to methane, carbon dioxide, and water in a mixed, heated, oxygen-deficient digester. The gas formed during the process is typically 40% to 75% methane and can be burned to heat the digester and, in some cases, to provide supplemental energy for auxiliary treatment plant functions. A two (2) stage system is often used in which digestion takes place in the first (heated, mixed) stage. In this stage high molecular weight organic compounds are converted to organic acids by acid forming bacteria. In the second stage is the conversion of the organic acids to methane and carbon dioxide by the acid-splitting methane-forming bacteria takes place.

The methane bacteria are strict anaerobes and are extremely sensitive to the presence of minute quantities of oxygen and other changes in their environment. This sensitivity exhibited by the methane forming bacteria coupled with the rugged nature of the acid-forming bacteria create a situation which can be easily upset, thus care and understanding of the biological process is essential for effective operation.

Supernatant quality from the digesters is high in pollutants, which contributes a significant load when recycled through the wastewater treatment plant. Thickening sludge before anaerobic digestion is usually advantageous, especially when working with thin activated sludge. Thickening minimizes the digester volume required, as well as the heating and mixing energy requirements and shall be considered during the design process.

Multiple units shall be required. In a two (2) stage system each stage shall be designed and equipped to act as the primary digester. The system shall be designed such that the units well operate both in series and in parallel.

In calculating the volume of the digester for determining unit loading rates, the cone volume should not be considered as part of the volume, because of the possibility of limited biological activity and solids destruction occurring in this region.

The heat exchange capacity of the anaerobic sludge digestion process should be based on an influent sludge temperature of 60° F, ambient air temperature of 45° F, and the digester temperature of 95° F. A minimum sidewater depth of 20' is required. The criteria for efficient operation of an anaerobic digester is given in Table E-14.

Tank covers shall be floating steel type, including gas storage type units, equipped with a guide rail system to prevent tipping, lower-landing ridges, and cover restraints. Multiple recirculation withdrawal and return points, to enhance flexible operation and effective mixing, should be provided, unless mixing facilities are incorporated within the digester. The returns, in order to assist in scum breakup, should discharge as near as possible to the liquid level and the center of the tank. Discharge to the digester should be through the sludge heater and recirculation return piping, or directly to the tank if internal mixing facilities are provided. Sludge withdrawal to disposal should be from the bottom of the tank. The disposal pipe should be interconnected with the recirculation piping, if such piping is provided, to increase versatility in mixing the tank contents.

The diameter of the supernatant piping should not be less than 6". Piping should be arranged so that withdrawal can be made from three (3) or more levels in the digester, if necessary. A positive unvalued vented overflow shall be provided. If a supernatant selector is provided, provisions shall be made for at least one (1) other draw-off level located in the supernatant zone of the tank, in addition to the unvalved emergency supernatant draw-off pipe. High pressure backwash facilities shall be provided in the sludge pipe lines. Additionally, provisions should be made for sampling at each supernatant draw-off level. Sampling pipes should be at least 1-1/2" in diameter, and should terminate at a suitably-sized sampling sink or basin.

All portions of the gas system, including the space above the tank liquor, storage facilities, and piping shall be so designed that under all normal operating conditions, including sludge withdrawal, the gas will be maintained under positive pressure. All enclosed areas where any gas leakage might occur shall be adequately ventilated. All necessary safety facilities shall be included where gas is produced. Pressure and vacuum relief valves and flame traps, together with automatic safety shut off valves, shall be provided.

Heating capacity sufficient to consistently maintain the design sludge temperature to within 1º shall be provided. Where digester tank gas is used for sludge heating, an auxiliary fuel supply is required. Piping shall be designed to provide for preheating of feed sludge before introduction to the digesters. Provisions shall be made in the lay-out of the piping and valving to facilitate cleaning of these lines. Heat exchanger sludge piping should be sized for heat transfer requirements.

All gas utilization equipment shall be provided with flame traps. Consideration should be given to using digester gas to fuel direct electric power generation. Additionally, waste gas burners equipped with an automatic ignition shall be provided.

All electrical fixtures and controls in enclosed areas where hazardous gases may accumulate shall comply with the NEC for Class I, Division 1, Group D locations.

Digester floors shall slope at least 2' in 12'. The digester contents shall operate under a complete mix mode.

(4) Other Sludge Stabilization Processes

Other methods of sludge stabilization include composting, pasteurization, heat treatment, incineration, wet air oxidation, and thermal drying. These processes are considered to be not cost effective at this time. As additional data are reviewed, the applicability of these processes will be reconsidered.

c. Sludge Dewatering

After the wastewater sludge has been properly treated, it can be dewatered and the moisture content reduced to the point where the sludge can be handled as a semisolid instead of a liquid. The methods to be considered for dewatering sludge include air drying on sand beds, centrifugation, and belt filter presses.

TABLE E-14
GENERAL DESIGN CRITERIA FOR
ANAEROBIC DIGESTION

Item	Values
Temperature	**95° F**
pH	
Optimum	**7.0 to 7.1**
General limits	**6.7 to 7.4**
Gas production	
cf/lbs.VSS added	**6 to 8 cf**
cf/lbs.VSS destroyed	**16 to 18 cf**
Gas composition	
Methane	**65% to 69%**
Carbon dioxide	**31% to 35%**
Hydrogen sulfide	**trace**
Volatile acids concentration as acetic acid	
Normal operation	**200 to 800 mg/l**
Maximum	**approximately 2,000 mg/l**
Alkalinity concentration as $CaCO_3$	
Normal operation	**2,000 to 3,000 mg/l**
Normal hydraulic retention time	**20 to 25 days**

(1) Air Drying Beds

The oldest method of drying digested wastewater sludges is the open sand bed. Beds of sand 8" to 12" thick are surrounded by a low retaining wall and flooded to a depth of 10" to 12" with well digested sludge. During this process a portion of the liquid or filtrate, in the sludge percolates through the sand layer and is collected in an underdrain system and returned to the WWTF flow. The remainder of the filtrate is lost by evaporation. After the sludge reaches the desired moisture content, it is removed manually from the bed surface. Under favorable weather conditions a moisture content of 60-percent may be achieved in 10 to 20-days.

The economical use of open sand drying beds is generally limited to small and medium size municipal facilities. The large land area required and the high operation cost associated with the removal of the sludge and the replacement of sand generally precludes the use of this process where the population served exceeds 20,000. Sludge bed loadings are computed either on a per capita basis or in a unit loading of pound of dry solids per square foot per year.

The lower course of media should be properly graded gravel and should be approximately 12" in depth at the underdrains, extending at least 6" above the top of the underdrains. The minimum depth of this course at any point in the bed should be 6". It is desirable that this lower course be placed in two or more layers. The top layer of preferably 3" should consist of gravel 1/8" to 1/4" in size. The top course layer should consist of 6" to 9" of clean coarse sand, the finished sand surface should be level .

Underdrains should be vitrified clay bell and spigot pipe at least 4" in diameter laid with open joints, farm distribution tile appropriately spaced and covered, or perforated clay pipe. Underdrains should be spaced not more than 12' apart on centers. Walls should be water-tight and extend at least 15" above and 6" below the sand surface.

At least two (2) beds should be provided and arranged to facilitate sludge removal. Concrete truck tracks are preferable for all sludge beds. It is usually advantageous that the design be such that no drying area is more than 10' from a prepared truck access. The sludge pipe to the beds should terminate at least 15" above the sand surface, and preferably be so arranged that it will drain. Concrete splash plates at least 4' by 4' should be provided at sludge discharge points. Drainage from the drying beds should be returned to the raw or settled sewage.

(2) Centrifugation

Centrifuges may be used to dewater sludge or to thicken slurries for further processing. The solids are separated from the liquid under the influence of a centrifugal force 100 to 600 times that of gravity. Solid particles are deposited against the spinning bowl and the overflow is a relatively clear liquid. Two (2) types of centrifuges which are common in the wastewater industry are the basket type and the solid bowl type.

The basket centrifuges are generally used for partial dewatering of sludges from small plants and are not designed for continuous operation. The sludge feed must be interrupted to release the accumulated cake. The cycle of operation may vary from 10 to 30 minutes with the removal of the cake requiring 1 to 2 minutes of the total.

In the solid-bowl machine the sludge is fed into the unit at a constant rate, and the centrifugal force of the rotating bowl separates liquid and solid fraction forming a dense cake containing 75% to 80% moisture. The sludge cake is continuously removed from the unit by a screw feeder and discharged into a hopper outside the unit. The cake can then be hauled away for disposal.

The major advantage of the solid bowl centrifuge is the flexibility of operation. The feed rate, solids content and prior chemical conditioning can be varied to meet specific requirements. However, clarification of the solid bowl type of centrifuge is better in the basket type and thus reasonable results can often be obtained without prior chemical conditioning.

Advantages of the centrifuge as a means of dewatering is the small area required for its installation with respect to that required by the vacuum filter and its lower initial costs. However, the higher operating costs partially negate this factor.

The hydraulic and solids loading rates and the conditioning requirements of the centrifuges system shall be based on operational results from similar treatment facilities. The results which may be anticipated from a solid-bowl centrifuge should be a cake solids of approximately 5% to 20% solids with solids capture of 90%.

It is not possible to design a centrifuge for a specific application, rather the design most often is based upon pilot test data. In the absence of pilot data, past performance at similar installations is used. Data shall be submitted to the City to substantiate the proposed design loading rates.

(3) Belt Filter Press

Belt filter press systems attempt to overcome the sludge pick-up problem occasionally experienced with rotary vacuum filters. A combination of sludge conditioning, gravity dewatering and pressure dewatering is utilized with this dewatering process to increase the solids content of either digested or undigested sludge.

The influent mixture of solids and polymer (or other chemical) is placed onto a moving porous belt. Dewatering occurs as the sludge moves through a series of rollers which squeeze the sludge to the belt or squeeze the sludge between two (2) belts much like an old washing machine wringer. The cake is discharged from the belt by a scraper mechanism.

Many physical differences exist between various types of belt filter presses. For example, the type of filtration belt used for each unit varies in size, porosity and material. The design engineer should note the specific requirements of the equipment. Filtrate from the belt filtration unit is usually returned to the secondary treatment process and normally causes no problem to process operation.

Hydraulic and solids loading rates and conditioning requirements shall be based on operational results on similar projects. This process is considered to be not cost effective at this time. As additional data are reviewed, the applicability of this process will be reconsidered.

d. Sludge Disposal

There are many methods of acceptable sludge disposal. The four (4) most common methods are liquid injection, composting, landfilling, and removal by a sludge hauler for reuse. The sludge disposal method used shall be subject to approval of the City.

9. WASTEWATER EFFLUENT DISPOSAL

a. General

After treatment, the wastewater is either reused or disposed of in the environment. In the natural environment, physical, chemical, and biological processes occur when water, soil, plants, microorganisms, and the atmosphere interact. The method of effluent disposal and associated treatment requirements may significantly impact the facilities necessary at an interim package or subregional WWTF. The general method of effluent disposal shall be by a public access or non-public access land application system (e.g., spray irrigation, reclaimed water reuse, overland flow or rapid infiltration basins) or a wetland system.

Wastewater effluent disposal facilities designed for subregional treatment plants shall conform to FDEP Chapter 62-610, FAC, the "Land Application of Domestic Wastewater Effluent in Florida" manual and accepted engineering practice.

b. Submittals

Due to the many complex hydrogeological factors that must be evaluated in the design of public and non-public access land application disposal systems, case by case review of each proposed system will be conducted in accordance with the requirements and provisions of Chapters 62-4, 62-600 and 62-610, FAC, information regarding project design and performance shall be provided to the City by the engineer. General engineering report requirements are specified in Section 62-600, FAC. Certain information, described below and in the FDEP report, "Land Application of Domestic Wastewater Effluent in Florida," shall also be included.

(1) Location: The location of the proposed effluent disposal system, illustrated on a 7.5 or 15 minute series USGS topographic map showing the following:

(a) Proposed wetted area of the wastewater discharge.

(b) Buffer zones.

(c) Surrounding land uses.

(d) Watercourses and water wells.

(e) Storage lagoons.

(2) Topography. A detailed map indicating:

(a) Original and proposed slope, with a contour interval of 2'.

(b) Limits of all flood plains and inland wetlands.

(c) Natural site drainage zones.

(3) Geology

(a) Depth to limerock.

(b) Limerock type.

(c) Geologic discontinuities - faults, fractures, sinkholes.

(d) Jointing and permeability of rock.

(4) Soils

(a) Depth, type, and texture of soil all from field confirmation of USDA Soil Conservation Service (SCS) information for a minimum depth of 20'.

(b) Permeability of soil mantle based on field testing.

(c) Chemical soil properties such as pH, nutrient levels, and cation exchange capacity may be required for some systems.

(5) Groundwater Hydrology

(a) Groundwater depth confirmed by field investigations for each season.

(b) Location of perched water tables.

(c) Groundwater contours.

(d) Direction of groundwater movement and flow.

(e) Groundwater points of discharge.

(f) Existing analyses of site groundwater quality and drinking water wells in the vicinity, including but not limited to coliform bacteria, pH, nitrates, total nitrogen, chloride sulfates, and total hardness.

(g) A description of the depth and type of all water supply wells in proximity to the land treatment - disposal site.

(6) Climate

(a) Monthly precipitation versus application rate.

(b) Monthly temperature versus application rate.

(c) Monthly wind velocities and direction.

(d) Monthly estimate of water lost through evaporation as applicable.

c. Treatment Guidelines - Land Application

(1) Spray Irrigation - Restricted and Public Access

Slow-rate land application usually involves treatment and disposal of domestic wastewater effluent through spray irrigation of crops or other vegetation. The waste treatment requirements for restricted and non-restricted public access spray irrigation systems are as follows:

(a) For irrigation to sod farms, forests, fodder crops, pasture land, or similar areas where it is intended that public access shall be restricted, preapplication waste treatment shall result in an effluent meeting, at a minimum, secondary treatment and basic disinfection levels prior to the land application.

(b) For all slow-rate systems involving irrigation of golf courses, cemeteries, public parks, landscaped areas, residential areas and other areas intended to be accessible to the public, waste treatment more stringent than secondary shall result in an effluent containing the following, prior to land application:

(i) A BOD_5 concentration not greater than secondary treatment criteria.

(ii) A TSS concentration of not greater than 5 mg/l.

(iii) No detectable fecal coliforms (high-level disinfection criteria).

(iv) Methods for ensuring protection from virus shall be approved by the FDEP and City.

(c) The effluent limitations shall be met after disinfection and before discharge to holding ponds or effluent disposal systems. Additional treatment may be required as a result of the alternate discharge, subsurface drainage, and the hydraulic application rate.

(2) Rapid-Rate

Rapid-rate land application generally involves treatment and disposal of domestic wastewater effluent by spreading in a system of percolation ponds, "Rapid Infiltration Basins" (RIB's) or cells. The percolation area shall be divided into two (2) or more cells to allow for alternate loading and resting. Because of the somewhat limited ability of these systems to renovate effluent, the engineer shall, in his report, address, in detail, the potential groundwater quality violations. The waste treatment requirements for rapid rate systems shall be:

At a minimum, preapplication waste treatment shall result in an effluent meeting secondary treatment and basic disinfection levels prior to spreading into the ponds. The nitrate-nitrogen (NO_3-N) content of the effluent prior to spreading into the pond system shall not exceed 12 mg/l unless reasonable assurance is provided in the engineering report that NO_3-N as measured in any hydraulically down-gradient monitoring well will not exceed 10 mg/l or background level in the receiving groundwater, whichever is less stringent. Design NO_3-N content of the effluent prior to disposal shall be established by the design engineer subject to City and FDEP approval. Additional treatment may be required as a result of the pond location, subsurface drainage, and the hydraulic application rate.

(3) Overland Flow

This method of land application involves treatment of domestic wastewater in order to meet effluent limitations for discharge to surface waters. Wastewater is applied by sprinkling or flooding upper reaches of terraced, sloped, vegetated surfaces, such as sod farms, forests, fodder crops, pasture lands, and similar areas. A runoff conveyance system shall be provided at the ends of the sloped surfaces. The waste treatment requirements for this type of system are as follows:

Approval of projects involving preapplication treatment below secondary treatment and basic disinfection levels may be provided based upon the review of the physical site conditions. Proposed preapplication treatment levels shall provide reasonable assurance that long-term performance of the land treatment system shall, at a minimum, result in an effluent meeting the secondary treatment and basic disinfection levels prior to release of effluent to the environment via final surface water discharge from land treatment sites. The pollutant content of the final effluent may be more stringently limited via effluent limitations required in Chapter 62-610, FAC, as required to satisfy water quality requirements. Preapplication treatment processes shall produce an effluent prior to discharge to holding not more than 40 to 60 mg/l BOD_5, or TSS, and meeting the low level disinfection criteria of 2,400 fecal coliforms per 100 ml. Additional treatment may also be required as a result of the alternate discharge, hydraulic application rate, and the provided surface runoff control facilities.

(4) Other Effluent Disposal Systems

Other treatment requirements for land application systems not described herein will be reviewed by the City on a case-by-case basis.

d. Operations and Maintenance - Land Application

All operations and maintenance specifications shall conform to requirements set forth in Chapter 62-610, FAC and the FDEP report entitled "Land Application of Domestic Wastewater Effluent in Florida," Chapter 6, "Operational and Maintenance Requirements." The Design Engineer's Report shall have a separate section discussing the proposed operations and maintenance program for the facility. The design engineer shall review this program with the City and shall modify the program in accordance with this review.

e. Groundwater Monitoring - Land Application

All facilities and associated appurtenances shall be provided as stated in Chapter 62-610, FAC and the FDEP report entitled "Land Application of Domestic Wastewater Effluent in Florida".

f. Groundwater Injection

The feasibility of shallow well injection of treated domestic wastewater has been studied. Presently, regulatory concerns regarding groundwater contamination may result in very stringent water quality requirements which may render this technique not viable. Until this technique has been further studied, specific water quality requirements delineated, and the present FDEP positions changed, shallow well injection will not be acceptable in City.

10. INSTRUMENTATION AND POWER

a. Instrumentation

The control system for the package or subregional WWTF may be analog. The process variable will be sensed and a current signal (4 to 20 mA) will be produced in proportion to the process variable. The current signal will be transmitted to a local or remote indicator, recorder or controller. If the measured variable is controlled, then a controller will receive the input, compare it to the desired setpoint and then output a current signal proportional to the deviation from the setpoint. The output signal may control the position of a valve, the speed of the motor or other process equipment applications. The analog control system will involve all monitoring and control from a central panel with satellite panels for specific unit processes.

All WWTFs shall be provided with a flow indicator-recorder-totalizer which shall pace the chlorine feed system. All WWTFs with design capacities of less than 0.5 MGD shall have a 30 day chart. For WWTFs with a design capacity equal to and greater than 0.5 MGD, they shall be equipped with either a 7-day (week) recorder or a 24-hour (day) recorder as approved by the City.

Manual overrides of control systems shall be provided where applicable. Automatic control systems whose failure could result in a controlled diversion or a violation of the effluent limitations shall be provided with a manual override. These automatic controls shall have annunciators to indicate malfunctions which require use of the manual override. The means for detecting the malfunction shall be independent of the automatic control system, such that no single failure will result in disabling both the automatic controls and the alarm annunciators.

Instrumentation failure which could result in a controlled diversion or a violation of the effluent limitations shall be provided with an installed backup sensor and readout. The backup equipment may be of a different type and located at a different point, provided that the same function is performed. No single failure shall result in disabling all instrumentation systems installed at the WWTF.

Alarm annunciators shall be provided to monitor the condition of equipment whose failure could result in a controlled diversion or a violation of the effluent limitations.

Alarm annunciators shall also be provided to monitor conditions which could result in damage to vital equipment or hazards to personnel. The alarms shall sound in areas normally occupied and also in areas near the equipment. For WWTFs that are not continuously manned, they shall have the alarm signals transmitted to a point stipulated by the City which is continuously manned, (i.e., fire station, Sheriff's station, etc) via an auto-dialer. The alarm annunciators shall be such that each announced condition is uniquely identified. Test circuits shall be provided to enable the alarm annunciators to be tested and verified to be in working order.

Vital instrumentation and control equipment shall be designed to permit alignment and calibration without requiring a controlled diversion or a violation of the effluent limitations.

The provisions for telemetry to remote pumping stations and other City facilities shall be in accordance with the instrumentation master plan (Data Acquisition System Study), when completed and approved by the City to ensure system compatibility. Instrumentation systems at the interim package or subregional WWTFs shall be compatible. Instrumentation plans and type of equipment shall be approved by the City prior to ordering the materials. Additionally, the instrumentation system shall be provided with lightening protection.

b. Power

As a minimum, two (2) separate and independent sources of electric power shall be provided to the interim package or subregional WWTF from a single substation and a site based emergency generator. If available from the electric utility, at least one (1) of the facility's power sources shall be a preferred source (i.e., a utility power source which is one of the last to lose power from the utility grid due to loss of power generating capacity). The City shall determine the reliability class to be utilized; this determination shall be governed by flow and effluent discharge sensitivity of the facility. The capacity of the backup power source for each class of treatment facilities shall be:

(1) Class I Reliability: Sufficient to operate all vital components, during peak wastewater flow conditions together with critical lighting and ventilation.

(2) Class II Reliability: Same as Reliability Class I, except that vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be included as long as treatment equivalent to sedimentation and disinfection is provided.

(3) Class III Reliability: Sufficient to operate the screening or communication facilities, the main wastewater pumps, the primary sedimentation basins, and the disinfection facility during peak wastewater flow condition, together with critical lighting and ventilation.

c. Power Source

Each utility source of power to the plant shall be transformed to usable voltage with a separate transformer. The transformers shall be protected from common mode failure by physical separation or other means.

d. Power Distribution

The internal power distribution system shall be designed such that no single fault or loss of a power source will result in disruption (extended, not momentary) of electric service to more than one (1) motor control (MCC) center associated with the reliability of Class I, II, or III vital components requiring backup power. Vital components of the same type and serving the same function shall be divided as equally as possible between at least two (2) MCC's. Additionally, all non-vital components shall be divided in a similar manner, where practical.

Where power feeder or branch circuit can be transferred from one (1) power source to another, a mechanical or electrical safety device shall be provided to assure that the two (2) power sources cannot be cross-connected, if unsynchronized. Automatic transfer shall be provided in those cases when the time delay required to manually transfer power could result in a failure to meet effluent limitations, a failure to process peak influent flow, or cause damage to equipment. Where automatic pump control is used, the control panel power source and pump power source shall be similarly transferred. The actuation of an automatic transfer switch shall be alarmed and annunciated.

e. Breakers and Fuses

Breaker settings or fuse ratings shall be coordinated to effect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activation of other breakers or fuses to the degree applicable. Failures resulting from plausible causes, such as fire or flooding, shall be minimized by equipment design and location. The following requirements apply:

1. Switch Gear: Electric switchgear and MCC's shall be protected from flooding, sprays, or moisture from liquid processing equipment and from breaks in liquid handling piping. Where practical, the electric equipment shall be located in a separate room from the liquid processing equipment. Liquid handling piping shall not be permitted to run through this room.

2. Wires: Wires in underground conduits or in conduits that can be flooded shall have moisture resistant insulation as identified in the NEC.

3. Outdoor Motors: All outdoor motors shall be adequately protected from the weather. Waterproof, totally enclosed or weather-protected, open motor enclosures with epoxy encapsulated windings or approved equal shall be used for exposed outdoor motors. Motors located indoors and near liquid handling piping or equipment shall be, at least, splash-proof design.

4. Explosion Proof Motors: Explosion proof motors, conduit systems, switches and other electrical equipment shall be used in areas where flammable liquid, gas, or dust is likely to be present.

5. Conduit Routing: To avoid a common mode failure, conductors to components which perform the same function in parallel shall not be routed in the same conduit or cable tray. Conduits housing such cable shall not be routed in the same underground conduit bank unless the conduits are protected from common mode failure (such as by encasing the conduit bank in a protective layer of concrete).

6. Three Phase Motors: Three (3) phase motors and their starters shall be protected from electric overload and short circuits on all three (3) phases.

Large motors shall have a low voltage protection device which on the reduction or failure of voltage will cause and maintain the interruption of power to that motor.

f. Equipment Testing

Provisions shall be included in the design of equipment requiring periodic testing, to enable the tests to be accomplished while maintaining electric power to all vital components. This requires being able to conduct tests, such as actuating and resetting automatic transfer switches, and starting and loading emergency generating equipment. The electric distribution system and equipment shall be designed to permit inspection and maintenance of individual items without causing a controlled diversion or causing violation of the effluent limitations.

Considerations shall be given to reduce voltage starting where required and/or economically justified. Power factor correction equipment shall be provided where required and/or economically justified.

The means for starting a works based emergency power generator shall be completely independent of the normal electric power source. Air starting systems shall have an accumulator tank(s) with a volume sufficient to furnish air for starting the generator engine a minimum of three (3) times without recharging. Batteries used for starting shall have a sufficient charge to permit starting the generator engine a minimum of three (3) times without recharging. The starting system shall be appropriately alarmed and instrumented to indicate loss of readiness (e.g., loss of charge on batteries, loss of pressure in air accumulators, etc.).

Control provisions shall be made for automatic and manual start-up and cut-in. The controls shall be such that upon automatic start-up under emergency conditions, shut-down can only be accomplished manually except for conditions which would damage the generator or engine. Provisions shall be made to permit the auxiliary power generator to peak-shave, if economically justified.