
**NORTH KENT SEWER AUTHORITY**
**KENT COUNTY, MICHIGAN**

# STANDARD SPECIFICATIONS

**December 2012**

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# SECTION 1

# GENERAL CONDITIONS

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# SECTION 1

# GENERAL CONDITIONS

## 1.1 SANITARY SEWER GENERAL NOTES

The following notes shall be included on the cover sheet of all North Kent Sewer Authority Sanitary Sewer System plan sets:

1. All sanitary sewer materials and workmanship shall conform to the North Kent Sewer Authority Sanitary Sewer System Specifications.

2. The North Kent Sewer Authority shall observe the construction and the testing, subject to the direction of the Director and the Community, in conjunction with the Contractor and Engineer. A digital video in MPEG format of the closed-circuit television (CCTV) pipe inspection and the accompanying NASSCO PACP survey database of the ready-for-service sewer and manhole system shall be submitted to the Authority.

3. The Contractor shall submit to the Authority a detailed construction schedule and provide a minimum 72-hour (three working days) notice prior to commencing construction.

4. Existing sewer lines are to be protected from contamination.

5. All lateral fittings are to be solvent weld. Lateral wyes, fittings and pipe shall be extra strength pipe, SDR 26 PVC, or approved equal.

6. All manhole castings shall have a clear opening of 24-inches or greater.

7. Manhole adjusting rings shall be precast concrete. All manholes shall have the top section, adjusting rings, and casting frame wrapped with a watertight joint encapsulation system. Manholes located in areas subject to local 1% probability storms and in all public sewer easements shall have a bolt down cover with gasket.

8. RECORD PLAN NOTES FOR SANITARY SEWER

   I. Uncover the lateral to verify the location and depth prior to any work on the building sewer. Lateral witnesses are based on measurements taken to a stake placed at the end of a lateral by the contractor. Notify the North Kent Sewer Authority immediately concerning any variations from the information shown on the plans.

   II. Lateral information is shown as follows and as in detail below:

   Y+ = Distance to wye in sewer main from downstream manhole.

   E+ = Distance along the sewer main from downstream manhole

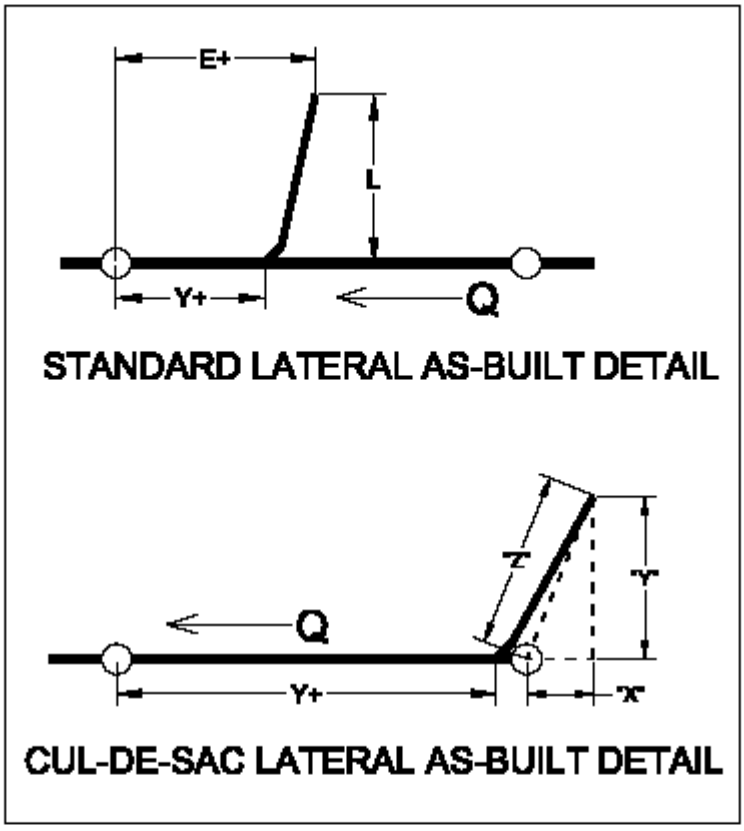
to a point where the end of lateral is at 90 degrees to the main sewer.

L = Length from the E+ location to the end of the lateral (i.e. distance from end of lateral to main sewer, measured perpendicular to main sewer). Lengths of laterals (including risers) are based on horizontal measurements from the center of the sewer main.

ER = Length of riser that was installed on the end of the lateral.

DEPTH = Laterals were placed at an elevation determined by the Engineer. See plan for invert elevation or cut (C). The cut is the approximate depth of the end of the lateral below the ground surface at the time of construction.

Where a lateral is constructed in a cul-de-sac, distances to the wye and end of the lateral are provided according to the Y+, X, Y and Z dimensions as detailed below.




III. Sewer laterals are 6-inch diameter solid wall SDR 26 PVC, unless otherwise noted.

## 1.2 CHECKLIST FOR CONSTRUCTION DRAWING REVIEW

The following items shall be provided for all construction drawings:

1. Map scale and north arrow.
2. MDEQ Permit Number.
3. Adjacent parcel number with street address and property owner last name.
4. Ten feet (10') of horizontal clearance from water main.
5. Eighteen inches (18") of vertical separation from water main.
6. Pipe angle into and out of manhole.
7. Match eight-tenths (8/10ths) point when different size pipes enter/exit manhole.
8. Pipe length, diameter, slope for each pipe segment.
9. Minimum slope for last (upstream) segment of dead end sewer is 0.5-percent.
10. Manhole cut (depth).
11. Manhole numbers.
12. Proposed sewer pipe depth, material and strength (mainline and laterals).
13. Soil boring(s) location and detail.
14. Existing and proposed rights-of-way and easements, including width.
15. Existing utilities (sanitary sewer, water main, storm sewer, electric, gas, telephone, fiber, etc) in plan and profile, if applicable.
16. Existing and proposed sewer lateral locations.
17. Manhole joint encapsulation system for all manholes.
18. Wetland boundary and date of delineation.
19. 100-year floodplain delineation.
20. Manholes in 100-year floodplain have bolt-down, gasketed covers.

## 1.3 RECORD DRAWING SUBMITTAL

Record drawings shall be provided to the North Kent Sewer Authority indicating and detailing all deviations from the approved plans and specifications. As-built information shall be provided on every plan sheet and shall include, but not be limited to, the following: pipe locations and elevations, manhole locations and elevations, manhole rim elevations, detailed lateral information including diameter, material and strength, pipe material and strength, manhole material, field-measured locations and elevations of adjacent utilities.

All construction record drawings shall include the following information in a box on the cover sheet entitled "REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS":

1. Contractor:
2. Construction Observer: (Company).
3. Pipe material and strength (also label every pipe segment on each sheet in profile).
4. Manhole material (also label every manhole if material type varies).
5. Record plan drawn by:
6. Record plan date:

Complete record drawings shall be provided to the North Kent Sewer Authority according to Appendix A - NKSA Digital Record Plan Submission Requirements. Record drawings shall be accompanied by the NKSA Sanitary Sewer As-Built Submission Form in Appendix B.

Record drawings shall be sealed and signed by a registered professional engineer. The professional engineer shall include with the record drawings the completed NKSA Sanitary Sewer System As-Built Certification form as found in Appendix C.

## 1.4 PRECONSTRUCTION MEETING

A preconstruction meeting shall be held a minimum of two (2) weeks prior to commencing construction. The North Kent Sewer Authority and all affected utilities shall be invited to attend.

## 1.5 CONSTRUCTION OBSERVATION FEES

The North Kent Sewer Authority or authorized representative thereof will provide construction observation for the sanitary sewer system work. Construction observation fees shall be coordinated with the NKSA and the local community and shall be paid into an escrow account maintained by the Authority.

## 1.6 INSURANCE REQUIREMENTS

**Insurance Required to be Purchased and Maintained by the Contractor**

Prior to commencement of the Work, Contractor shall purchase and keep in force during the entire period of the Contract between Owner and Contractor such insurance as will provide protection to the Contractor, Owner, Engineer, any additional insureds and loss payees from physical loss and damage to the Work, temporary buildings, falsework, materials, equipment and other property and any claims which may arise out of or result from Contractor's obligations under the Contract Documents and/or the performance of the Work, whether the Work is performed by Contractor, Subcontractor, Supplier, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable.

The following insurance is required:

### 1.6.1 Insurance - Liability

1.6.1.1 IN GENERAL. To protect against liability, loss and/or expense arising from damage to property or injury or death of any person or persons incurred in any way out of, in connection with or resulting from the Work, Contractor shall obtain and keep in force during the entire period of the Contract between Owner and Contractor without interruption, at its own expense, the following insurance:

1.6.1.2 Owner's & Contractor's Protective Liability Policy

Contractor shall furnish and maintain an Owner's & Contractor's Protective Liability Policy ("OCP policy"). The OCP policy will name the Owner, the Engineer, their consultants, agents, employees and such public corporations in whose jurisdiction the Work is located as the insureds (hereinafter collectively called the "named insureds"). The OCP policy will protect the named insureds for any actual or alleged liability arising out of the work performed by the Contractor, the Subcontractor(s) or Suppliers on this project. The OCP policy will provide primary, non- contributing coverage.

1.6.1.3 Commercial General Liability Policy

Contractor shall furnish and maintain a Commercial General Liability Policy and/or Comprehensive General Liability Insurance Policy ("CGL policy"). The CGL policy shall include coverage for:

a. All premises and operations;

b. Explosion, collapse and underground hazards;

c. Products and Completed Operations Coverage. This coverage shall extend through the contract guarantee period;

d. Contractual Liability Coverage for the obligations assumed by Contractor in the Indemnification and Hold Harmless agreement found in the General Conditions and Supplementary Conditions of the Contract Documents;

e. Personal injury, including employees (with no exclusions pertaining to employment);

f. Advertising injury;

g. Contractor's Protective Liability Coverage for independent contractors or subcontractors employed by the Contractor.

The CGL policy shall be an occurrence policy.

1.6.1.4 Automobile Liability Policy

Contractor shall furnish and maintain a Comprehensive Automobile Liability Policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned, and hired motor vehicles. In light of the standard policy provisions concerning (a) loading and unloading, and (b) definitions pertaining to motor vehicles licensed for road use versus unlicensed or self-propelled construction equipment, it is recommended that the Comprehensive Automobile Liability insurance and the Comprehensive General Liability

insurance be written by the same insurance carrier, though not necessarily in one policy.

1.6.1.5 Worker's Compensation Insurance and Employer's Liability Insurance

Contractor shall furnish and maintain Worker's Compensation insurance including Employer's Liability insurance to cover employee injuries or disease compensable under the Worker's Compensation statutes of the States in which the Work is conducted, applicable disability benefit laws, if any, and Federal compensation acts, if applicable, such as the Merchant Marine Act, Federal Employers Liability Act, and the Longshore and Harbor Workers Compensation Act. Self-insurance plans approved by the regulatory authorities in the States in which the Work is performed are acceptable.

1.6.1.6 Umbrella or Excess Liability

Contractor shall furnish and maintain an Excess or Umbrella Liability policy applicable to both the Commercial General Liability/Comprehensive General Liability Policy and the Automobile Liability Policy. The Contractor is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limits requested. Umbrella or Excess policy language shall be at least as broad as the primary or underlying policy(ies).

The umbrella or excess liability insurance shall be an occurrence policy.

1.6.1.7 Railroad Protective Liability

Contractor shall furnish and maintain a Railroad Protective Liability policy, where such an exposure exists, to provide coverage in the name of each railroad company having jurisdiction over rights-of-way across which Work under the Contract Documents is to be performed. The form of the policy and the limits of liability shall be determined by the railroad company(ies) involved.

## 1.6.2 Insurance - Property

1.6.2.1 IN GENERAL. To protect against physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment, Contractor shall obtain and keep in force during the entire period of the Contract between Owner and Contractor without interruption, at its own expense, the following insurance:

1.6.2.2 Builder's Risk

Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Contractor shall be responsible for any deductible or self-insured retention. This insurance shall:

a. include the interests of Owner, Contractor, Subcontractors, Engineer, and *[others as identified in 1.3.2]* and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as a named insured, additional insured or loss payee;

b. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment and shall insure against at least the following perils or causes of loss: fire, wind, lightning, mold, mildew, extended coverage, theft, vandalism, and malicious mischief, earthquake, actual and constructive collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, flooding and such other perils or causes of loss as may be specifically required by these Insurance Specifications;

c. include an endorsement extending coverage to provide insurance against risks not covered under the basic policy. "Extended coverage" is a term used in the insurance business. All basic insurance policies have exclusions - specific loss causalities that are not covered by the insurance company. An Extended Coverage (EC) policy or endorsement is required to cover any such exclusions;

d. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

e. cover materials and equipment that is in place, stored at the job site, stored elsewhere, or in transit at the risk of the insureds;

f. allow for partial utilization of the Work by Owner;

g. include testing and startup;

h. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

i. contain a waiver whereby Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by the policy. In addition, the waiver must contain a provision whereby the Owner and Contractor waive all such rights against Subcontractors, Engineer, and all other individuals or entities identified in the

Insurance Specifications as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each of any of them) under such policy for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

### 1.6.3 Insurance - Other Requirements

1.6.3.1 Additional Insureds

Contractor is required to list as additional insureds on the Commercial General Liability policy/Comprehensive General Liability policy, the Worker's Compensation/Employer's Liability policy, the Automobile Liability policy, the Railroad Protective Liability policy, and the Builder's Risk policy, the following persons or entities:

a. North Kent Sewer Authority

b. Municipality where work occurs

c. NKSA's Engineer

d. Kent County Road Commission

e. Their Directors, Officers, Agents and Employees

1.6.3.2 Loss Payees

Contractor is required to list as loss payees on each property insurance policy, including but not limited to the Builder's Risk policy, the following persons or entities:

a. North Kent Sewer Authority

b. Municipality where work occurs

c. NKSA's Engineer

d. Kent County Road Commission

e. Their *Directors, Officers, Agents and Employees*

1.6.3.3 Notice of Cancellation or Intent Not to Renew

The policies required by these Insurance Specifications shall contain a provision or endorsement that the coverage afforded cannot be canceled, materially changed or renewal refused unless, at least 30 days prior to such cancellation, material change or refusal to renew, written notice of such action has been given to Owner, Engineer, Contractor and to each other additional insured and loss payee. All notices of cancellation, material change or refusal to renew shall be made by certified mail or personal

delivery to the Owner, Engineer, Contractor and each other additional insured and loss payee.

1.6.3.4 Evidence of Coverage

Prior to commencement of the Work, Contractor shall furnish to the Owner, Engineer and each other additional insured and loss payee identified in these Insurance Specifications, Certificates of Insurance on the form provided by the Owner, if any. Other forms of Certificate are acceptable only if (1) they include all of the information set forth on the form provided by the Owner, including but not limited to the cancellation provisions set forth in Paragraph 1.3.3; (2) show that all the insurance requirements set forth in these Insurance Specifications are met, and; (3) are approved for use, in writing, by the Owner.

If requested by Owner, Contractor shall furnish complete copies of the policies, including all declaration sheets, endorsements, riders, amendments and all other changes or attachments to the policy. Such policy copies shall be certified by the insurance carrier as true and accurate copies of the originals, or shall be designated by the insurance carrier as "Originally Signed Copies."

1.6.3.5 Qualifications of Insurers

In order to determine the financial strength and reputation of insurance carriers, all companies providing the coverages required by these Insurance Specifications shall be authorized to do business in the State or States where the project is located and shall have a financial rating not lower than VIII and a policyholder's service rating not lower than "A-" as listed in A.M. Best's Key Rating Guide, current edition. Companies with ratings lower than A-:VIII will be acceptable only upon written consent of the Owner.

1.6.3.6 Deductible Liability

Any and all deductibles in the policies described in these Insurance Specifications shall be assumed by, for the account of, and be the sole responsibility of Contractor. The amount of any deductible is subject to approval by the Owner.

1.6.3.7 Insurance will be Primary

The insurance required to be obtained and kept in force by the Contractor under these Insurance Specifications shall be primary (i.e. pay first) as respects any insurance, self-insurance or self-retention maintained by the Owner, Engineer, and any additional insureds or loss payees. Any insurance, self-insurance or self-retention maintained by the Owner, Engineer or any additional insureds or loss payees shall be in excess of the insurance obtained and kept in force by the Contractor under these Insurance Specifications and shall not contribute with it.

### 1.6.4 Minimum Limits

1.6.4.1 The minimum limits for the insurance required by these Insurance Specifications shall provide coverage for not less than the following amounts or greater where required by Laws or Regulations:

1.6.4.2 Owner's & Contractor's Protective Liability Policy

| | | |
|---|---|---|
| a. | Each Occurrence | $ 1,000,000 |
| b. | General – Aggregate | $ 2,000,000 |

1.6.4.3 Contractor's Commercial General Liability and/or Comprehensive General Liability:

| | | |
|---|---|---|
| a. | General – Aggregate | $ 2,000,000 |
| b. | Products – Completed Operations Aggregate | $ 2,000,000 |
| c. | Personal and Advertising Injury | $ 1,000,000 |
| d. | Each Occurrence | $ 1,000,000 |
| | Fire Damage | $ 50,000 |
| | Medical Expense | $ 5,000 |

1.6.4.4 Comprehensive Automobile Liability *(in accordance with Michigan's No Fault Statute)*

| | | |
|---|---|---|
| a. | Combined Single Limit of | $ 1,000,000 |

1.6.4.5 Worker's Compensation and Employer's Liability:

| | | |
|---|---|---|
| a. | State: | Statutory |
| b. | Employer's Liability: | |
| | Each accident | $ 500,000 |
| | Disease - Each employee | $ 500,000 |
| | Disease - policy limit | $ 500,000 |
| c. | Federal, if applicable (e.g. FELA, Longshoreman's, etc.): | Statutory |

1.6.4.6 Excess or Umbrella Liability

| | |
|---|---|
| General Aggregate | $ 2,000,000 |
| Each Occurrence | $ 2,000,000 |

1.6.4.7 Builder's Risk "all risk" policy — Full Replacement Cost
☐ Check if requested

1.6.4.8 Railroad Protective Liability
☐ Check if requested — $

1.6.4.9 Other insurance
a. *Type* $

**– Pages 13 and 14 (samples) Follow –**

# ACORD CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

**PRODUCER**

**THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.**

| INSURERS AFFORDING COVERAGE | AM BEST | FINANCIAL | NAIC # |
|---|---|---|---|
| INSURER A: Insurance Company Name | | | |
| INSURER B: | | | |
| INSURER C: | | | |
| INSURER D: | | | |
| INSURER E: | | | |

**INSURED**

Owner's Name and Address

**COVERAGES**

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

| INSR LTR | ADD'L INSRD | TYPE OF INSURANCE | POLICY NUMBER | POLICY EFFECTIVE DATE (MM/DD/YY) | POLICY EXPIRATION DATE (MM/DD/YY) | Minimum LIMITS | |
|---|---|---|---|---|---|---|---|
| | | **GENERAL LIABILITY** | | | | EACH OCCURRENCE | $ $1,000,000 |
| | | COMMERCIAL GENERAL LIABILITY | | | | DAMAGE TO RENTED PREMISES (Ea occurence) | $ |
| | | CLAIMS MADE OCCUR | | | | MED EXP (Any one person) | $ |
| | | X Owner's & Contractor's Prot | | | | PERSONAL & ADV INJURY | $ |
| | | | | | | GENERAL AGGREGATE | $ $2,000,000 |
| | | GEN'L AGGREGATE LIMIT APPLIES PER: | | | | PRODUCTS - COMP/OP AGG | $ |
| | | POLICY PRO-JECT LOC | | | | | |
| | | **AUTOMOBILE LIABILITY** | | | | COMBINED SINGLE LIMIT (Ea accident) | $ |
| | | ANY AUTO | | | | BODILY INJURY (Per person) | $ |
| | | ALL OWNED AUTOS | | | | BODILY INJURY (Per accident) | $ |
| | | SCHEDULED AUTOS | | | | PROPERTY DAMAGE (Per accident) | $ |
| | | HIRED AUTOS | | | | | |
| | | NON-OWNED AUTOS | | | | | |
| | | **GARAGE LIABILITY** | | | | AUTO ONLY - EA ACCIDENT | $ |
| | | ANY AUTO | | | | OTHER THAN AUTO ONLY: EA ACC | $ |
| | | | | | | AGG | $ |
| | | **EXCESS/UMBRELLA LIABILITY** | | | | EACH OCCURRENCE | $ |
| | | OCCUR CLAIMS MADE | | | | AGGREGATE | $ |
| | | | | | | | $ |
| | | DEDUCTIBLE | | | | | $ |
| | | RETENTION $ | | | | | $ |
| | | **WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** | | | | WC STATU-TORY LIMITS OTH-ER | |
| | | ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? | | | | E.L. EACH ACCIDENT | $ |
| | | If yes, describe under SPECIAL PROVISIONS below | | | | E.L. DISEASE - EA EMPLOYEE | $ |
| | | | | | | E.L. DISEASE - POLICY LIMIT | $ |
| | | **OTHER** | | | | | |

**DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS**

Name of Additional Insured

**CERTIFICATE HOLDER**

Contractor's Name and Address

**CANCELLATION**

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ~~ENDEAVOR TO~~ MAIL * 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT ~~BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.~~

* by certified mail

AUTHORIZED REPRESENTATIVE

# ACORD CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

**PRODUCER**

**THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.**

| INSURERS AFFORDING COVERAGE | AM BEST | FINANCIAL | NAIC # |
|---|---|---|---|
| INSURER A: Insurance Company Name | | | |
| INSURER B: | | | |
| INSURER C: | | | |
| INSURER D: | | | |
| INSURER E: | | | |

**INSURED**

Contractor's Name and Address

**COVERAGES**

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

| INSR LTR | ADD'L INSRD | TYPE OF INSURANCE | POLICY NUMBER | POLICY EFFECTIVE DATE (MM/DD/YY) | POLICY EXPIRATION DATE (MM/DD/YY) | Minimum LIMITS | |
|---|---|---|---|---|---|---|---|
| | | **GENERAL LIABILITY** | | | | | |
| | | [X] COMMERCIAL GENERAL LIABILITY | | | | EACH OCCURRENCE | $ $1,000,000 |
| | | [ ] CLAIMS MADE [X] OCCUR | | | | DAMAGE TO RENTED PREMISES (Ea occurence) | $ $50,000 |
| | | | | | | MED EXP (Any one person) | $ $5,000 |
| | | | | | | PERSONAL & ADV INJURY | $ $1,000,000 |
| | | GEN'L AGGREGATE LIMIT APPLIES PER: | | | | GENERAL AGGREGATE | $ $2,000,000 |
| | | [ ] POLICY [ ] PRO-JECT [ ] LOC | | | | PRODUCTS - COMP/OP AGG | $ $2,000,000 |
| | | **AUTOMOBILE LIABILITY** | | | | | |
| | | [X] ANY AUTO | | | | COMBINED SINGLE LIMIT (Ea accident) | $ $1,000,000 |
| | | [ ] ALL OWNED AUTOS | | | | BODILY INJURY (Per person) | $ |
| | | [ ] SCHEDULED AUTOS | | | | | |
| | | [X] HIRED AUTOS | | | | BODILY INJURY (Per accident) | $ |
| | | [X] NON-OWNED AUTOS | | | | | |
| | | | | | | PROPERTY DAMAGE (Per accident) | $ |
| | | **GARAGE LIABILITY** | | | | AUTO ONLY - EA ACCIDENT | $ |
| | | [ ] ANY AUTO | | | | OTHER THAN AUTO ONLY: EA ACC | $ |
| | | | | | | AGG | $ |
| | | **EXCESS/UMBRELLA LIABILITY** | | | | EACH OCCURRENCE | $ $2,000,000 |
| | | [X] OCCUR [ ] CLAIMS MADE | | | | AGGREGATE | $ $2,000,000 |
| | | | | | | | $ |
| | | [ ] DEDUCTIBLE | | | | | $ |
| | | [ ] RETENTION $ | | | | | $ |
| | | **WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** | | | | [X] WC STATU-TORY LIMITS [ ] OTH-ER | |
| | | ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? | | | | E.L. EACH ACCIDENT | $ $500,000 |
| | | If yes, describe under SPECIAL PROVISIONS below | | | | E.L. DISEASE - EA EMPLOYEE | $ $500,000 |
| | | | | | | E.L. DISEASE - POLICY LIMIT | $ $500,000 |
| | | **OTHER** | | | | | |

**DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS**

Name of Additional Insured

**CERTIFICATE HOLDER**

Owner's Name and Address

**CANCELLATION**

**SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ~~ENDEAVOR TO~~ MAIL* 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT ~~BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.~~**

* by certified mail

**AUTHORIZED REPRESENTATIVE**

## 1.7 APPENDICES

APPENDIX A. Digital Record Plan Submission Requirements

APPENDIX B. Sanitary Sewer System As-Built Submission Form

APPENDIX C. Sanitary Sewer System Certification Form

North Kent Sewer Authority

# Digital Record Plan Submission Requirements

## ELECTRONIC DRAWING FILES

A. The engineer shall deliver digital data in AutoCAD (.dwg, .dxf) or Esri (shapfile or geodatabase) format. Standard transfer media will be accepted. This media includes CD, DVD, email, ftp or portable storage device.

B. Drawing files of the completed record plans at a minimum must contain all new and altered infrastructure including but not limited to mains, cleanouts, manholes, hydrants, and valves as well as pertinent location information such as back of curb, sidewalks, nearby structures and existing utilities. It is not necessary to include background information such as logos or title blocks in the drawings.

C. Drawing files shall be submitted in the following projection and datum:

NAD_1983_StatePlane_Michigan_South_FIPS_2113_IntlFeet
Projection: Lambert_Conformal_Conic
False_Easting: 13123359.58005249
False_Northing: 0.00000000
Central_Meridian: -84.36666667
Standard_Parallel_1: 42.10000000
Standard_Parallel_2: 43.66666667
Latitude_Of_Origin: 41.50000000
Linear Unit: Foot (0.304800)

Geographic Coordinate System:
GCS_North_American_1983
Datum: D_North_American_1983
Prime Meridian: 0

Vertical datum shall be in:
NGVD 1988 also expressed in international feet

If for any reason, a drawing is not in NAD 1983 Michigan State Plan South projection, the drawing must include reference and coordinates to 2 existing Public Land Survey System (PLSS) section corners.

## ELECTRONIC PLOT FILES

A. The engineer shall deliver one scanned or exported set of approved record plans in Adobe

PDF format. The record plan sets shall be complete and include the title sheet, plan/profile sheets, cross- sections, and details. Each individual sheet contained in the printed set of the drawings shall be included in the electronic submittal as a separate PDF document. The plan sheets shall be scanned or exported at a minimum of 300 dpi resolution to maintain legibility of each drawing. These drawings will assist in the process of performing quality control and quality assurance. The drawings will be reviewed for format and completeness.

B. Only drawings relevant to the project's completion shall be included. For example, do not include "Bid Set" drawings in a record plan submittal. Also, do not include documents that would not normally be included in the set of imaged drawings.

C. Include a label on the media or digital file indicating project name and number, consultant name, project manager and telephone number, type of submittal, subdivision name, date of submittal, and file format.

North Kent Sewer Authority

## Sanitary Sewer System As-Built Submission Form

In order to keep the North Kent Sewer Authority's Regional Geographic Information System (REGIS) updated with the most current information, sanitary sewer system as-builts are required to be submitted to the **North Kent Sewer Authority, 4775 Coit Avenue NE, Grand Rapids, MI 49525**.

The as-builts are to be submitted as both electronic drawing files and electronic plot files as described in the Digital Record Plan Submission Requirements.

**Project Information:**

| | |
|---|---|
| Permit Number: | |
| Project Name/Street: | |
| Project Location: | |
| Completion Date: | |
| Other Information: | |

**Submitter's Information:**

| | |
|---|---|
| Company Name: | |
| Submitter's Name: | |
| Submitter's Title: | |
| Address: | |
| City/State/Zip: | |
| Phone Number: | |
| Email: | |
| Other Information: | |

**Digital File Information (on standard transfer media):**

| | |
|---|---|
| Have Digital As-Builts Been submitted? | |
| File Name: | |
| File Type: | |

Submitted By: _____ Date: _____
(Signature Required)

**4775 Coit Avenue NE**
**Grand Rapids, MI 49525**
**(616) 363-0702**

# Sanitary Sewer System As-Built Certification

***(Print Clearly or Type):***

**Permit #** _____

**Project Name:** _____

**Project Location:** _____

**Checklist:**

☐ **I hereby certify that all components of the sanitary sewer system have been built in accordance with the approved plans and specifications. All deviations have been noted on the as-built record drawings.**

☐ **I hereby certify that all required public sanitary sewer easements have been submitted to the North Kent Sewer Authority in a form acceptable for recording.**

| | |
|---|---|
| Name | Signature |
| Company Name | Michigan Registration # |
| Company Address | Date |
| City/State/Zip | Telephone # |
| Fax | |

***Engineer's Seal***

**Note: Digital as-built drawings are required to be submitted to the North Kent Sewer Authority. See the NKSA Digital Record Plan Submission Requirements form.**

# SECTION 2

# SPECIFICATIONS FOR EXCAVATING, TRENCHING, & BACKFILLING FOR UTILITIES

## 2.01 DESCRIPTION OF WORK

The work shall consist of furnishing all materials, equipment, and labor for excavating, trenching, and backfilling for utilities. The work also shall include the necessary clearing, sheeting and shoring, boring and jacking, dewatering, pipe embedment, and other appurtenant work.

The work shall be performed in accordance with the specifications and drawings, the MDOT 2012 Standard Specifications for Construction and the following specifications.

## 2.02 CLEARING, BRUSHING & TREE REMOVAL

### 2.02.01 General

The Contractor shall perform all clearing, brushing, and tree removal required for the proposed construction. Where indicated on the drawings for a specific area, that area shall be completely cleared in accordance with Sections 201 and 202 of the MDOT 2012 Standard Specifications for Construction. The Contractor shall notify the Engineer 48 hours (two working days) prior to commencement of clearing, brushing and tree removal. Clearing and brushing shall be confined to the limits of the right-of-way or easements unless otherwise directed and shall be kept to a practicable minimum.

Trees marked "Remove" on the drawings shall be taken down and removed from the right-of-way in a manner that does not endanger the adjoining property or persons or traffic using the right-of-way. Unless approved otherwise by the Engineer, stumps of trees are to be removed. All stump removal, shall be considered included in the major items of work to the project.

Selective pruning of trees will be permitted to allow operation of the Contractor's equipment. Trees shall be pruned neatly, and the scars from pruning or other damage by the Contractor's equipment shall be covered with a preservative.

### 2.02.02 Preservation of Trees

Because of the special concern for preservation of trees, all trees six (6) inches in diameter and larger, measured at a point 4 1/2' above the ground line at the base of the tree, which are to be removed have been marked on the drawings. Where there is more than one tree that has grown from a common stump, each tree is measured as a separate tree. All other trees are to be preserved unless written permission for

removal is obtained from the NKSA and/or the Engineer. Where tunneling is necessary to preserve a tree, it shall be included in the major items of work. Trees that may have to be tunneled may or may not be specified on the drawings. Where tunneling is necessary, excavation may have to be done by hand to prevent damage to the tree or to its roots. When tunneling or excavating is done close to a tree to be preserved, every effort shall be made to preserve the main roots.

2.02.03 Disposal of Debris

All trees, brush, and stumps from clearing and brushing operations shall be disposed of by the Contractor by hauling from the site, or other suitable means approved by the Engineer. Burning of debris will be allowed if approved by the Engineer and NKSA. The Contractor shall obtain the necessary burning permits and shall comply with the safety regulations required.

2.02.04 Measurement & Payment

The cost of all clearing, brushing, tunneling, and protection of trees which are left standing shall be considered included in the major items of work unless specific items have been provided in the Proposal in which case the prices shall be payment in full for performing this work as specified herein. All tree preservation shall be included in the major items of work to the project. Trees will be measured at a point 4-1/2' above the ground line at the base of the tree. Where more than one tree has grown from a common stump, each tree is measured as a separate tree. Trees six (6) inches in diameter and smaller will not be considered pay items.

## 2.03 REMOVAL OF SURFACE IMPROVEMENTS

Surface improvements such as sidewalks, improved lawns, drives, curb and gutter, and all types of pavement shall be removed just prior to excavating or trenching operations. All improvements shall be cut at the expected trench width prior to excavating using suitable equipment which does not damage the improvement outside of the trench area.

Concrete and bituminous pavement and drives shall be cut with a pavement cutting saw. The depth of the cut shall be the full depth of the pavement. Pavement crushers or breakers of any type are prohibited unless specifically authorized by the Engineer. Pavement which is removed shall not become mixed with backfill material. Power equipment may be used for pavement removal, provided that damage is not caused to improvements which are to remain.

Removal of surface improvements shall be included in the major items of work and no specific payment will be made therefore unless specific Proposal items are provided, in which case the prices bid shall be payment in full for performing this work as specified herein.

## 2.04 EXISTING SOIL / SUBSURFACE CONDITIONS

Where provided, soil borings are shown on the drawings only as information for use by the Engineer in preparing the contract documents. The Contractor is solely responsible for confirming actual soil conditions and depth of the water table.

## 2.05 EXISTING UNDERGROUND UTILITIES & STRUCTURES

### 2.05.01 Location

No less than three (3) working days prior to excavating, the Contractor is to call "MISS DIG" at 1-800-482-7171 or 811. Existing utilities are shown only at their approximate locations. The Contractor shall be responsible for determining their exact elevations and location in the field. The Contractor shall notify the owners of all underground utilities before starting any work. House sewer connections, water and gas services, and other utility lines may not be indicated on the drawings. However, the Contractor shall make every effort to locate all underground utilities from information obtained from the utility owner or by prospecting in advance of trench excavation.

### 2.05.02 Replacement

Certain underground utilities such as sewers may require removal and subsequent replacement in lieu of supporting or bracing during the proposed construction, or the Contractor may elect this option when temporary provisions to maintain essential services have been previously approved by the Engineer.

Unless otherwise specified, any utilities removed during the proposed construction shall be replaced by the Contractor. Materials and installation shall be equal to or better than original construction in every way. Salvaged materials may be reused when they are in good condition, and a satisfactory installation can be accomplished in the judgment of the Engineer.

Replacement of existing utilities shall be considered included in the major items of work unless specific items have been provided in the Proposal, in which case the prices bid shall be payment in full for performing this work as specified herein.

### 2.05.03 Relocation

Should any pipe or other existing utility require raising or lowering or moving to another location because of interference with the pipe or structure being constructed under these specifications, such changes which in the opinion of the Engineer are necessary shall be made by the Contractor unless otherwise specified. Relocation of existing utilities shall be included in the major items of work unless specific items are provided in the Proposal.

2.05.04 Reconnection

Where lateral services, house connections, or other pipe lines require reconnection to the proposed utility, as is the case when an existing utility is being reconstructed, the Contractor shall make these connections as specified or as shown on the drawings. All costs for making these connections, including provisions for maintaining flows and providing temporary service during the proposed construction, shall be included in the major items of work unless specific items are provided in the Proposal.

2.05.05 Utilities to be Abandoned

When pipes, conduits, sewers, or other structures are removed from the trench leaving dead ends in the ground, such ends shall be fully plugged or sealed with brick and mortar by the Contractor. Abandoned structures such as manholes or chambers shall be entirely removed unless otherwise specified or shown on the drawings.

All materials from abandoned utilities which can be readily salvaged shall be removed from the excavation by the Contractor and stored on the site or loaded on the NKSA's truck as directed by the Engineer. NKSA shall have first claim to salvageable materials. The Contractor is responsible to dispose of salvageable materials not desired to be kept by the NKSA.

All costs for abandoning utilities and for removing and salvaging materials, when required, shall be considered included in the major items of work unless specific items have been provided in the Proposal, in which case the prices bid shall be payment in full for performing this work as specified herein.

## 2.06 EXCAVATING & TRENCHING

2.06.01 General

Excavating and trenching operations shall at all times be conducted in a safe, orderly manner using methods and equipment designed and suited to the intended use by personnel experienced in the work being performed.

None of the requirements or provisions specified herein or shown on the drawings shall nullify or restrict any safety provisions required by any regulation or law governing the protection and/or safety of persons or property.

2.06.02 Width of Trench

The width of the trench shall be ample to permit the pipe to be laid and joined properly and the pipe embedment material and backfill to be placed and compacted as specified. Trenches shall be of sufficient extra width when required as will permit the convenient placing of trench supports, sheeting, and bracing.

2.06.02.01 Width of Trench for Rigid Pipe

In order to limit excessive loads on rigid pipe, the maximum width of trench for pipe 36 inches and larger in diameter shall not be more than twice the nominal diameter. For smaller sizes of pipe, the maximum width of trench shall be not more than 3 feet greater than the nominal diameter of the pipe except as otherwise specified or directed. The above limiting restrictions on trench width apply from outside bottom of pipe to outside top of pipe.

Where the width of trench within these limits exceeds the maximum limit specified, the Contractor shall install a heavier class of pipe or use other means to provide additional load-carrying capacity at no additional cost to the NKSA. Any changes in class of pipe or other variation shall be approved in writing by the Engineer before the work progresses.

When the trench width above the top of the pipe is appreciably greater then that which is reasonably required by project conditions in the judgment of the Engineer, any additional cost for backfill material, surface restoration, or other items that are the result of such excess width shall be borne by the Contractor.

2.06.02.02 Width of Trench for Flexible Pipe

Unless otherwise specified or approved by the Engineer, a minimum trench width of at least two (2) feet on each side of the pipe for placement of select embedment material will be required.

2.06.03 Excavating to Grade

The trench shall be excavated to a depth required for the proper installation of the pipe and placing of the pipe embedment material as specified.

Any part of the bottom of the trench excavated below the specified subgrade shall be refilled with approved materials compacted to 95% of maximum unit weight in accordance with MDOT procedures at no additional cost to the NKSA. If additional excavation is required to correct unstable foundation conditions, payment will be made as specified in Section 2.08.

2.06.04 Sheeting, Shoring, Bracing, & Shelving

2.06.04.01 General

The Contractor shall brace or slope back the sides of all excavations in accordance with current MIOSHA regulations. The Contractor shall be responsible for compliance to such regulations and for the design, installation, and maintenance of all excavation safety measures.

2.06.04.02 Measurement & Payment

Unless otherwise specified in the Proposal, the costs incurred in the installation of bracing, sheeting, shoring, and shelving shall be included in the unit price bid for the work being performed.

Payment for sheeting left in place where directed by the Engineer shall be negotiated with the Contractor in accordance with the contract provisions for extra work unless specific items have been provided in the Proposal.

2.06.05 Rock Excavation

2.06.05.01 General

Wherever the word rock is used in these specifications, it shall mean boulders, solid ledge rock, and other minerals geologically placed and of a hardness when first exposed of 3 or greater in scales of mineral hardness, which in the opinion of the Engineer requires continuous use of drilling and blasting or special power equipment for its removal.

Soft disintegrated rock which can be removed with a power-operated excavator or with hand tools and loose, shaken, or previously blasted rock and broken stone in rock fillings shall not be classified as rock, nor will it be included in measurements for payment.

2.06.05.02 Hardness

The Engineer will determine the hardness of the material or minerals in question. The following accepted hardness will be used as a guide in the field for specific situations:

Gypsum - hardness of 2
Fingernail - hardness of approximately 2-1/2
Calcite - hardness of 3
Copper Coin - hardness of approximately 3
Brass Pin - hardness of approximately 3

A mineral with a hardness of 3 will scratch a copper coin and can be scratched with a brass pin. Determinations of hardness which cannot readily be determined in the field shall be resolved by laboratory analysis of the material in question.

2.06.05.03 Blasting

Where blasting is necessary, the Contractor shall obtain the required permits and licenses at his own expense. This work shall be done with due regard to the safety of workmen, other people, and public and private property. The method of covering blasts, amounts of charges used, and the general procedure for doing this work shall

conform to the standard practice and shall meet all requirements of local ordinances and other regulations and shall be subject to the approval of the Engineer.

2.06.05.04 Clearance

Rock shall be removed to provide a clearance for all pipes, appurtenances, or structures of at least eight (8) inches below, and a minimum of eight (8) inches on each side of the pipe, appurtenance, or structure.

The specified minimum clearances are the minimum clear distance which will be permitted between any part of the pipe or appurtenances being laid and any part, point, or projection of the rock.

2.06.05.05 Measurement

Only boulders of 1 cubic yard or greater in volume that cannot be removed with power excavating equipment or rock as defined herein will be measured for payment. Measurements of rock will be made by the Engineer after rock is removed from the excavation by measuring the trench before the pipe is installed.

The cross sectional area will be measured at 25 foot intervals or closer if required to accurately measure the trench. The maximum depth which will be measured for payment shall be from the top of the rock formation to the specified subgrade for the pipe embedment material. The maximum width of trench to be considered for payment shall be as follows:

1. Below outside top of pipe, maximum width shall be the outside diameter of the pipe bell plus 12 inches but not less than 30 inches.

2. From outside top of pipe to top of rock formation, maximum width shall be computed based on a 5 on 1 slope vertically for the sides of the trench.

The volume will be computed by the Engineer using the method of average end areas based on measurements of rock actually removed subject to the maximum limits specified.

2.06.05.06 Basis of Payment

Rock excavation shall be paid for at the contract price per cubic yard, which price shall be payment in full for completing all work as specified herein including removal and disposal of the rock.

If a unit price has not been established in the Proposal, payment to the Contractor will be based on the contract provisions for extra work.

2.06.06 Dewatering

The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water including water or sewage from exposed sewers or water mains, from all excavations and trenches, or other parts of the work. Each excavation shall be kept dry during the preparation of the subgrade and continually thereafter until the structure to be built or the installation of the pipe line is completed to such extent that no damage from hydrostatic pressure, flotation, or other cause will result.

Where work is in soil containing an excessive amount of water, the Contractor shall provide, install, and maintain suitable well points or wells connected to manifolds or reliable pumping equipment, or other suitable dewatering methods, and shall so operate the dewatering system to insure proper construction of the work. If the Contractor elects to use a trench underdrain or similar dewatering system, he shall receive prior approval of the Engineer as to location and installation methods for this type of system. The Contractor shall make every effort to prevent sand, sediment, or debris from entering any existing pipe line or conduit which he may use for drainage purposes. The repair or cleaning of drainage structures made necessary by the Contractor's operations shall be performed by and at the expense of the Contractor. Arrangements for discharge of ground water into any public sewer shall be previously approved by the Engineer and NKSA of the receiving sewer.

Dewatering including the use of stone or gravel for dewatering purposes when required will not be paid for separately but shall be included in the contract price for the major items of work.

The Contractor shall limit his dewatering operation to the minimum time and depth required for construction. The Contractor will be required to furnish temporary water service and/or provide potable water at the direction of the Engineer to property owners whose wells are affected by the dewatering operations.

## 2.07 BORING & JACKING

2.07.01 General

Where so specified on the drawings, railroad tracks, streets, or other obstructions to be crossed by utilities shall be bored and/or jacked as hereinafter specified. These specifications describe the general method of conducting the boring and jacking operations and set forth minimum conditions. The location and details of the proposed installation will be shown on the Drawings.

Unless otherwise specified, the Contractor shall be responsible for obtaining any permits required for the work under the right-of-way, or other facility to be crossed, and shall carry out the details of his work in a manner that will fully meet the requirements of the authority having jurisdiction over the facility affected. No interruption of traffic will be permitted, and the Contractor shall take all precautions to that effect.

2.07.02 Casing Method

When the casing method is specified, a casing pipe shall be jacked into place and a carrier pipe shall then be installed in the casing pipe. The casing pipe shall be jacked into place by approved methods that will provide accurate alignment and grade and that will allow the carrier pipe to be installed within the casing at the specified alignment and grade.

The carrier pipe shall be joined together to form a continuous run through the casing. It shall be supported on wooden shoes or blocks which shall be securely fastened to each end of each piece of pipe or as recommended by the pipe manufacturer. The carrier pipe shall then be drawn or shoved through the casing. Junction with pipes of other materials at each end shall be made as shown on the Drawings. After the pipe has been inspected and accepted, the annular space between the pipe and the casing shall be filled with materials approved by the NKSA, such as, peastone or flowable fill. After the casing has been filled, the ends of the casing shall be sealed as shown on the Drawings or in the Specifications.

2.07.03 Jacking Pipe Method

When specified or indicated on the Drawings, the pipe to be jacked shall also be utilized as the carrier pipe. The pipe shall be jacked into place by approved methods that will provide accurate alignment and grade. Excavation shall be performed ahead of the pipe by working inside the pipe or shall be performed by boring with approved equipment suitable for the intended use.

2.07.04 Measurement & Payment

The length of pipe to be measured for payment shall be the actual length of casing or jacking pipe actually jacked or pushed into place. When additional casing is specified or authorized, but is not actually jacked in place, the cost for furnishing and placing such additional casing will be paid for separately. If a unit price has not been established in the Proposal, payment will be based on the contract provisions for extra work. No additional payment will be made where the Contractor jacks or installs additional casing not shown on the Drawings or authorized by the Engineer.

The contract price per lineal foot for furnishing and jacking the pipe, or casing, where the casing method is used shall be payment in full for completing the work as specified herein including the necessary jacking pits and connections to pipes of other materials.

The carrier pipe shall be paid at the contract price for watermain, storm sewer, sanitary sewer, or force main per unit prices shown on the proposal and shall be payment in full for furnishing and installing the carrier pipe inside the casing.

## 2.08 SUBGRADE

The subgrade for pipe and/or structures shall be firm, dense, and thoroughly compacted and consolidated, free from mud and muck, and sufficiently stable to remain firm and intact under the feet of the workmen.

### 2.08.01 Unstable Foundation

When the soil beneath the normal pipe embedment area is soft or unstable, even with adequate dewatering, or in the opinion of the Engineer cannot support the pipe or utility, further depth shall be excavated and refilled to the proposed grade with MDOT Class II granular material (for plastic pipe the material must comply with ASTM D2321) compacted in twelve (12) inch layers as specified in Section 2.09.05, or other approved means shall be employed to assure a firm foundation for the utility. The volume of unstable foundation removed and replaced with approved materials for which payment will be allowed shall be determined in cubic yards unless otherwise specified on the Drawing or in the proposal. Said volume to be computed by assuming that the cross section area of the unstable foundation takes the form of a trapezoid as shown on the Standard Detail for Unstable Soil Removal for Utility.

Payment for removal and replacement of unstable foundation will be paid under the contract provisions for extra work, unless specific Proposal items have been provided, in which case, the unit price bid shall be payment in full for performing the work as specified. If the soil in the bottom of trench is soft due to excessive amounts of ground water, and/or the Contractor's method of operation, stabilization of the trench bottom shall be at the Contractor's expense.

### 2.08.02 Special Foundations

Where the subgrade at the bottom of the excavation consists of soil which is unstable or yielding to such a degree that, in the opinion of the Engineer, it cannot properly support the pipe or structure, the Contractor shall construct such additional foundation or reinforcement of the subgrade as may be specified, such as timber piling, geotextiles, or other means as approved by the Engineer to provide a proper foundation.

The construction of special foundations will be paid for separately based on the contract provisions for extra work, unless specific Proposal items have been provided, in which case the unit price bid shall be payment in full for performing the work as specified.

## 2.09 PIPE EMBEDMENT

### 2.09.01 General

Pipe embedment shall include the furnishing and placing of approved materials as specified or as directed from 4 inches under the outside bottom of the pipe to 12

inches over the outside top of the pipe. Various classes of pipe embedment may be specified or shown on the Drawings or Standard details in which case the limits of the various types will also be specified.

2.09.02 Flexible Pipe Embedment

Flexible pipe is any pipe having a pipe stiffness of 115 psi. or less as defined under the requirements of ASTM Designation D2412 (this includes all plastic pipe except Composite (Truss) pipe, and may include corrugated metal pipe, ductile iron pipe, and steel pipe, depending on pipe diameter and wall thickness).

Pipe embedment for flexible pipe shall be Class B as shown in the attached standard details. For pipes less than fifteen (15) inches in diameter, bedding material meeting the requirements of Section 902.07 of the MDOT 2012 Standard Specifications for Construction for granular materials Class II, modified to 100% passing a 1" sieve shall be used. If stone is used for bedding, it shall meet the requirements of ASTM D2321 (Table 1 – Embedment Classes for Plastic Pipe) for Class 1A crushed stone. An Engineer approved geotextile filter fabric shall be placed around all areas where Class 1A crushed stone pipe embedment is used as shown on the standard details. Transition zones between crushed stone and sand embedment shall be separated by a geotextile fabric. For pipes fifteen (15) inches in diameter and larger, bedding material meeting the requirements of Section 902.07 of the MDOT 2012 Standard Specifications for Construction for granular materials Class II, modified to 100% passing a 1 sieve shall be used.

2.09.03 Class B Pipe Embedment

Unless otherwise specified or shown on the Drawings, all pipe embedment shall be Class B pipe embedment as shown on the Standard details. When the soil in the bottom of the trench at pipe subgrade meets all the requirements for Granular Material Class II as specified in the MDOT 2012 Standard Specifications for Construction, Section 902.07 and in the opinion of the Engineer will provide suitable bedding for the pipe, such soil may be utilized as bedding material and prepared to receive the pipe as specified without undercutting and subsequent replacement.

Plastic pipe embedment shall comply with ASTM D2321.

2.09.04 Special Pipe Embedment

Various types of special pipe embedment may be specified or shown on the Drawings in locations where special conditions require their use. The Contractor shall perform all the work of constructing special pipe embedment where specified.

2.09.05 Placing Pipe Embedment Material

Pipe embedment material shall be placed in the bottom of the trench and shaped by hand to provide a firm and uniform bearing for the barrel of the pipe with additional shaping to accommodate the bells on bell and spigot pipe. After each pipe has been

graded, aligned, and placed in final position on the bedding material and jointing is complete, additional embedment material shall be carefully placed and compacted under and around each side of the pipe and over the pipe until it is completely covered by 12 inches of embedment material. Said material shall be distributed along both sides of the pipe uniformly and simultaneously to prevent lateral displacement of the pipe. All granular embedment material shall be compacted to 95% of maximum unit weight in accordance with MDOT procedures.

All the work of placing pipe embedment shall be considered an integral part of installing the pipe and shall be completed immediately after the pipe is laid to the correct alignment and grade.

2.09.06 Basis of Payment

All the work of furnishing and/or placing pipe embedment material as specified shall be included in the contract items for the proposed work as follows:

2.09.06.01 Class B Pipe Embedment

When a contract item has been provided in the proposal for special backfill, payment will be made under this item as specified in Paragraph 2.10 for approved granular material obtained off the site. When no specific item for special backfill has been provided, this work shall be included in the major work items.

2.09.06.02 Special Pipe Embedment

When one or more contract items have been provided in the Proposal for special pipe embedment, payment to the Contractor will be based on the prices bid for the respective items. When no specific items have been provided in the Proposal, the cost for completing this work as specified shall be included in the major work items except for authorized extra work in which case the contract provisions for extra work shall apply.

## 2.10 BACKFILLING ABOVE PIPE EMBEDMENT

2.10.01 General

All backfill material shall be free from cinders, ashes, refuse, sod, organic material, boulders, or rocks larger than 3 inches in diameter, frozen material or other material which in the opinion of the Engineer is unsuitable. The soil excavated from the trenches shall be used for backfilling when it is classified as suitable by the Engineer. If all or a portion of the excavated material is classified as unsuitable for backfilling, the Contractor shall remove and dispose of the unsuitable material and shall furnish and place granular material meeting the requirements of Section 902.07 of the MDOT 2012 Standard Specifications for Construction for Granular Material Class II.

All backfilling and compaction shall be performed by the Contractor using methods and equipment approved by the Engineer.

2.10.02 Trenches Requiring Compacted Granular Backfill

Trenches and excavations in the following locations shall be backfilled with approved granular material meeting the requirements of Section 902.07 of the MDOT 2012 Standard Specifications for Construction for Granular Material Class II:

a. Improved areas, including drives, sidewalks, parking areas, around structures, etc.

b. Within the limits of the roadway (within a 1 on 1 slope beginning two (2) feet from the edge of pavement or back of curb towards the right-of-way line).

c. Within the limits of future improvements (shown on Drawings).

d. Within limits specified on Drawings.

e. All sanitary sewer lateral trenches within the limits of the right-of-way.

All backfill within these areas shall be placed in layers not exceeding twelve (12) inches thick, and shall be compacted to 95% of maximum unit weight in accordance with MDOT procedures. Tests for compaction will be made by the Engineer or other representative designated by the Engineer at no cost to the Contractor. When tests indicate a density which is less than that required, the methods or equipment being used shall be modified to obtain the density specified, and the section in question shall be recompacted until the required density is obtained. The cost of retesting shall be borne by the Contractor.

2.10.03 Trenches Not Requiring Compacted Granular Backfill

Where not otherwise specified or directed, backfilling above the pipe embedment shall be made with material which is originally excavated, which is suitable. Backfill materials shall be consolidated by mechanical equipment working longitudinally in the trench, or by other approved methods, so as to be free of large voids with any excess material mounded over the trench or removed as directed by the Engineer. The trench shall be graded to a reasonable uniformity and left in a neat condition.

2.10.04 Basis of Payment

Payment for backfilling including compaction shall be made as follows:

a. When a contract item has been provided in the Proposal for special backfill, payment will be made under this item as specified in Paragraph 2.11 for approved granular material obtained off the site.

b. When no specific item for special backfill has been provided in the Proposal, this work shall be included in the major items of work.

## 2.11 SPECIAL BACKFILL - MEASUREMENT AND PAYMENT

### 2.11.01 Measurement

When an item has been provided in the Proposal for special backfill, approved granular material obtained off the site which is required by these specifications or authorized by the Engineer shall be included in this item. Special backfill shall be measured compacted in place. The Contractor shall furnish a delivery ticket for each truck load at the time the material is delivered to the project. The delivery ticket shall be prepared at least in duplicate, one copy of which shall be furnished to the Engineer or his representative, the other copy to be retained in the Contractor's file. No payment shall be made for special backfill unless the individual truck delivery tickets are furnished in this manner. The Engineer will use the delivery tickets when calculating the compacted in place quantity.

### 2.11.02 Payment

The Proposal unit price per cubic yard for special backfill shall be payment in full for furnishing, placing, and compacting the special backfill and for disposing of the material excavated from the trench as directed and in accordance with the Drawings and Specifications.

Stone used specifically for dewatering procedures shall not be classified as special backfill and no specific payment will be made therefor.

## 2.12 DISPOSAL OF EXCESS EXCAVATION

All excavated material in excess of that needed for backfill or that material classified as unsuitable by the Engineer shall be disposed of by the Contractor. However, the Engineer reserves the right to direct the Contractor to haul all or a portion of the material not required for backfilling to an area designated by the Engineer which is not more than 1,000 feet outside the project and which is reasonably accessible. This work, when directed, shall be performed at no additional cost to the NKSA.

## 2.13 LIMITATIONS ON OPERATIONS

The Contractor shall at all times conduct his work so that there is a minimum of inconvenience to the residents and businesses in the vicinity of this project. To this end, he shall complete his backfill and remove all debris and unsuitable backfill to a point as close to the actual pipe installation as is practical and keep the area where the pipe construction and backfill has been completed in a neat condition. Open excavations shall be protected by signs, lights, barricades, and/or fence at all times when work is not actually taking place at that excavation. The placement of excavated earth along the line of the trench shall be controlled by the public's use of the street or right-of-way and shall always be confined to approved limits.

Not more than 300 consecutive feet of street shall be closed at one time, and vehicular traffic through any street shall not be stopped for a period longer than two weeks without the written permission of the Engineer. Not more than one cross street shall be closed to vehicular traffic at the same time except by permission of the Engineer. Contractor shall maintain access for emergency vehicles at all times.

## 2.14 SOIL EROSION AND SEDIMENTATION CONTROL

The Contractor shall conduct his operations in such a manner that all soil is confined within the project limits and prevented from entering storm sewers, water courses, rivers, lakes, reservoirs, or wetlands.

The Contractor shall place a filter or barrier composed of straw, stone or other approved material around all catch basins or other inlets to the storm sewer or drainage courses to prevent sedimentation in these structures. After the construction operations are completed, the Contractor shall remove these filters and clean all the sediment and debris from the catch basins, ditches or other storm sewer structures.

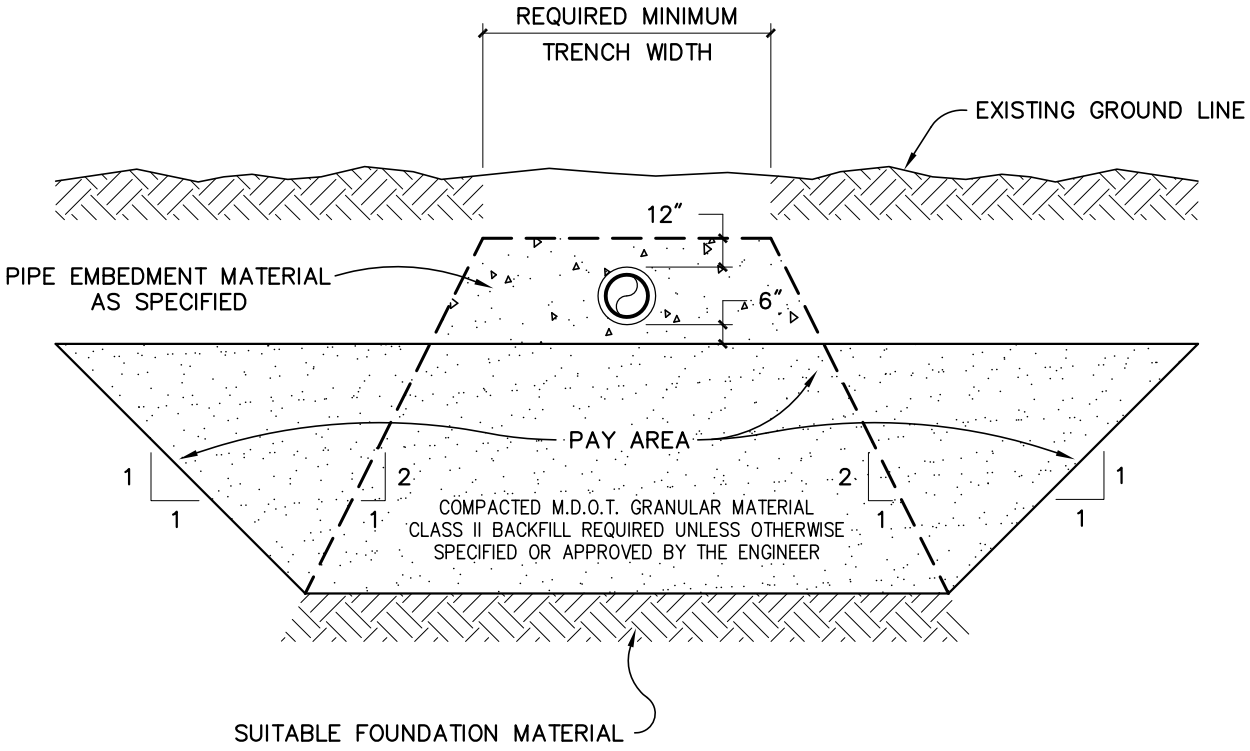
Soil erosion and sedimentation control measures if indicated on the Drawings are considered as minimum requirements and are not to be considered as complete and all-inclusive. Additional control measures as may be required due to circumstances or conditions at the time of construction or as directed by the Engineer, or the designated Soil Erosion Control agency, shall be placed as required to insure conformance with the Part 91 of PA 451 of 1994. Deviations from or additions to the erosion control measures shown on the Drawings shall be subject to the approval of the Engineer or enforcing agency.

The Contractor is responsible to have a certified storm water operator and complete all such reports as required by regulatory agencies as it relates to storm water and soil erosion and sedimentation control.

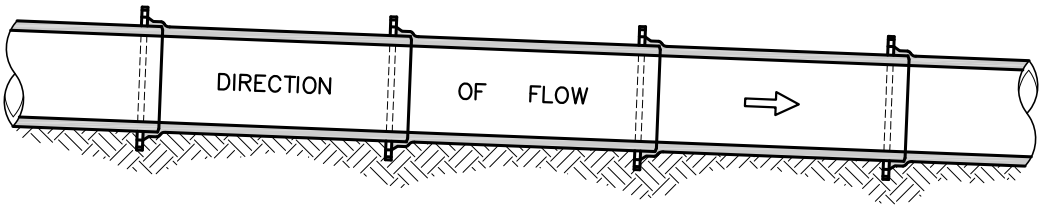
The cost of this work and other control measures which may be required or directed by the Engineer shall be included in the major work items to the cost of the project unless specific items have been provided in the proposal.

## 2.15 STREAM CROSSING

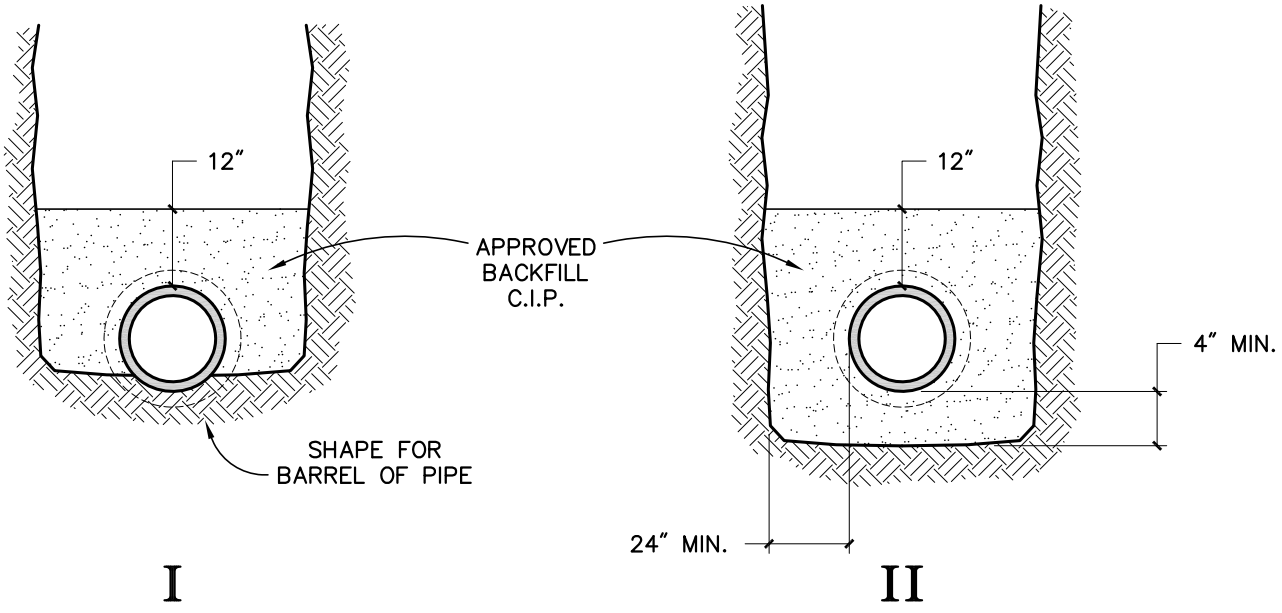
The rules and regulations of Act 451, shall govern all streams, wetland and river crossings.




# UNSTABLE SOIL REMOVAL FOR UTILITY




# EXCAVATION FOR BELLS




# CLASS B PIPE EMBEDMENT

## NOTES

1. ALL BACKFILL INDICATED SHALL BE COMPACTED TO 95% OF MAXIMUM DENSITY IN ACCORDANCE WITH M.D.O.T. PROCEDURES.
2. METHOD I SHALL BE USED IN AREAS OF UNCONSOLIDATED SOILS. (e.g. SAND, GRAVEL)
3. METHOD II SHALL BE USED IN AREAS OF CONSOLIDATED SOILS (e.g. CLAY, HARDPAN, ROCK)

# SECTION 3

# SPECIFICATIONS FOR SANITARY SEWER

## 3.01 DESCRIPTION OF WORK

The work shall consist of furnishing and installing sanitary sewer pipe of the specified size or sizes in a trench and shall include the construction of manholes, lateral connections to the abutting property and other appurtenant work. Excavating, trenching and backfilling shall be as specified in Section 2.

The work shall be performed in accordance with the specifications and drawings, the MDOT 2012 Standard Specifications for Construction and the following specifications.

## 3.02 MATERIALS

All materials furnished by the Contractor shall conform to the specifications which follow. Where reference specifications are used, they shall be considered as referring to the current edition or latest issue. Certified test reports for strength from the manufacturer shall be submitted to the NKSA or Engineer when the pipe is delivered to the site.

### 3.02.01 Sewer Pipe

All sewer pipe shall be of the materials and strengths shown on the drawings or as specified.

#### 3.02.01.01 Clay Sewer Pipe

Clay sewer pipe may be used only when specifically approved by the NKSA and Engineer. If approved, clay sewer pipe shall meet the following:

Extra strength clay sewer pipe shall conform to the requirements of ASTM Designation C700.

Joints for clay sewer pipe shall be of resilient materials conforming to the requirements of ASTM Designation C425.

#### 3.02.01.02 Concrete Sewer Pipe (12" Diameter and Larger Only)

Concrete sewer pipe may be used only when specifically approved by the NKSA and Engineer. If approved, concrete sewer pipe shall meet the following:

Non-reinforced concrete pipe, fittings, and accessories shall conform to the requirements of ASTM Designation C14, Class 3.

Reinforced concrete sewer pipe shall conform to the requirements of the current specifications of the ASTM for reinforced concrete culvert, storm drain and sewer pipe, Designation C76 for the various classes specified.

Joints for concrete sewer pipe shall be premium rubber joints conforming to the requirements of ASTM Designation C443, except the infiltration and exfiltration allowance shall be as specified herein.

3.02.01.03 Polyvinyl Chloride (PVC) Solid-Wall Pipe

Polyvinyl chloride (PVC) solid-wall pipe less than 18 inches in diameter shall conform to the requirements of ASTM Designation D3034, with a standard dimension ratio of 35 (SDR-35).

Polyvinyl chloride (PVC) solid-wall pipe 18 inches in diameter and larger shall conform to the requirements of ASTM Designation F679, with a standard dimension ratio of 35 (SDR-35).

Extra strength pipe shall conform to the requirements of ASTM Designation D3034, with a standard dimension ratio of 26 (SDR-26). Extra strength pipe shall be required for installations over 18 feet deep based on the average depth of the manholes for each section of pipe.

Joints shall be flexible elastomeric sealed type joint in accordance with ASTM D3212.

3.02.01.04 Polyvinyl Chloride (PVC) Composite (Truss) Pipe

Polyvinyl Chloride (PVC) Composite (Truss) Pipe shall conform to the requirements of ASTM Designation D2680.

Joints shall be flexible elastomeric sealed type joint in accordance with ASTM D3212.

3.02.01.05 Profile Polyvinyl Chloride (PVC) Pipe

Profile polyvinyl chloride (PVC) pipe shall conform to the requirements of ASTM Designation D794. Pipe shall have a minimum pipe stiffness designation of "PS-46" or greater. If no specific pipe is specified in project specification, the Contractor shall use a closed profile pipe. All profile PVC pipe shall conform to the ASTM requirements specific for the specified pipe.

Joints shall be flexible elastomeric sealed type joint in accordance with ASTM D3212.

3.02.01.06 Ductile Iron Pipe

Ductile iron pipe shall conform to the requirements of AWWA C151 (ANSI

A21.51), and shall be Class 53, unless otherwise specified. All pipe and fittings shall have a cement mortar lining conforming to the requirements of AWWA C104 (ANSI A21.4), unless otherwise specified. Epoxy lining may be used when approved by the NKSA.

Joints shall be rubber gasket joints conforming to the requirements of AWWA C111 (ANSI A21.11). Joints on fittings shall be bolted mechanical joints.

When laying ductile iron pipe in corrosive type soils, the pipe shall be encased in a seamless polyethylene tube in accordance with AWWA C105 (ANSI A21.5) of eight (8) mills minimum thickness. The ends of adjacent sections of polyethylene tubing shall be overlapped a minimum of one (1) foot, and the joint taped or otherwise secured to prevent displacement during backfill operations.

3.02.02 Sanitary Sewer Laterals

All lateral fittings are to be solvent weld. Lateral wyes, fittings and pipe shall be extra strength pipe, SDR 26, or an approved equal of any material specified in Paragraph 3.02.01, unless otherwise specified. Any specified bends or curves shall be smooth, long-radius type curves. No mitered or segmental type bends will be approved.

3.02.03 Wyes and Tees

Wyes and Tees may be cast fittings of the same material and joints as the main sewer, or may be an approved fabricated special fitting which provides a suitable connection for the lateral to the main sewer.

Details of special fittings and/or adapters for connecting laterals of a material different from the main sewer shall be approved by the NKSA before they are manufactured.

Wyes and Tees will be required as follows:

6" Wyes on main sewer of 8" or 10" diameter
6" Wyes or Tees on main sewer of 12" diameter or larger
6" Inserta-Tee, or approved equal, on main sewer of 24" diameter or larger.

3.02.04 Plugs and Stoppers

Plugs, stoppers or glued caps for plugging the ends of laterals or risers which are not extended shall make a water tight seal and shall be of such a design that they can be readily removed without damage to the pipe.

Plugs, stoppers or glued caps shall be installed at the connection point(s) to the existing sewer system to protect existing sewer lines from contamination. The plugs, stoppers or caps shall not be removed until the new system is approved by the NKSA.

3.02.05 Cement Mortar

Mortar shall consist of one part Air Entraining Portland Cement, and two parts masonry sand. These proportions shall be measured by volume.

The sand and cement shall be mixed dry in a clean tight box until a mixture of uniform color is produced, after which water shall be added until the required consistency is obtained. Mortar shall be mixed only in such quantities as needed for immediate use. The retempering of mortar will not be permitted.

3.02.05.01 Cement

Air Entraining Portland Cement shall conform to the requirements for Type 1A of the MDOT 2012 Standard Specifications for Construction for Air Entraining Portland Cement, ASTM Designation C150.

3.02.05.02 Masonry Sand

Masonry Sand shall conform to the requirements of "Natural Sand, 2MS" of the MDOT 2012 Standard Specifications for Construction.

3.02.05.03 Water

Water for mixing mortar shall be obtained from the public water supply unless otherwise approved by the NKSA.

3.02.06 Concrete

Concrete for pipe encasement, special pipe embedment, manhole bases and similar items shall meet the requirements of the MDOT 2012 Standard Specifications for Construction for Grade S3 concrete. Grade S3 concrete shall have the strength of 3,000 psi at 28 days.

3.02.07 Manhole Materials

3.02.07.01 Adjusting Rings

Precast grade adjusting rings shall conform to the requirements of ASTM Designation C478.

3.02.07.02 Precast Units

Unless otherwise specified, all manholes shall be precast and water tight.

Precast reinforced concrete manhole risers and precast reinforced concrete manhole conical top sections shall conform to the requirements of ASTM C478, Precast Reinforced Concrete Manhole Sections. Bituminous waterproofing shall be applied to outer surface of manhole at a rate of one gallon per 100 square feet.

Manholes shall be free of holidays and open pinholes.

Joints for precast sections shall be premium rubber, butyl rubber composition seals, "RAM-NEK", or approved equal.

3.02.07.03 Castings

Castings shall meet the requirements specified in the MDOT 2012 Standard Specifications for Construction Section 908. Manhole covers and rings and similar combinations of castings shall be machined to provide an even bearing.

Unless otherwise specified, manhole castings shall be provided with 24 inch openings and shall be East Jordan No. 1040 with Type A solid cover, or approved equal.

Where indicated on the plans, water-tight manhole covers shall be East Jordan No. 1040 WT, with Type A solid cover, or approved equal.

3.02.07.04 External Casting and Adjusting Ring Seals

The casting frame, adjusting rings and top section of all manholes shall be wrapped with a watertight seal joint encapsulation system with rubber backing to minimize infiltration into the manhole. Material shall be Infi-Shield External Uni-band Seal by Sealing Systems, Wrapid Seal by CANUSA-CPS, or approved equal. Installation shall follow manufacturer's recommendations.

3.02.07.05 Steel Reinforcement

Steel Reinforcement shall conform to the requirements for steel reinforcement of Section 905 of the MDOT 2012 Standard Specifications for Construction.

3.02.07.06 Flexible Manhole Connectors (Rubber Boots)

Flexible manhole connectors (also called rubber boots) shall be "Kor-N-Seal" by National Pollution Control Systems, Inc., "P.S.X." or "Press Wedge II" by Press Seal Gasket Corporation, "Lock Joint Flexible Manhole Sleeve" by Inter Pace Corporation, "A-LOK," "Z-LOK," or "QUIK-LOK" by A-LOK Products, Inc. or approved equal. Flexible manhole connectors shall conform to the requirements of ASTM Designation C923, Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

3.02.07.07 Manhole Steps

Unless otherwise specified, manhole steps shall be plastic coated steel steps conforming to the requirements of ASTM Designation C478, or approved equal, spaced at sixteen inches (16") on center.

3.02.07.08 Manholes with Corrosive Conditions

When shown on the drawings, or included in the proposal items, manholes that are anticipated to have corrosive conditions due to septicity, forcemain connection or other causes shall be provided with corrosion protection on the interior of the manhole.

Corrosion protection may be provided via a polymer concrete manhole, a bond welded PVC cast in place liner, or an epoxy liner as approved by the NKSA.

## 3.03 INSPECTION OF MATERIALS BY CONTRACTOR

It shall be the responsibility of the Contractor to inspect all materials for cracks, flaws or other defects before they are incorporated into the work. Any materials found to be defective or damaged shall be promptly removed from the job site by the Contractor.

## 3.04 LAYING PIPE

3.04.01 Alignment and Grade

3.04.01.01 Laser Alignment

The Contractor shall use the laser beam method of maintaining line and grade for sewer construction, unless otherwise approved by the NKSA. The Contractor shall submit evidence to the NKSA that a qualified operator will operate the laser beam equipment during the course of construction.

The Engineer shall place line and grade stakes at each manhole, or more often, as determined by the Engineer. The Contractor shall check the line and grade at every point at which a stake has been placed.

3.04.02 Handling

Pipe shall be protected during unloading and handling against impacts, shocks and free fall. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

3.04.03 Direction of Laying

Excavation of trenches and laying of pipe shall begin at the outlet for the sewer and proceed upgrade with the individual pipe being laid with the spigot end downstream.

3.04.04 Placing

The pipe shall be placed on the prepared sub-grade and held firmly in place during subsequent pipe jointing and embedment operations. Successive pipes shall be carefully positioned so that when laid, they form a sewer with a uniform

invert true to line and grade.

Sufficient pressure shall be applied by an approved method to each pipe as it is laid to ensure that the spigot is completely home in the bell. Care shall be exercised to prevent joints from opening as successive lengths of pipe are placed. The Contractor shall take the necessary precautions when using a trench box to prevent joint separation when the box is pulled ahead.

All plastic/flexible pipe shall be installed in accordance with ASTM D2321. Rigid pipe shall be installed in accordance with ASTM C12 (vitrified clay pipe) and ASTM C1479 (precast concrete pipe), if approved by the NKSA.

3.04.05 Cleaning Sewer

The interior of the sewer shall be cleaned of all jointing material, dirt and debris as the work progresses.

In small sewers where cleaning after laying may be difficult, a swab or drag may be required in the pipeline to satisfactorily complete this work. Where possible, a plug shall be installed on the downstream end of the sewer to prevent any sand and debris from entering the existing sewer.

## 3.05 PIPE JOINTS

Pipe joints shall be made in strict accordance with the pipe manufacturer's recommendations unless otherwise specified herein. All lubricants, gaskets and other materials required to make the joints shall be supplied or recommended by the pipe manufacturer, and approved by the NKSA.

Pipe layers shall be fully qualified and experienced in the work being performed and shall check each joint after it is completed to see that no part of the joint material is left on the inside of the pipe and that the joint is properly made.

## 3.06 LOCATION OF WYES AND TEES

The approximate locations of wyes or tees are shown on the drawings. These locations may be adjusted where necessary to best serve the various properties. Exact locations shall be determined by the NKSA or Engineer before the wyes or tees are installed.

The Contractor shall keep an accurate record of measurements from the nearest downstream manhole to each wye or tee which is installed, the length of each lateral, the depth at the end of each lateral and the distance to the downstream manhole parallel to the sewer at the end of each lateral. These measurements shall be recorded on the record plan to be furnished by the Contractor to the Engineer and NKSA.

## 3.07 SANITARY SEWER LATERALS

### 3.07.01 General

Installation of sanitary sewer laterals shall meet all requirements specified for sanitary sewers. All laterals shall be inspected by the NKSA before the trench is backfilled.

### 3.07.02 Length

All sanitary sewer laterals shall be laid at right angles to the sanitary sewer mainline unless otherwise shown on the drawings, and shall extend to a point one foot outside the street right of way (property line) unless otherwise directed. No payment will be made for pipe laid beyond this point unless specifically ordered by the Engineer.

The Contractor shall measure and record on his record drawing the horizontal length of the lateral from the main line sewer to the end of the lateral and provide this information to the NKSA.

### 3.07.03 Grade

It is intended that the ends of laterals at property lines will be deep enough to service the lowest floor of all existing buildings by gravity flow.

The minimum grade on the lateral shall be 2 percent (1/4 in/ft.). Where minimum depths as specified herein cannot be obtained and when approved by the NKSA, minimum grades may be reduced to 1 percent (1/8 in/ft.).

Where the elevation of the end of the lateral to serve an existing structure is not shown on the drawings it shall be set at 3 feet below basement grade for standard houses (11 feet below first floor) or 4 feet below basement grade for houses with walkout basements (12 feet below first floor) where the set-back is 50 feet or less. When the house is set back further than 50 feet it may be set at 2 feet below the basement elevation for standard houses (3 feet for walkouts) plus an additional depth of 2 percent multiplied by the set-back distance to the structure.

The minimum depth of the end of the lateral at the property line in all cases shall be a minimum 9'-0" below centerline of the street. (See lateral and property line riser detail in these specifications.)

### 3.07.04 Risers

Where the sanitary sewer is more than twelve feet deep, a main line riser shall be constructed in accordance with the standard details or as shown on the drawings. Backfill shall be carefully placed and compacted around the riser in an approved manner which will not damage the sewer or riser.

Property line risers shall be constructed at the end of the lateral (at a point

approximately five (5) feet from the right-of-way line unless otherwise specified).

The property line riser shall consist of a 6" sewer lateral pipe extended upward to a minimum of one (1) foot above the normal groundwater table, or to a depth of not greater than four (4) feet below grade at the end, whichever is the closest to finished grade. In all cases the lateral shall have a minimum of two (2) feet of cover.

3.07.05 Markers and Measurements

After installation of the service lateral, but prior to backfilling, the Contractor shall provide and install a 2" x 2" wood marker for each service. The wood markers shall be set vertically from the end of the lateral to twelve (12) inches above finish surface elevations. Also, a 1/2" diameter by 3' long metal stake shall be placed vertically and adjacent to the wood marker with 6" cover. The Contractor shall assist the Construction Observer in locating the end of each lateral, and in recording the location by measuring to the nearest downstream manhole.

After the record drawing locations have been recorded and checked by the Construction Observer, the Contractor shall cut off the markers as follows: in improved areas, the markers shall be cut off two inches below grade; in undeveloped areas, the markers shall be cut off six inches above grade.

## 3.08 MANHOLE CONSTRUCTION

Manholes shall be constructed in accordance with the standard details and as specified herein. Manholes shall be water tight.

Unless specified otherwise, all manholes shall be precast.

Precast bases shall be installed on sand or gravel subbase in such a way as to provide a uniform bearing under the manhole base.

Precast manholes with integral bottom and channel may be used; however, any changes to the structure due to minor field adjustments in alignment and grade required to meet construction conditions, shall be made by the Contractor at no additional cost to the NKSA.

Benches shall be constructed from the invert to the crown on the pipe for the entire length of the manhole or junction point.

Stubs shall be provided in manholes for future connections as shown on the drawings or as directed by the NKSA. All such stubs shall be sealed with standard watertight, removable plugs.

All openings in manholes for the purpose of receiving pipes (including openings for future pipes) shall be fitted with a flexible type connector. Flexible connectors shall be factory installed. Openings for future connections shall be sealed by an

approved prefabricated cap or plug.

Precast concrete adjusting rings shall be used to bring existing and new manhole structure covers within the proposed pavement to grade. After the cover is brought to grade, the entire hole created by excavating to raise the casting shall be filled in three-inch (3") lifts with Hot Mix Asphalt Mixture 3C or 13A to the top of the leveling course and air tamped to achieve proper compaction. Special care shall be taken to prevent debris from entering sewers.

## 3.09 CUT-INS

When cutting into an existing manhole, the opening shall be no larger than is necessary to admit the new sewer. The opening shall be made by a concrete drilling or coring machine and shall have a mechanically compressed flexible joint connection installed. All broken or surplus material falling inside the structure shall be removed.

Flow channels and/or drop connections shall be constructed as specified or as directed to accommodate the sewer being cut-in.

Unless otherwise specified, cut-ins shall be considered part of the major items of work, and no specific payment will be made therefor.

## 3.10 ACCEPTANCE TESTS

### 3.10.01 Alignment and Grade

Each section of sewer may be checked by the NKSA or Engineer for alignment and grade using lights and mirrors, television inspection, or other similar means. The Contractor shall assist the NKSA or Engineer in the performance of these tests when necessary.

If a section of sewer is determined by the NKSA or Engineer not to be acceptable for alignment or grade, the Contractor shall relay the sewer at no additional cost to the NKSA.

### 3.10.02 Leakage Tests

The completed sewer shall be free from leaks either by infiltration or exfiltration. Manholes will be visually inspected for leakage. No more than 1,000 feet of main sewer will be considered for partial payment until it has been satisfactorily tested and approved.

The Contractor shall provide all necessary labor, equipment and supervision to perform infiltration, exfiltration and air tests in accordance with the requirements of the NKSA. All sewers shall be subjected to an air test unless otherwise specified below.

All sewers which are submerged by ground water to an average depth of greater than seven (7) feet above the crown of the sewer at the time of the test shall be subjected to an infiltration test.

The air test shall be performed on each section of pipe between manholes after laterals are installed. Testing shall conform to ASTM F1417 for plastic flexible pipe, ASTM C828 for clay pipe (if approved) and ASTM C924 for reinforced concrete pipe. The section of pipe being tested shall be sealed at each manhole using inflatable plugs or other approved devices. All plugs shall be adequately braced.

Where the expected water table level, as determined by the soil borings, is above the sewer elevation, the pressure testing limits for dry trench conditions shall be as follows:

1. Where the expected water table level is 0' to 7' above the pipe, the test pressure limits will be 3.5 to 2.5 psig.

2. Where the expected water table level is over 7' above the pipe, the test pressure limits will be 4.5 to 3.5 psig.

In a wet trench condition where the water table has risen above the pipe to a depth of less than 7' above the crown of the pipe prior to testing, the air testing limits shall be determined by adding to the original 3.5 psig. an additional 0.433 psig. for each foot the water table is above the crown of the pipe, or as determined in the dry trench condition, whichever is greater.

The air pressure in the section under test shall be raised to an initial pressure of 0.5 psig. above the beginning test pressure and allowed to stabilize for a minimum of five (5) minutes. Air shall be added during this stabilization period as required to maintain the pressure at or above the beginning test pressure.

The rate of air loss shall be determined by measuring the time interval required for the internal pressure to decrease 1.0 psig. within the limits previously specified.

Minimum time interval for satisfactory test shall be in accordance with Table 1 and Table 2 following this section.

In the event the NKSA or Engineer determines that the results of the air test are inconclusive because of visible infiltration, unsatisfactory or incomplete records, or improper application of testing methods or equipment, or other similar reasons, the NKSA or Engineer may require either an exfiltration test or an infiltration test for the section or sections of sewer involved.

The allowable leakage as measured by either an infiltration test or an exfiltration test shall not exceed 50 gallons per day per inch of diameter per mile of sewer.

Sewers shall be tested for exfiltration by isolating a section or sections of the sewers between manholes by means of an approved temporary type of water-tight bulkhead. The isolated section of sewer shall then be filled with water to a level which is two and one-half (2-1/2) feet above the existing water-table but not less than two and one-half (2-1/2) feet above the crown of the sewer pipe at the high end of the isolated section under the test. The length of the section shall be such that, where possible, the water level at its lower end will not be more than five (5) feet above the crown of the pipe except as may be required by a high water table.

The length of time and the exfiltration test period shall be at the discretion of the NKSA. Determination of the amount of exfiltration shall be made by measurement of the loss of volume of water in the manholes. The amount of exfiltration over a 24 hour period will then be calculated from the measured loss of volume and time period.

On any section of sewer that the NKSA shall deem impractical to test by means of the exfiltration test specified above, as may be the case when local connections are involved, a suitable infiltration test will be required.

3.10.03 Pipe Deflection Tests (Flexible Pipe Only)

Flexible pipe is any pipe having a pipe stiffness of 115 psi. or less as defined under the requirements of ASTM Designation D2412. Truss pipe will not require a deflection test if it has less than twelve feet (12') of cover.

The completed installation of flexible pipe shall at no point have out-of-round deflections in the main sewer pipe greater than five percent (5%) of the pipe's actual original inside diameter. Go/no go gauging tests, using an approved pointed mandrel with nine (9) points, shall be performed by the Contractor in the presence of the NKSA, or his authorized representative after the trench is backfilled, and before the surface restoration is begun. Pipe with deflections greater than five percent (5%) shall be relaid by the Contractor at no additional expense to the NKSA. Use of mechanical devices or equipment to complete the go/no go tests and vibratory rerounding of failed sections are prohibited. A minimum of thirty (30) days shall elapse between installation and backfilling and deflection testing.

3.10.04 Televising

After the pipe deflection test, placement of base course (when the pipe is proposed under pavement), and pipe cleaning (when the sewer has been live prior to televising), the Contractor shall conduct a continuous digital video recording inspection of all sanitary sewers. The inspection and documentation shall meet the requirements of the National Association of Sewer Service Companies (NASSCO) specification for television inspection of sewers. Closed-circuit television (CCTV) recording shall be conducted in compliance with the North American Pipeline Assessment and Certification Program (PACP) standards for sewer defect identification and assessment. Work shall be performed by a PACP-

certified operator and delivered on professional quality recording media with audio input that is compatible with the Engineer's and NKSA's equipment for viewing. The televising software shall be PACP-certified by NASSCO and shall be capable of both exporting to and importing from the standard PACP database.

If the television inspection of an entire section (manhole to manhole) cannot be successfully performed from one manhole, a reverse setup shall be performed per PACP requirements as a second survey.

The Contractor shall provide a written report, two copies of the recording on DVD, and a digital copy of the exported PACP database. The recording shall show the name of the project, the purpose of inspection, the date and approximate time of recording, the name of the street, the manhole numbers of each end of each run (the "from" and "to" manholes) and stationing between manholes. The recording shall clearly show the pipe interior, joints, alignment, and wye locations and stations, and shall be reviewed by the Engineer for evidence of compliance with the Contract Documents for workmanship and materials. The written report shall contain a log for each recording to provide a written record of the information provided on the recording, and shall show the name of the project and all other pertinent data.

## 3.11 MEASUREMENT AND PAYMENT

### 3.11.01 General

All proposed construction shall be measured for payment by the Engineer in accordance with the items listed in the Proposal.

The unit price bid for each Proposal item shall be payment in full for completing the work, ready for use as specified.

### 3.11.02 Sanitary Sewers

Measurement of the length of the sewer shall be in lineal feet along the centerline of the sewer from center of manhole to center of manhole.

Where depth classifications are provided, the depth of the sewer connecting two adjacent structures shall be considered as being the average of the depth from earth grade to the sewer invert at these structures.

### 3.11.03 Manholes

Manholes shall be paid for in accordance with the units established in the Proposal. When no Proposal item is provided for castings, the castings and their installation shall be considered part of the major items of work.

When corrosion protection is needed for existing manholes, this shall be paid for separately in accordance with the units established in the Proposal. When called

for on the drawings or in the project specifications for corrosion protection in new manholes, this shall be paid for separately in accordance with the units established in the Proposal; if no Proposal item is provided, corrosion protection shall be considered included in the Proposal item for manholes.

3.11.04 Wyes or Tees

When a specific item is provided in the Proposal for Wyes or Tees the unit price bid shall be the additional cost of furnishing and placing the wye or tee over and above the cost of furnishing and laying the sewer pipe.

When no Proposal item is provided, the wyes or tees and their installation shall be considered part of the major items of work.

3.11.05 Sanitary Sewer Laterals

The length of sewer laterals shall be measured horizontally from the center of the main sewer to the end of the lateral as specified.

3.11.06 Cut-Ins

Cut-ins shall be considered part of the major items of work and no specific payment will be made therefor.

3.11.07 Stubs

Stubs shall be considered part of the major items of work and no specific payment will be made therefor.

3.11.08 Risers

The length of main line risers shall be measured vertically from the top of the main sewer to the end of the riser. The length of property line risers shall be measured vertically from the top of the lateral at the lower bend for the riser to the end of the riser. When no Proposal item is provided, the risers and their installation shall be considered part of the major items of work.

## TABLE 1 – PVC and DI Pipe

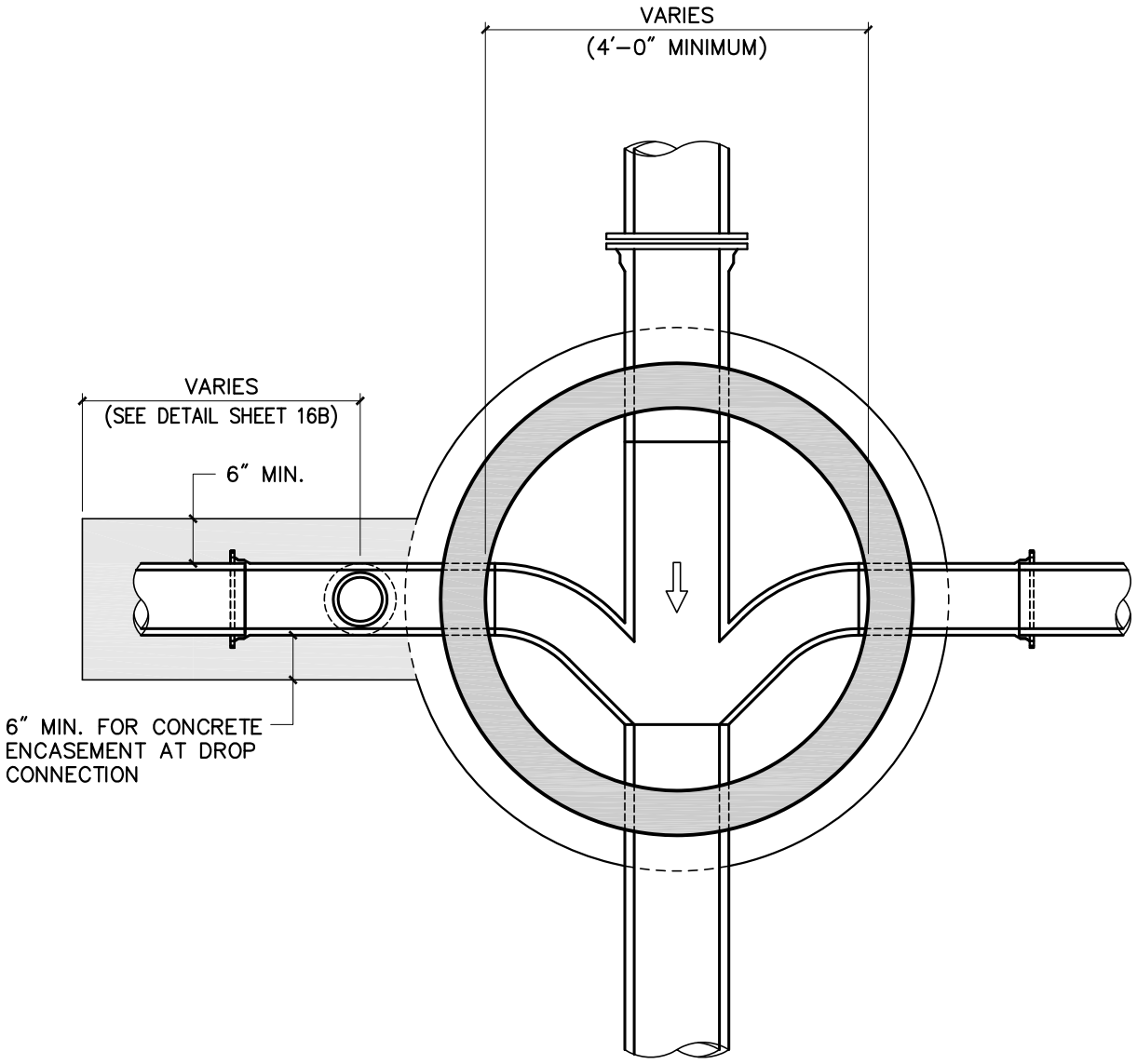
| Pipe Diameter, in. | Minimum Time, min:s | Length for Minimum Time, ft | Time for Longer Length, s | Specification Time for Length (L) Shown, min:s | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |
| 4 | 3:46 | 597 | 0.380 L | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 |
| 6 | 5:40 | 398 | 0.854 L | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:42 | 6:24 |
| 8 | 7:34 | 298 | 1.520 L | 7:34 | 7:34 | 7:34 | 7:34 | 7:36 | 8:52 | 10:08 | 11:24 |
| 10 | 9:26 | 239 | 2.374 L | 9:26 | 9:26 | 9:26 | 9:53 | 11:52 | 13:51 | 15:49 | 17:48 |
| 12 | 11:20 | 199 | 3.418 L | 11:20 | 11:20 | 11:24 | 14:15 | 17:05 | 19:56 | 22:47 | 25:38 |
| 15 | 14:10 | 159 | 5.342 L | 14:10 | 14:10 | 17:48 | 22:15 | 26:42 | 31:09 | 35:36 | 40:04 |
| 18 | 17:00 | 133 | 7.692 L | 17:00 | 19:13 | 25:38 | 32:03 | 38:27 | 44:52 | 51:16 | 57:41 |
| 21 | 19:50 | 114 | 10.470 L | 19:50 | 26:10 | 34:54 | 43:37 | 52:21 | 61:00 | 69:48 | 78:31 |
| 24 | 22:40 | 99 | 13.674 L | 22:47 | 34:11 | 45:34 | 56:58 | 68:22 | 79:46 | 91:10 | 102:33 |
| 27 | 25:30 | 88 | 17.306 L | 28:51 | 43:16 | 57:41 | 72:07 | 86:32 | 100:57 | 115:22 | 129:48 |
| 30 | 28:20 | 80 | 21.366 L | 35:37 | 53:25 | 71:13 | 89:02 | 106:50 | 124:38 | 142:26 | 160:15 |
| 33 | 31:10 | 72 | 25.852 L | 43:05 | 64:38 | 86:10 | 107:43 | 129:16 | 150:43 | 172:21 | 193:53 |
| 36 | 34:00 | 66 | 30.768 L | 51:17 | 76:55 | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 | 230:46 |

## TABLE 2 – VCP and Concrete Pipe

| Pipe Diameter, in. | Minimum Time, min:s | Length for Minimum Time, ft | Time for Longer Length, s | Specification Time for Length (L) Shown, min:s | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft |
| 4 | 1:53 | 597 | 0.190 L | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 |
| 6 | 2:50 | 398 | 0.427 L | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:51 | 3:12 |
| 8 | 3:47 | 298 | 0.760 L | 3:47 | 3:47 | 3:47 | 3:47 | 3:48 | 4:26 | 5:04 | 5:42 |
| 10 | 4:43 | 239 | 1.187 L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 | 8:54 |
| 12 | 5:40 | 199 | 1.709 L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:58 | 11:24 | 12:50 |
| 15 | 7:05 | 159 | 2.671 L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 | 20:02 |
| 18 | 8:30 | 133 | 3.846 L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 | 28:51 |
| 21 | 9:55 | 114 | 5.235 L | 9:55 | 13:05 | 17:27 | 21:49 | 26:11 | 30:32 | 34:54 | 39:16 |
| 24 | 11:20 | 99 | 6.837 L | 11:24 | 17:57 | 22:48 | 28:30 | 34:11 | 39:53 | 45:35 | 51:17 |
| 27 | 12:45 | 88 | 8.653 L | 14:25 | 21:38 | 28:51 | 36:04 | 43:16 | 50:30 | 57:42 | 64:54 |
| 30 | 14:10 | 80 | 10.683 L | 17:48 | 26:43 | 35:37 | 44:31 | 53:25 | 62:19 | 71:13 | 80:07 |
| 33 | 15:35 | 72 | 12.926 L | 21:33 | 32:19 | 43:56 | 53:52 | 64:38 | 75:24 | 86:10 | 96:57 |
| 36 | 17:00 | 66 | 15.384 L | 25:39 | 38:28 | 51:17 | 64:06 | 76:55 | 89:44 | 102:34 | 115:23 |

Note: Table to be used when testing one diameter only.
When testing two sizes of pipe simultaneously, time shall be computed by the ratio of lengths involved.

$$\text{Time} = \frac{\text{Length 1} \times \text{Time1} + \text{Length 2} \times \text{Time 2}}{\text{Length 1} + \text{Length 2}}$$



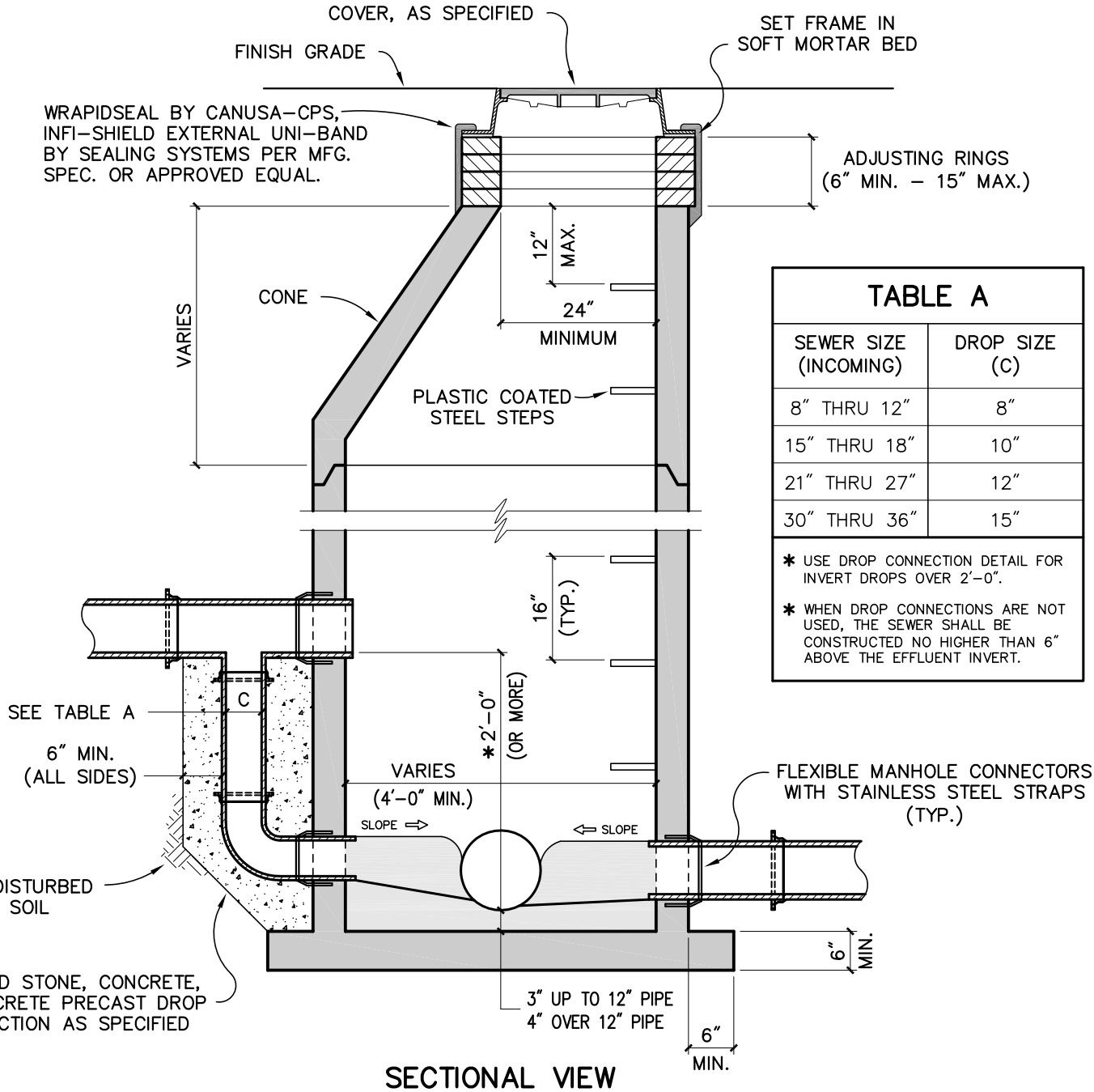

PLAN VIEW

# STANDARD SANITARY SEWER MANHOLE

## (PRECAST CONCRETE)

### NOTES

1. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED WITH GEOTEXTILE FABRIC..
2. CONE MAY BE ROTATED TO ALIGN STEPS TO VARIOUS LOCATIONS IN MANHOLE.
3. FLOW CHANNEL WALL HEIGHT SHALL BE EQUAL TO CROWN OF PIPE.




| TABLE A | |
|---|---|
| SEWER SIZE (INCOMING) | DROP SIZE (C) |
| 8" THRU 12" | 8" |
| 15" THRU 18" | 10" |
| 21" THRU 27" | 12" |
| 30" THRU 36" | 15" |

* USE DROP CONNECTION DETAIL FOR INVERT DROPS OVER 2'-0".

* WHEN DROP CONNECTIONS ARE NOT USED, THE SEWER SHALL BE CONSTRUCTED NO HIGHER THAN 6" ABOVE THE EFFLUENT INVERT.

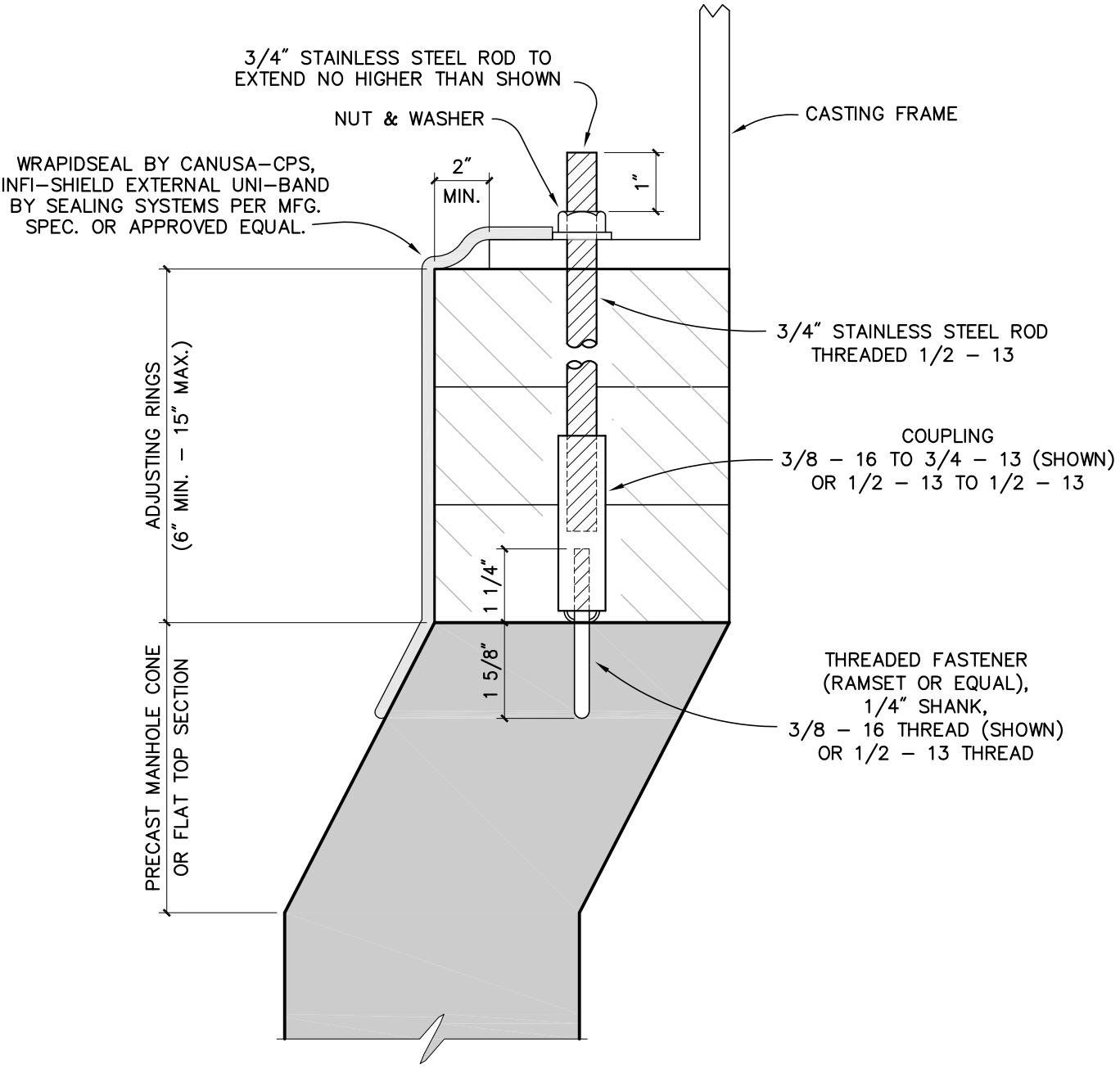
SECTIONAL VIEW

# STANDARD SANITARY SEWER MANHOLE

## (PRECAST CONCRETE)

### NOTES

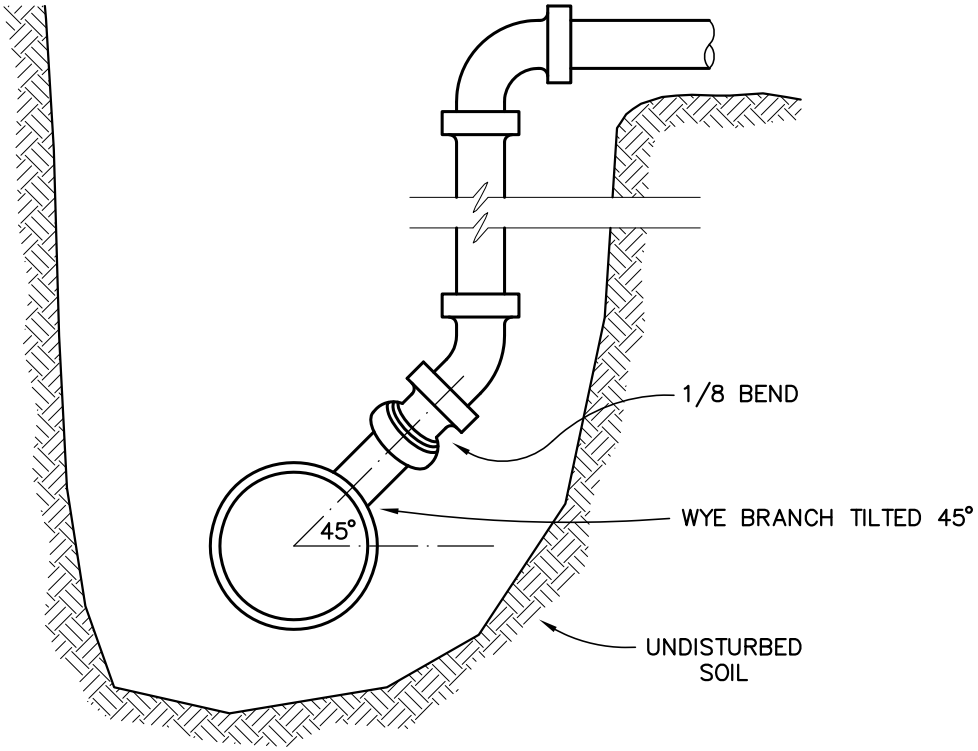
1. PRECAST CONCRETE MANHOLE SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED IN GEOTEXTILE FABRIC.
3. CONE MAY BE ROTATED TO ALIGN STEPS TO VARIOUS LOCATIONS IN MANHOLE.
4. FLOW CHANNEL WALL HEIGHT SHALL BE EQUAL TO CROWN OF PIPE.




# ANCHOR DETAIL

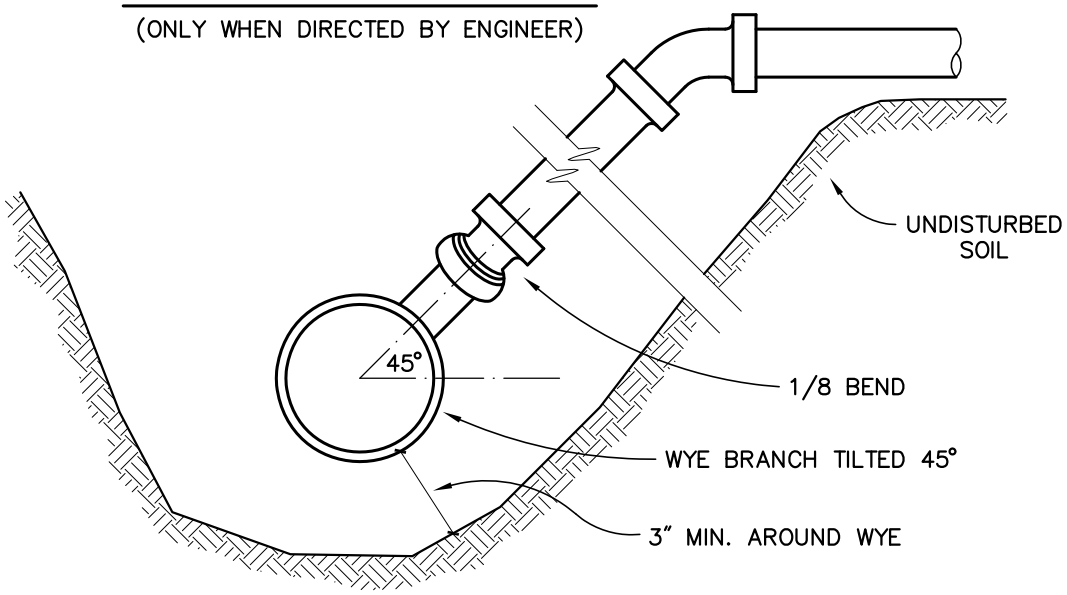
## NOTE

FOR ALL PRESSURE TIGHT OR WATERTIGHT COVERS,
FOUR (4) ANCHORS PER COVER




VERTICAL TRENCH

(ONLY WHEN DIRECTED BY ENGINEER)




SLOPING TRENCH

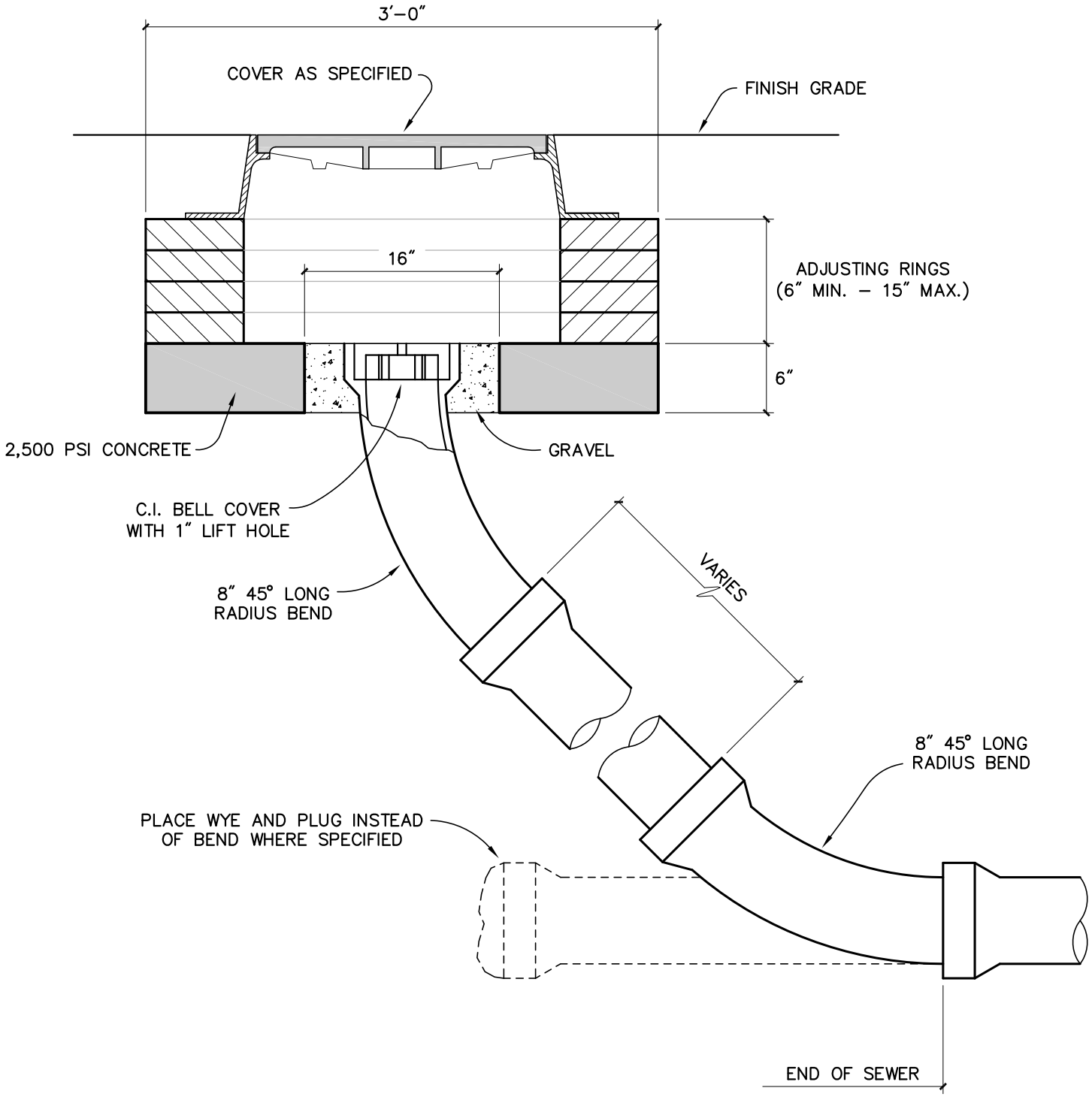
(STANDARD)

# STANDARD RISER DETAILS

## (SEWERS OVER 12 FEET DEEP)

### NOTE

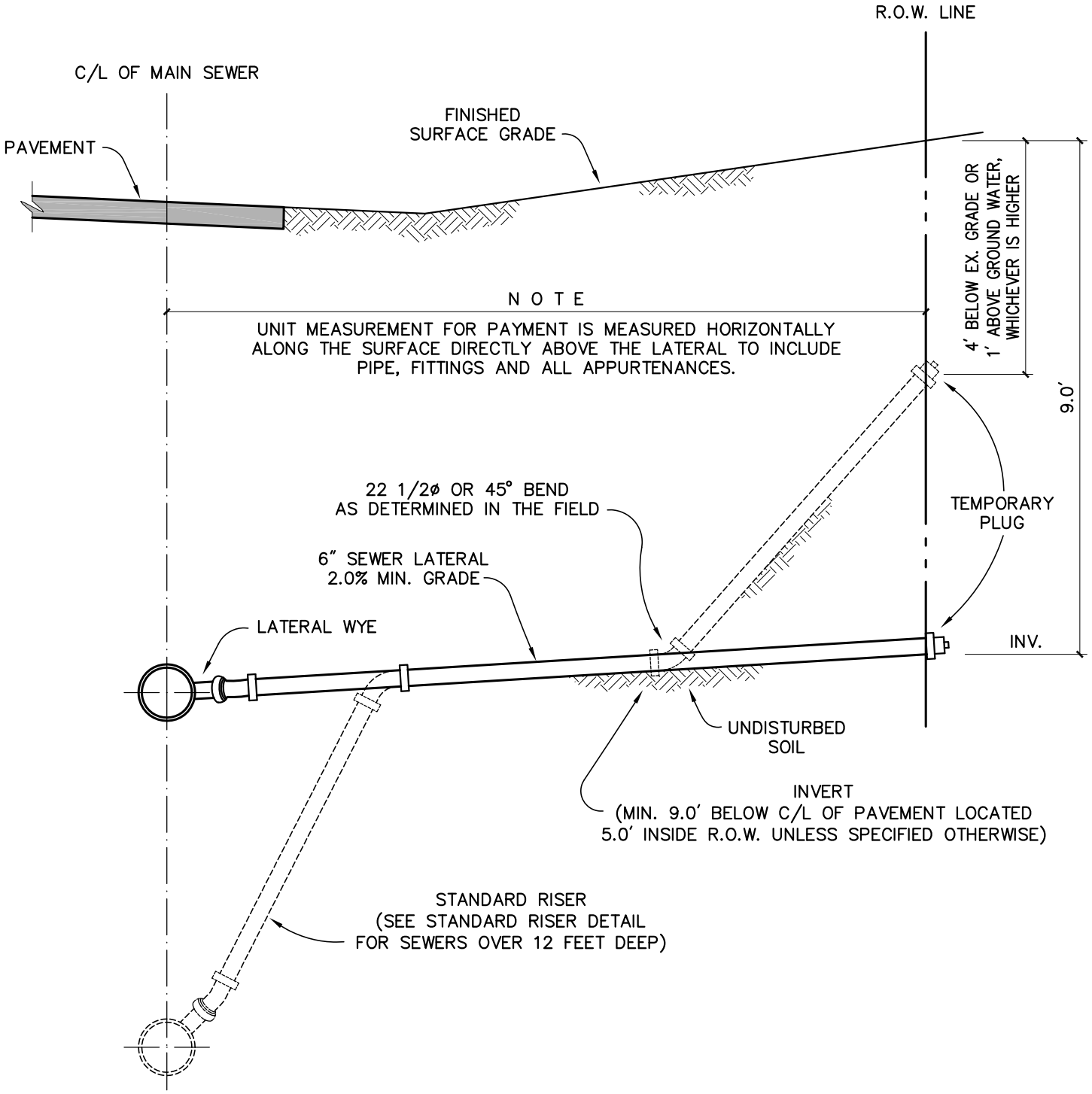
SEE PLANS OR SPECS FOR SIZE AND DEPTH OF LATERAL




# SEWER CLEANOUT

## NOTES

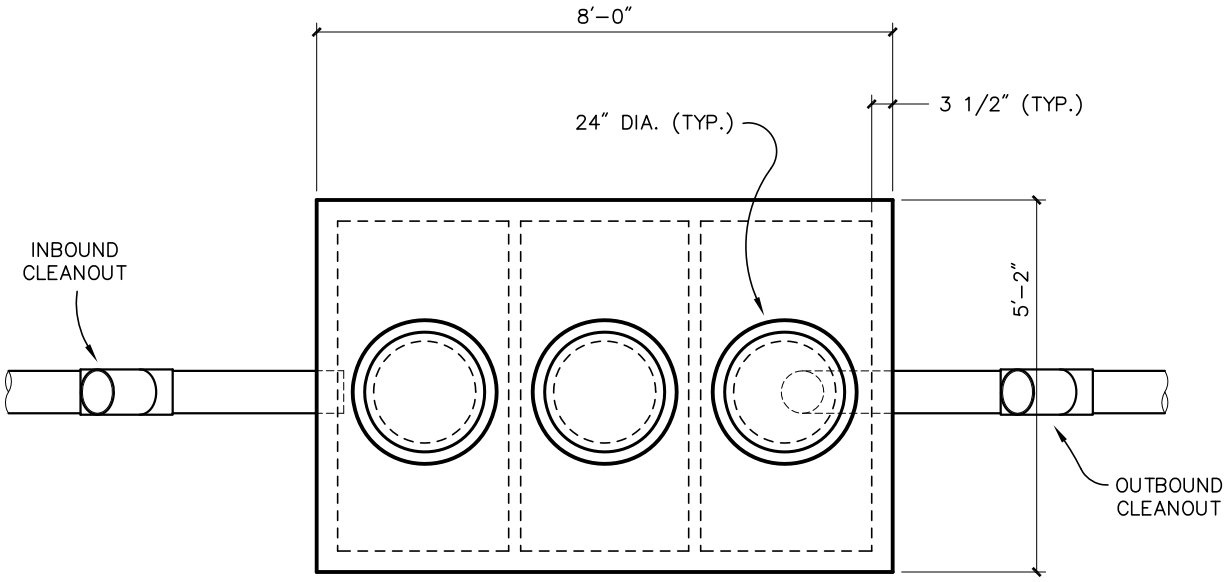
1. THE PIPE FOR THE INCLINED EXTENSION FOR CLEANOUT SHALL BE 8" DIA. IF SEWER IS LARGER THAN 8", THEN A REDUCER SHALL BE PLACED BETWEEN END OF SEWER AND LONG RADIUS BEND.
2. JOINTS SHALL BE SAME AS SPECIFIED FOR SEWER CONSTRUCTION.




# LATERAL AND PROPERTY LINE RISER DETAILS

## NOTE

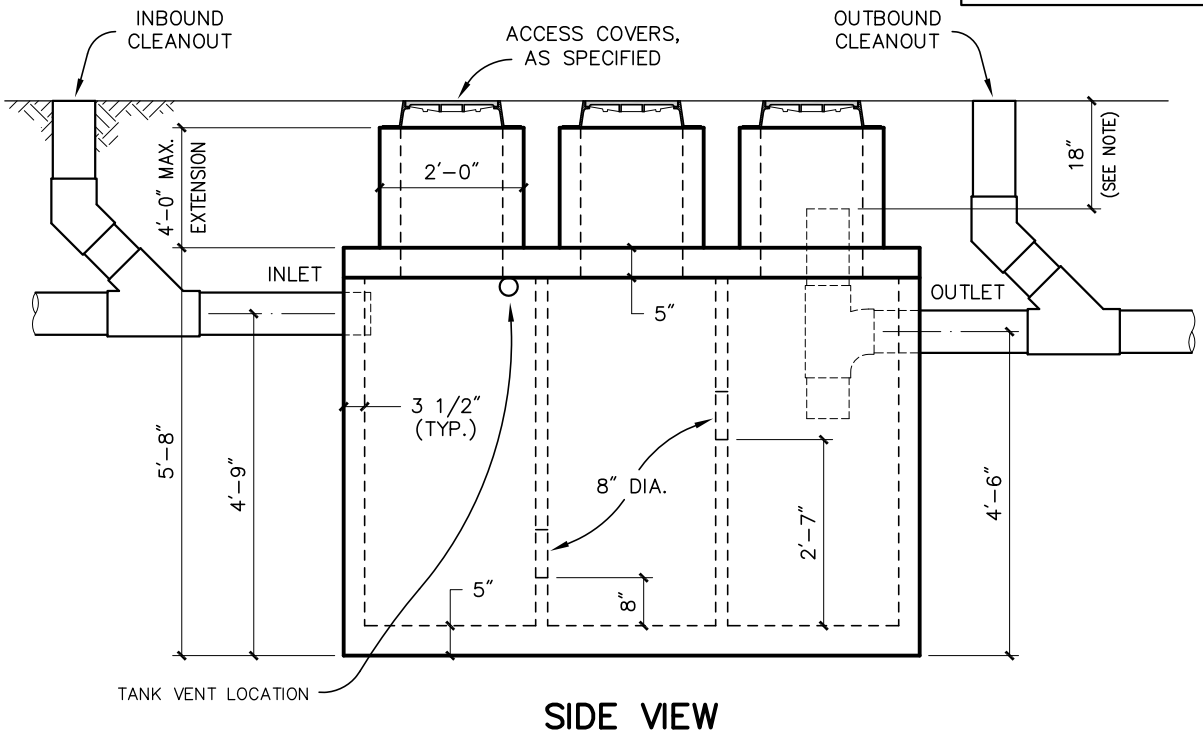
PROPERTY LINE RISER IS REQUIRED WHEN LATERAL IS IN WATER OR WHEN OTHERWISE SPECIFIED.




TOP VIEW

NOTE

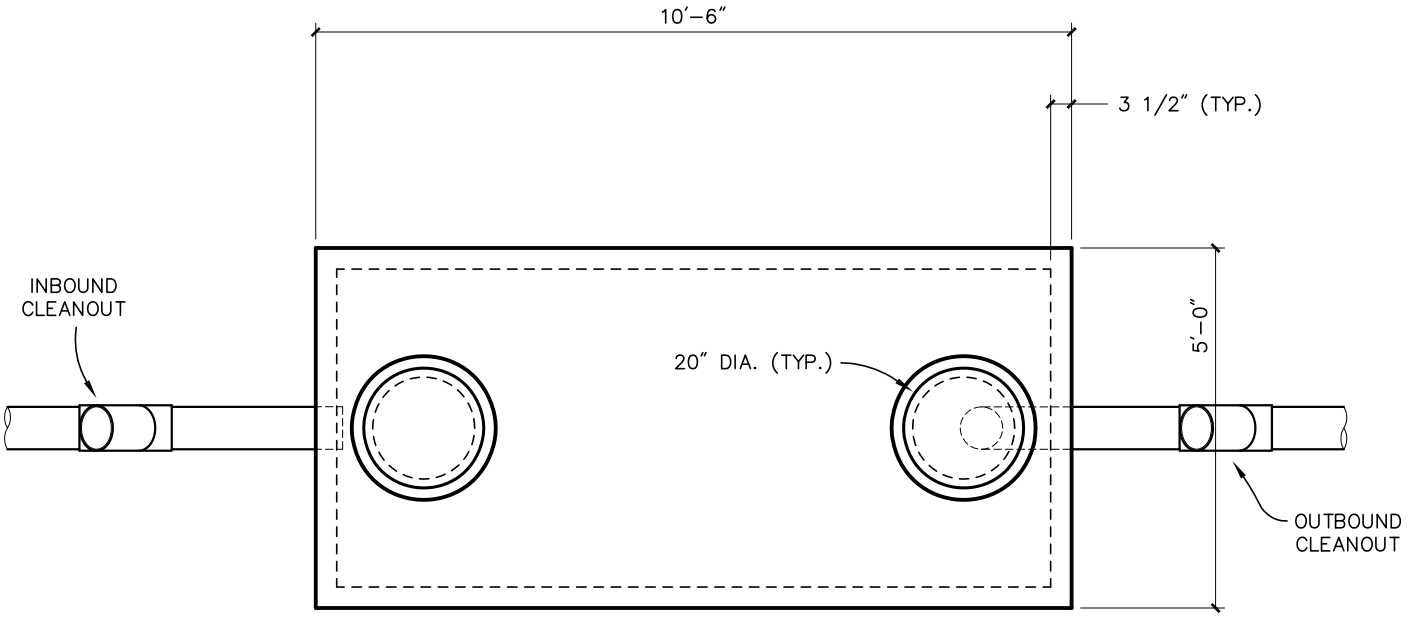
DROP LEG ASSEMBLY RISER MUST BE BROUGHT UP TO WITHIN 18" OF GRADE ELEVATION



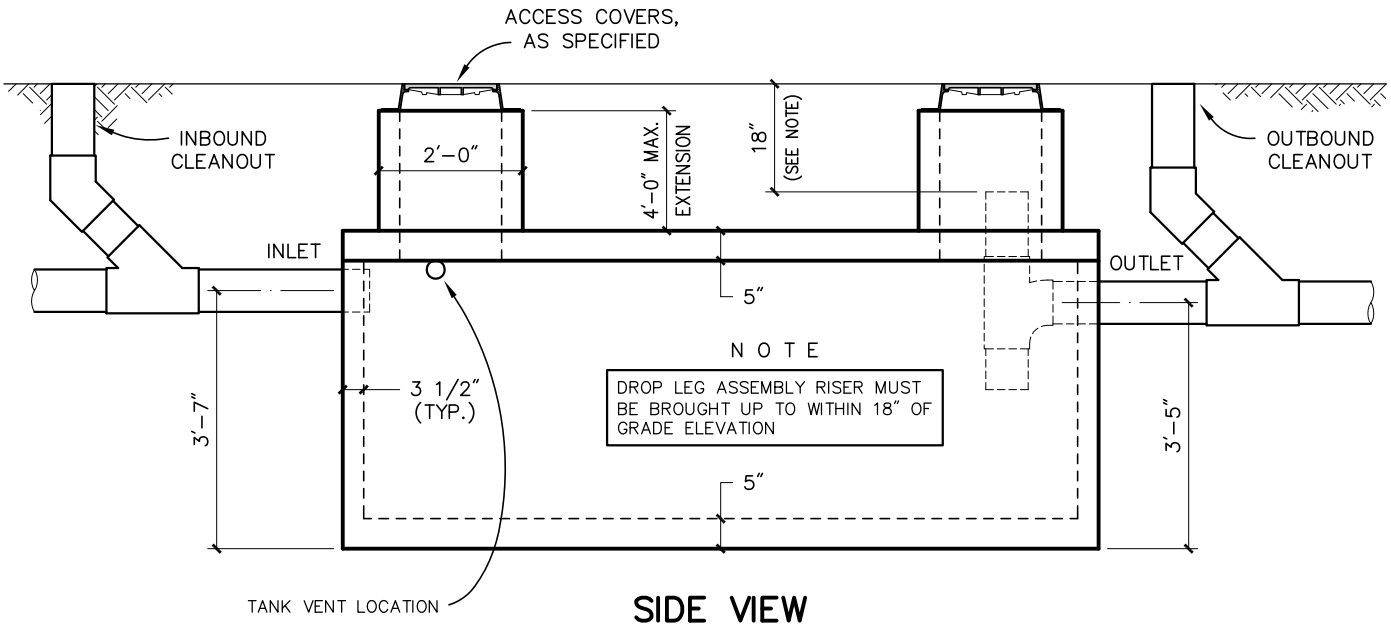

SIDE VIEW

- ACCESS COVERS MUST BE RATED FOR ANTICIPATED TRAFFIC LOAD.
- SEAL BETWEEN TANK AND EXTENSIONS MUST BE WATER TIGHT.
- THE TANK JOINT MUST BE GASKETED AND ENCAPSULATED WITH WRAPIDSEAL OR INFI-SHIELD.
- THE TANK MUST HAVE A VENT ABOVE ALL TANK INVERTS AND MUST BE MADE WATER TIGHT.
- INBOUND AND OUTBOUND PIPES MUST HAVE BOOTED SEAL AT TANK OPENING.
- 18" MINIMUM LENGTH ON OUTBOUND DROPLEG
- A SANITARY TEE MUST BE INCLUDED ON THE DROPLEG ASSEMBLY.

# 1,000 GALLON OUTDOOR GREASE INTERCEPTER




## TOP VIEW




## SIDE VIEW

- ACCESS COVERS MUST BE RATED FOR ANTICIPATED TRAFFIC LOAD.
- SEAL BETWEEN TANK AND EXTENSIONS MUST BE WATER TIGHT.
- THE TANK JOINT MUST BE GASKETED AND ENCAPSULATED WITH WRAPIDSEAL OR INFI–SHIELD.
- THE TANK MUST HAVE A VENT ABOVE ALL TANK INVERTS AND MUST BE MADE WATER TIGHT.
- INBOUND AND OUTBOUND PIPES MUST HAVE BOOTED SEAL AT TANK OPENING.
- 18″ MINIMUM LENGTH ON OUTBOUND DROPLEG
- A SANITARY TEE MUST BE INCLUDED ON THE DROPLEG ASSEMBLY.

# 1,000 GALLON OUTDOOR OIL & SAND SEPARATOR

## (SHALLOW)

# SECTION 4

# SPECIFICATIONS FOR FORCE MAIN

## 4.01 DESCRIPTION OF WORK

The work shall consist of furnishing and installing force main of the specified size or sizes at the depths shown on the drawings or specified herein, and furnishing all labor, materials, tools, and equipment for receiving, unloading, transporting, laying, and testing of force main pipe and fittings. Contractor shall furnish all necessary accessories to complete the pipe work as shown on the drawings and specified herein. Excavating, trenching and backfilling shall be as specified in Section 2.

The work shall be performed in accordance with the specifications and drawings, the MDOT 2012 Standard Specifications for Construction and the following specifications.

## 4.02 MATERIALS

All materials furnished by the Contractor shall conform to the specifications which follow. Where reference specifications are mentioned the current edition or latest issue shall be used.

### 4.02.01 Ductile Iron Pipe

#### 4.02.01.01 Pipe

Ductile iron pipe shall conform to the requirements of AWWA C151 (ANSI A21.51). Ductile iron pipe shall be Class 53 unless otherwise specified.

#### 4.02.01.02 Fittings

All fittings shall be ductile iron in accordance with AWWA C153 (ANSI A21.53). Fittings twenty-four (24) inches in diameter and smaller shall have a minimum pressure rating of 350 psi; fittings larger than twenty-four (24) inches in diameter shall have a minimum pressure rating of 250 psi.

#### 4.02.01.03 Joints

Unless otherwise specified, all pipe joints shall be rubber gasket joints conforming to the requirements of AWWA C111 (ANSI A21.11) for bolted mechanical joints or push-on joints. Joints on fittings shall be bolted mechanical joints.

4.02.01.04 Cement Lining

All pipe and fittings shall have a cement mortar lining conforming to the requirements of AWWA C104 (ANSI A21.4). Epoxy lining may be used when approved by the Engineer.

4.02.02 Polyvinyl Chloride (PVC) Pipe

Polyvinyl Chloride (PVC) force main pipe may be used only when specifically approved by the NKSA and Engineer. If approved, PVC force main shall meet the following requirements:

4.02.02.01 Pipe

Polyvinyl chloride (PVC) pipe, four inch through twelve inch (4" - 12") diameter, shall conform to ANSI/AWWA C900. The pipe shall have a pressure rating of 305 psi. The PVC pressure pipe shall have an outside diameter equivalent to cast iron and ductile iron pipe.

Polyvinyl chloride (PVC) pipe, fourteen inch through forty-eight inch (14" – 48") diameter shall conform to ANSI/AWWA C905. The pipe shall have a pressure rating of 305 psi. The PVC pressure pipe shall have an outside diameter equivalent to cast iron and ductile iron pipe.

Molecularly Oriented Polyvinyl Chloride (PVCO) pipe four inch through twenty-four inch (4" - 24") diameter shall conform to ANSI/AWWA C909. The pipe shall have a pressure rating of 30 5 psi. The PVCO pressure pipe shall have an outside diameter equivalent to cast iron and ductile iron pipe.

4.02.02.02 Fittings

Fittings shall be ductile iron as specified in Section 4.02.01.02.

4.02.02.03 Joints

Joints shall be bell and spigot with elastometric rubber gasket conforming to Section 4 of AWWA C900, C905, or C909, as applicable.

4.02.03 High Density Polyethylene (HDPE)

(When approved by Engineer or specified in project specifications.)

4.02.03.01 Materials

Pipe: Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350 with a minimum cell classification of PE345464C. Pipe O.D. sized 4" to 24" shall be available in both steel pipe sized (IPS) and ductile iron pipe sized

(DIPS); unless otherwise specified or approved by the Engineer, iron pipe sized (IPS) shall be used. Pipe O.D. sized 26" to 54" shall be available in steel pipe sized (IPS). Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

The pipe shall have a minimum working pressure rating of 160 psi.

4.02.03.02 Pipe Restraint

When thermal conditions can cause elongation or contraction of the pipe, the pipe shall have restraint collar(s) as shown in the locations and as detailed on the drawings. Restraint collars or restraining flanges may be required at locations where HDPE pipe connects to other pipe or when connecting to a manhole.

To limit the range of thermal expansion or contraction, HDPE force main shall be in place a minimum of 72 hours prior to any connections being made.

4.02.03.03 Fittings

A. BUTT FUSION FITTINGS: Butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification. All fittings shall be pressure rated to provide a working pressure rating no less than that of the pipe. The fitting shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

B. FLANGED AND MECHANICAL JOINT ADAPTERS: Flanged and mechanical joint adapters shall be PE 3408 HDPE, cell classification of 345464C as determined by ASTM D3350 and be the same base resin as the pipe. Flanged and mechanical joint adapters shall have a manufacturing standard of ASTM D3261. All adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe.

C. MECHANICAL RESTRAINT: Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure.

Serrated restrainer shall be ductile iron ASTM A536 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel.

The restrainer shall have a pressure rating of, or equal to, that of the pipe on which it is used or 150 PSI which ever is lesser. Restrainers shall be JCM Industries, Sur-Grip or pre-approved equal.

| Nominal Size | Restraint Width | Serrations per inch |
|---|---|---|
| 4", 6" | 1 ½" | 8 |
| 8", 10" & 12" | 1 ¾" | 8 |

Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or pre-approved equal.

4.02.03.04 Joining

A. BUTT FUSION: Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 - 450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.

B. SIDEWALL FUSION: Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

C. MECHANICAL: Bolted joining may be used where the butt fusion method cannot be used. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as

manufactured by JCM Industries, Inc. Either mechanical joint joining method will have a ductile iron mechanical joint gland.

D. OTHER: Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

4.02.04 Resilient Seated Gate Valves (4"-24")

Resilient seated gate valves shall be added at manifolds of forcemain or as shown on the drawings.

All valves shall conform to AWWA C509 or C515, Standards for Resilient-Seated Gate Valves for Water Supply Service. The valves shall be fully bronze mounted and shall be furnished with O-ring packing. The direction of the opening shall conform to the NKSA's standards.

Valves shall be East Jordon Iron Works FlowMaster, Clow Corporation R/W Resilient Wedge, Waterous Resilient Wedge, U.S. Pipe Metroseal 250 or equal.

4.02.05 Plastic Wrap for Pipe

Where indicated on the drawings or in the specifications, the pipe shall be encased in a seamless polyethylene tube, in accordance with AWWA C105 (ANSI A21.5) of eight (8) mills minimum thickness. The ends of adjacent sections of polyethylene tubing shall be overlapped a minimum of one (1) foot, and the joint taped or otherwise secured to prevent displacement during backfill operations.

## 4.03 HANDLING OF MATERIAL

The Contractor shall use care and proper equipment during the unloading and distribution of force main materials on the job site to insure the materials are not damaged.

Pipe and/or fittings shall not be rolled or skidded off the truck beds against previously unloaded materials.

## 4.04 ALIGNMENT AND GRADE

4.04.01 General

The force main shall be laid and maintained to the required lines and grades with fittings at the required locations. All force mains shall maintain a ten foot (10') horizontal separation and eighteen inch (18") vertical separation from water main.

4.04.02 Deviations Occasioned by Other Structures

Whenever obstructions not shown on the drawings are encountered during the progress of the work and interfere to such an extent that an alteration in the drawings is required, the Engineer shall have the authority to change the drawings and order a deviation from the line and grade or arrange with the owner of the structures for the removal, relocation, or reconstruction of the obstructions. If the change in drawings results in a change in the amount of work by the Contractor, such altered work shall be done by written change order only on the basis of payment to the Contractor for extra work or credit to the NKSA for less work.

4.04.03 Depth of Pipe

All pipe shall be laid with the top of the pipe a minimum depth of five (5) feet below established street centerline grade, and with a minimum cover of five (5) feet below existing grade at the force main, unless specified otherwise.

## 4.05 LAYING

4.05.01 Lowering of Force Main Material Into Trench

Proper implements, tools, and facilities shall be provided and used by the Contractor for the safe and expedient completion of the work. All pipe and fittings shall be carefully lowered into the trench by means of suitable tools or equipment, in such a manner as to prevent damage to force main material and protective coatings and linings. Under no circumstances shall force main materials be dropped or dumped into the trench.

If damage occurs to any pipe or fittings in handling, the damage shall be immediately brought to the Engineer's attention. The Engineer shall prescribe corrective repairs or rejection of the damaged items.

4.05.02 Inspection Before Installation

All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the Engineer, who will prescribe corrective repairs or rejection.

4.05.03 Cleaning of Pipe and Fittings

All lumps, blisters, and excess coating shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

4.05.04 Laying of Pipe

All dirt or other foreign material shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying. No tools or other articles shall be stored in the pipe at any time.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. For force main construction, the spigot end shall be installed in the direction away from the pump station so as to minimize effluent material hanging up on the pipe joints. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

4.05.05 Cutting of Pipe

The Contractor shall cut the pipe in a straight and uniform manner, at right angles to the axis of the pipe, wherever necessary for placing valves, fittings, or closure pieces without damage to the pipe, and without extra cost to the NKSA. The cut ends of the pipe shall be beveled before assembly of the joint.

The method of cutting pipe shall be subject to the approval of the Engineer.

4.05.06 Locator Wire

A 12 AWG insulated copper locator wire shall be attached to the force main pipe (regardless of material type) at approximately five (5) foot intervals using tape or other suitable methods to assure that the wire is not dislocated during pipe installation and backfilling. All joints shall be soldered and taped or suitably insulated.

The locator wire shall be brought to the surface at all cleanouts and attached to a cleanout plug bolt. At air release valve manholes, the locator wire shall be brought to the ground surface and attached to a post above grade.

Locator wire for Horizontal Directional Drilling (HDD) operations shall be 12 AWG (min.) high strength locator wire with a minimum break load of 1150 lbs. Protective insulating coating shall be High Molecular Weight, High Density Polyethylene (HWD-HDPE) 45 mil. (min.).

## 4.06 JOINING OF MECHANICAL - JOINT PIPE

4.06.01 General Requirements

The general requirement in Sec. 4.04 - 4.05 inclusive shall apply except that, where the terms "bell" and "spigot" are there used, they shall be considered to refer to the bell and spigot ends of the lengths of mechanical-joint pipe.

4.06.02 Cleaning and Assembly of Joint

The last eight inches (8") outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint and then coated with a lubricant as supplied or recommended by the pipe manufacturer and approved by the Engineer. The retaining gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell, end. The rubber gasket shall be coated with lubricant and placed on the spigot end with the thick edge toward the gland.

4.06.03 Bolting of Joint

The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell; care shall be taken to locate the gasket evenly around the entire joint. The retaining gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a suitable (preferably torque-limiting) wrench. The torque for various sizes of bolts shall conform to ANSI/AWWA C600, Standard for Installation of Ductile-Iron Mains and Their Appurtenances as follows:

| Size<br>Inches | Range of Torque<br>Foot – Pounds |
|---|---|
| 5/8 | 45 – 60 |
| 3/4 | 75 - 90 |
| 1 | 100 - 120 |
| 1-1/4 | 120 – 150 |

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. Repeat this cycle until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint should be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice is not allowed. Unless

otherwise specified, Mega-lugs as manufactured by EBAA Iron Sales, Inc. or approved equal shall be used for restraining gland.

4.06.04 Permissible Deflection in Mechanical-Joint Pipe

Whenever it is desirable to deflect mechanical-joint pipe in order to form a long radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 1.

TABLE 1

PERMISSIBLE DEFLECTIONS IN MECHANICAL - JOINT PIPE

| Size of Pipe Inches | Max. Permissible Deflection Per Length - Inches | | Approx. Radius of Curve Produced By Succession of Joints - Feet | |
|---|---|---|---|---|
| | 18' | 20' | 18' | 20' |
| 3 | 31 | 35 | 125 | 140 |
| 4 | 31 | 35 | 125 | 140 |
| 6 | 27 | 30 | 145 | 160 |
| 8 | 20 | 22 | 195 | 220 |
| 10 | 20 | 22 | 195 | 220 |
| 12 | 20 | 22 | 195 | 220 |
| 14 | 13.5 | 15 | 285 | 320 |
| 16 | 13.5 | 15 | 285 | 320 |
| 18 | 11 | 12 | 340 | 380 |
| 20 | 11 | 12 | 340 | 380 |
| 24 | 9 | 10 | 450 | 500 |

## 4.07 JOINING OF PUSH-ON JOINT PIPE

4.07.01 General Requirements

The general requirements in Section 4.04 - 4.05 inclusive shall apply except that, where the terms "bell" and "spigot" are there used, they shall be considered to refer to the bell and spigot ends of the lengths of push-on joint pipe.

4.07.02 Cleaning and Assembly of Joint

The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket.

A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant shall be as supplied or recommended by the pipe manufacturer and approved by the Engineer.
The spigot end of the pipe shall be centered in the bell and forced or pushed home. Smaller sizes of pipe can be pushed or forced into place by hand; larger sizes will require the use of mechanical assistance.

4.07.03 Permissible Deflection in Push-On Joint Pipe

Whenever it is desirable to deflect push-on joint pipe, in order to form a long radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 2, unless recommended by the pipe manufacturer and approved by the Engineer.

TABLE 2

PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE

| Size of Pipe Inches | Max. Permissible Deflection Per Length - Inches | | Approx. Radius of Curve Produced By Succession of Joints - Feet | |
|---|---|---|---|---|
| | 18' | 20' | 18' | 20' |
| 3 | 19 | 21 | 205 | 230 |
| 4 | 19 | 21 | 205 | 230 |
| 6 | 19 | 21 | 205 | 230 |
| 8 | 19 | 21 | 205 | 230 |
| 10 | 19 | 21 | 205 | 230 |
| 12 | 19 | 21 | 205 | 230 |
| 14 | 11 | 12 | 340 | 380 |
| 16 | 11 | 12 | 340 | 380 |
| 18 | 11 | 12 | 340 | 380 |
| 20 | 11 | 12 | 340 | 380 |
| 24 | 11 | 12 | 340 | 380 |
| 30 | 11 | 12 | 340 | 380 |
| 36 | 11 | 12 | 340 | 380 |
| 42 | 11 | 12 | 340 | 380 |
| 48 | - | 12 | - | 380 |

## 4.08 ANCHORAGE

4.08.01 Anchorage for Plugs, Caps, Tees, and Bends

Unless otherwise specified or approved by the Engineer, movement of all plugs, caps, tees, and bends shall be prevented by use of restrained joint pipe or joint restraining glands.

4.08.01.01 Restrained Joint Pipe

The use of restrained joint pipe first shall be approved by the NKSA. If approved, all ductile iron restrained joint pipe shall be Clow Corporation "Super-Lock"; American Ductile Iron Pipe "Lok-Ring Joint" or Flex-Ring Joint; Griffin Pipe Products Co. "Snap-Lok"; or approved equal. Gripper gaskets shall not be acceptable. All components of the restrained joint shall be as manufactured, supplied, or recommended by the manufacturer of the restrained joint pipe system actually installed.

4.08.01.02 Joint Restraining Glands

Joint restraining glands shall be Megalug as manufactured by EBAA Iron Sales, Inc. or approved equal.

When joints are to be restrained with mechanical devices as noted above, all joints shall be restrained for a minimum distance from the fitting as required in the following table:

PIPE RESTRAINT LENGTH REQUIRED, FEET*

| Pipe Diameter | Tees, 90º Bends | 45º Bends | 22-1/2º Bends | 11-1/4º Bends | Dead Ends | Reducers (one size) | ** |
|---|---|---|---|---|---|---|---|
| 4" | 23 | 9 | 5 | 2 | 57 | | |
| 6" | 32 | 13 | 6 | 3 | 82 | 43 | 63 |
| 8" | 41 | 17 | 8 | 4 | 104 | 43 | 55 |
| 12" | 58 | 24 | 12 | 6 | 149 | 80 | 120 |
| 16" | 74 | 31 | 15 | 7 | 192 | 82 | 110 |
| 20" | 89 | 37 | 18 | 9 | 233 | 82 | 104 |
| 24" | 104 | 43 | 21 | 10 | 272 | 82 | 99 |
| 30" | 123 | 51 | 25 | 12 | 328 | 115 | 148 |
| 36" | 141 | 58 | 28 | 14 | 379 | 115 | 140 |

***A multiplier of 1.43 shall be used if the pipe is installed with polyethylene wrap.**

**If the straight run of pipe on the small side of the reducer exceeds this value, then no restrained joints are necessary.

NOTE: The length of restrained joint pipe required as shown in the table above is based on trench backfill being compacted to ninety five (95%) percent of maximum unit weight in accordance with MDOT procedures. If the pipe is wrapped in polyethylene, a greater length of restrained pipe will be required as specified or shown on the drawings.

All joints lying within the above minimum distances from the fitting must be restrained as noted herein.

Tees: Tees shall be restrained in the branch direction as required in the table above. Also, to augment the above, in the straight through direction, the minimum length of the first pipe on either side of the tee shall be ten (10) feet.

Bends: Bends shall be restrained in both directions as required in the table above.

4.08.02 Reaction Backing (Thrust Blocks)

Reaction backing (thrust blocks) shall be used only at locations indicated on the drawings, or approved by the Engineer.

Reaction backing shall be concrete having a compressive strength of not less than 2,000 psi after twenty-eight (28) days. Backing shall be placed between solid, undisturbed ground and the fitting to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown in the table below or directed by the Engineer. The backing shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair.

REACTION BACKING

Minimum Bearing Area against undisturbed trench wall, in square feet, for sand is indicated in the table below. Details of placement are shown in Standard Details.

| Pipe Size | Tees, Plugs, Wyes, 45º Els | 90º Els | Wyes, 22-1/2º Els or Less |
|---|---|---|---|
| 6" | 3 | 3 | 1 |
| 8" | 4 | 6 | 2 |
| 10" | 7 | 9 | 3 |
| 12" | 9 | 11 | 3 |
| 16" | 13 | 20 | 6 |
| 20" | 20 | 28 | 8 |
| 24" | 28 | 40 | 11 |

Other Soil Conditions

| | | |
|---|---|---|
| Cement Sand or Hardpan | - | multiply above by 0.5 |
| Gravel | - | multiply above by 0.7 |
| Hard Dry Clay | - | multiply above by 0.7 |
| Soft Clay | - | multiply above by 2.0 |

Muck – secure all fittings with restrained joint pipe or joint restraining glands, with concrete reaction backing the same as listed for sand conditions.

## 4.09 CLEAN OUTS

Single and double clean outs shall be constructed as shown on the standard detail. All pipe and fittings for the clean out shall be ductile iron.

Unless otherwise specified, manhole castings shall be East Jordan No. 1040 with Type A solid cover or approved equal.

## 4.10 AIR RELEASE VALVES

### 4.10.01 Air Release Valve

Air release valve shall be APCO 400WA sewage valve, Crispin, Valmatic VM-48ABW, ARI-025 combination valve, or approved equal, with two inch (2") inlet and five-sixteenths inch (5/16") orifice. Riser and fittings to be brass, gate valve to be iron pipe gate valve. Location of air release valve shall be shown on the construction drawings.

### 4.10.02 Air Release Valve Manhole

Air release valve manholes shall be constructed in accordance with the Standard Details and as specified herein.

Precast bases shall be installed on the subbase in such a way as to provide a uniform bearing under the manhole base.

Precast manholes with integral bottom may be used; however, any changes to the structure due to minor field adjustments in alignment and grade required to meet construction conditions, shall be made by the Contractor at no additional cost to the NKSA.

### 4.10.03 Flexible Manhole Connectors (Rubber Boots)

Flexible manhole connectors (also called rubber boots) shall be "Kor-N-Seal" by National Pollution Control Systems, Inc., "P.S.X." or "Press Wedge II" by Press Seal Gasket Corporation, "Lock Joint Flexible Manhole Sleeve" by Inter Pace Corporation, “A-LOK,” “Z-LOK,” or “QUIK-LOK” by A-LOK Products, Inc. or approved equal. Flexible manhole connectors shall conform to the requirements of ASTM Designation C923, Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

## 4.11 HYDROSTATIC TESTS

4.11.01 Procedure

All tests will be made by the Contractor using his own equipment, operators, and supervision, in the presence of the Engineer or his duly authorized representative. The length of the section to be tested shall be as approved by the Engineer, or as shown on the drawings.

4.11.02 Air Removal Before Test

Before applying the specified test pressure, all air shall be expelled from the pipe.

If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so the air can be expelled as the line is filled with potable water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure of 150 psi applied.

4.11.03 Leakage Test

A leakage test shall be conducted during the hydrostatic pressure test in the presence of the Engineer. The Contractor shall furnish the pump, pipe, connections, gages, and all other necessary apparatus, and shall furnish the necessary assistance to conduct the test. The duration of the leakage test shall be a minimum of two (2) hours and during the test the main shall be subjected to a pressure of 150 psi. When several valved sections are tested as one test, the maximum allowable leakage will be equivalent to the calculated allowable leakage for the smallest valved section therein.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled, and the pipe has been filled with water. No pipe installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where:

L = Allowable leakage in gallons per hour

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the leakage test, in pounds per square inch gage.

This formula is based on allowable leakage of 10.49 gallons per day, per mile of pipe, per inch of nominal diameter at 150 psi.

The NKSA shall be furnished a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, the duration of the test, and the amount of leakage. The report shall be signed by the Contractor and the Engineer.

4.11.04 Hydrostatic Test – HDPE Pipe

The hydrostatic test procedure shall conform to ASTM F2164. Testing in the trench, fill the pipeline with water and bleed off any trapped air. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure or a minimum of 100 psi, whichever is greater, and check for any leakage. When, in the opinion of the Engineer, local conditions require that the trenches be backfilled immediately after the pipe has been laid, apply the pressure test after backfilling has been completed but not sooner than a time which will allow sufficient curing of any concrete that may have been used. Typical minimum concrete curing times are two (2) days for early strengths and seven (7) days for normal strengths.

The test procedures consist of two steps; the initial expansion and the test phase. When test pressure is applied to a water-filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system as needed for up to four (4) hours to maintain the test pressure. After about four (4) hours, initial expansion should be complete and the actual test can start.

After four (4) hours of maintaining pressure as described above, the pressure shall then be dropped by 10 psi. At this point do not increase pressure or add make-up water. If the pressure then remains within five (5%) percent of the target value for one (1) hour, this indicates there is no leakage in the system.

Note: Under no circumstances shall the total time under test exceed eight (8) hours at 1 ½ times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section shall be permitted to "relax" for eight (8) hours prior to the next test sequence.

4.11.05 Variation from Permissible Leakage

If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall at his own expense locate and repair the leaks until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the allowance used for testing.

4.11.06 Time for Making Test

The pipe may be subject to hydrostatic pressure and inspected and tested for leakage at any convenient time after the trench has been partially backfilled. Where any section of the main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least seven (7) days have lapsed after the concrete reaction backing was installed. If high-early-strength cement is used in the concrete reaction backing, the hydrostatic pressure test shall not be made until at least two (2) days have elapsed.

## 4.12 MEASUREMENT AND PAYMENT

4.12.01 General

All proposed construction shall be measured for payment by the Engineer in accordance with the items listed in the proposal.

The unit price bid for each Proposal item shall be payment in full for completing the work, ready for use as specified.

4.12.02 Force Main

Measurement of the length of the force main shall be in lineal feet along the centerline of the force main.

4.12.03 Fittings

When a specific item is provided in the Proposal for Bends, Tees, or Wyes, the unit price bid shall be the additional cost of furnishing and placing the Bend, Tee or Wye over and above the cost of furnishing and laying the force main.

When no proposal item is provided, the work shall be incidental to the major items of work.

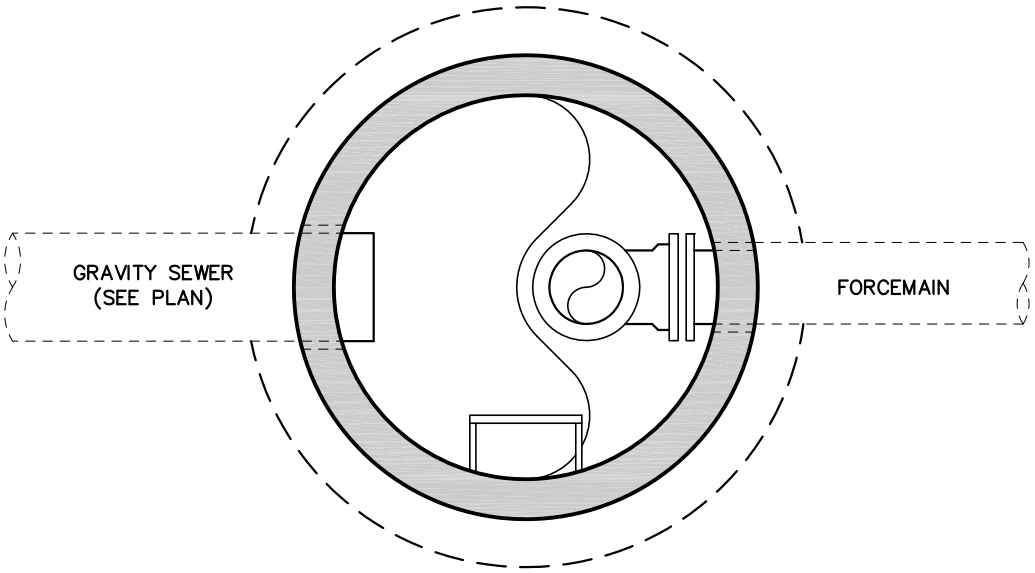
4.12.04 Clean-Outs

When a specific item is provided in the proposal for Single or Double Clean-Out, the unit price bid shall be the additional cost of furnishing and placing the required fittings, plug and pipe over and above the cost of furnishing and laying the force main.

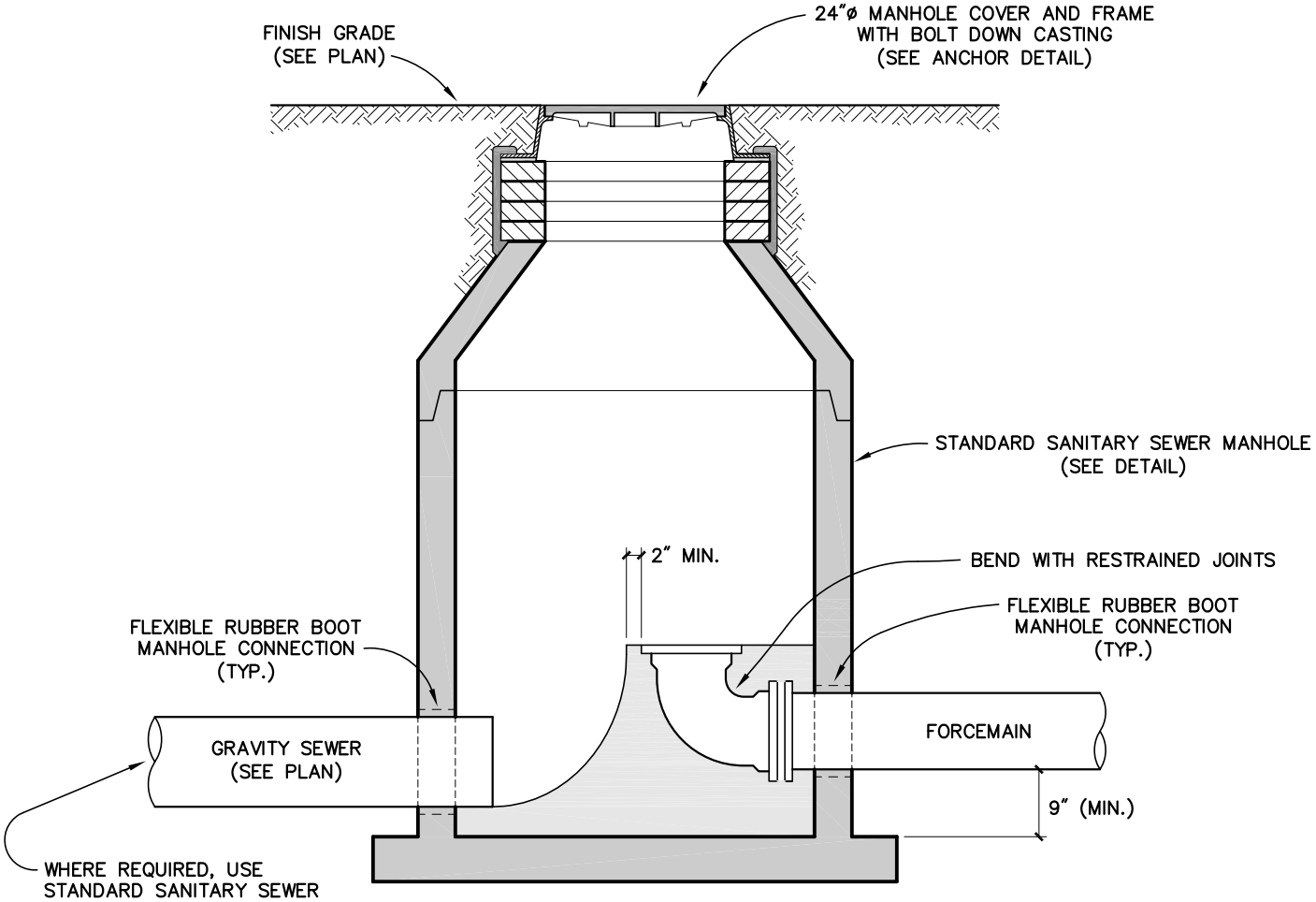
When no proposal item is provided, the work shall be incidental to the major items of work.

4.12.05 Air Release Valves

Air release valves shall be paid for in accordance with the units established in the proposal and shall include the furnishing and installing the precast manhole in accordance with the standard detail.

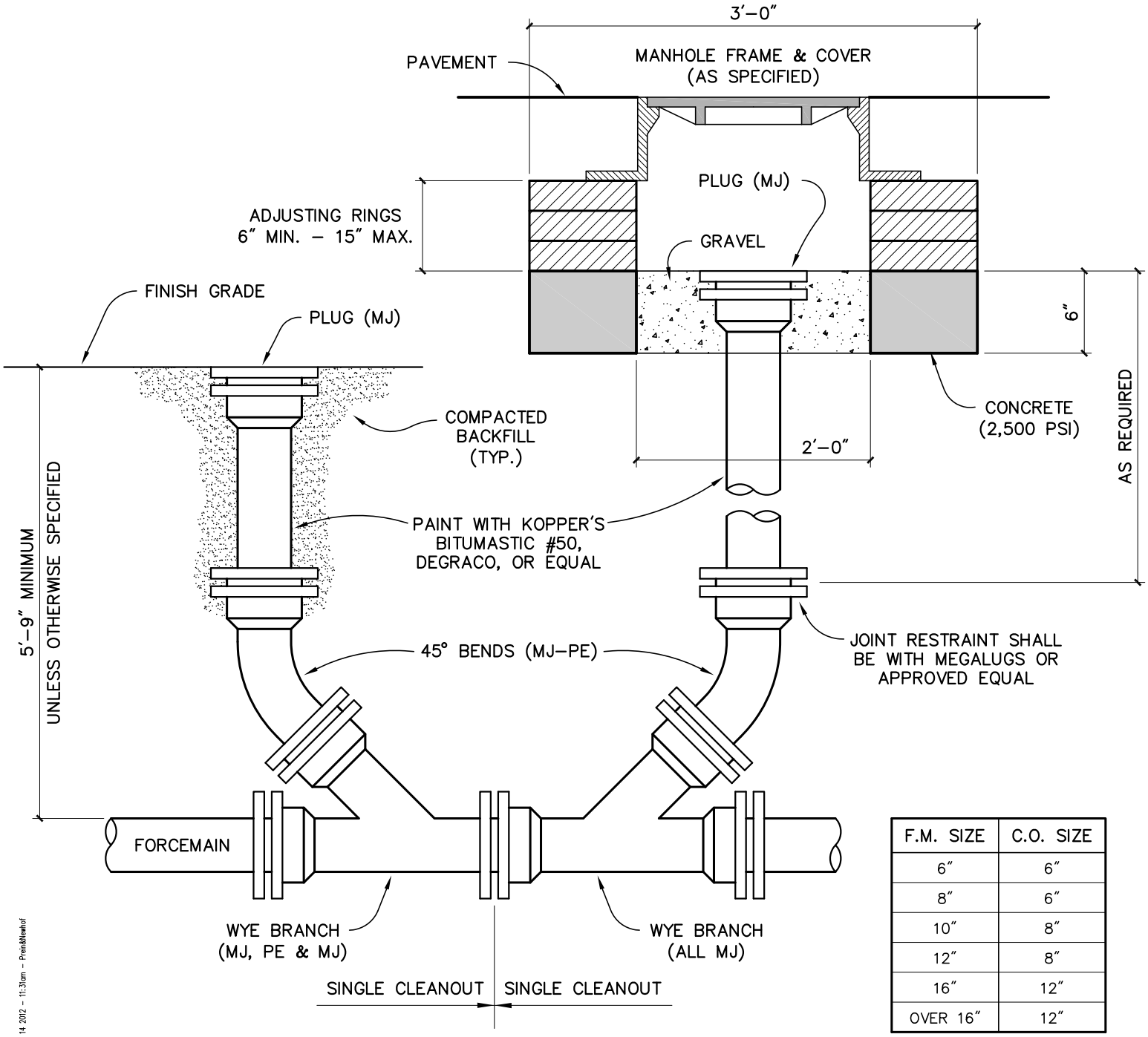



PLAN VIEW




SECTIONAL VIEW

# STANDARD FORCE MAIN DISCHARGE MANHOLE



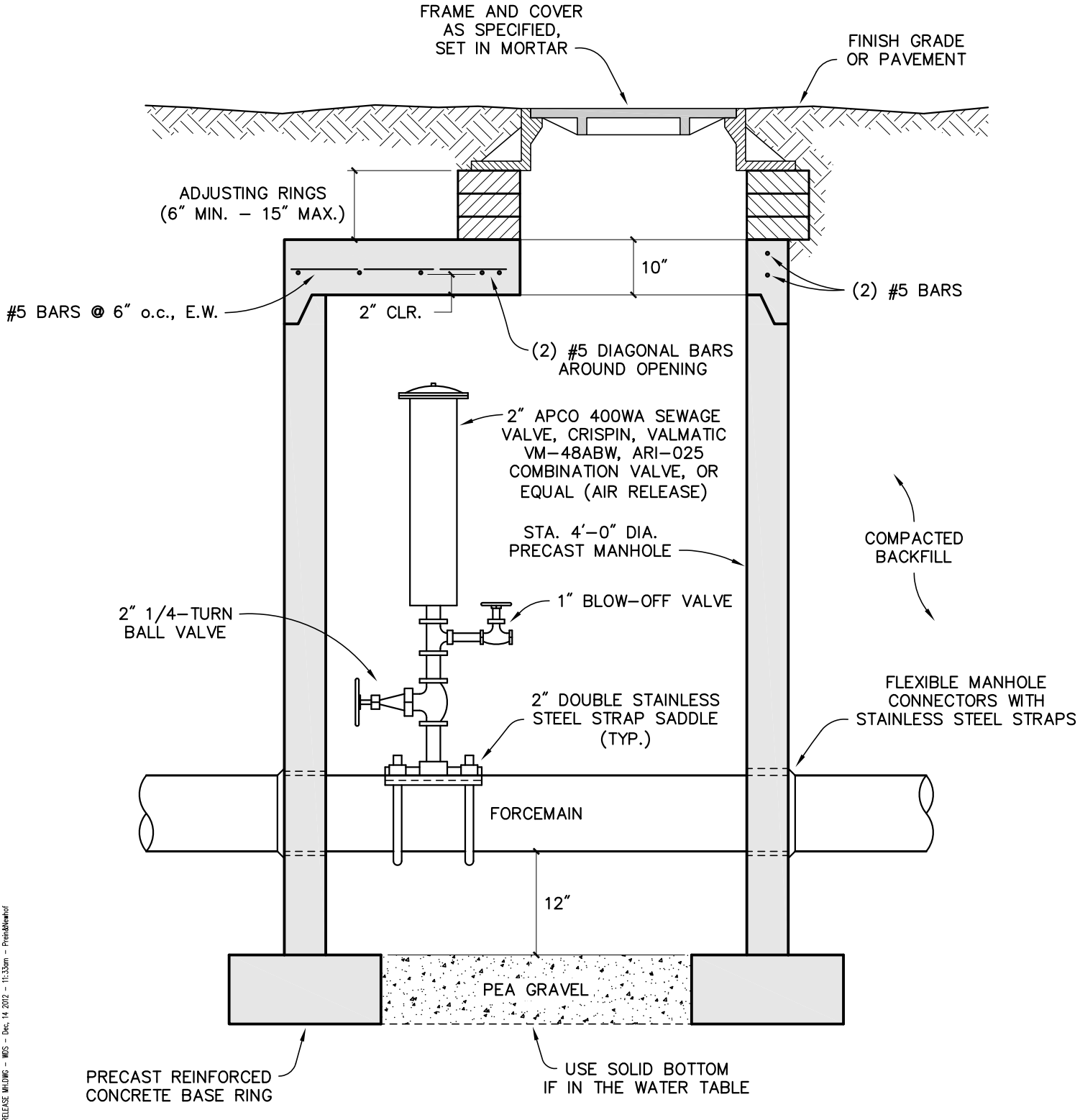

| F.M. SIZE | C.O. SIZE |
|---|---|
| 6" | 6" |
| 8" | 6" |
| 10" | 8" |
| 12" | 8" |
| 16" | 12" |
| OVER 16" | 12" |

# STANDARD DOUBLE CLEAN OUT

## (FORCEMAIN)

### NOTE

1. ALL MATERIALS IN CLEAN OUT ASSEMBLY SHALL BE DUCTILE IRON.
2. ALL CLEANOUTS SHALL HAVE MANHOLE FRAME AND COVER UNLESS OTHERWISE SPECIFIED.




# STANDARD AIR RELEASE VALVE – MANHOLE

## NOTE

1. PRECAST CONCRETE MANHOLE SHALL MEET ASTM C478.
2. INSTALL AIR RELEASE VALVE AT THE VERY HIGHEST ELEVATION OF THE FORCEMAIN.



12/2012
Section 4 Forcemain

# SECTION 5

# SUBMERSIBLE LIFT STATIONS

## 5.01 DESCRIPTION OF WORK

RESERVED FOR FUTURE SECTION.

*[Intentionally left blank.]*

# SECTION 6

# SPECIFICATIONS FOR WATER MAINS IMPACTED BY SANITARY SEWER SYSTEM

## 6.01 DESCRIPTION OF WORK

The work shall consist of furnishing and installing water main of the specified size or sizes at the depths shown on the drawings or specified herein, and furnishing all fittings and joint material, labor, materials, tools, and equipment for receiving, unloading, transporting, laying, testing, and disinfecting of water pipe and fittings. Contractor shall furnish all hydrants, valves, valve boxes and other accessories necessary to complete the pipe work as shown on the drawings and specified herein. Excavating, trenching and backfilling shall be as specified in Section 2.

Where the sanitary sewer work requires any water main repair, replacement, or construction activity in a local community public or private water system service area, all materials and workmanship shall conform to the latest revision of the local water system requirements and specifications. The local water system requirements and specifications are hereby included by reference and shall supersede the requirements of this specification where specifically addressed.

When used herein, the term "Owner" refers to the local community water system whose water main is impacted by the sanitary sewer system.

The work shall be performed in accordance with the specifications and drawings, the MDOT 2012 Standard Specifications for Construction and the following specifications.

## 6.02 MATERIALS

All materials furnished by the Contractor shall conform to the specifications which follow. Where reference specifications are mentioned the current edition or latest issue shall be used. All water main material shall meet NSF Standard 61.

### 6.02.01 Ductile Iron Pipe

#### 6.02.01.01 Pipe

Ductile iron pipe shall conform to the requirements of AWWA C151 (ANSI A21.51) and C150 (ANSI A21.50). Ductile iron pipe shall be Class 53 unless otherwise specified.

All pipe shall have a cement mortar lining with seal coat conforming to the requirements of AWWA C104 (ANSI A21.4). Seal coat shall have NSF61 approval for use with potable water.

6.02.01.02 Fittings

All fittings shall be ductile iron in accordance with AWWA C110 (ANSI A21.10) or AWWA C153 (ANSI A21.53). Fittings twenty four (24) inch diameter and smaller shall have a minimum pressure rating of 350 psi.; fittings larger than twenty four (24) inch diameter shall have a minimum pressure rating of 250 psi. Fittings shall have either cement mortar lined with seal coat in accordance with AWWA C104 (ANSI A21.4) or fusion bonded epoxy coating in accordance with AWWA C116 (ANSI A21.16). Lining shall have NSF61 approval for use with potable water.

6.02.01.03 Joints

Unless otherwise specified, all pipe joints shall be rubber gasket joints conforming to the requirements of AWWA C111 (ANSI A21.11) for bolted mechanical joints or push-on joints. Joints on fittings shall be bolted mechanical joints.

6.02.03 Valves

6.02.03.01 Resilient Seated

All resilient seated valves shall conform to AWWA C509 or AWWA C515, Standards for Resilient-Seated Gate Valves for Water Supply Service. The valves shall be fully bronze mounted and shall be furnished with O-ring packing. The direction of the opening shall be to the Owner's standard.

Valves shall be East Jordan Iron Works, Clow Corporation R/W Resilient Wedge, Waterous Resilient Wedge, U.S. Pipe Metroseal 250 or equal.

6.02.03.02 Butterfly Valves

All butterfly valves shall conform to AWWA C504, Standard for Rubber Seated Butterfly Valves. Valves shall be Class 150B and shall have a "short body" form. Valves suitable for buried service will be acceptable without a manhole. Shaft seals shall be replaceable without removing the valve shaft. Valves shall be equipped with totally enclosed worm gear actuators conforming to AWWA C504.

6.02.04 Hydrants

Fire hydrants shall conform to AWWA C502, Standard for Dry Barrel Fire Hydrants. The hydrants shall have two 2-1/2 inch hose connections and 1 pumper connection of standard thread and size of the Owner, 5-inch valve opening, 8-inch I.D. barrel and 6-inch mechanical joint inlet which shall be located five feet six inches (5'-6") below the ground. Joint materials shall conform to those

previously specified under ductile iron joints. Operating nut shapes, direction of opening and color shall conform to Owner's standard.

Hydrants shall be placed at high points in water main larger than 8-inch diameter for the purpose of air release. Below-grade air release valves in manholes will not be acceptable.

6.02.05 Valve Boxes

Valve boxes shall be screw type, three sectional, adjustable with round bases with an overall length sufficient to permit the tops to be set flush with the established pavement or ground surface. The box shall be provided with a cast iron lid or cover and marked with the word "WATER". The valve boxes shall be designed to withstand heavy traffic.

6.02.06 Water Service Materials

6.02.06.01 Copper Water Service Pipe

Copper water service pipe shall be in accordance with ASTM Specification B88 for Type K annealed, seamless copper. Unless otherwise approved, water services shall have no unions between the corporation stop and curb stop.

6.02.06.02 Corporation Stops

Corporation stops shall conform to Owner's standards. If Owner does not have a standard, corporation stop shall be ball valve style with compression type copper connection Mueller Company P-25008, Ford FB1000 (compression fitting), or approved equal.

6.02.06.03 Curb Stops

Curb stops shall conform to Owner's standards. If Owner does not have a standard, curb stop shall be ball valve style with compression type copper connections Mueller Company P-25155, or approved equal.

6.02.06.04 Curb Boxes

Curb boxes shall conform to Owner's standards. If Owner does not have a standard, curb stop box shall be Mueller Company H-10300, Ford EM2-55-56, or approved equal.

6.02.07 Plastic Wrap for Pipe

Where indicated on the drawings or in the specifications, the pipe shall be encased in a seamless polyethylene tube, in accordance with AWWA C105 (ANSI A21.5) of eight (8) mills minimum thickness. The ends of adjacent sections of polyethylene tubing shall be overlapped a minimum of one (1) foot,

and the joint taped or otherwise secured to prevent displacement during backfill operations.

## 6.03 INSPECTION

6.03.01 Shop Inspection

All materials furnished by the Contractor are subject, at the discretion of the Owner, to inspection and approval at the Manufacturer's plant. The inspection in the plant of the manufacturer of materials furnished by the Contractor shall be made at the expense of the Owner.

6.03.02 Field Inspection

All pipe and accessories shall be laid, joined, and tested under pressure for defects and leakage in the manner specified herein and as approved by the Engineer.

6.03.03 Disposition of Defective Material

All material found during the progress of the work to have cracks, flaws, or other defects shall be rejected by the Engineer. All defective materials furnished by the Contractor shall be promptly removed from the site. Any material furnished by the Owner and found defective shall be set aside and removed from the site of the work by the Owner.

## 6.04 RESPONSIBILITY FOR MATERIAL

6.04.01 Responsibility for Material Furnished by Contractor

The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacturing or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labor required for the replacement of defective or damaged installed material discovered prior to the final acceptance of the work.

6.04.02 Responsibility for Material Furnished by Owner

The Contractor's responsibility for material furnished by the Owner shall begin at the point of its delivery to the Contractor. Materials already on the site shall become the Contractor's responsibility on the day of the award of the contract. The Contractor shall examine all material furnished by the Owner at the time and place of delivery to him and shall reject all defective material. Any material furnished by the Owner and installed by the Contractor without discovery of such defects will, if found defective prior to final acceptance of the work, be exchanged for sound material by the Owner. The Contractor, however, shall at his own expense, furnish all supplies, labor, and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the Engineer.

6.04.03 Responsibility for Safe Storage

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

6.04.04 Replacement of Damaged Material

Any material furnished by the Owner that becomes damaged after acceptance by the Contractor shall be replaced by the Contractor at his own expense.

## 6.05 HANDLING OF MATERIAL

The Contractor shall use care and proper equipment during the unloading and distribution of water main materials on the job site to insure the materials are not damaged.

Pipe and/or fittings shall not be rolled or skidded off the truck beds against previously unloaded materials.

## 6.06 ALIGNMENT AND GRADE

6.06.01 General

The water main shall be laid and maintained to the required lines and grades with fittings, valves, and hydrants at the required locations and all valve and hydrant stems plumb. The water main shall have a ten foot (10') horizontal separation and an eighteen inch (18") vertical separation from all sewer piping.

6.06.02 Deviations Occasioned by Other Structures

Whenever obstructions not shown on the drawings are encountered during the progress of the work and interfere to such an extent that an alteration in the drawings is required, the Engineer shall have the authority to change the drawings and 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. If the change in drawings results in a change in the amount of work by the Contractor, such altered work shall be done by written order only on the basis of payment to the Contractor for extra work or credit to the Owner for less work.

6.06.03 Depth of Pipe

All pipe shall be laid with the top of the pipe a minimum depth of five (5) feet below established street centerline grade, and with a minimum cover of five (5) feet below existing grade at the water main, unless specified otherwise. When

elevations and grades are provided on the drawings, the Contractor shall install in accordance with those elevations and grades.

## 6.07 LAYING

### 6.07.01 Lowering of Water Main Material Into Trench

Proper implements, tools, and facilities shall be provided and used by the Contractor for the safe and expedient completion of the work. All pipe fittings, valves, and hydrants shall be carefully lowered into the trench by means of suitable tools or equipment, in such a manner as to prevent damage to water main material and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

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

### 6.07.02 Inspection Before Installation

All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings shall be laid aside for inspection by the Engineer, who will prescribe corrective repairs or rejection.

### 6.07.03 Cleaning of Pipe and Fittings

All lumps, blisters, and excess coating shall be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

### 6.07.04 Laying of Pipe

All dirt or other foreign material shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying. No tools or other articles shall be stored in the pipe at any time.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

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

provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

6.07.05 Cutting of Pipe and Connections to Existing Water Mains

The Contractor shall cut the pipe in a straight and uniform manner, at right angles to the axis of the pipe, wherever necessary for placing valves, fittings, or closure pieces without damage to the pipe, and without extra cost to the Owner. The cut ends of the pipe shall be beveled before assembly of the joint.

The method of cutting pipe shall be subject to the approval of the Engineer.

Connection to existing mains shall be done at a time when it will least interfere with normal use of the main. The Contractor shall be responsible for draining water from the closed off section of the existing main so that the connection can be made.

The Contractor shall uncover existing mains at points of connection sufficiently in advance of making the connection to allow verification of the dimensions and elevation of the existing main and shall make any revisions required to the fitting, or obtain special adaptors required for the connection. Existing pipe lines shall be adequately supported during the connection operation and prior to placement of backfill.

The Contractor shall be responsible for preventing contamination of existing water mains while the connection is made. He shall be responsible for any damage caused by his operations to existing mains to which the connections are being made.

6.07.06 Bell Ends to Face Direction of Laying

Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer. Where pipe is laid on a grade of 10 percent or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe upgrade.

6.07.07 Ductile/Cast Iron Sleeves

In connecting ductile/cast iron pipe together with a ductile/cast iron sleeve, the space between adjoining ductile/cast iron pipes shall not exceed two (2) inches. Where the space between adjoining ductile/cast iron pipes exceeds two (2) inches, a spacer shall be placed to fill the space. The spacer shall be a piece of ductile iron pipe of the same diameter and class as the adjoining pipe, and shall be cut straight and uniform and be free of defects and damage. In lieu of a spacer, the Contractor may elect to use Megalug joint restraining glands as manufactured by EBAA Iron Sales, Inc. or approved equal on both sides of the sleeve. If Megalug restraining glands are used, the pipe shall extend into each end of the sleeve a minimum of one-third (1/3) the length of the sleeve, unless approved otherwise by the Engineer.

## 6.08 JOINING OF MECHANICAL - JOINT PIPE

6.08.01 General Requirements

The general requirements in Section 6.03 - 6.07 inclusive shall apply except that, where the terms "bell" and "spigot" are there used, they shall be considered to refer to the bell and spigot ends of the lengths of mechanical-joint pipe.

6.08.02 Cleaning and Assembly of Joint

The last eight inches (8") outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint and then coated with a lubricant. The gasket lubricant shall be nontoxic, tasteless, and odorless, and shall be as supplied or recommended by the pipe manufacturer and approved by the Engineer. The retaining gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell, end. The rubber gasket shall be coated with lubricant and placed on the spigot end with the thick edge toward the gland.

6.08.03 Bolting of Joint

The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell; care shall be taken to locate the gasket evenly around the entire joint. The retaining gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a suitable (preferably torque-limiting) wrench. The torque for various sizes of bolts shall conform to ANSI/AWWA C600, Standard for Installation of Ductile-Iron Mains and Their Appurtenances, as follows:

| Nominal Joint Size Inches | Bolt Size Inches | Range of Torque Foot – Pounds |
|---|---|---|
| 3” | 5/8 | 45 - 60 |
| 4”-24” | 3/4 | 75 - 90 |
| 30”-36” | 1 | 100 - 120 |
| 42”-48” | 1-1/4 | 120 - 150 |

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. Repeat this cycle until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint

should be disassembled and reassembled after thorough cleaning. Over-stressing of bolts to compensate for poor installation practice is not allowed.

6.08.04 Permissible Deflection in Mechanical-Joint Pipe

Whenever it is desirable to deflect mechanical-joint pipe in order to form a long radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 1.

TABLE 1

PERMISSIBLE DEFLECTIONS IN MECHANICAL - JOINT PIPE

| Size of Pipe Inches | Max. Permissible Deflection Per Length - Inches | | Approx. Radius of Curve Produced By Succession of Joints - Feet | |
|---|---|---|---|---|
| | 18' | 20' | 18' | 20' |
| 3 | 31 | 35 | 125 | 140 |
| 4 | 31 | 35 | 125 | 140 |
| 6 | 27 | 30 | 145 | 160 |
| 8 | 20 | 22 | 195 | 220 |
| 10 | 20 | 22 | 195 | 220 |
| 12 | 20 | 22 | 195 | 220 |
| 14 | 13.5 | 15 | 285 | 320 |
| 16 | 13.5 | 15 | 285 | 320 |
| 18 | 11 | 12 | 340 | 380 |
| 20 | 11 | 12 | 340 | 380 |
| 24 | 9 | 10 | 450 | 500 |

## 6.09 JOINING OF PUSH-ON JOINT PIPE

6.09.01 General Requirements

The general requirements in Section 6.03 - 6.07 inclusive shall apply except that, where the terms "bell" and "spigot" are there used, they shall be considered to refer to the bell and spigot of the lengths of push-on joint pipe.

6.09.02 Cleaning and Assembly of Joint

The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket.

The thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe or both.

Gasket lubricant shall be nontoxic, tasteless, and odorless and shall be as supplied or recommended by the pipe manufacturer and approved by the Engineer.

The spigot end of the pipe shall be centered in the bell and forced or pushed home. Smaller sizes of pipe can be pushed or forced into place by hand; larger sizes will require the use of mechanical assistance.

The condition of the trench bottom must be such that location and position of the pipe to be joined is in a straight line assuring a joint of maximum tightness and permanent seal.

6.09.03 Permissible Deflection in Push-On Joint Pipe

Whenever it is desirable to deflect push-on joint pipe in order to form a long radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 2, unless recommended by the pipe manufacturer and approved by the Engineer.

TABLE 2

PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE

| Size of Pipe Inches | Max. Permissible Deflection Per Length - Inches | | Approx. Radius of Curve Produced By Succession of Joints - Feet | |
|---|---|---|---|---|
| | 18' | 20' | 18' | 20' |
| 3 | 19 | 21 | 205 | 230 |
| 4 | 19 | 21 | 205 | 230 |
| 6 | 19 | 21 | 205 | 230 |
| 8 | 19 | 21 | 205 | 230 |
| 10 | 19 | 21 | 205 | 230 |
| 12 | 19 | 21 | 205 | 230 |
| 14 | 11 | 12 | 340 | 380 |
| 16 | 11 | 12 | 340 | 380 |
| 18 | 11 | 12 | 340 | 380 |
| 20 | 11 | 12 | 340 | 380 |
| 24 | 11 | 12 | 340 | 380 |
| 30 | 11 | 12 | 340 | 380 |
| 36 | 11 | 12 | 340 | 380 |
| 42 | 11 | 12 | 340 | 380 |
| 48 | - | 12 | - | 380 |

6.09.04 Brass Wedges

Unless otherwise specified, brass wedges will be required for all push on joint pipe. A minimum of two wedges shall be used at each joint.

## 6.10 SETTING OF VALVES AND FITTINGS

6.10.01 General Requirements

Valves, fittings, plugs, and caps shall be set and joined to pipe in the manner specified above for cleaning, laying and joining pipe.

6.10.02 Location of Valves

Valves in water mains shall, where possible, be located on the street property lines extended unless shown otherwise on the drawings.

6.10.03 Valve Boxes and Valve Pits

A valve box or a precast concrete chamber shall be provided for every valve.

A valve box shall be provided for every valve that has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast-iron grease case. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

A precast concrete chamber shall be provided for every valve that has exposed gearing or operating mechanisms. The valve nut shall be readily accessible for operation through the opening in the manhole, which shall be set flush with the surface of the finished pavement or such other level as may be specified. Pits shall be so constructed as to permit minor valve repairs and afford protection to the valve and pipe from impact where they pass through the pit walls.

6.10.04 Dead Ends

All dead ends on new mains shall be closed with ductile iron plugs or caps; such dead ends shall be equipped with suitable blowoff facilities.

## 6.11 SETTING OF HYDRANTS

6.11.01 Location

Hydrants shall be located as shown or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

When placed behind the curb, unless otherwise directed, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than two (2) feet from the face of the curb.

When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6 inches of the sidewalk.

6.11.02 Position

All hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to, the curb, with the pumper nozzle facing the curb, except that hydrants having two hose nozzles 90 degrees apart shall be set with each nozzle

facing the curb at an angle of 45 degrees. Hydrants shall be set to the established grade, with nozzles a minimum of twenty seven (27) inches above the street centerline grade and a minimum of twenty one (21) inches above the ground at the hydrant, unless otherwise directed by the Engineer.

6.11.03 Connection to Main

Each hydrant shall be connected to the main with a 6 inch ductile iron branch controlled by an independent 6 inch gate valve, unless otherwise specified. The cost of the branch pipe shall be incidental to cost of installing the hydrant.

6.11.04 Hydrant Drainage

All hydrant drains shall be plugged unless otherwise directed by the Owner.

6.11.05 Pumping of Hydrants

All hydrants shall be pumped completely dry when the water main is placed in service.

## 6.12 ANCHORAGE

6.12.01 Restrained Joint Pipe

All ductile iron restrained joint pipe shall be Clow Corporation "Super-Lock"; American Ductile Iron Pipe "Lok-Ring Joint" or Flex-Ring Joint; Griffin Pipe Products Co. "Snap-Lok"; or approved equal. Gripper gaskets shall not be acceptable. All components of the restrained joint shall be as manufactured, supplied, or recommended by the manufacturer of the restrained joint pipe system actually installed.

6.12.02 Joint Restraining Glands

Joint restraining glands shall be Megalug as manufactured by EBAA Iron Sales, Inc., or approved equal.

6.12.03 Mechanical Joint Anchoring Fittings

Mechanical joint anchoring fittings shall be as manufactured by Clow Corporation, Tyler Corporation, or approved equal.

6.12.04 Anchorage for Hydrants

All hydrants shall be restrained to the hydrant lateral valve, and the hydrant lateral valve shall be restrained to the main using an approved joint restraint system consisting of restrained joint pipe, joint restraining glands, mechanical joint anchoring fittings, or approved equal.

6.12.05 Anchorage for Plugs, Caps, Tees, Bends and Valves

Unless otherwise specified or approved by the Engineer, movement of all plugs, caps, tees, bends, and valves shall be prevented by use of restrained joint pipe or joint restraining glands such as Megalugs as manufactured by EBAA Iron Sales, or approved equal. When joints are to be restrained with mechanical devices as noted above, all joints shall be restrained for a minimum distance from the fitting as required in the following table.

PIPE RESTRAINT LENGTH REQUIRED, FEET

| Pipe Diameter | Tees, 90º Bends | 45º Bends | 22-1/2º Bends | 11-1/4º Bends | Dead Ends | Reducers (one size) | ** |
|---|---|---|---|---|---|---|---|
| 4" | 23 | 9 | 5 | 2 | 57 | | |
| 6" | 32 | 13 | 6 | 3 | 82 | 43 | 63 |
| 8" | 41 | 17 | 8 | 4 | 104 | 43 | 55 |
| 12" | 58 | 24 | 12 | 6 | 149 | 80 | 120 |
| 16" | 74 | 31 | 15 | 7 | 192 | 82 | 110 |
| 20" | 89 | 37 | 18 | 9 | 233 | 82 | 104 |
| 24" | 104 | 43 | 21 | 10 | 272 | 82 | 99 |
| 30" | 123 | 51 | 25 | 12 | 328 | 115 | 148 |
| 36" | 141 | 58 | 28 | 14 | 379 | 115 | 140 |

**If straight run of pipe on small side of reducer exceeds this value, then no restrained joints are necessary.

NOTE: The length of restrained joint pipe required as shown in the table above is based on trench backfill being compacted to 95% of maximum unit weight in accordance with MDOT procedures. If the pipe is wrapped in polyethylene, a greater length of restrained pipe will be required as specified, shown on the Drawings, or directed by the Owner. **A multiplier of 1.43 shall be used if the pipe is installed with polyethylene wrap.**

All joints lying within the above minimum distances from the fitting must be restrained as noted herein.

Tees: Tees shall be restrained in the branch direction as required in the table above. Also, to augment the above, in the straight through direction, the minimum length of the first pipe on either side of the tee shall be ten (10) feet. In those cases where a valve is placed at the tee, the valve shall be restrained to the tee as noted below, and the next pipe shall be a minimum length of ten (10) feet.

Plugs/Caps: All dead ends on water mains shall be plugged or capped with standard plugs or caps. The water main, including the plug or cap shall be restrained back from the plug or cap as required in the table above.

Bends: Bends shall be restrained in both directions as required in the table above.

Valves: Valves used in conjunction with restrained joint pipe shall be restrained in accordance with the recommendations of the manufacturer of the restrained joint pipe. All valves at crosses or tees shall be restrained to the tee by use of restrained joint pipe or joint restraining glands as specified above. Hydrant valves may be restrained using mechanical joint anchoring fittings.

Secure all fittings with restrained joint pipe or joint restraining glands throughout entire area of muck plus an additional length beyond the muck area in suitable soils for a distance in accordance with this section.

6.12.06 Reaction Backing (Thrust Blocks)

Reaction backing (thrust blocks) shall be used only at locations indicated on the Drawings, or approved by the Engineer.

Reaction backing shall be concrete having a compressive strength of not less than 2,000 psi after twenty-eight (28) days. Backing shall be placed between solid, undisturbed ground and the fitting to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown in the table below or directed by the Engineer. The backing shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair.

REACTION BACKING

Minimum Bearing Area against undisturbed trench wall, in square feet, for sand is indicated in the table below. Details of placement are shown in Standard Details.

| Pipe Size | Tees, Plugs, Wyes, 45 Els | Hydrants, 90 Els | Wyes, 22-1/2 Els or Less |
|---|---|---|---|
| 6" | 3 | 3 | 1 |
| 8" | 4 | 6 | 2 |
| 10" | 7 | 9 | 3 |
| 12" | 9 | 11 | 3 |
| 16" | 13 | 20 | 6 |
| 20" | 20 | 28 | 8 |
| 24" | 28 | 40 | 11 |

Other Soil Conditions

| | | |
|---|---|---|
| Cement Sand or Hardpan | - | multiply above by 0.5 |
| Gravel | - | multiply above by 0.7 |
| Hard Dry Clay | - | multiply above by 0.7 |
| Soft Clay | - | multiply above by 2.0 |

## 6.13 HYDROSTATIC TEST

### 6.13.01 Procedure

All tests will be made by the Contractor using his own equipment, operators, and supervision, in the presence of the Engineer or his duly authorized representative. The length of the section to be tested shall be as approved by the Engineer, or as shown on the drawings. The test shall not be against an existing valve, unless written permission is obtained from the water system operator. In no case shall a test be made against an existing valve that is found to be leaking or otherwise defective. Testing shall be in accordance with AWWA C600.

### 6.13.02 Air Removal Before Test

Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied.

6.13.03 Leakage Test

A leakage test shall be conducted during the hydrostatic pressure test in the presence of the Engineer The contractor shall furnish the pump, pipe, connections, gages and all other necessary apparatus, and shall furnish the necessary assistance to conduct the test. The duration of the test shall be a minimum of 2 hours, and during the test the main shall be subjected to a pressure of 150 psi. When several valved sections are tested as one test, the maximum allowable leakage will be equivalent to the calculated allowable leakage for the smallest valved section therein.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled, and the pipe has been filled with water. No pipe installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where:

L = Allowable leakage, in gallons per hour

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the leakage test, in pounds per square inch (gage).

This formula is based on allowable leakage of 10.49 gallons per day, per mile of pipe, per inch of nominal diameter at 150 psi.

The Owner shall be furnished a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, the duration of the test, and the amount of leakage. The report shall be signed by the Contractor and the Engineer.

6.13.04 Variation from Permissible Leakage

If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall at his own expense locate and repair the leaks until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the allowance used for testing.

6.13.05 Time for Making Test

The pipe may be subjected to hydrostatic pressure and inspected and tested for leakage at any convenient time after the trench has been partially backfilled.

Where any section of the main is provided with concrete reaction backing, the hydrostatic pressure test shall not be made until at least 7 days have elapsed after the concrete reaction backing was installed. If high-early-strength cement is used in the concrete reaction backing, the hydrostatic pressure test will not be made until at least 2 days have elapsed.

## 6.14 CLEANING AND DISINFECTING

### 6.14.01 Flushing Water Main

The water main and services three (3) inch diameter and larger shall be flushed by providing taps in sufficient size or number to provide a velocity of 2-1/2 feet per second in the line being flushed. Hydrants may be used providing the requirements listed below are met.

#### 6.14.01.01 Procedure

The Contractor shall submit to the Engineer a procedure schedule outlining the method he proposes to use for flushing water mains. Mains shall be flushed at a maximum of 1/4-mile intervals.

#### 6.14.01.02 Time for Flushing

Flushing may be done prior to hydrostatic pressure testing or following hydrostatic pressure testing, but, in any case, prior to chlorination of the water main.

### 6.14.02 Chlorination

All newly-laid lines shall be chlorinated. The Contractor shall furnish all necessary equipment and materials and shall furnish all necessary assistance for effective disinfection of the water mains. Chlorination shall be accomplished by using the following general procedure.

#### 6.14.02.01 Procedure

Disinfection shall be in accordance with AWWA C651. After the water main has been pressure tested and flushed, the Contractor shall employ one of the following methods to disinfect the new water main:

*Continuous Feed Method:* the potable water shall be chlorinated so that after a 24-hour holding period in the main, a free chlorine residual of not less than 10 ppm (mg/L) exists in the main.

*Slug Method:* the water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 ppm (mg/L) free chlorine. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or slug, of chlorinated water that will, as it moves through the main, expose all interior surfaces (including fittings, valves, hydrants,

and other appurtenances) to a concentration of approximately 100 ppm for at least three (3) hours.
The free chlorine residual shall be measured in the slug as it moves through the main. If at any time it drops below 50 ppm, the flow shall be stopped; chlorination equipment shall be relocated at the head of the slug; and, as flow resumes, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 ppm.

The amount of chlorine required for each 100 feet of pipe of various diameters to produce 50 ppm chlorine solution is as follows:

| Pipe Sizes (Inches) | 100 Percent Chlorine (lb.) | 16% Bleach (gal.) |
|---|---|---|
| 6 | 0.062 | 0.046 |
| 8 | 0.110 | 0.081 |
| 10 | 0.171 | 0.128 |
| 12 | 0.247 | 0.18 |
| 16 | 0.439 | 0.313 |
| 24 | 0.987 | 0.737 |
| 30 | 1.542 | 1.100 |

6.14.02.02 High Test Calcium Hypochlorite

("HTH", "Perchloren", "Pittchlor"). Prepare a ten-thousand-parts-per-million solution in water and pump at a constant rate into the water main while bleeding off the water at the extreme end. The bleed rate will determine the feed rate of the chlorine in order to arrive at a 50 to 100 ppm solution in the water main.

6.14.02.03 Liquid Chlorine

Liquid chlorine may be applied to the water main much the same way as the hypochlorite solution listed above. The rate of application will have to be adjusted for the degree of concentration of the liquid chlorine.

6.14.02.04 Point of Application

The chlorinating agent shall be applied at the supply end of the line through a corporation cock. The water for injecting the chlorine into the new main may be taken from the pressure side of the isolation valve or by utilizing a pressure pump. Care shall be exercised to prevent any of the strong chlorine solution from entering existing water mains.

6.14.02.05 Retention Period

The chlorinated water shall be retained in the new water main according to the requirements of AWWA C651 described in Section 6.14.02.01 of this Specification. The chlorinated water in the new main shall be retained for a period not to exceed 24 hours. In cases where a shorter retention period is necessary, a stronger solution may be used and the retention period reduced accordingly. For these stronger solutions the approval of the Utility's Engineer must be secured in writing as to the length of retention time in relationship to chlorine strength.

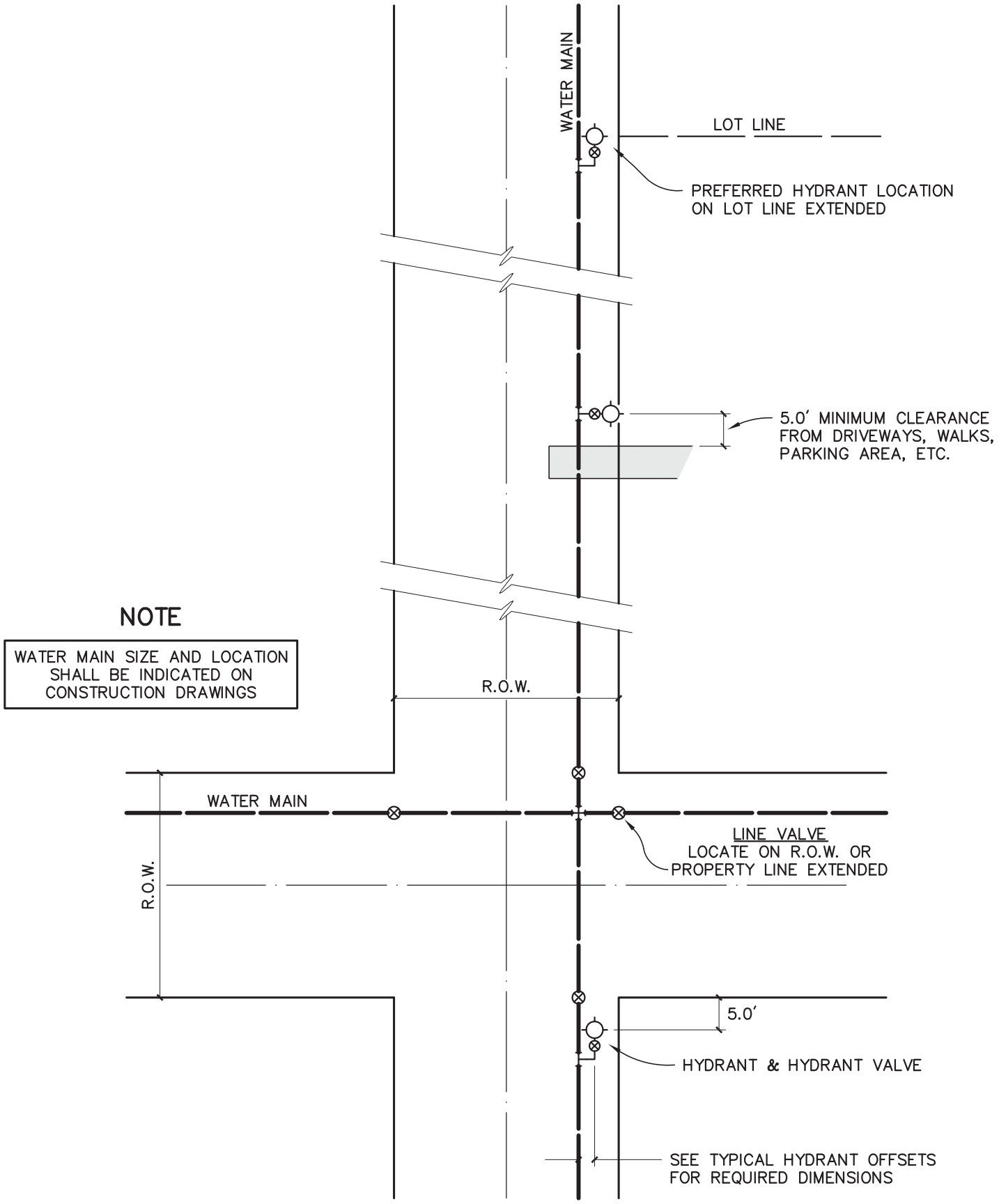
While the chlorine solution is in the line, the Contractor shall operate valves and hydrants in the chlorinated section to ensure the complete disinfection thereof.

6.14.02.06 Flushing and Testing

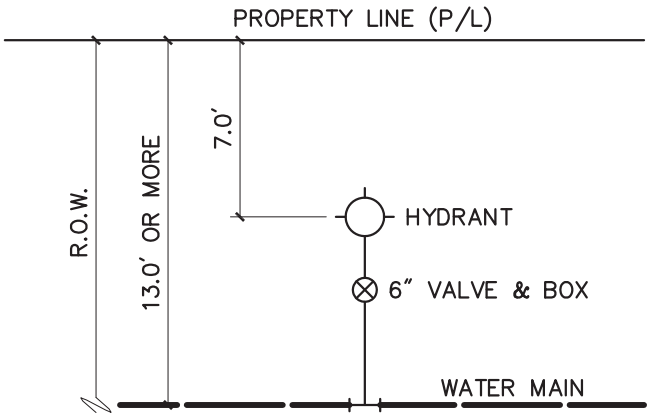
The chlorinated water shall be flushed from the main, fittings, valves, branches, and hydrants at the end of the retention time so that the entire line is clear of any residual chlorine. The environment to which the chlorinated water is to be discharged shall be inspected. If the chlorinated discharge could cause damage to the environment, a neutralizing chemical shall be applied to the water to thoroughly neutralize the residual chlorine.

A sample shall then be taken from the line in the presence of the Engineer. Samples shall be taken for every 1,200 feet of water main installed, and the end of the line, and from each branch. The Engineer shall deliver the sample(s) to a laboratory for bacteriological analysis. In the event that the water sample(s) does not pass this bacteriological test, the chlorination procedure outlined above shall be repeated until the quality of water is substantially the same as that being delivered from the existing distribution system. The test procedure shall be repeated until two consecutive safe results are obtained at each location as required by the Michigan Department of Environmental Quality. The two samples shall be taken 24 hours apart. The main shall be re-chlorinated after two (2) failed consecutive tests, whether the test fails at a different sample point or not.

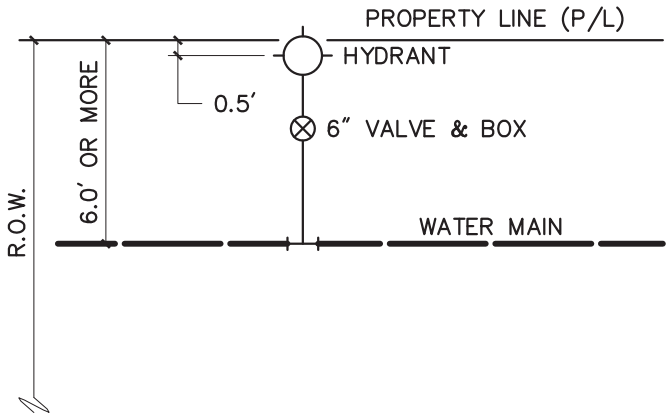
Testing shall be coordinated with laboratory schedules for holidays and weekends.



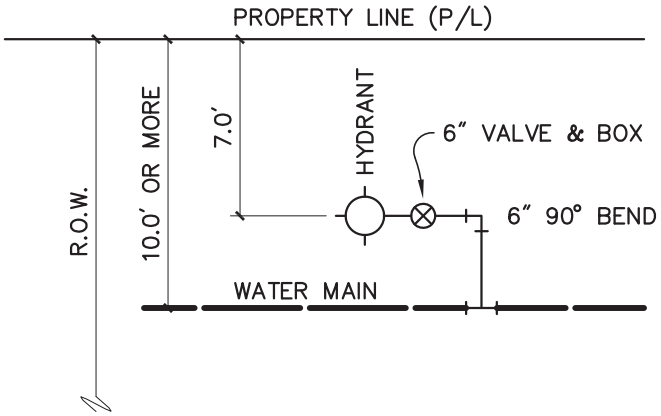

# VALVE & HYDRANT LOCATIONS



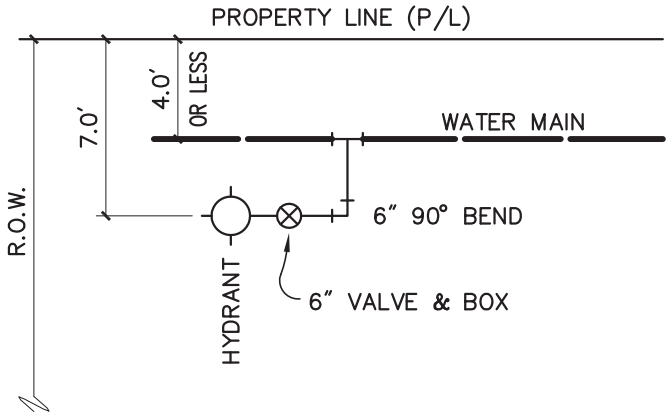

(A) WATER MAIN MORE THAN 13.0' FROM P/L
HYDRANT LOCATED AT 7.0' FROM P/L



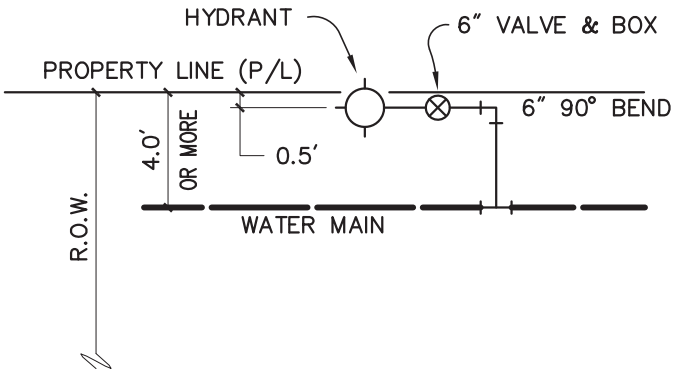

(B) WATER MAIN MORE THAN 6.0' FROM P/L
HYDRANT LOCATED AT 0.5' FROM P/L



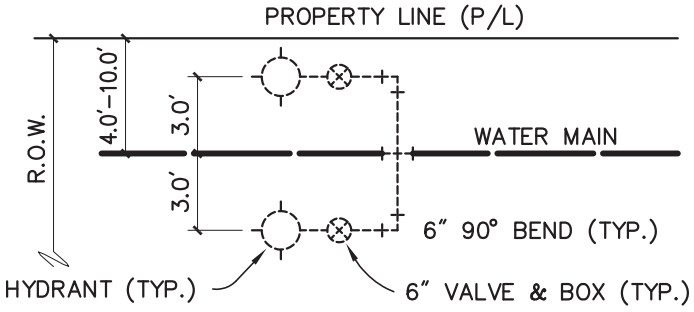

(C) WATER MAIN MORE THAN 10.0' FROM P/L
HYDRANT LOCATED AT 7.0' FROM P/L
(WHEN REQUIRED BY OWNER)




(D) WATER MAIN LESS THAN 4.0' FROM P/L
HYDRANT LOCATED AT 0.5' FROM P/L




(E) WATER MAIN MORE THAN 4.0' FROM P/L
HYDRANT LOCATED AT 7.0' FROM P/L

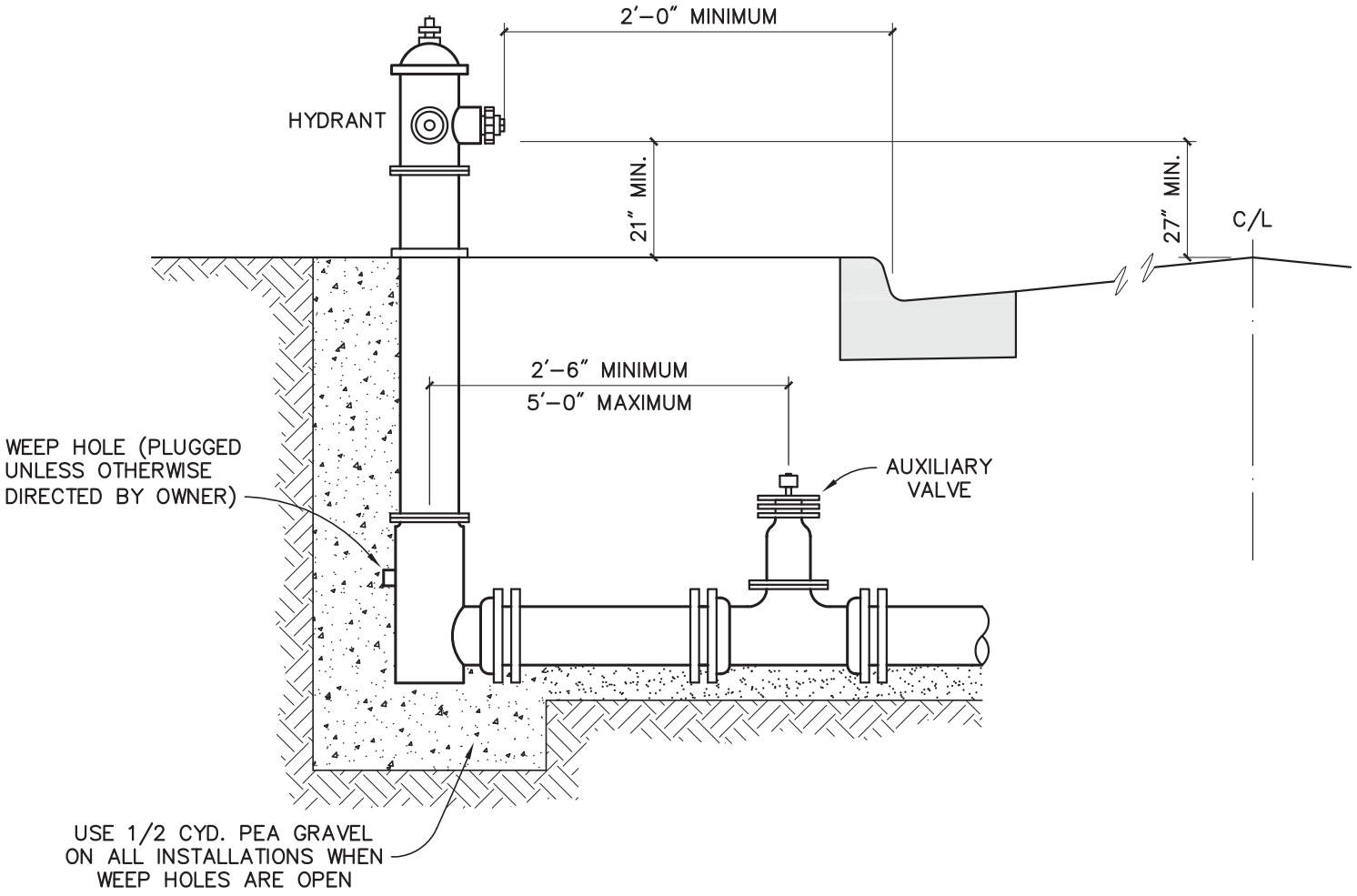



(F) WATER MAIN BETWEEN 4.0' & 10.0' FROM P/L
HYDRANT LOCATED AT 3.0' FROM P/L

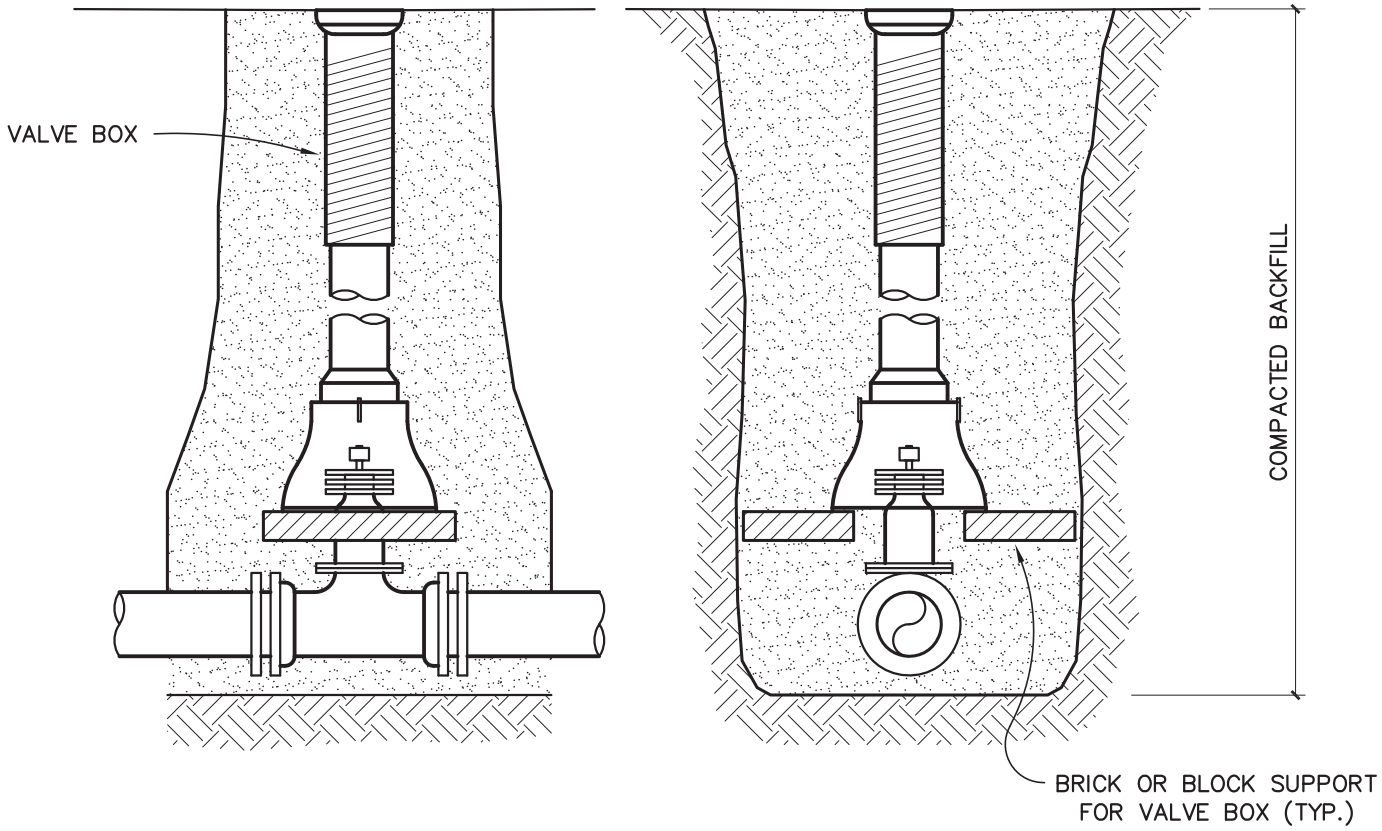
# HYDRANT OFFSETS



12/2012
Section 6 Water Main



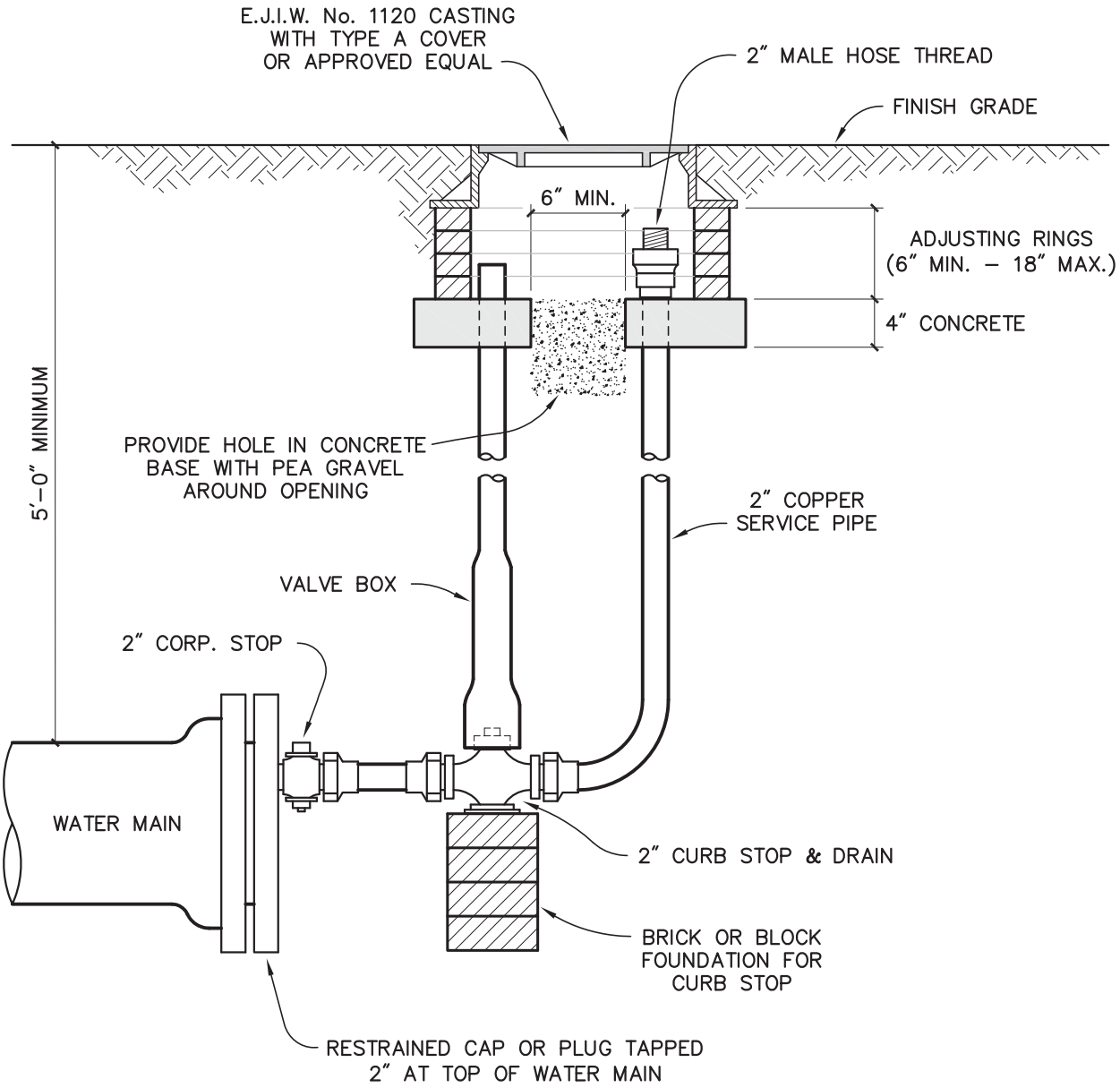

# HYDRANT DETAIL



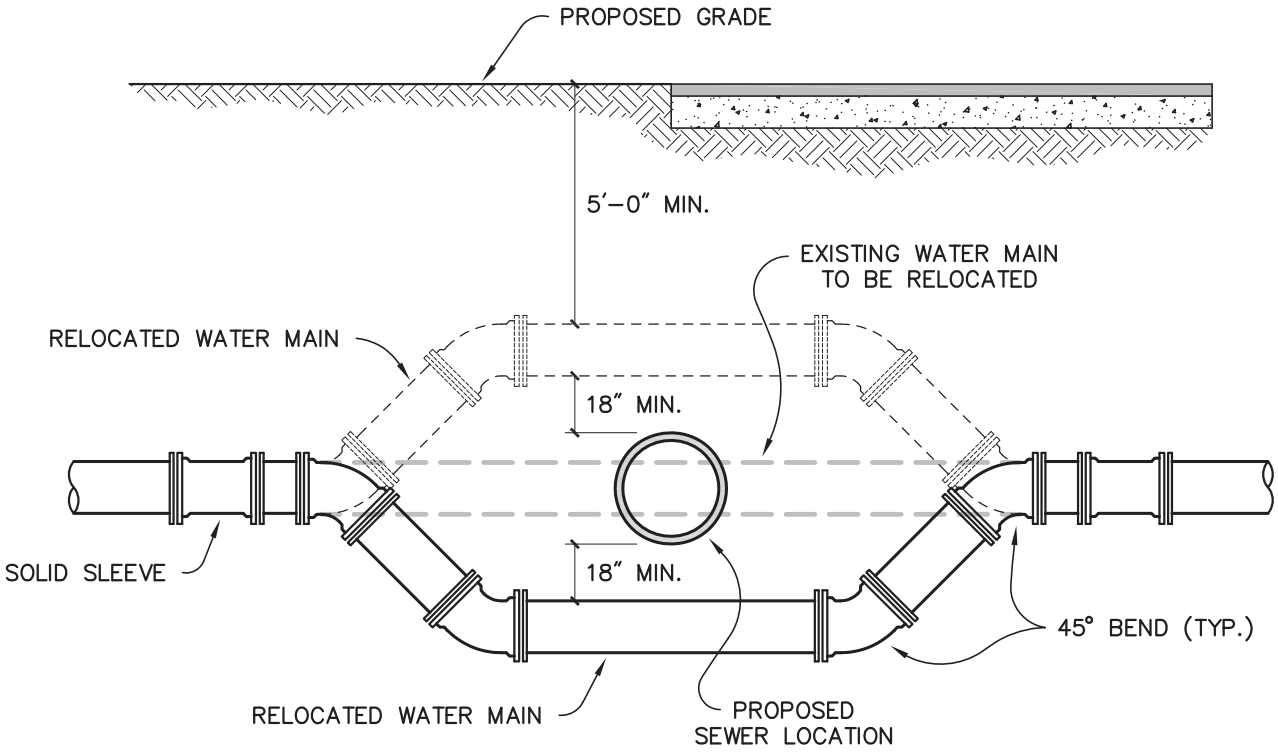

# VALVE & BOX FOUNDATION

## NOTE

VALVE BOX AND SUPPORTS SHALL NOT BE IN CONTACT WITH VALVE OR PIPE. MAINTAIN MINIMUM 2" CLEARANCE.




# BLOW OFF DETAIL




# WATERMAIN RELOCATION DETAIL

## NOTE

WHEN THE MINIMUM CLEARANCE AND COVER CAN BE OBTAINED, THE WATER MAIN IS TO BE RELOCATED ABOVE THE SEWER.

# SECTION 7

# SPECIFICATIONS FOR STORM SEWERS IMPACTED BY SANITARY SEWER SYSTEM

## 7.01 DESCRIPTION OF WORK

The work shall consist of furnishing and installing storm sewer pipe of the specified size or sizes in a trench and shall include the construction of manholes, catch basins, and other appurtenant work as required by the sanitary sewer system. Excavating, trenching and backfilling shall be as specified in Section 2.

Where the sanitary sewer work requires any storm sewer repair, replacement, or construction activity, all materials and workmanship shall conform to latest revision of the local requirements and specifications. The local requirements and specifications are hereby included by reference and shall supersede the requirements of this specification where specifically addressed.

The work shall be performed in accordance with the specifications and drawings, the MDOT 2012 Standard Specifications for Construction and the following specifications.

## 7.02 MATERIALS

All materials furnished by the Contractor shall conform to the specifications which follow. Where reference specifications are used, they shall be considered as referring to the current edition or latest issue.

### 7.02.01 Sewer Pipe

All sewer pipe shall be of the materials and strengths shown on the Drawings or as specified.

#### 7.02.01.01 Reinforced Concrete Sewer Pipe

Reinforced concrete sewer pipe, fittings, and accessories shall conform to the requirements of ASTM Designation C76 for the various classes specified.

Unless otherwise specified, joints for reinforced concrete sewer pipe shall be premium rubber joints conforming to the requirements of ASTM Designation C443.

#### 7.02.01.02 Nonreinforced Concrete Pipe

Nonreinforced concrete pipe, fittings, and accessories shall conform to the requirements of ASTM Designation C14, Class 3, unless otherwise specified.

Unless otherwise specified, joints for non-reinforced concrete sewer pipe shall be premium rubber joints conforming to the requirements of ASTM Designation C443.

7.02.01.03 Reinforced Concrete Elliptical Pipe

Reinforced concrete elliptical pipe, fittings, and accessories shall conform to the requirements of ASTM Designation C507 for the various classes specified.

Unless otherwise specified, joints for reinforced concrete elliptical pipe shall conform to one of the following requirements:

Premium joints shall conform to one of the following requirements:

External sealing bands conforming to the requirements of ASTM Designation C877,

Soil tight joints shall conform to the following requirements:

Bituminous mastic conforming to the requirements of Section 909.09 of the MDOT 2012 Standard Specifications of Construction shall completely fill the annular space in the joint. Any excess mastic squeezed into the interior of the conduit shall be troweled smooth.

The joint surface shall also be evenly wrapped with a three (3) foot wide geotextile fabric meeting the requirements of Section 910.03A of the MDOT 2012 Standard Specifications of Construction, Geotextile Blanket for pipe wrap.

Geotextiles shall be stored, handled, and placed in accordance with the manufacturer's recommendations. Torn or punctured geotextiles shall not be used. Geotextile fabric which has deteriorated due to ultraviolet exposure (sunlight) during storage or has been damaged in placing will be rejected.

7.02.01.04 Reinforced Concrete Box Culverts

This section covers precast reinforced concrete box culverts and joints to be furnished and installed as specified and as shown on the drawings.

Box culverts shall be furnished and installed complete with all fittings, specials, jointing materials, and other necessary appurtenances.

Except as modified or supplemented herein, the manufacture and design of concrete box culvert shall be governed by the requirements of ASTM C1433, as applicable.

Unless otherwise specified herein, all materials used in the manufacture of culvert, fittings, and accessories shall conform to the requirements of ASTM C1433, as applicable.

Unless otherwise specified, joints for reinforced concrete box culverts shall conform to one of the following requirements:

Premium joints shall conform to one of the following requirements:

External sealing bands shall conform to the requirements of ASTM Designation C877. The width of the bands shall be thirteen (13) inches. External sealing bands shall be installed in accordance with the sealing band manufacturer's recommendations. Care shall be taken to ensure stretch of the band along the bottom surface of the conduit, and to prevent pulling of the sealing band into the bottom of the joint, by keeping the weight of the conduit off of the bedding until the sealing band is fully installed.

Soil tight joints shall conform to the following requirements:

Bituminous mastic conforming to the requirements of Section 909.09 of the MDOT 2012 Standard Specifications of Construction shall completely fill the annular space in the joint. Any excess mastic squeezed into the interior of the conduit shall be troweled smooth.

The joint shall surface shall also be evenly wrapped with a three (3) foot wide geotextile fabric meeting the requirements of Section 910.03A of the MDOT 2012 Standard Specifications of Construction, Geotextile Blanket for pipe wrap.

Geotextiles shall be stored, handled, and placed in accordance with the manufacturer's recommendations. Torn or punctured geotextiles shall not be used. Geotextile fabric which has deteriorated due to ultraviolet exposure (sunlight) during storage or has been damaged in placing will be rejected.

Except for fittings, bends, tees, and closure pieces, each piece of culvert shall be not less than six (6) feet long. Shorter length to help align precast holes may be allowed with the approval of the Engineer.

Joints shall conform to ASTM C1433, as applicable. Joint design shall be suitable for the joint sealing material to be used.

The total area of longitudinal steel reinforcement shall meet or exceed ASTM C1433. Longitudinal reinforcement shall be spaced uniformly around the culvert, and shall be continuous in each cage.

In no case shall the cover over the reinforcement be less than 5/8 inch, as measured from the internal surface or the external surface of the culvert, except the cover

over the reinforcement for the external surface of the top slab of box culverts with less than two (2) feet of cover shall not be less than 1-5/8 inches.

In addition to the requirements of ASTM C1433, as applicable, each culvert and fitting shall have plainly and permanently marked thereon:

Identification of specials to show the location in the line.

On bends, the angle turned.

All bends, tees, closure pieces, wall fittings, end sections, and other fittings which are indicated on the drawings, or required to complete the work shall be furnished. Except as modified or otherwise provided herein, the design and manufacture of fittings shall be governed by the same requirements as the connecting culvert.

Concrete box culverts shall not be delivered to the site until concrete control cylinders representing such culverts shall have attained a compressive strength of at least eighty (80) percent of the specified minimum twenty-eight (28) day strength.

Concrete culvert and fittings shall be handled carefully and shall not be bumped or dropped. Hooks shall not be permitted to come in contact with joint surfaces. Use of lifting holes will be permitted with a minimum of four holes. Holes shall be plugged with non-shrink grout or other means acceptable to the Engineer, after installation.

Bedding for concrete box culverts shall be at least twelve (12) inches below the bottom of the box culvert on rock, and at least six (6) inches below the bottom of the box culvert laid on stable earth. The bedding shall be aggregate, thoroughly compacted to not less than ninety-five (95) percent of maximum unit weight – ninety-eight (98) percent if within the roadway influence – in accordance with MDOT procedures. Bedding material shall conform to the requirements of MDOT for 6A aggregate, or crushed concrete meeting the requirements for 22A aggregate, or approved equal. Bedding material shall extend a minimum of one (1) foot beyond the outside faces of the culvert.

Culvert laying shall begin at the lowest elevation, with the female ends facing the direction of laying, except when reverse laying is permitted by the Engineer.

The interior of all culvert and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Jointing of precast concrete box culvert shall be as specified. Joints shall not be made when weather conditions may interfere with obtaining a satisfactory seal.

The gap width between successive box culvert sections after placement shall be a maximum of 3/4 inch at the nearest surfaces of the joint, and two (2) inches

maximum at any other location as measured on the interior exposed edge of the joint. This permissible tolerance shall not affect the lines and grades and their permissible tolerances as shown on the drawings and specified.
Box culverts delivered to the job site with any patching shall not be accepted. If the Contractor wishes to seek acceptance for a patched box culvert, it must be inspected by the Engineer prior to patching at the point of manufacture, and accepted subject to an approved method of patching.

Drawings, specifications, schedules, and other data showing complete details of the fabrication and construction of box culvert and fittings, together with complete data covering all materials proposed for use, shall be submitted for approval. The drawings and data shall include, but not be limited to, the following for each size culvert:

Details of joints.

Details of fittings and specials.

Details of end sections and tees.
Test reports.

Laying schedules.

Details of reinforcement at openings in the top or sides of the box culvert.

7.02.01.05 Corrugated Metal Pipe

Corrugated metal pipe shall conform to the applicable requirements of Sections 401 and 402 of the MDOT 2012 Standard Specifications of Construction for the various types and gauges specified.

Premium soil tight joints will be required.

7.02.01.06 Smooth Lined Corrugated Polyethylene Pipe

Smooth Lined Corrugated Polyethylene Pipe in sizes up to forty-eight (48) inch diameter shall conform to the requirements of AASHTO M-294, Type S. The material shall have a minimum resin cell classification of 335420 C as determined under ASTM Designation D3350. Pipe shall have annular corrugations, and joints shall have integral bell & spigot with gaskets. Gaskets shall be placed in annular corrugations. Gaskets shall be solid cross section rubber seals conforming to ASTM Designation F477. A protective removable shrink wrap material shall be placed on all exposed gaskets at the factory. Gaskets and sleeves shall be lubricated prior to insertion as required by the pipe manufacturer. Pipe fittings shall conform to AASHTO M-294. Installation and testing shall be as required in Section 2, "Excavating, Trenching, and Backfilling for Utilities", except a minimum of three (3) feet of cover shall be maintained over any pipe during construction staging

when construction equipment is crossing the pipe. The cost of temporary cover shall be incidental to the item of work.

7.02.01.07 Polyvinyl Chloride (PVC) - (Roof Drain Laterals Only)

Solid wall PVC plastic pipe shall be extra strength conforming to the requirements of ASTM D3034, with a standard dimension ratio of 23.5 (SDR-23.5).

Joints for PVC plastic may be chemically welded. Manufacturers are required to "guide line" the uncoupled end of each joint of pipe so that in the field, it can be visually determined that the joint is properly made up.

Joints for PVC shall be integral bell & spigot design.

Polyvinyl Chloride (PVC) solid wall schedule 80, ASTM D1785, is also permitted.

7.02.02 Roof Drain Laterals

All roof drain laterals shall be extra strength pipe, and unless otherwise specified, shall be of any material specified in Paragraph 7.02.01. Where bends or curves are specified they shall be smooth long radius type curve. No mitered or segmented type bends will be approved.

7.02.03 Wyes and Tees

Wyes and Tees shall be cast fittings of the same material and joints as the main sewer, or may be an approved fabricated special fitting which provides a suitable connection for the lateral to the main sewer.

Details of special fittings and/or adaptors for connecting laterals of a material different from the main sewer shall be approved by the Engineer before they are manufactured.

Wyes and tees will be required as follows:

6" Wyes on main sewer of 8" or 10" diameter;
6" Wyes or Tees on main sewer of 12" diameter or larger.

7.02.04 Plugs and Stoppers

Plugs or stoppers for plugging the ends of laterals, risers or storm sewers, which are not extended shall make a water tight seal. Design shall be such that they can be readily removed without damage to the pipe.

7.02.05 Underdrains

Materials for underdrains shall conform to the requirements of Section 404 of the MDOT 2012 Standard Specifications of Construction.

7.02.06 Cement Mortar

Mortar shall consist of one part of Air Entraining Portland Cement, and two parts of masonry sand. These proportions shall be measured by volume.

The sand and cement shall be mixed dry in a clean tight box until a mixture of uniform color is produced, after which water shall be added until the required consistency is obtained. Mortar shall be mixed only in such quantities as needed for immediate use. The retempering of mortar will not be permitted.

7.02.06.01 Cement

Air Entraining Portland Cement shall conform to the requirements for Type 1A of the MDOT 2012 Standard Specifications for Construction for Air Entraining Portland Cement, ASTM Designation C150.

7.02.06.02 Masonry Sand

Masonry Sand shall conform to the requirements of "Natural Sand, 2MS" of the MDOT 2012 Standard Specifications for Construction.

7.02.06.03 Water

Water for mixing mortar shall be obtained from the public water supply unless otherwise approved by the Engineer.

7.02.07 Concrete

Concrete for pipe encasement, special pipe embedment, manhole bases and similar items shall meet the requirements of the 2012 MDOT Standard Specifications for Construction for Grade S3 concrete. Grade S3 concrete shall have the strength of 3,000 psi at 28 days.

7.02.08 Manhole and Catch Basin Materials

7.02.08.01 Adjusting Rings

Precast grade adjusting rings shall conform to the requirements of ASTM Designation C478.

7.02.08.02 Precast Units

Precast reinforced concrete manhole risers and precast reinforced concrete manhole conical top sections shall conform to the requirements for reinforced concrete manhole risers and tops, ASTM Designation C478.

Joints for precast sections shall be premium rubber, butyl rubber composition seals, "RAM-NEK", or approved equal.

7.02.08.03 Castings

Castings shall meet the requirements specified in the MDOT 2012 Standard Specifications for Construction Section 908. Manhole covers and rings and similar combinations of castings shall be machined to provide an even bearing.

Unless otherwise specified, manhole castings shall be East Jordon No. 1120 with Type A solid cover, or approved equal.

Unless otherwise specified, catch basin castings at curb inlets shall be East Jordan No. 7020, with Type M2 grate and Type T1 back, or approved equal.

7.02.08.04 Steel Reinforcement

Steel reinforcement shall conform to the requirements for steel reinforcement of Section 905 of the MDOT 2012 Standard Specifications for Construction.

7.02.08.05 Manhole Steps

Unless otherwise specified, manhole steps shall be plastic coated steel steps conforming to the requirements of ASTM Designation C478, or approved equal, spaced at 16" on center.

## 7.03 INSPECTION OF MATERIALS BY CONTRACTOR

It shall be the responsibility of the Contractor to inspect all materials for cracks, flaws or other defects before they are incorporated into the work. Any materials found to be defective or damaged, shall be promptly removed from the job site.

## 7.04 LAYING PIPE

7.04.01 Alignment and Grade

7.04.01.01 Laser Method

The Contractor shall use the laser beam method of maintaining line and grade for sewer construction, unless otherwise approved by the Engineer. The Contractor shall submit evidence to the Engineer that a qualified operator will handle the laser beam equipment during the course of construction.

The Engineer shall place line and grade stakes at each manhole, or more often, as determined by the Engineer. The Contractor shall check the line and grade at very point at which a stake has been placed.

7.04.02 Handling

Pipe shall be protected during unloading and handling against impacts, shocks and free fall. Pipe handled on skid-ways shall not be skidded or rolled against pipe already on the ground.

Pipe shall be carefully lowered into the trench in such a way as to avoid danger to the workmen or damage to the pipe.

7.04.03 Direction of Laying

Excavation of trenches and laying of pipe shall begin at the outlet for the sewer and proceed upgrade with the individual pipe being laid with the spigot end downstream.

7.04.04 Placing

Unless otherwise specified, installation of precast concrete sewer, storm drain, and culvert pipe shall conform to the requirements of ASTM Designation C1479, as applicable.

The pipe shall be placed on the prepared sub-grade and held firmly in place during subsequent pipe jointing and embedment operations. Successive pipes shall be carefully positioned so that when laid they form a sewer with a uniform invert true to line and grade.

Sufficient pressure shall be applied by an approved method to each pipe as it is laid to ensure that the spigot is all the way home in the bell. Care shall be exercised to prevent joints from opening up as successive lengths of pipe are placed. The Contractor shall take the necessary precautions when using a trench box to prevent joint separation when the box is pulled ahead.

7.04.05 Cleaning Sewer

The interior of the sewer shall be cleaned of all jointing material, dirt and debris as the work progresses.

In small sewers where cleaning after laying may be difficult, a swab or drag may be required in the pipe line to satisfactorily complete this work. Where possible, a plug shall be installed on the downstream end of the sewer to prevent any sand and debris from entering the existing sewer.

## 7.05 PIPE JOINTS

Pipe joints shall be made in strict accordance with the pipe manufacturer's recommendations unless otherwise specified herein. All lubricants, gaskets and other materials required to make the joints shall be supplied or recommended by the pipe manufacturer and approved by the Engineer.

Pipe layers shall be fully qualified and experienced in the work being performed and shall check each joint after it is completed to see that no part of the joint material is left on the inside of the pipe and that the joint is properly made.

## 7.06 LOCATION OF WYES AND TEES

The approximate locations of wyes or tees are shown on the Drawings. These locations may be adjusted where necessary to best serve the various properties. Exact locations will be determined by the Engineer before the wyes or tees are installed.

The Contractor shall keep an accurate record of measurements from the nearest downstream manhole to each wye or tee which is installed, the length of each lateral, and the depth at the end of each lateral. These measurements shall be recorded on the record drawings to be furnished by the Contractor.

## 7.07 ROOF OR FOOTING DRAIN LATERALS

### 7.07.01 General

Installation of roof/footing drain laterals shall meet all requirements specified for storm sewers. All laterals shall be inspected by the Engineer before the trench is backfilled. The end of all laterals shall be properly sealed with a standard stopper or plug, unless directed otherwise by the Engineer.

### 7.07.02 Length

All roof/footing drain laterals shall be laid at right angles to the storm sewer main line and shall extend to a point one foot outside the street right-of-way (property line) unless otherwise directed. No payment will be made for pipe laid beyond this point unless specifically ordered by the Engineer.

The Contractor shall measure and record the horizontal length of the lateral from the main line sewer to the end of the lateral and provide this information to the Engineer.

### 7.07.03 Grade

The roof/footing drain lateral shall be laid with a rise of one-quarter (1/4) inch per foot unless otherwise directed.

### 7.07.04 Markers and Measurements

After installation of the roof/footing drain lateral, but prior to backfilling, the Contractor shall provide and install a 2" x 2" wood marker for each service. The wood markers shall be set vertically from the end of the lateral to twelve (12) inches above finish surface elevations. Also, a 1/2" diameter by 3' long metal stake shall be placed vertically and adjacent to the wood marker with 6" cover. The

Contractor shall assist the Construction Observer in locating the end of each lateral and in recording the location by measuring to the nearest downstream manhole.

After the record locations have been recorded and checked by the Construction Observer, the Contractor shall cut off the markers as follows: in improved areas, the markers shall be cut off two inches below grade; and in undeveloped areas, the markers shall be cut off six inches above grade.

## 7.08 MANHOLE AND CATCH BASIN CONSTRUCTION

Manholes and catch basins shall be constructed in accordance with the standard details and as specified herein.

Unless otherwise specified, or approved by the Engineer, all manholes and catch basins shall be precast.

Precast bases shall be installed on the subbase in such a way as to provide a uniform bearing under the manhole base.

Precast concrete adjusting rings shall be used to bring existing and new manhole structure covers within the proposed pavement to grade. After the cover is brought to grade, the entire hole created by excavating to raise the casting shall be filled with concrete to the bottom of the base or leveling course and hand tamped or vibrated to ensure all voids are filled. Special care shall be taken to prevent debris from entering sewers.

Precast manholes and catch basins with integral bottom and channel may be used; however, any changes to the structure due to minor field adjustments of alignment and/or grade required to meet construction conditions, shall be made by the Contractor at no additional cost to the NKSA.

Stubs shall be provided in manholes for future connections as shown on the Drawings or as directed by the Engineer. All such stubs shall be sealed with standard plugs or brick bulkheads, in accordance with Section 403.03 of the MDOT 2012 Standard Specifications for Construction.

## 7.09 CUT-INS

When cutting into an existing manhole, the opening shall be no larger than is necessary to admit the new sewer. All broken or surplus materials falling inside the structure shall be removed. The opening around the pipe shall then be properly sealed with brick and mortar or by other approved means which will result in a water tight and durable repair to the structure.

Flow channels shall be constructed as specified or as directed to accommodate the sewer being cut in.

Cut-ins to existing manholes shall be considered included in the major items of work and no specific payment will be made therefor.

## 7.10 ACCEPTANCE TESTS

### 7.10.01 Alignment and Grade

Each section of sewer may be checked by the Engineer for alignment and grade using lights and mirrors, television inspection, or other similar means. The Contractor shall assist the Engineer in the performance of these tests when necessary.

### 7.10.02 Pipe Deflection Tests (Flexible Pipe Only)

Flexible pipe is any pipe having a pipe stiffness of less than 115 psi. as defined under the requirements of ASTM Designation D2412.

The completed installation of flexible pipe shall at no point have out-of-round deflections in the main sewer pipe greater than five percent (5%) of the pipe's actual original inside diameter. Go/no go gauging tests, using an approved pointed mandrel with a minimum of nine (9) points, shall be performed by the Contractor in the presence of the Engineer, or his authorized representative after the trench is backfilled and before the surface restoration is begun. Pipe with deflections greater than five percent (5%) shall be re-laid by the Contractor at no additional expense to the NKSA. Use of mechanical devices or equipment to complete the go/no go tests and vibratory re-rounding of failed sections are prohibited. A minimum of 30 days shall elapse between installation with backfilling and deflection testing.

## 7.11 MEASUREMENT AND PAYMENT

### 7.11.01 General

All proposed construction shall be measured for payment by the Engineer in accordance with the items listed in the proposal.

The unit price bid for each proposal item shall be payment in full for completing the work, ready for use as specified.

### 7.11.02 Storm Sewers

Measurement of the length of the sewer shall be in lineal feet along the centerline of the sewer from center to center of manhole or catch basin structures.

Where depth classifications are provided, the depth of the sewer connecting two adjacent structures shall be considered as being the average of the depth from earth grade to the sewer invert at these structures.

7.11.03 Manholes and Catch Basins

Manholes and catch basins shall be paid for in accordance with the units established in the proposal. When no proposal item is provided for castings, the work shall be considered part of the major items of work.

7.11.04 Wyes or Tees

When a specific item is provided in the proposal for Wyes or Tees the unit price bid shall be the additional cost of furnishing and placing the wye or tee over and above the cost of furnishing and laying the sewer pipe.

When no proposal item is provided, the work shall be considered part of the major items of work.

7.11.05 Roof or Footing Drain Laterals

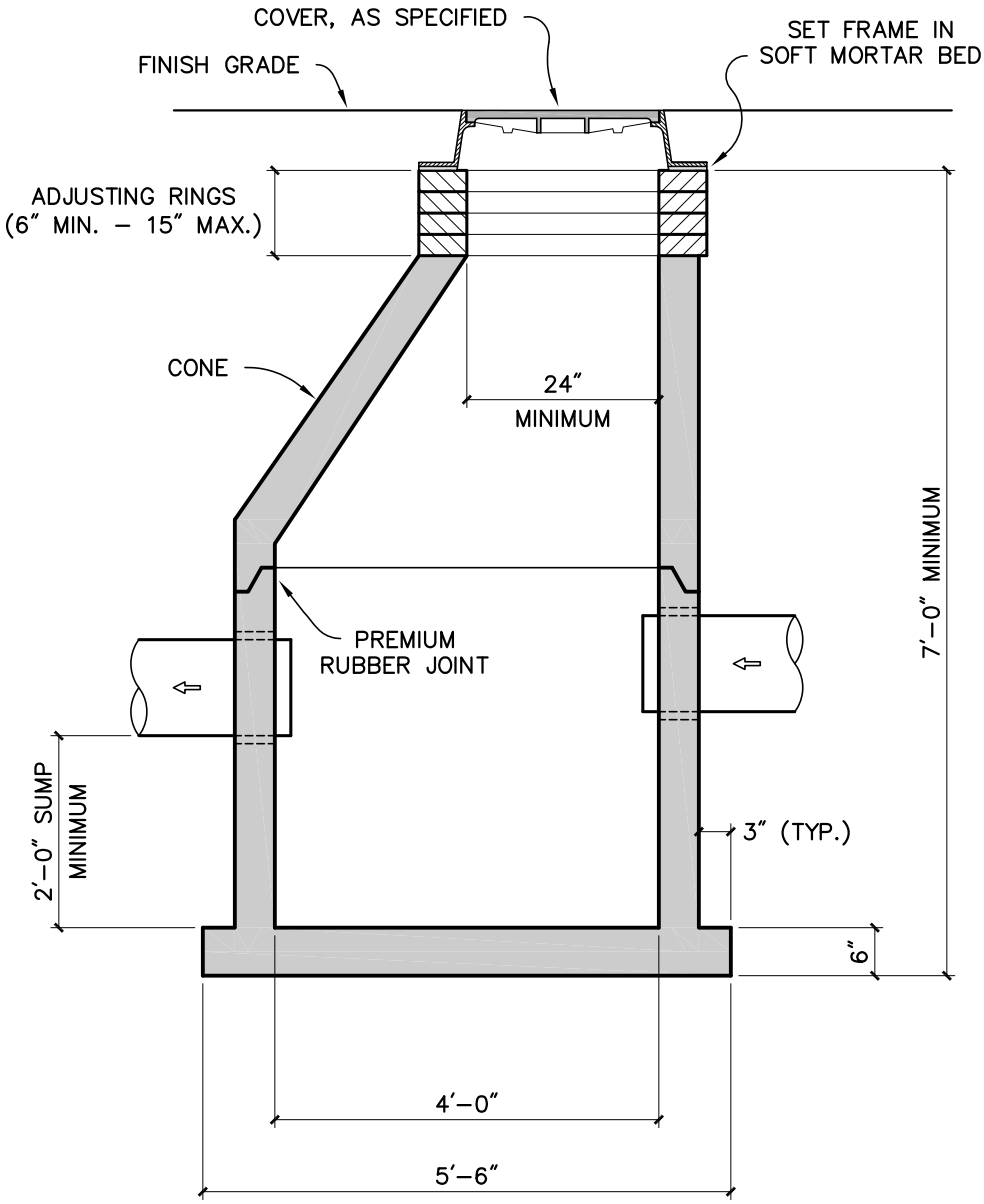
The length of roof/footing drain laterals shall be measured horizontally from the center of the main sewer to the end of the lateral as specified.

7.11.06 Cut-Ins

Cut-ins shall be considered part of the major items of work and no specific payment will be made therefor.

7.11.07 Stubs

Stubs shall be considered part of the major items of work and no specific payment will be made therefor.

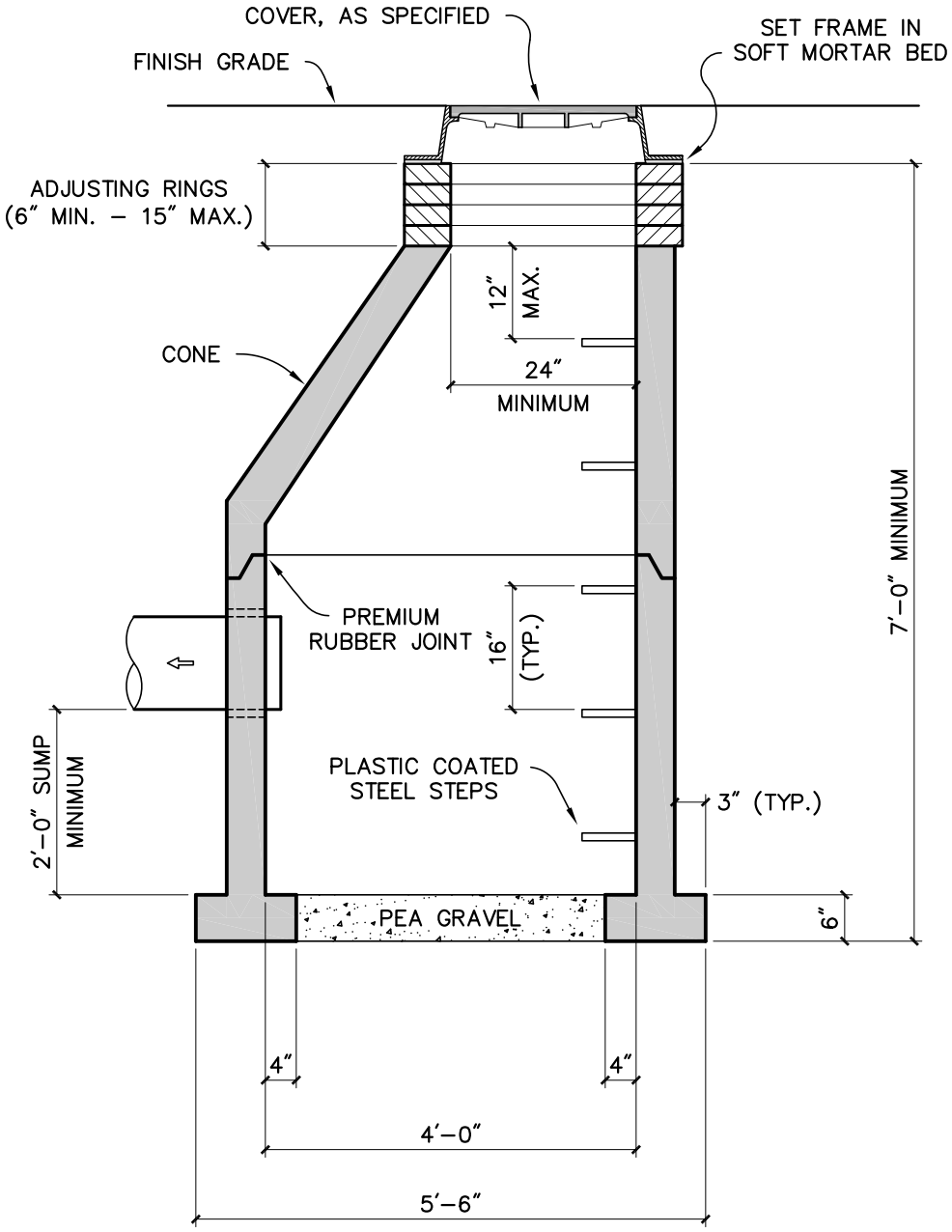



# STANDARD CATCH BASIN

## (PRECAST CONCRETE)

### NOTES

1. PRECAST CONCRETE CATCH BASIN SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED WITH GEOTEXTILE FABRIC.
3. STD. 4'–0" DIAMETER INLET SAME AS CATCH BASIN WITHOUT SUMP.

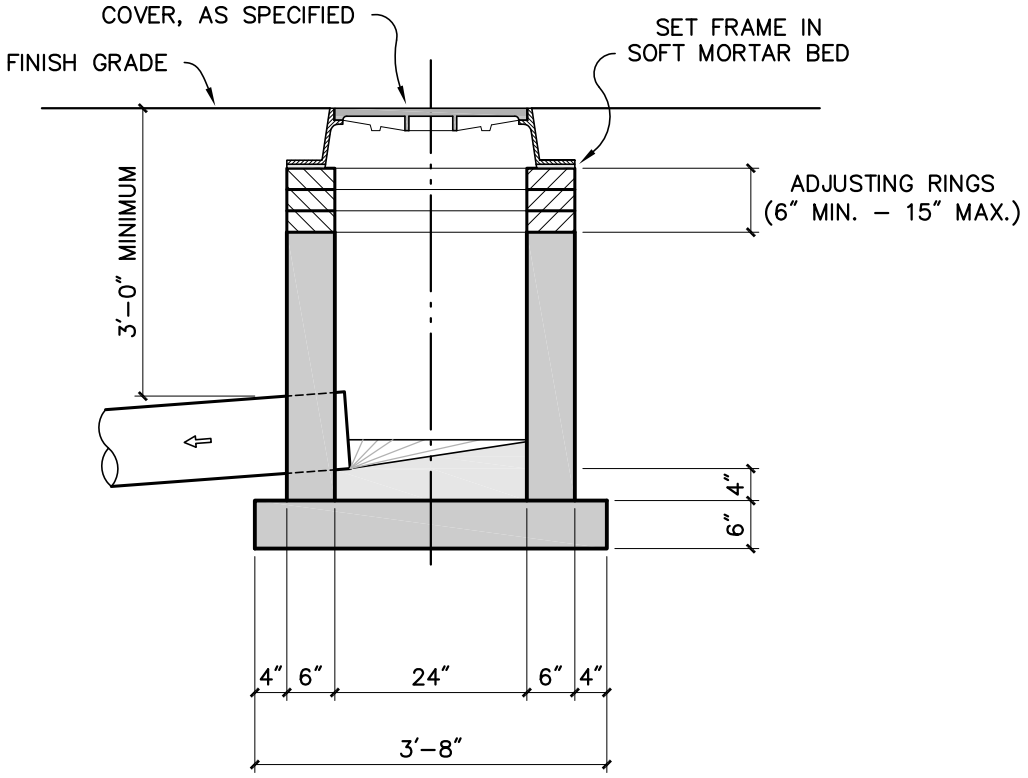



# DRYWELL CATCH BASIN

## (PRECAST CONCRETE)

### NOTES

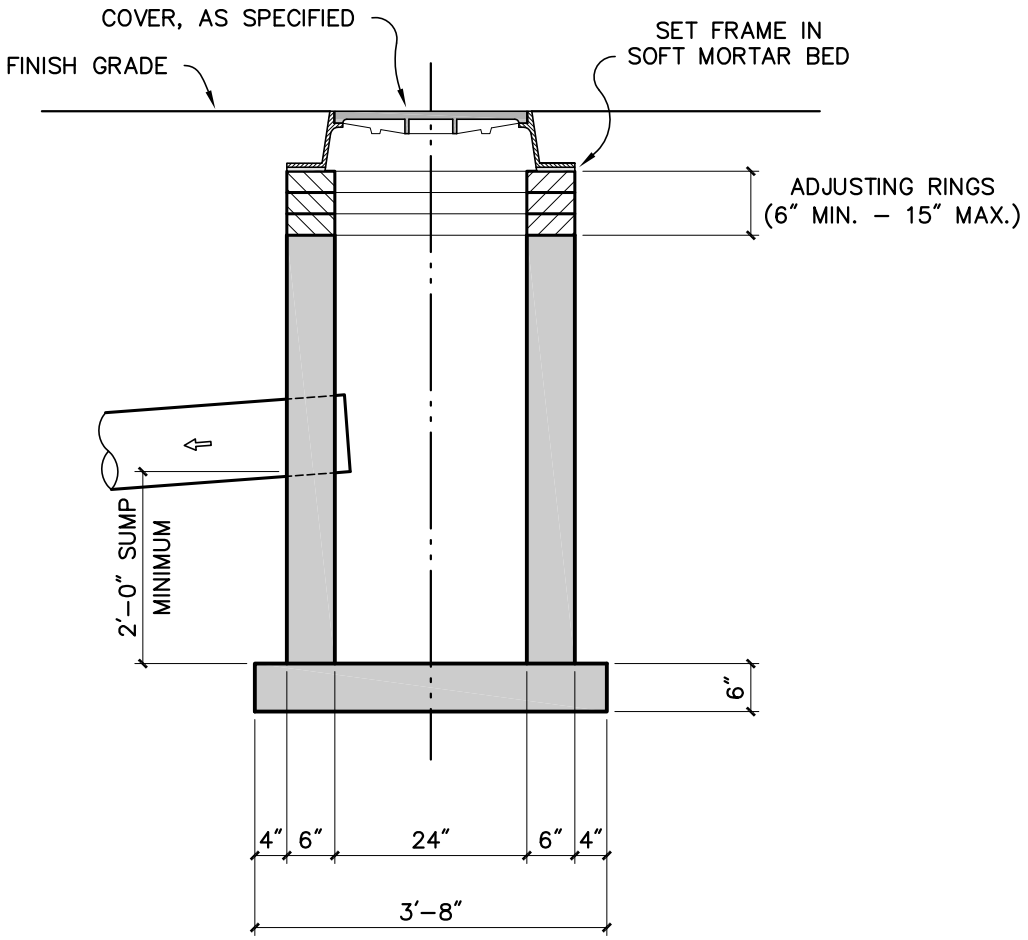
1. PRECAST CONCRETE CATCH BASIN SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED IN GEOTEXTILE FABRIC.
3. STD. 4'–0" DIAMETER INLET SAME AS CATCH BASIN WITHOUT SUMP.




# 2' DIAMETER INLET

## NOTE

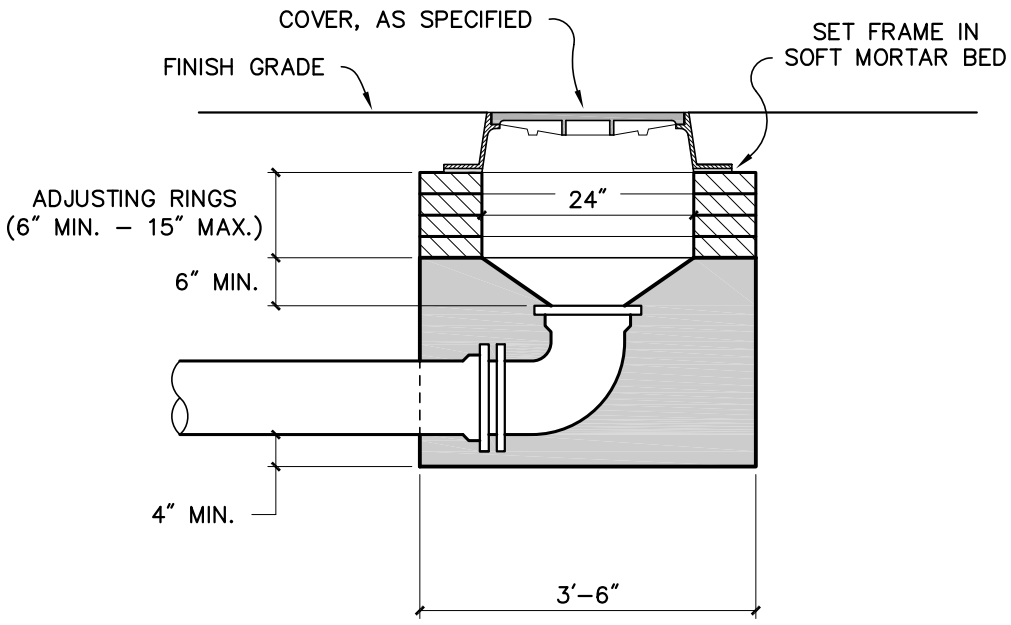
1. PRECAST CONCRETE INLET SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED WITH GEOTEXTILE FABRIC.




# 2' DIAMETER INLET w/SUMP

## NOTE

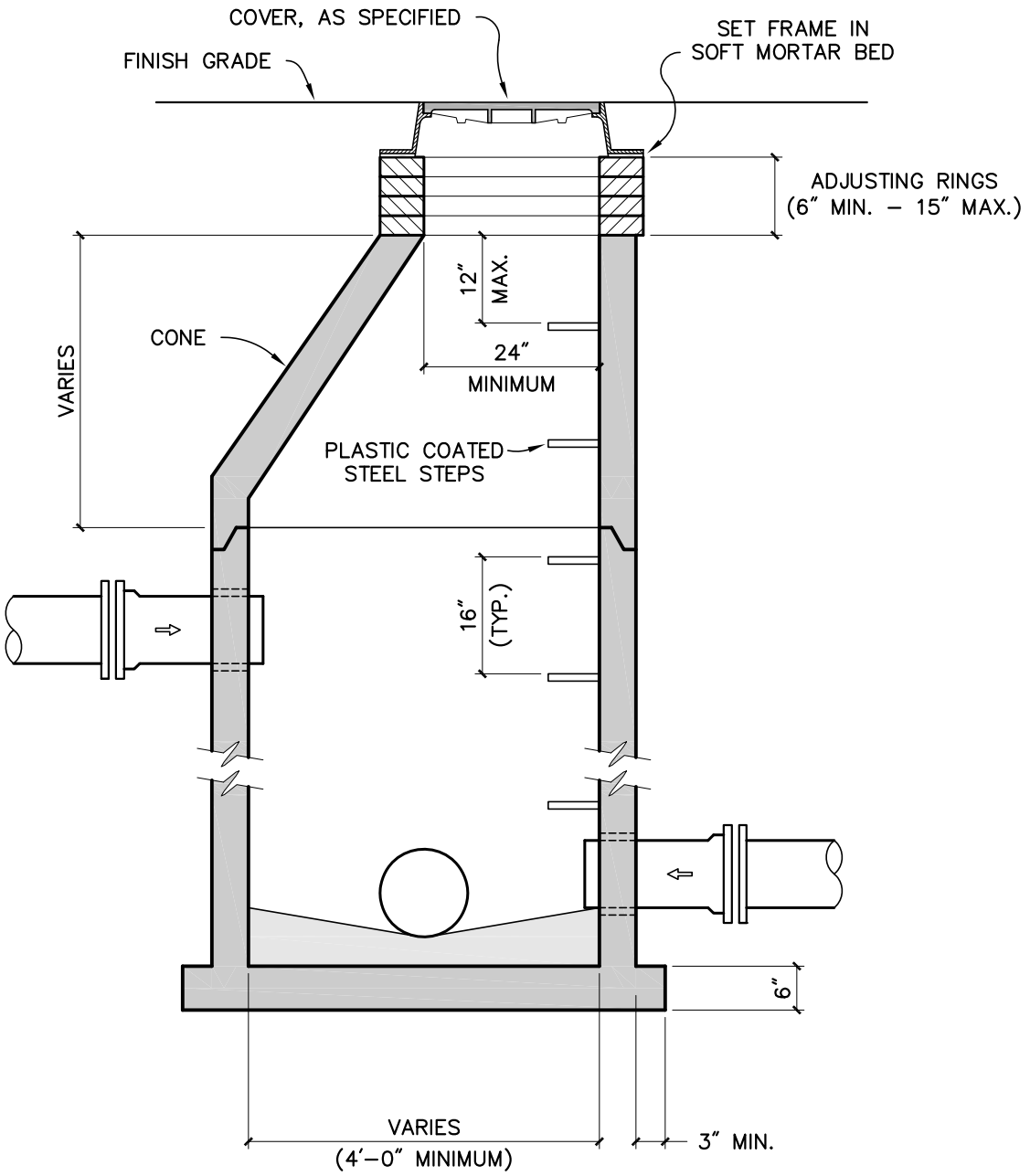
1. PRECAST CONCRETE INLET SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED WITH GEOTEXTILE FABRIC.




# CURB INLET

## NOTE

ALSO SEE "STANDARD CATCH BASIN"
PLANS FOR STD. 4'–0" DIA. INLETS

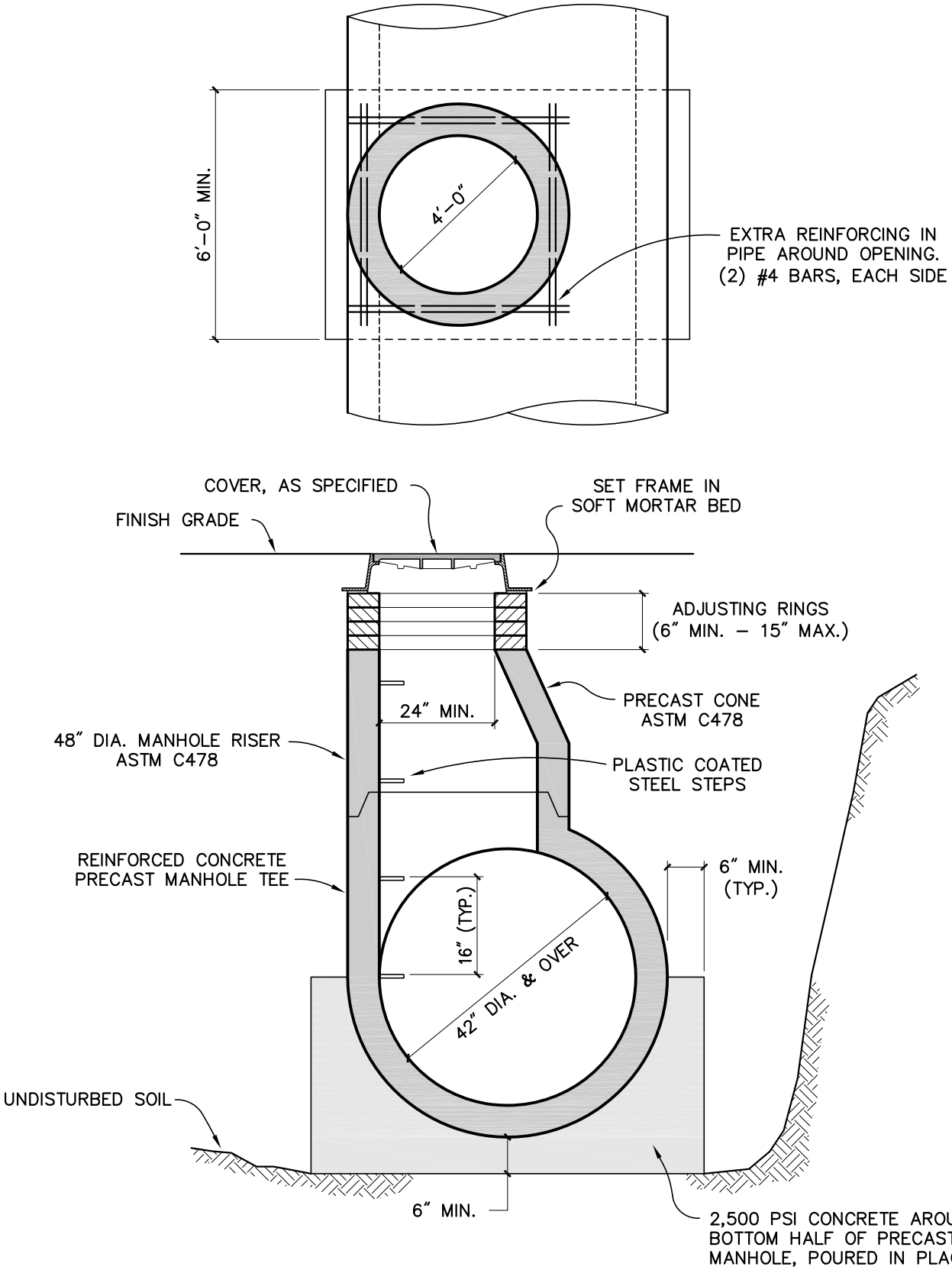



# STANDARD STORM SEWER MANHOLE

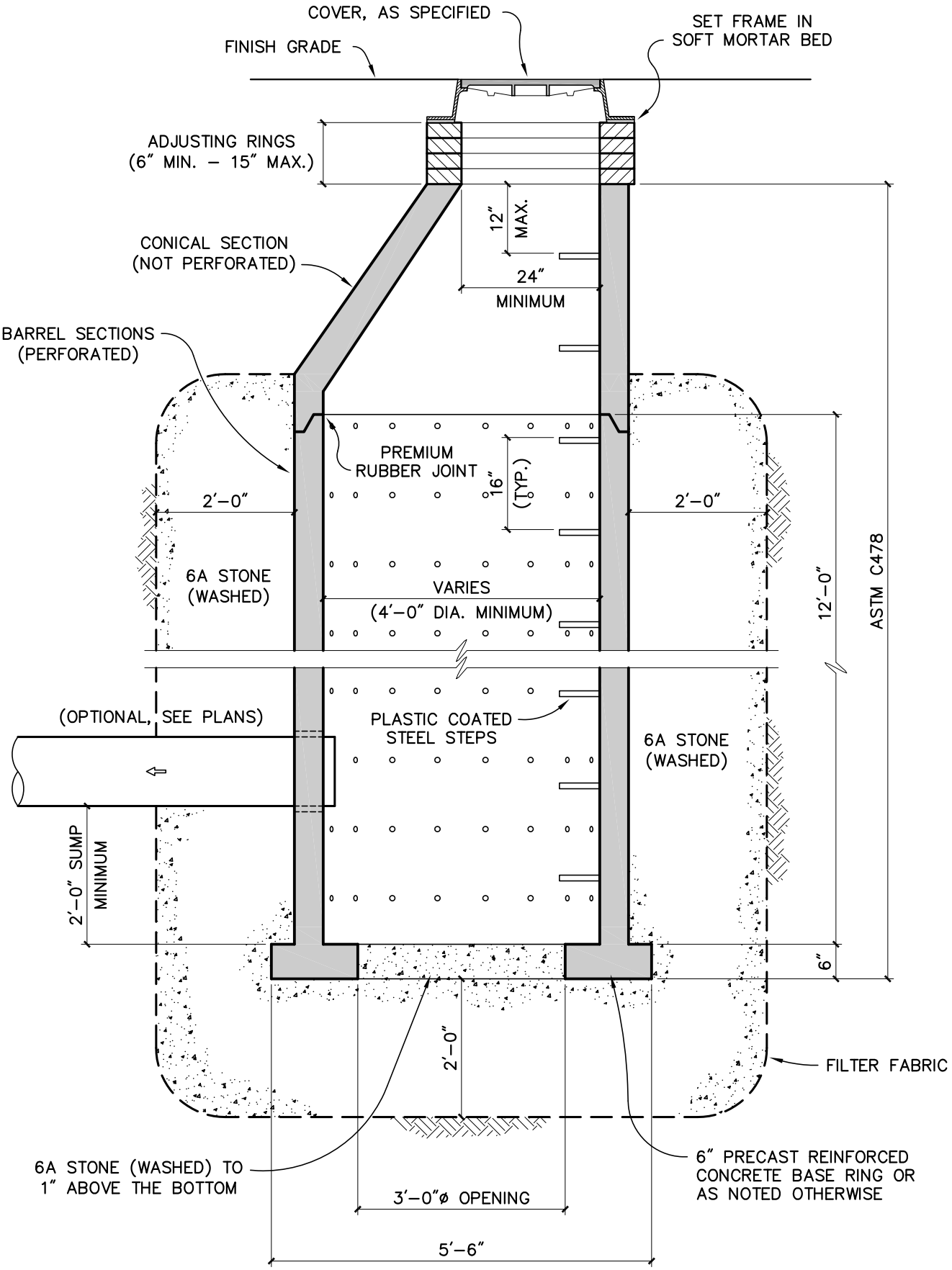
## (PRECAST CONCRETE)

### NOTES

1. PRECAST CONCRETE MANHOLE SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED IN GEOTEXTILE FABRIC.
3. CONE MAY BE ROTATED TO ALIGN STEPS TO VARIOUS LOCATIONS IN MANHOLE.




# STANDARD STORM SEWER TEE MANHOLE




# LEACHING BASIN

# SECTION 8

# SPECIFICATIONS FOR SURFACE RESTORATION

## 8.01 DESCRIPTION OF WORK

All areas disturbed by construction operations shall be restored to the original condition thereof as determined by the Engineer using information from drawings, surveys, and photographs or video tapes when available.

The work shall be performed in accordance with the specifications and drawings, the MDOT 2012 Standard Specifications for Construction and the following specifications.

## 8.02 GRADING

All streets, walks, and other improved surfaces disturbed by construction operations shall be replaced to uniform lines and grades established by the Engineer. The finish grade line will be established within three (3) inches of the existing ground profile shown on the drawings unless a proposed grade is shown which indicates otherwise.

The Contractor shall perform all grading, compacting, shaping, and related work required to prepare the subgrade to the satisfaction of the Engineer. The cost for preparing the subgrade as specified herein shall be incidental to the cost of the project, and no specific payment will be made therefor.

## 8.03 REPLACEMENT OF AGGREGATE STREETS AND DRIVEWAYS

Aggregate streets shall be constructed in accordance with the typical section shown on the drawings and shall consist of a minimum of six (6) inches of aggregate surface course as specified below.

### 8.03.01 Materials

Aggregate surface course shall meet the requirements specified in Section 306 of the MDOT 2012 Standard Specifications for Construction. All material shall be taken from stockpiles that have recently been tested by the county road commission, MDOT, or an independent laboratory.

Aggregate material that is removed from roadways and driveways shall not be reused but shall be replaced with an equivalent depth of newly compacted aggregate conforming to MDOT 22A.

8.03.02 Construction Methods

Placement of aggregate surface course shall be in accordance with the applicable portions of Section 306 of the MDOT 2012 Standard Specifications for Construction.

8.03.03 Aggregate Driveways and Field Drives

Aggregate driveways and field drives shall be replaced with a minimum of six (6) inches of MDOT 22A aggregate compacted in place.

8.03.04 Culverts

Culverts that are removed may be reused, if they are in sound condition. If damaged, the culverts shall be replaced with ASTM C76 Class III concrete pipe or equivalent pipe. The cost of removing and replacing the culverts shall be considered part of the major items of work found in the Proposal unless otherwise specified.

8.03.05 Measurement & Payment

Except as specified in Section 8.04, all replacement of aggregate streets and driveways shall be measured in lineal feet along the centerline of the main line utility being constructed and shall include all final grading and shaping required. The width of gravel replacement will not be considered for payment unless specific items to that end have been provided in the Proposal.

## 8.04 REPLACEMENT OF SURFACE AGGREGATE IN SPECIFIED AREAS

The Contractor shall furnish and place additional aggregate conforming to MDOT Specifications in locations determined by the Engineer for the replacement of aggregate shoulders, drives, and streets where linear measurement (as specified in Section 8.03.05) is impractical, where only part of an existing aggregate surface requires replacement, or where field conditions require replacement of the aggregate to a greater or lesser thickness than six (6) inches as determined by the Engineer.

Aggregate shoulders disturbed by the Contractor's operations shall be restored or replaced to their original width and thickness with aggregate conforming to the requirements of Section 902 of the MDOT 2012 Standard Specifications for Construction for 22A or 23A aggregate as specified.

8.04.01 Measurement & Payment

Surface aggregate shall be measured in tons or cubic yards or as specified in the Proposal. The Contractor shall furnish a truck delivery ticket for each load when it is delivered to the project which clearly states the quantity in tons or cubic yards, date of delivery, and the specific location used on the project. The price per ton or

cubic yard as bid in the Proposal shall be payment in full for furnishing, placing, compacting, and grading the surface aggregate as directed by the Engineer.

Measurement of shoulder restoration shall be in lineal feet along the centerline of the main line utility being constructed directly below the shoulder or in square yards according to the Proposal Item. If there is no Proposal Item for shoulder restoration, it shall be considered incidental to the project, and no separate payment shall be made therefor.

## 8.05 REPLACEMENT OF HOT MIX ASPHALT (HMA) STREETS

Hot Mix Asphalt (HMA) streets shall be constructed in accordance with the typical section shown on the drawings and, unless otherwise specified, shall meet the requirements of 13A in Section 501 of the MDOT 2012 Standard Specifications for Construction placed at 330 lbs./sq.yd. minimum (165 lbs./sq. yd. leveling, 165 lbs./sq. yd. surface) over six (6) inches of compacted 22A aggregate.

### 8.05.01 Materials

Aggregate base for HMA streets shall meet the requirements of 22A in Section 902 of the MDOT 2012 Standard Specifications for Construction. HMA for base, leveling, and surface courses shall be as specified, and shall conform to the requirements of Section 501 of the MDOT 2012 Standard Specifications for Construction. Materials for bond coat shall be as specified in Section 501 of the MDOT 2012 Standard Specifications for Construction.

### 8.05.02 Construction Methods

Aggregate base for HMA streets shall be placed in accordance with Section 302 of the MDOT 2012 Standard Specifications for Construction.

HMA mixtures shall be placed in accordance with the applicable portions of Section 501 of the MDOT 2012 Standard Specifications for Construction. For replacement of valley gutters, pavers shall be equipped with an extension to the vibrating screed adjustable to fit the typical section shown on the drawings.

The Contractor shall not place the aggregate base course until the subgrade has been approved by the Engineer. The Contractor shall not place the first HMA course and each successive HMA course until the underlying aggregate or HMA course has been approved by the Engineer.

### 8.05.03 Saw Cutting

HMA street, driveway and spillway replacement shall include saw cutting the asphalt pavement at the edge of the trench for the full depth of the pavement. Payment for saw cutting shall be included in the pay items for street replacement and driveway replacement unless otherwise specified.

8.05.04 Measurement & Payment

HMA street replacement shall be measured in lineal feet along the centerline of the main line utility being constructed. The width of the street replaced will not be considered for payment, and payment will not be made for any length of street replaced beyond that which is directly above the pipe installed. HMA street replacement may also be measured in square yards or tons as specified in the Proposal.

Aggregate base for HMA shall be considered part of the HMA items, and no separate payment will be made therefor unless a specific Pay Item for aggregate base is listed in the Proposal.

The cost of HMA bond coat shall be considered part of the bituminous paving.

## 8.06 REPLACEMENT OF AGGREGATE SURFACE OR HOT MIX ASPHALT (HMA) PAVED AREAS (PATCHING)

When the drawings and specifications do not require that the Contractor replace an entire street, the surface that is disturbed shall be replaced as specified herein.

8.06.01 Materials

Surfacing aggregate and aggregate base for HMA pavement shall conform to the requirements for 22A aggregate in Section 902 of the MDOT 2012 Standard Specifications for Construction.

Unless otherwise specified on the drawings or in the specifications, HMA 13A, conforming to the requirements in Section 501 of the MDOT 2012 Standard Specifications for Construction, shall be used for HMA patches. When existing seal coat pavement is disturbed, a HMA patch shall be placed.

8.06.02 Construction Methods

When an aggregate surface is disturbed by the Contractor's operations, the edges of the existing aggregate surface shall be trimmed and shall be free of all foreign material before the new aggregate is placed. The subgrade shall be graded and compacted to the proper lines and grades to match the adjacent surface. The aggregate shall be placed in layers not to exceed six (6) inches and shall be compacted to 98% of its maximum unit weight in accordance with MDOT procedures.

When a HMA surface is disturbed by the Contractor's operations, that surface shall be replaced at a thickness equal to the thickness of the existing pavement adjacent to the trench but not less than one and one-half (1-1/2) inches thick. If existing pavement is greater than two (2) inches in thickness, the replacement pavement shall be placed in two or more layers. Aggregate base shall be replaced at a thickness equal to the adjacent aggregate base (minimum six inches) as specified

for aggregate patches above. After placement of the aggregate base but prior to its final shaping and compaction, the edges of the existing pavement shall be trimmed to straight lines a minimum of one (1) foot from the edge of the trench to permit a straight and uniform surface between the existing and new aggregate base. Trimming of the existing pavement shall be by sawcutting or other suitable means approved by the Engineer.

All bituminous valley gutter located in disturbed HMA surface areas shall be replaced by the Contractor. Replacement of valley gutter in disturbed HMA areas shall be considered part of the HMA replacement.

8.06.03 Measurement & Payment

Replacement of aggregate surface shall be measured in lineal feet along the centerline of the main utility line being constructed. HMA paved areas (patching) shall be measured in square feet or square yards of actual aggregate surface and HMA patching replaced. Payment shall be made according to the Proposal Item for the type of surface to be replaced and shall include all trimming, removal, shaping, compacting, aggregate base, and HMA or aggregate surface.

## 8.07 REPLACEMENT OF CONCRETE IMPROVEMENTS

The Contractor shall replace all concrete sidewalk, drives, curb and gutter, and pavement removed during the installation of the utility or broken by the Contractor.

8.07.01 Materials

Concrete shall meet the requirements for Grade S2 Concrete as specified in Section 701 of the MDOT 2012 Standard Specifications for Construction. Other materials shall meet the requirements of the applicable portions of the MDOT 2012 Standard Specifications for Construction.

8.07.02 Construction Methods

The thickness of the concrete shall be the same as the concrete adjacent to the trench but shall not be less than four (4) inches. The alignment and grade and the contour and finish of the surface shall be the same as the concrete adjacent to the trench unless otherwise directed by the Engineer.

Pavements, walks, and drives shall be sawcut at the edges of the trench or removed to existing joints. The depth of the saw cut shall not be less than the full depth of the concrete.

The forms and joints and the methods of placing, curing, and protection shall be consistent with standard practice and shall meet all the requirements of the MDOT 2012 Standard Specifications for Construction for the various items.

8.07.03 Concrete Curb & Gutter (Header Curb, 18 inch, 24 inch, and 30 inch)

Concrete curb and gutter shall match the existing curb and contain two No. 4 steel reinforcing bars. Concrete grade shall be S2. Payment shall be made in lineal feet of curb and gutter replaced. All joints shall be saw cut. Curb and gutter shall be placed in accordance with Section 802 of the MDOT 2012 Standard Specifications for Construction.

8.07.04 Sidewalk and Concrete Driveways

Sidewalk and concrete driveways shall be placed in accordance with Section 801 & 803 of the MDOT 2012 Standard Specifications for Construction. Concrete shall be air entrained. All 6-inch thick concrete sidewalks shall include 6x6-W2.9xW2.9 woven wire steel mesh.

8.07.05 Measurement & Payment

Concrete walks, pavement, and drives will be measured in square feet or square yards of actual concrete surface replaced. Concrete curb and gutter shall be considered part of the construction of the utility line unless a specific item is provided in the Proposal for its replacement. If so specified, the concrete curb and gutter or valley gutter replacement shall be paid for in lineal feet measured along the face of a header curb or along the flow line of gutter when constructed as part of the curb. Concrete that has been broken by the Contractor outside the limits of the trench will not be considered for payment unless otherwise specified.

## 8.08 REPLACEMENT OF LAWN IMPROVEMENTS

8.08.01 Underground Sprinkling Equipment

Underground sprinkling lines, valves & heads, and water system curb stops and boxes are specifically excluded from the pay items. The Contractor shall take the necessary precautions to preserve this equipment during construction. Any underground sprinkling equipment disturbed by the Contractor shall be replaced at the Contractor's expense.

All underground sprinkling equipment shall be replaced in a timely fashion so as to minimize damage to the lawn areas. The Contractor will be responsible for any lawn damage caused by delayed replacement of the sprinkling equipment.

8.08.02 Fences

Fences, which are removed for construction, shall be replaced with equal or better type and size. The cost of removing and replacing the fences shall be considered part of the major items of work found in the Proposal unless otherwise specified.

8.08.03 Ornamental Shrubbery and Bushes

Ornamental shrubbery and bushes that are removed during construction shall be replaced in kind and size in a vigorous growing condition. Replacement costs shall be considered part of the major items of work found in the Proposal unless otherwise specified. All shrubs and bushes replaced shall be insured by a one-(1) year warranty commencing from the date of installation.

## 8.09 TURF RESTORATION

All areas of established turf shall be replaced as nearly as possible to their original condition.

8.09.01 Topsoil

Topsoil shall be placed at a minimum depth of four (4) inches over all areas disturbed by the Contractor's operations. The subgrade shall be graded to conform to the adjacent contours and shall be approved by the Engineer before placing topsoil. The topsoil shall then be placed in accordance with Section 816 of the MDOT 2012 Standard Specifications for Construction.

The soil shall be dark, organic natural surface soil, exclusive of muck or peat, suitable for the establishment of grass or other vegetable growth.

8.09.02 Fertilizer

After the topsoil has been placed, it shall be fertilized with a starter fertilizer at the rate of two (2) pounds per 1,000 square feet, in proportions of 16% nitrogen, 32% phosphoric acid, and 3% potash, or as directed by the Engineer. Fertilizer shall be applied just before the placing of the seed to retain its full benefit before unfavorable weather can cause deterioration.

8.09.03 Seeding

All previously seeded lawn areas shall be reseeded with Class A seed. Other areas disturbed by the Contractor's operations shall be seeded with Roadside seed. Temporary seed shall be placed for erosion control or temporary soil stabilization of stockpile areas. Seed mixtures, application rates, and methods shall be in accordance with Section 816 of the MDOT 2012 Standard Specifications for Construction.

Seasonal limitations on seeding in Section 816 of the MDOT 2012 Standard Specifications for Construction are waived. The Contractor shall repeat the seeding procedure as often as necessary to produce a close stand of weed-free grass.

8.09.04 Mulching

All seeded areas shall be mulched immediately following the seeding. Mulching shall be applied to all newly seeded areas at a rate of two (2) tons per acre in accordance with the requirements of Section 816 of the MDOT 2012 Standard Specifications for Construction, or as directed by the Engineer. Separate loose straw mulch is prohibited on residential lawn areas.

8.09.05 Hydro Application

All fertilizing, seeding and mulching shall be applied by an approved Hydro seeding and mulching process unless separate applications as heretofore described are approved by the Engineer.

8.09.06 Erosion Control

All erosion control measures shall be installed and maintained in accordance with the Soil Erosion and Sedimentation Control plan and permit. Unless otherwise specified, mulch blanket and high velocity blanket shall be placed in accordance with Section 816 of the MDOT 2012 Standard Specifications for Construction.

8.09.07 Sod

Sod shall be placed only where directed by the Engineer or as noted on the drawings or specifications.

All sod shall be nursery grown, conforming to MDOT requirements for Class A. Sod shall be approved by the Engineer before placing and shall be placed in accordance with the requirements of Section 816 of the MDOT 2012 Standard Specifications for Construction. The base on which the sod is to be laid shall consist of a minimum of four (4) inches of topsoil placed, watered and fertilized in the same manner required for seeding.

8.09.08 Measurement & Payment

Turf restoration will be measured in lineal feet along the centerline of the main utility line being constructed. Payment will be made according to the appropriate item for seeding or sod. Topsoil, fertilizer, mulch and erosion control shall be incidental to these items unless specific proposal items are provided. Any area disturbed by the Contractor's operations outside of the limits of the trench shall be restored by the Contractor to its original condition but will not be considered for payment.

## 8.10 SCHEDULING OF RESTORATION WORK

Initial restoration (rough grading, temporary aggregate if necessary, removal of excess excavated material and debris) shall be done each day to the extent necessary to allow the movement of local traffic and permit access to all properties

for emergency vehicles. Maintenance of streets, drives, sidewalks, etc. shall be the responsibility of the Contractor (including dust control, grading, stabilization, etc.) until the restoration is complete and has been accepted by the Engineer.

Restoration of each street or section of utility line shall follow the construction in a timely fashion so as to minimize inconvenience to the adjacent property owners and the general public. The manner in which this restoration is done by the Contractor will be a determining factor in the approval by the Engineer of staking requests and partial payment requests.

## 8.11 LIMITS FOR MEASUREMENT & PAYMENT FOR SURFACE RESTORATION

All work necessary to return the area of construction operations to its original condition, other than the items listed in the Proposal, shall be considered incidental to the construction, and no specific payment will be made therefor.

For surface restoration items measured in lineal feet, payment will be based upon the type of surface that is directly above the utility. Only one surface restoration item shall be paid for each lineal foot of utility. Additional restoration on either side of the utility to the limits of construction will be done by the Contractor at no additional cost to the Owner. For example, when the utility is directly under the bituminous street, only the item of bituminous street restoration will be paid. Topsoil, seed, fertilizer and mulch required to restore the area adjacent to the street will not be paid for separately.

Payment will be made for the proposal items only. All of the work specified above and indicated on the drawings will be considered included in the unit prices.

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