

DETAILED SPECIFICATIONS FOR SEWER CONSTRUCTION  
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**DEFINITIONS & ABBREVIATIONS**

Whenever in the specifications, or in any documents or instruments in construction operations where the specifications govern, the following abbreviations, terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Abbreviations

AASHTO	The American Association of State Highway and Transportation Officials
AISI	The American Iron and Steel Institute
ANSI	The American National Standards Institute
ASTM	The American Society of Testing and Materials
AWWA	The American Water Works Association
HDPE	High density polyethylene
NAVD88	The North American Vertical Datum of 1988
OSHA	Federal Occupational Safety and Health Administration
PE	Polyethylene plastic
PVC	Polyvinyl chloride
SDR	Standard dimension ratio
UL	Underwriters Laboratories, Inc.
WDNR	Wisconsin Department of Natural Resources
WisDOT	Wisconsin Department of Transportation

Definitions

1. Change Order shall be understood to mean a written order by the authorized representative of the Owner covering work not otherwise provided for, revision in or amendments to the Contract, or conditions specifically prescribed in the specifications as requiring contract change orders. Such document becomes part of the Contract.
2. City, Municipality, Owner shall be understood to mean the City of Fond du Lac, Wisconsin.
3. Contractor shall be understood to mean the individual, firm, partnership or corporation or a combination of any or all jointly submitting a proposal to whom the Contract is awarded by the Owner or its heirs, executors, administrators, successors, or assigns.
4. Contract shall be understood to mean the written agreement between the Owner and the Contractor setting forth the obligations of the parties to the contract, including, but not limited to, performance of the work, furnishing of labor and materials, and basis of payment. The Contract includes the advertisement for bids, proposal, contract form, performance bond, detailed specifications, special provisions, addenda, general plans, detailed plans, notice to proceed, and contract change orders and agreements required to complete the construction of the work in an acceptable manner, including authorized extensions, all of which constitute one instrument.
5. Engineer shall be understood to mean the City Engineer of the City of Fond du Lac, Wisconsin or any person designated by the City Engineer to perform a particular task. The Engineer shall have the full decision-making authority on behalf of the City as described or reasonably implied in this Contract.
6. Plans shall be understood to mean all drawings or reproductions of drawings, including profiles, sections, and sketches which have been made for the purpose of representing the work to the Contractor, all of which are to be considered a part of the Contract. Plans and drawings are used synonymously.
7. Special Provisions shall be understood to mean the special body of directions, provisions, or requirements peculiar to a project, and otherwise not thoroughly or satisfactorily detailed or

described in the specifications. The requirements of these Special Provisions shall govern the work and shall take precedence over the specifications or plans whenever they conflict.

## **SITE PREPARATION**

### Scope

This section includes all plant, labor, equipment, and appliances as required or necessary to clear and prepare the work site for further construction as shown and specified.

### General Requirements

Site preparation shall be performed in such a manner as not to harm lawns; trees; shrubs; landscape work; fences; sanitary and storm sewer pipes and structures; hydrants; water mains; electrical and communication conduits, wires, and structures; pavement; sidewalks; and curb and gutter that are to remain in place. Adequate protection shall also be provided for vehicle and pedestrian traffic in the vicinity of any open excavation. Such protection shall be maintained as long as necessary to prevent damage from the Contractor's operations. Any damage that may occur shall be repaired by the Contractor at no cost to the Owner.

When damage is done to water laterals (service), sanitary sewer laterals (house connections), or any other underground facilities belonging to the Owner, which facilities are not being removed or abandoned, such damage will be repaired by the Contractor's forces to the satisfaction of the Engineer. If the Contractor cannot, or does not wish to, make such repairs, said repairs will be made by the Owner's forces and the Contractor shall be charged for the actual cost of such repairs on a time and material basis. Any charges for repairs of said damages will be deducted from moneys due the Contractor.

### Construction

The Contractor shall perform all clearing and grubbing, and perform all demolition and removal work as required and shown for the proper construction and completion of the work.

### Clearing and Grubbing

The site shall be cleared of all trees, stumps, logs, tree trimmings, roots, brush, heavy sod, vegetation, rocks in excess of six inches, debris, and other obstruction of whatever kind or character as required to perform the work. Do not remove or damage trees that do not interfere with the work, and properly treat any damaged trees that can be saved. Where trees are required to be removed, the trunk and branches shall be completely removed, with tree stumps and root systems left in place unless required to be removed because of interference in performing the work. All tree trunks and limbs greater than two inches in diameter shall be cut into 16 inch lengths, and those two inches or less in diameter shall be chopped into wood chips. All material shall be removed from the site of the work and disposed of by the Contractor in a manner acceptable to the Engineer. Open burning on the site of the work will not be permitted.

After clearing and grubbing, the topsoil shall be stripped. The topsoil may be stockpiled as required for reuse, or it may be removed from the site of the work and replaced with acceptable imported topsoil. If the topsoil is stockpiled, care shall be taken to prevent mixing with the subsoil. All soil stockpiles existing for more than seven days shall be temporarily seeded or otherwise stabilized to the satisfaction of the Engineer. Excess topsoil shall be removed from the site of the work and disposed of by the Contractor.

### Demolition and Removal

1. All structures including superstructures, foundation walls, footing, slabs, and other on-grade or below-grade construction shall be demolished and removed. Excavations caused by removal of existing structures shall be cleaned of all waste and debris.
2. The removal of pavement shall be made along sharp, clean, saw cut lines as shown or required. Curb and gutter shall be saw cut, on a neat line at right angles to the curb face. All concrete or asphalt shall be saw cut to a minimum depth of three inches. If a saw cut in concrete pavement or curb and gutter falls within three feet of a construction joint, cold joint, expansion joint or edge the concrete shall be removed to the joint or edge.
3. A drop weight or other type of machinery for breaking pavement may be used when such usage does not become a nuisance or a source of damage to underground or adjacent utilities or structures. Before employing a drop weight, the Contractor shall verify that there are no nearby underground or adjacent utilities or structures that could be damaged by its use. The Owner reserves the right to order the discontinuance of the use of a drop weight at any time.

### Basis of Payment

No separate payment will be made for work specified in this section. All costs involved with site preparation work for the sewer installation shall be included in the unit price for the work it is associated with.

## **EROSION & SEDIMENT CONTROL**

### Scope

This section describes the erosion and sediment control measures to minimize erosion and the discharge of sediment as shown and specified until site restoration, landscaping, and paving are complete.

### General Requirements

1. Erosion and sediment control shall strictly comply with the guidelines and requirements set forth in Section 628 of the Standard Specifications for Highway and Structure Construction. In addition, the methods outlined in the WDNR Conservation Practice Standards (Technical Standards), shall be utilized. The Contractor shall comply with all requirements of the State of Wisconsin Construction Site Storm Water Runoff General Permit.
2. The methods and types of erosion and sediment control will be dependent on the location and type of work involved and shall be adjusted to meet field conditions at the time of construction. Sediment control practices shall be installed prior to any grading or disturbance of existing surface material. All temporary sediment control practices shall remain until the site has been completely stabilized (pavement placed and at least 70% vegetative cover established) and removed at that time.
3. Erosion and sediment control practices shall be inspected for integrity weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period. Any damaged practices shall be corrected and restored by the end of each working day.

### Materials

All manufactured erosion and sediment control products shall be found on the WisDOT Product Acceptability List.

### Maintenance

All erosion and sediment control measures shall be maintained until the site is stabilized.

### Basis of Payment

The cost for erosion and sediment control measures not having a discrete pay item shall be considered incidental to construction.

## **GENERAL REQUIREMENTS FOR SEWER CONSTRUCTION**

### Scope

This section describes general requirements for sewer construction.

### General Requirements

#### Project Closeout Requirements – Record Drawings

The owner or developer of newly installed sanitary sewer pipe and manhole shall provide the Village of North Fond du Lac or Sanitary District Owner and the City of Fond du Lac a digital copy of record drawings for each project. Submittal shall be made to the attention of the City of Fond du Lac Director of Public Works. Acceptable formats include AutoCAD files or ESRI geodatabase or shape files; geodatabase files are preferred. Similar digital files can be accepted with prior approval from the Technical Standards Committee. Handwritten plan sheets, Adobe PDFs, or similar formats are not acceptable. Record drawings shall be in Fond du Lac County Coordinate System with NAVD88 datum elevations. Required information is final location and elevation of sanitary sewer manholes, lift stations, or cleanouts; pipe size, direction, and invert; and sanitary wyes and lateral end or connections. City of Fond du Lac projects are exempt from these requirements.

### Materials

#### Submittals

The Contractor shall submit to the Engineer two copies of current manufacture's specifications, mix designs, sieve and fracture analyses and construction details for review prior to installation or fabrication. All submittals shall be provided a minimum of two weeks before a proposed material will be used or a structure will be constructed or installed. Each submittal shall indicate the proposed material or structure, compliance with specified standard(s), supplier and manufacturer's name, address and phone number. The Contractor may consider a submittal reviewed upon receiving one copy bearing the stamp of review and signature of the Engineer. Any submittal rejected by the Engineer shall be resubmitted for approval prior to installation or fabrication. No materials subject to construction detail review shall be ordered prior to receipt of an approved submittal. Materials installed shall match approved submittals. The Owner reserves the right to randomly sample and test at any time during the project.

#### Substitution of Materials

Whenever, in any part of the Contract documents, an article, material, or equipment is defined by a proprietary product, or by using the name of a manufacturer or vendor, the term "or equal", if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired and shall not be construed in such manner as to exclude manufacturer's products of comparable quality, design, and efficiency.

The Contractor shall submit plans, manufacturer's data, shop drawings, specifications, test results, certifications, or other pertinent data for any materials other than those covered by the contract documents. In all cases the proposed substitute must be approved by the Engineer in writing. The

Engineer shall have the sole discretion to make this determination. In the event of such substitution, the Owner may require from the Contractor a credit deduction from the contract amount equal to any saving in material cost resulting from use of the proposed substitute.

#### Insulation

Insulation used for frost prevention shall be expanded or extruded polystyrene foam insulation with a minimum thickness of two inches with a minimum "R" value of 8.7 (at 75 degrees Fahrenheit mean temperature). Insulation shall have a minimum compressive strength of 40 psi.

#### Tracer Wire

For direct burial installations, tracer wire shall be 12 AWG, copper-clad steel wire with a minimum 280 lb. break load, with a minimum 30 mil insulation thickness, and complying with **ASTM B910 / B910M, ASTM B170, and ASTM D1248**. For directional drilling or boring installations, tracer wire shall be 10 AWG, copper-clad steel wire with a minimum 1,150 lb. break load, with a minimum 45 mil insulation thickness, and complying with **ASTM B869, ASTM B170, and ASTM D1248**. Tracer wire for sanitary or storm sewer installation shall have green colored insulator.

#### Tracer Wire Connectors

Tracer wire connectors shall be designed for direct bury installations. Tracer wire connectors shall be Copperhead SnakeBite Locking Connectors or 3M DBR connectors.

#### Tracer Wire Terminal Location Boxes

Tracer wire terminal location boxes shall traffic rated boxes by Bingham & Taylor with a cast iron lockable top. Cast iron tops shall be labeled "SEWER".

#### Tracer Wire Ground Rod

Tracer wire ground rods shall be a drive-in magnesium grounding anode rod with a minimum of 20 feet of 12 AWG red colored insulated copper-clad steel wire connected to anode (minimum 1.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the sewer.

#### Portland Cement

All cement shall be delivered to the job site in original packages bearing the type and brand name or stamp of the manufacturer. Bulk cement may be used at ready-mixed concrete plants only. Cement containing lumps or crusts shall not be used.

Use cement conforming to ASTM specifications as follows:

- Type I portland cement; **ASTM C150**
- Type IS portland blast-furnace slag cement; **ASTM C595**, except maximum slag content is 30 percent

#### Air-Entraining Admixtures

Use air-entraining admixtures conforming to **ASTM C260**.

#### Aggregates for Portland Cement Concrete

Coarse and fine aggregates shall comply with **ASTM C33** except as modified by these specifications.

Fine aggregate shall consist of sand composed of clean hard, tough, durable grains of approved inert materials from natural deposits and shall conform to the gradation requirements of **Table 1**.

**Table 1****Fine Aggregate**

U.S. Standard Sieve Size	Percent Passing by Weight
$\frac{3}{8}$ Inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

Coarse aggregates shall comply with **ASTM C33**, Size 67 for No. 1 and **ASTM C33**, Size 4 for No. 2 except as modified by these specifications.

Coarse aggregates shall consist of clean, hard, tough, durable crushed rock, crushed gravel or gravel free from adherent coatings, soft, flat or elongated particles and free from vegetation or other deleterious substances and shall meet the gradation requirements in **Table 2** and **Table 3**.

**Table 2****No. 1 Crushed Stone**

U.S. Standard Sieve Size	Percent Passing by Weight
1 Inch	100
$\frac{3}{4}$ Inch	90-100
$\frac{3}{8}$ Inch	20-55
No. 4	0-10
No. 8	0-5

**Table 3****No. 2 Crushed Stone**

U.S. Standard Sieve Size	Percent Passing by Weight
2 Inch	100
1½ Inch	90-100
1 Inch	20-55
$\frac{3}{4}$ Inch	0-15
$\frac{1}{2}$ Inch	0-5

Gradations not meeting these requirements may be accepted if the composite gradation of Size No. 1 combined with Size No. 2 meets the gradation of Size No. 467 of **ASTM C33**.

Water for Concrete

Use drinking water from municipal water supplies whenever possible. Where municipal water is not available, water which is free of oil, acid, excessive alkalinity, organic matter and other harmful ingredients may be used with the approval of the Engineer.

Cellular Concrete

Cellular concrete shall be produced by mixing a predetermined quantity of preformed foam with a concrete slurry mixture of Type I portland cement and water. The compressive strength and wet density of the resulting concrete mix shall be as specified in the Special Provisions. Fine aggregate may be added to the slurry mixture to obtain the specific concrete density and strength requirements. A foam generator, approved by the foaming agent manufacturer, shall be used to produce a predetermined quantity of preformed foam which shall be injected into the mixer and blended with a concrete slurry. Two type of foam generating systems, batch and continuous generating, are acceptable. The foaming agent used to generate the preformed foam shall comply with **ASTM C869** when tested in accordance with **ASTM C796**. Concrete admixtures may be used with the foaming agent in accordance with the manufacturer's recommendations. Equipment used to mix and pump cellular concrete shall be specifically designed for this purpose.

## Construction

### Existing Sewers

The Contractor is responsible for maintaining an active sanitary and storm sewer system at all times including during rain events. If pumping is required, it shall be incidental to the cost of construction unless specified otherwise.

### Line and Grade for Open-Cut Construction

The Contractor shall use a laser beam to facilitate the installation of the sewer mains unless an alternate method is approved by the Engineer. The Owner will provide line and grade stakes for construction unless noted otherwise in the Special Provisions. Staking requests shall be made a minimum of three working days prior to the time the stakes are needed. The Contractor shall take adequate measures to protect said stakes, if said stakes are disturbed by carelessness of the Contractor or his forces, the cost of resetting will be deducted from monies due to the Contractor.

### Laying of Pipe

1. Begin laying pipes in finished trenches at the lowest point and proceed towards the upper end, also lay the pipe so the spigot or tongue ends point in the direction of flow. Any other procedure shall be used only with permission of the Engineer.
2. The Contractor shall verify the location, elevation, material, and size of all connections to existing upstream structures and pipes prior to installing new pipes.
3. Thoroughly clean dust, dirt, and other foreign matter from joining surfaces of the bell or groove end of pipe and the spigot or tongue ends before lowering pipes into trenches.
4. Lower and place the pipes to avoid unnecessary handling in the trench or damage to the pipe. Provide a firm bearing beneath the entire length of each section and make it substantially true to the line and grade required.
5. Lay pipes with ends abutting. Take care when shoving the pipes together so the joints are properly adjusted and not overly large. Fit and match the pipes so that if set firmly in line and grade they form a sewer with a smooth and uniform invert.
6. During the laying of sewer lines and appurtenances, due care shall be taken to protect pipe, fittings, and joints from disturbance or damage.
7. Pipe cutting shall be done in a neat workmanlike manner without damage to the pipe and so as to leave a smooth end.
8. After installing the pipe, seal lift holes with suitable concrete or other Engineer-approved plugs.
9. During all intermissions in construction of the sewer, the open face of the last pipe shall be covered or bulkheaded so as to prevent sand, water, earth or other materials from entering the pipe.

10. Provide joint ties on concrete storm sewer system infall and outfall pipes. Tie the last three sections or, if using apron endwalls, the endwall and the last two sections. Ties are not required on installations with masonry endwalls unless the plans show otherwise.

#### Laying Pipe in Cold Weather

1. The Engineer reserves the right to order pipe-laying discontinued whenever, in his/her opinion, there is a danger of the quality of work being impaired because of cold weather.
2. The Contractor shall be responsible for heating the pipe and jointing material so as to prevent freezing of joints.
3. No pipe shall be laid on or in frozen ground.

#### Cleaning of Sewer Pipes

Clean out all new or re-laid sewer pipes of accumulations of silt, debris, and other foreign matter.

#### Testing

Testing procedures shall conform to the testing section of these specifications.

#### Sanitary Sewer Main & Laterals Insulation

Sanitary sewer main and laterals constructed within five feet of the ground surface or within two feet of a catch basin or inlet shall be protected with insulation. The minimum width of insulation varies with the depth of ground cover as shown in **Table 4**. The width of insulation is not required to exceed the trench width when the width in **Table 4** exceeds the constructed trench width.

**Table 4**  
**Minimum Width of Insulation**

Depth of Sewer (Feet)	Minimum Width of Insulation (Feet)
2.0	8
2.5	7
3.0	6
3.5	5
4.0	4
4.5	3
5.0	2

Prior to placement of the insulation, bedding material shall be placed to a height six inches over the top of the pipe, leveled and compacted. The insulation shall be placed on the cover material with the long side parallel to the centerline of the pipe. The insulation shall be placed in a staggered arrangement so as to eliminate continuous transverse joints. The first lift of backfill material shall consist of six inches of bedding material which shall be end or side dumped onto the insulation and spread in such a manner that the construction equipment does not operate directly on the insulation. This layer shall be compacted with equipment that exerts a compact stress of 70 to 80 psi. Once this layer has been compacted to the specified density, the remaining layers of backfill may be constructed utilizing conventional procedures.

#### Tracer Wire

1. Provide tracer wire for force mains and pipes installed using trenchless construction methods. A minimum of two wires shall be provided for pipes installed using trenchless construction methods. The tracer wire shall be secured to the pipe every five feet using a minimum of two



wraps of tape around the pipe. The tracer wire shall be placed in the same orientation to all installed pipe.

2. Provide 36 inches of additional wire at all terminations.
3. Tracer wire systems shall be installed as a continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
4. Tracer wire shall be properly grounded at all dead ends and stubs.
5. All new tracer wire installations shall be located using typical utility locating equipment in the presence of the Engineer prior to acceptance.

#### Concrete

1. Portland cement concrete shall be composed of a mixture of portland cement, fine and coarse aggregates and water as required for the class of concrete specified.
2. The air content by volume of air-entrained concrete containing No. 1 and No. 2 coarse aggregate shall be between 4 and 7% and between 4.5 and 8% when the concrete contains only No. 1 coarse aggregate.
3. Concrete delivered at air temperatures lower than 45 degrees Fahrenheit shall have a minimum temperature of 50 degrees Fahrenheit. The maximum temperature of concrete produced shall at no time during its production or transportation exceed 90 degrees Fahrenheit. The Engineer reserves the right to order concreting discontinued when the air temperature falls below 35 degrees Fahrenheit.

#### Concrete Classification

The classes of concrete to be used for the different items of construction, except when otherwise specified, shall be in accordance with **Table 5**.

**Table 5**  
**Concrete Classification**

Class of Concrete	Minimum Bags of Cement Per Cubic Yard	Type of Cement Required	Size of Coarse Aggregate
A	7.0	Type I or Type IS	No. 1 & No. 2 or No. 1
C	6.0	Type I or Type IS	No. 1 & No. 2 or No. 1
D	5.5	Type I or Type IS	No. 1 & No. 2 or No. 1
Backfill Concrete	2.25	Type I or Type IS	No. 1
Cellular Concrete	8.0	Type I	None

Use Class A concrete for high early strength concrete. Use Class C concrete for manholes or other structures constructed in open cut, concrete collars and outside drops. Use Class D concrete for concrete envelope, cradles, and caps.

#### Protection of New Concrete

1. Adequate equipment shall be provided for heating concrete materials and protecting concrete when the temperature is below 35 degrees Fahrenheit. No frozen materials or materials containing ice or snow shall be used. All reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from ice and snow. All concrete placed in forms shall have a temperature of 50 degrees Fahrenheit or higher after placement. Adequate means shall be provided for maintaining this temperature for three days.
2. In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided as directed by the Engineer. Concrete deposited in hot weather shall not have a

placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperatures shall be less than 80 degrees Fahrenheit unless higher temperatures are permitted by the Engineer.

#### Concrete Testing

Testing shall be in accordance with the following standards:

1. The method of making and storing compression test specimens of concrete (6x12 inch cylinders) in the field shall be in accordance with **ASTM C31**.
2. The method of making the compression test on 6x12 inch cylinders shall be in accordance with **ASTM C39**.
3. The slump shall be determined in accordance with **ASTM C143**.
4. The weight per cubic foot, yield, air content and cement content shall be determined by measurement in a standard measure in conformance with **ASTM C138**. The air content may be determined by the pressure method in accordance with **ASTM C231** or the volumetric method in accordance with **ASTM C173**.

#### Ready-Mixed Concrete

Ready-mixed concrete shall be in accordance with **ASTM C94** except as modified by these specifications.

1. Concrete mixed completely in truck-type mixers shall be mixed between 70 and 100 revolutions at designated mixing speed. All revolutions after 100 shall be at agitating speed.
2. All concrete shall be deposited on the job site within 1½ hours after the introduction of the mixing water.
3. Rejected loads of concrete shall not be retempered or adjusted by additional ingredients.
4. With each load of concrete delivered to the job there shall be furnished by the ready-mix plant a duplicated delivery ticket, one copy to be retained by the Contractor and the other given to the inspector of the job.
5. Batch hopper scales shall be tested and approved by the local Sealer of Weights and Measures, WisDOT, or an approved testing service at intervals not exceeding twelve months. The hopper scales or portable plants shall have an approval after each movement of the plant.
6. The Engineer reserves the right to require that portland cement concrete be produced in a plant which complies with the requirements of the National Ready Mixed Concrete Association certification plan.

#### Use of High Early Strength Concrete

When the Contractor, at his own request, uses high early strength cement or a Class A concrete to shorten the time required prior to placing load on the structure, the added cost shall be borne by the Contractor.

#### Site Restoration

Site restoration, including paving and landscaping, shall follow the *Standard Specifications for Highway and Structure Construction* if no other specifications are provided for the site restoration work in other sections of the Contract.

#### Basis of Payment

1. Rigid insulation for frost protection shall be measured by the square foot or by lineal foot of a specified width completed and accepted. Payment for insulation is full compensation for providing required materials and for installing and backfilling.

2. No separate payment will be made for all other work covered in this section, unless noted otherwise. All costs shall be included in the unit price of work it is associated with.

## TRENCHING

### Scope

This section describes excavating, bedding, covering, and backfilling, for the construction of sewers and appurtenances.

### General Requirements

1. The Contractor shall submit test reports which include moisture density relationship, and gradation results prepared by a certified testing laboratory acceptable to the Engineer for bedding, cover, and backfill materials. A labeled jar containing a sample of each material shall be submitted with the results. No material shall be used unless it has been accepted by the Engineer.
2. The standard test to define maximum densities of all compaction work shall be **ASTM D1557**. All densities shall be expressed as a percentage of the maximum density obtained in the laboratory by the foregoing standard procedure. The Engineer may perform density tests on fills and backfills as placed by the Contractor. The Contractor shall permit the Engineer to sample, test, and inspect in-place materials at times selected by the Engineer and without additional compensation or additional time.

### Materials

#### Bedding Materials

Crushed stone chips shall be made from crushing limestone, dolomite ledge rock, or other rock materials of regional significance. The material shall be hard, tough and durable. The crushing process shall produce material of which 85% to 100% of the particles shall have at least one machine fractured face. Crushed pea gravel will be acceptable if it meets this criteria.

**Table 6**

#### **¾ Inch Crushed Stone Chips**

U.S. Standard Sieve Size	Percent Passing by Weight
½ Inch	100
¾ Inch	90-100
No. 8	0-15
No. 30	0-3

**Table 7**

#### **¾ Inch Crushed Stone Chips (ASTM C33 – Size No. 67)**

U.S. Standard Sieve Size	Percent Passing by Weight
½ Inch	100
¾ Inch	90-100
No. 8	0-15
No. 30	0-3

### Cover Material for Pipe

Material which is to be used around and over the sewer pipe and above the pipe bedding shall be termed cover material. It shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. Unwashed bank-run sand, and crushed bank-run gravel will be considered generally acceptable under this specification. This material shall conform substantially to the gradations requirements of **Table 8**.

Bedding material may be substituted for cover material in sewer installation.

**Table 8**

**Cover Material**

U.S. Standard Sieve Size	Percent Passing by Weight
1 Inch	100
¾ Inch	85-100
⅝ Inch	50-80
No. 4	35-65
No. 40	15-30
No. 200	5-15

Backfill Materials

Granular material for backfilling shall consist of durable particles ranging from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids of the coarse material. No stones over 3-inch sieve size shall be present. Some fine clay or loam particles are desirable, but shall not be present in the form of lumps.

**Table 9**

**Crushed Stone Screenings**

U.S. Standard Sieve Size	Percent Passing by Weight
½ Inch	100
No. 4	75-100
No. 100	10-25

**Table 10**

**1½ Inch Dense Base**

U.S. Standard Sieve Size	Percent Passing by Weight
1½ Inch	95-100
¾ Inch	70-93
⅝ Inch	42-80
No. 4	25-63
No. 10	16-48
No. 40	8-28
No. 200	2-12

**Table 11**

**¾ Inch Dense Base**

U.S. Standard Sieve Size	Percent Passing by Weight
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1 Inch	100
¾ Inch	95-100
⅝ Inch	50-90
No. 4	35-70
No. 10	15-55
No. 40	10-35
No. 200	5-15

Excavated Material Used As Backfill

Excavated material to be used as backfill shall consist of loam clay, or other materials which, in the judgement of the Engineer, are suitable for backfilling. Unstable backfill materials include vegetable or other organic material, all types of refuse, large pieces or fragments of concrete and such other material as in the judgement of the Engineer are unsuitable for backfilling. Frozen backfill material shall not be used.

Aggregate Slurry Backfill

Aggregate slurry backfill consists of No. 1 and No. 2 coarse aggregate Class C concrete mix with the cement deleted.

The material shall be mixed with water to inundate the aggregate sufficient to provide an approximate three inch slump. The mix shall be deposited in the trench directly from a concrete transit mix truck.

Lean Concrete Mix Backfill

Lean concrete mix backfill shall conform to the requirements of aggregate slurry backfill with the addition of a minimum of one bag of cement per cubic yard.

Geotextile Bags

Use type II geotextile bags as defined in *WDNR Technical Standard 1061*. Use polymers approved by WDNR.

ConstructionGeneral RequirementsWork Limits

Length of trench excavated in advance of the pipe laying shall be kept to a minimum, and in no case shall it exceed 50 feet unless otherwise authorized. The total length of open trench shall not exceed 100 feet for each main pipe laying operation unless otherwise authorized. Not more than one street crossing may be obstructed by the same trench at any one time unless otherwise authorized. The length of unrestored work area and total unfinished trench construction shall not exceed a length of 800 feet, for each main pipe laying operation unless otherwise authorized. Trench construction will not be considered completed until all restoration is completed. A section of trench shall not be considered as finished until excavation, construction, backfilling, compaction, surface restoration and replacement, and cleanup operations have been completed.

Control of Water

The Contractor shall provide all necessary machinery, appliances, and equipment to keep excavation free from water during construction, and shall dewater and dispose of the water so as to minimize discharge of turbid water to surface water and not to cause injury to public or private property, or to cause a nuisance or a menace to the public. Before dewatering is started, the Contractor shall obtain acceptance from the Engineer for the method, installation and details of the dewatering system he proposes to use. The Contractor shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outage, and shall have available at all times competent workmen for the operation of the pumping equipment. The dewatering system shall not be shut down between shifts, on holidays or weekends, or during the work stoppages without written permission from the Engineer. The control of groundwater shall be such that softening of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented. Dewatering systems shall be designed and operated so as to prevent the removal of the natural soils. During excavating, construction of sewers and appurtenances, and backfilling, excavations shall be kept free of water. The static water level shall be drawn down a minimum of one foot below the bottom of the excavation so as to maintain the undisturbed state of the natural soils and allow the placement of any fill or backfill to the required density. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill and prevent flotation or movement of all sewers and appurtenances.

#### Trench Dewatering

All trench dewatering pumps shall have a sediment control/capture mechanism at the discharge of the pump hose. Discharging into an inlet that has inlet protection installed does not count as having sediment control/capture mechanism installed. All trench dewatering shall be in accordance with *WDNR Technical Standard 1061*. Type II geotextile bags require a polymer additive for effective treatment with clay loam, silty clay, and clay soils.

#### Removal of Obstructions

The Contractor shall remove all rock, stones, debris and all obstructions of whatsoever kind or character, whether natural or artificial, encountered in the work. Material shall be removed from the site of the work and disposed of in a manner acceptable to the Engineer.

#### Sheathing, Shoring, and Bracing

The Contractor shall provide all necessary sheathing and shoring including all labor, material, equipment and tools required or as necessary to maintain the excavation in a condition to furnish safe working conditions, to permit the safe and efficient installation of all items of contract work, and to protect adjacent property. The Contractor shall be held liable for any damage, which may result, to neighboring property from excavation or construction operations. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the OSHA and the State of Wisconsin.

The Engineer may order sheeting and bracing to be left in place at the completion of the work. The Contractor shall be paid for such materials left in place in open cut trenches on order of the Engineer as an extra, but no payment shall be made for the placing of same.

#### Portable Trench Box and Sliding Trench Shield

1. Portable trench boxes and sliding trench shields approved by the State of Wisconsin may be used as long as in the judgment of the Contractor, job conditions warrant such use. Use of the shield shall not relieve the Contractor of any liability for damages to persons or property occurring from or upon the work of constructing the sewer, or appurtenances occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheathing and bracing to prevent the caving or moving of the ground, or disturbance of the completed work or any of the surface or subsurface structures.
2. Care shall be taken when a trench box or shield is moved ahead so as not to pull the already jointed pipe apart or leave voids around the pipe wall.
3. When required by the Engineer, the Contractor shall provide an acceptable method of rechecking line, grade and horizontal location of the pipe after the shield has been moved ahead. If the pipe has moved, it shall be reset to the proper line and grade.
4. Where a concrete cradle or envelope is required, a suitable spacer between the concrete and the shield shall be provided. Tar paper or other suitable material shall be used to prevent a bond between the spacer and the concrete, so as to permit moving of the shield without disturbing the pipe, cradle or envelope.
5. The width of the trench shield or box shall be such that a minimum six inch horizontal clearance is maintained between the pipe and shield at all times.
6. Any voids between the trench box or shield and the undisturbed trench wall within the bedding section (bottom of trench to top of initial backfill) shall be filled with bedding material, immediately after the box or shield is positioned.

#### Unstable Foundations

When the trench bottom is wet, soft, or spongy so that, in the opinion of the Engineer, it will not provide a proper foundation for the pipe, the trench shall be over excavated until a firm foundation is obtained. The over excavated portion of the trench shall be backfilled with such material and in such a manner as may be required by the Engineer. All over excavation and associated backfilling shall be paid for as extra work, except when the unstable foundation is a result of the Contractor's operations in which case it shall be provided for at the Contractor's expense. Where the distance to stable ground is excessive the Owner reserves the right to order, in writing, as extra work such other types of foundation as the Engineer shall deem necessary.

#### Over Excavation

Whenever the excavation is carried beyond the lines and grades shown on the contract drawings, or as determined by the Engineer, the Contractor shall at his own expense, backfill all such excavated space with such material and in such a manner as may be required by the Engineer. The space beneath and around concrete structures, which was over excavated shall be thoroughly compacted when backfilling or, if deemed necessary by the Engineer, shall be backfilled with concrete at the Contractor's expense.

### Excavation

#### General

1. Unless otherwise indicated, excavation for sewers and appurtenances shall be open cut using an unrestricted trench. When a restricted trench is specified or indicated, sheeting, shoring, and bracing shall be provided to limit the width of the trench to the width of the bedding section. The Contractor may use any method of excavation that will not damage or

endanger adjacent structures, utilities, or property, or disturb the natural soils at or below the bottom of the excavation.

2. Excavation for the trench shall begin at the downstream end of the proposed sewer and proceed toward the upstream end.
3. The trenches shall be excavated to the required alignment and grades indicated on the plans and as laid out in the field by the engineer.
4. Keep trenches dewatered at all times.
5. If the contract specifies or the Engineer allows, the Contractor may construct sewers by tunneling or jacking instead of open trenches. Adhere to the construction details, construction specifications, and Engineer's decision.

#### Trench Width

1. The maximum allowable width of trench measured at the top of the pipe shall be the outside diameter of the pipe exclusive of bells and collars, plus 24 inches, and such maximum width shall be inclusive of all trench timbers unless otherwise indicated. Always provide sufficient space between the pipe and the sides of the trench to allow for preparing the foundation, laying the pipe, and placing and compacting the backfill. A minimum of six inches shall be maintained between the pipe and the trench wall. A minimum of one foot shall be maintained between the pipe and the trench wall for corrugated steel pipe and pipe arch. The trench walls shall be kept vertical from the bottom of the trench to the top of the pipe, wherever possible.
2. Where the normal trench width below the top of the pipe is exceeded for any reason, the Contractor, at his own expense, shall furnish an adequate section for the actual trench width. This may be accomplished by furnishing a stronger pipe, a better bedding section, or providing concrete encasement, whichever is an adequate section as determined by the Engineer. When the pipe specified is strong enough for the actual trench width, as determined by the Engineer, no further provisions need be made for this greater trench width.
3. Where wide trench construction is specified, the width of the trench at the top of the pipe is not limited. The bedding section width for wide trench construction shall be extended two and one-half diameters on either side of the pipe or to the trench wall, whichever is less.

#### Excavated Materials

1. All excavated material to be used as backfill shall be stockpiled in a manner that will not endanger the work, cause an obstruction, or block drainage.
2. Excavated material not to be used for backfill shall be removed from the site of the work as soon as excavated. The Owner shall have prior claim to all surplus excavated material. If the Owner exercises such claim, the material shall be deposited by the Contractor, at such points as designated by the Engineer up to three miles from the site of the work. If the Owner wishes to use a site greater than three miles from the site of the work an adjustment to the Contract price will be made with a Change Order. After delivery to such designated location the material shall be spread and leveled. If the Owner does not wish to claim any or all excavated material, the Contractor shall be responsible for obtaining a site for disposal of the material.

#### Materials Type

1. The materials of excavation shall be classified either as earth excavation or as rock excavation.



2. Earth excavation shall include all clay, silt, loam, sand, gravel, slate, hard pan, pavements of all kinds, soft sandstone or limestone, loose stone, all boulders measuring less than one cubic yard in volume, all old sewers and manholes being abandoned and lying in the path of new construction, and all storm sewer laterals and catch basins requiring removal to make way for new sewer construction.
3. Rock is any hard, solid material in ledges, bedded deposits, and unstratified masses, and conglomerate deposits or any other material so firmly cemented they present the characteristics of solid rock, and the Engineer determines it is impracticable to excavate this material without blasting or using rippers. Rock also includes removing rock boulders having a volume of one cubic yard or more.

#### Tunnel Excavation

1. Tunnel shafts shall be located as shown on the plans or as approved by the Engineer. The excavation shall be of sufficient size to permit the construction of the sewer to the lines, grades and dimensions called for by the plans.
2. The Contractor shall adequately sheet and brace all tunnel excavations. No payment will be made for bracing or sheeting left in place in tunnels.
3. Should the soil be so unstable as to require extraordinary measures to protect the work such as liner plates and/or air pressure, the measures to be adopted and the costs of the extra work shall be agreed upon in advance.

#### Bedding - Constructing Foundation

1. Construct the foundation in the excavation to prevent subsequent settlement or rupture of the sewer pipe or catch basin, manhole, or inlet base.
2. The Contractor may not lay the pipe or catch basin, manhole, or inlet base in rock, wet conditions, or on a firm earth subgrade.
3. The Contractor shall lay pipe or catch basin, manhole, or inlet bases on a backfilled granular foundation or bed. When placing the pipe on backfilled granular foundation, excavate the trench to at least four inches below the elevation established for the bottom of the pipe and a minimum of three inches below the bell. For sewer pipe 18 inches in diameter or less, use  $\frac{3}{8}$  inch crushed stone chips meeting the gradation requirements of **Table 6**. For pipe larger than 18 inches in diameter,  $\frac{3}{4}$  inch crushed stone chips meeting the gradation requirements of **Table 7** may be used. When placing precast concrete box sections or catch basin, manhole, or inlet bases on backfilled granular foundation, excavate the trench to at least six inches below the elevation established for the bottom of the box section or base and backfill with  $\frac{3}{8}$  inch crushed stone chips or  $\frac{3}{4}$  inch crushed stone chips. If excavation has been carried deeper than six inches below the pipe barrel or catch basin, manhole, or inlet base, the excess depth shall be filled with backfill concrete or No. 1 crushed stone. Compact the material before laying the pipe on the backfilled granular material.
4. Care shall be taken to insure that pipe does not rest directly on the bell but is uniformly supported through the entire length.
5. After laying the pipe, bedding material shall be placed around the sides of the pipe, except reinforced concrete pipe, up to a level 12 inches above the top of the pipe. This material shall be placed by hand or equally careful means. When reinforced concrete pipe is installed, the bedding stone shall extend to the spring line of the pipe and cover material shall be added up to a level 12 inches above the top of the pipe. Where horizontal elliptical pipe is being laid, special care shall be taken to insure proper bedding of the pipe, making certain that the space under the bottom half of the pipe is completely filled with the

bedding material and that such material is properly compacted to prevent settlement of the pipe after the trenches are backfilled.

6. Excavate recesses to receive bells as necessary.
7. If the contract details types of bedding or required excavation widths others than those described above, conform to the construction details.
8. If the foundation material encountered lacks satisfactory bearing strength, the sewer shall be laid in a concrete cradle supported on a masonry foundation carried to a soil of satisfactory bearing strength or supported on a structure designed to carry the weight of the sewer and its load to firm bearing. Concrete cradles shall be constructed of Class D concrete.

#### Backfilling

1. Trench backfill shall not commence until pipe has been properly bedded.
2. Backfill material shall be carefully deposited in uniform layers.
3. Debris, frozen material, large clods or stones, organic matter, or other unstable materials may not be used for backfill.
4. When the trench is under or within two feet of any future pavement, gravel shoulder or sidewalk, the remainder of the sewer trench shall be filled with crushed stone screenings meeting the gradation requirements of **Table 9**, 1½ inch dense base meeting the gradation requirements of **Table 10**, or ¾ inch dense base meeting the gradation requirements of **Table 11** up to the subgrade elevation. Install backfill at a 1:1 slope to the bottom. Install a two foot lift for the first lift and ten inch lifts for subsequent lifts. Compact using a vibratory compactor to 95% modified proctor.
5. The Contractor may use material from the trench excavation that meets the granular backfill requirements with the approval of the Engineer. If the Contractor decides to use the excavated material, they must supply a gradation analysis showing that it meets the minimum requirements of granular backfill.
6. Suitable excavated material may be used as backfill when the trench is greater than two feet from any future pavement, gravel shoulder or sidewalk. Install a two foot lift for the first lift and 12 inch lifts for subsequent lifts. Compact using a vibratory compactor to a minimum 80% and maximum 90% modified proctor. The backfill material shall be topped with a minimum of four inches of topsoil suitable for seeding. Topsoil shall be finish-graded.
7. Use aggregate slurry backfill or lean concrete mix backfill when required on the plans and/or specifications.
8. Special compaction methods shall be utilized around catch basins, manholes, or inlets to insure proper compaction. Backfilling shall simultaneously occur around all sides so that appurtenances do not suffer damage and remain plumb.
9. Use concrete backfill to support sewers, laterals, and other utilities crossing trenches or when directed by the Engineer.
10. Normally, jetting or flooding of trenches for compaction will not be permitted. However, if jetting or water flooding for consolidating the backfilling is directed or ordered by the Engineer the first flooding shall not be applied until after the backfilling, to a height at least two feet above the top of the pipe or sewer, has been thoroughly compacted by tamping, and the second flooding shall be applied during or after the subsequent filling of the trench. An excess of water shall be avoided in order to prevent undue pressure upon the pipe or sewer. When jetting or flooding is authorized such water shall be removed from the trench by well-pointing or a sump pump located downstream from the section being jetted or flooded, in order to get excess water out of the trenches and to facilitate better settling of the granular backfill.

11. The Contractor shall carefully draw, and remove all sheeting and braces in a manner that will not disturb the completed work. The Contractor shall carefully refill all openings left from the pulled sheeting with an Engineer-approved backfill material and compact.
12. Do not walk or work on completed pipes, except as necessary to tamp or backfill, until the trench has been backfilled to at least two feet above the top of the pipe.
13. The Contractor shall backfill the trenches to the surface within 24 hours after installation and haul away all surplus materials.
14. Backfilling shall in every case be conducted in a manner which will insure that the pipes and appurtenances are not damaged in any way. To this end, backfilling materials shall be placed with a minimum drop. In case of breakage or disturbance to the sewer pipe or appurtenances, the Contractor will be required at his/her own expense to re-excavate, repair, and replace in-kind.
15. Sewers, where they do not terminate in a manhole, shall not be backfilled until the ends have been surveyed for position and grade by the Engineer. In case the Contractor fails to observe this requirement, he shall uncover the end of such sewer to permit and survey and refill the trench, at no additional cost to the Owner.
16. The Contractor shall leave streets, sidewalks, and other places disturbed or affected by the excavation in, as near practicable, the same condition as they were prior to being disturbed; and must keep said streets, sidewalks, and places disturbed in good condition, satisfactory to the Engineer throughout the project. Trench disruptions located in the traveled way of public streets or sidewalks that remain open to through pedestrian or vehicular traffic shall be maintained by the Contractor with temporary asphalt, concrete pavement, or suitable hard surface approved by the Engineer until permanent pavement is installed.

#### Basis of Payment

No separate payment will be made for work specified in this section. All costs involved with trenching work for the sewer installation shall be included in the unit price for the work it is associated with.

### **ROCK EXCAVATION**

#### Scope

This section describes excavating, loading, transporting, and disposing of hard solid rock and boulders larger than one cubic yard taken from within the right-of-way for project construction.

#### General Requirements

##### Rock

Rock is any hard, solid material in ledges, bedded deposits, and unstratified masses, and conglomerate deposits or any other material so firmly cemented they present the characteristics of solid rock, and the Engineer determines it is impracticable to excavate this material without blasting or using rippers. Rock also includes removing rock boulders having a volume of one cubic yard or more.

##### Blasting

All blasting shall be performed in accordance with Wisconsin Administrative Code Chapter SPS 307. All blasting operations shall be conducted by persons holding a valid Class 4 or 5 blasters license issued by the Department of Safety and Professional Services. Proof of the blaster's license shall be submitted to the Engineer for review. When blasting is used, the Contractor shall have a seismograph available at all times, which is acceptable to the Engineer, to be used at any location

designated by the Engineer. The Contractor shall secure all permits or licenses required for blasting or use of explosives.

#### Dust Control

The Contractor shall take all necessary precautions to minimize construction dust. All plant and equipment shall be fitted with suitable dust control devices such as continuous water spray systems or vacuum filter systems, which shall be maintained in good working order. The Engineer shall decide on the adequacy of provision and maintenance of dust control systems. When so instructed in writing by the Engineer, the Contractor shall immediately withdraw any item of plant or equipment from service and carry out all necessary additions, replacements, or repairs to the dust control systems to the satisfaction of the Engineer.

#### Materials

Explosives shall be fresh stable materials manufactured to the standards of the "Institute of Makers of Explosives".

#### Construction

##### Inspection and Measurement

When rock is encountered it shall be exposed by removing the material above it and notifying the Engineer in order that he may measure and record the amount of material to be removed. In lieu of exposing the rock surface, the Engineer and the Contractor may agree on a method to define the vertical limits of the rock. Any rock excavated before such measurement is made will not be paid for.

##### Method of Removal

After measurement of the rock the Contractor may proceed with drilling or breaking the rock with power operated tools specially designed for rock excavation. After the rock is broken it shall be loaded and disposed of unless the Engineer allows its temporary storage or reuse on site.

##### Use of Explosives

Use of explosives shall be avoided as far as practicable. Such blasting as must be done shall be controlled in a manner which will avoid possible shattering or loosening of materials outside of the project area and shall not cause damages to property or injury to persons resulting from blasting or handling explosives. The Contractor shall give adequate warnings to all affected persons or adjacent property owners prior to blasting. The Contractor shall use blasting mats or other acceptable type of protective material to prevent scattering of rock fragments outside the excavation area.

##### Limits of Removal

Rock shall be removed to provide a minimum of six inches of clearance on the sides and six inches of clearance below all pipes. The minimum trench width is 30 inches.

#### Basis of Payment

Rock excavation shall be measured by the in place cubic yard completed and accepted. The pay width for rock excavation in trenches shall be the pipeline outside diameter plus 12 inches but not less than 30 inches. The pay width for rock excavation in common trench construction shall be the pipelines outside diameter plus 48 inches. The pay depth for rock excavation in trenches shall be the depth from the rock surface to six inches below the bottom of the pipes or catch basin, manhole, or inlet. Payment for rock excavation is full compensation for all rock excavation and disposal.

## CRACK AND DAMAGE SURVEY

### Scope

This section describes the requirements of performing a crack and damage survey for affected properties, as required by the Contract.

### General Requirements

1. Conduct a crack and damage survey of the businesses and residences located adjacent to the project limits. Crack and damage survey limits are to be established by the Contractor, as required by the scaled-distance equation specified in Wisconsin Administrative Code Chapter SPS 307 but, at a minimum, should include the properties outlined in the Special Provisions.
2. The crack and damage survey shall consist of two parts. The first part, performed prior to construction activities, shall include a visual inspection, digital images, and a written report describing any existing defects in the buildings and pavements being inspected. The second part, performed after construction activities, shall also include a visual inspection, digital images, and written report describing any changes in the structure or pavement condition.
3. A letter will be sent by the Owner to all affected property owners, informing them of the crack and damage survey process, prior to the Contractor making initial contact with the property owners.
4. The Contractor shall notify the Owner a minimum of three working days prior to making initial contact with the property owners. The Engineer shall be present when contacting the property owners concerning access for the survey work. Should a property owner refuse entry to a property, the Contractor shall have the property owner sign a waiver indicating they have refused entry and are releasing the Contractor and the Owner from any potential liability related to a claimed change in condition of the structure. If the property owner refuses all requests, this shall be documented and signed by both the Contractor and Engineer present at the time of the property owner visit.
5. The absence of the requirement to perform a crack and damage survey does not relieve the Contractor of the requirement to perform trenching, backfilling, compaction, and other work operations in a manner which does not adversely impact adjacent properties.

### Construction

1. Before any construction activities, thoroughly inspect the building structures for existing defects, including interior and exterior walls. Electronically submit a written report to the Engineer with the inspector's name, date of inspection, descriptions and locations of defects, and digital images. The intent of the written report and digital images is to procure a record of the general physical condition of the building's interior and exterior walls and foundation.
2. Use a digital camera capable of producing sharp, grain free, high contrast colored digital images with good shadow details. Label each digital image with the following information:
  - A. I.D.
  - B. Building Location.
  - C. View Looking.
  - D. Date.
  - E. Photographer.
3. Before the start of any construction activities related to this survey, submit a copy of the written report and digital images to the Engineer electronically.
4. After the construction activities are complete, conduct another survey in the same manner, take digital images, and submit another written report to the Engineer electronically.
5. Instead of digital images, a digital video camera capable of producing sharp, high contrast, colored digital video with good shadow detail may be used to perform this work.

### Basis of Payment

Crack and damage survey shall be measured by each individual unit completed and accepted. Payment is full compensation for providing the before and after written reports, and for photographs or video. Payment of fifty percent (50%) of this bid item will be made after the successful completion of the pre-construction report. The final payment of this bid item will be made after the successful completion of the post-construction report.

## **PIPES**

### Scope

This section describes excavating required trenches or tunnels, laying or constructing sanitary sewer and storm sewer pipe inside, and then backfilling and cleaning out as necessary.

### General Requirements

The Contractor shall submit manufacturer's data for the pipe, fittings, gaskets, and appurtenances.

### Materials

#### General

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Round Reinforced Concrete Pipe **ASTM C76**
  - B. Horizontal Elliptical Reinforced Concrete Pipe **ASTM C507**
  - C. Precast Reinforced Concrete Box Sections **ASTM C1433**
  - D. Polyvinyl Chloride Sewer Pipe and Fittings (15" and smaller) **ASTM D3034**
  - E. Polyvinyl Chloride Pressure Pipe and Fittings **AWWA C900**
  - F. Polyvinyl Chloride Sewer Pipe and Fittings (18" to 48") **ASTM F679**
  - G. Polyvinyl Chloride Corrugated Exterior, Smooth Interior Sewer Pipe and Fittings (8" to 36") **ASTM F949**
  - H. Fiberglass Reinforced Polymer Mortar Pipe **ASTM D3262**
  - I. Double Wall Polypropylene Pipe (12" to 36") **ASTM F2881 or AASHTO M330**
  - J. Triple Wall Polypropylene Pipe (12" to 60") **ASTM F2764**
  - K. Corrugated Polyethylene with Smooth Inner Liner Pipe (12" to 36"), **ASTM F2306 or AASHTO M294 type S**
  - L. Ductile Iron Pipe **AWWA C151**
  - M. Corrugated Steel Pipe and Pipe Arch **AASHTO M36**
2. All concrete pipe shall be manufactured at a facility on the WisDOT pre-qualified list for precast concrete fabricators.
3. Sewer pipes shall be clearly marked as follows at intervals of five feet or less:
  - A. Manufacturer's name or trademark.
  - B. Nominal pipe size.
  - C. Pipe classification.
  - D. The legend, i.e. "SDR-35 PVC Sewer Pipe".
  - E. ASTM designation.
  - F. Extrusion date, period of manufacture, or lot number.
4. Packaging, handling, and shipment of sewer pipes shall be in accordance with manufacturer's instructions and specifications. Any pipe damaged in shipment shall be replaced as directed by the Engineer.

5. Pipes shall be stored in the supplier's yard or on the project site in accordance with manufacturer's recommendations.
6. The Contractor shall install all sewer pipes per the manufacturer's recommended bury depth chart.
7. Pipe shall be subject to rejection for failure to conform to any of the specification requirements or for any of the following reasons:
  - A. Any visible damage; fractures; cracks; chips; defects that indicate imperfect proportioning, mixing, or molding; variations in alignment; damaged ends or gaskets; or misplaced reinforcement; which are sufficient to impair the strength, durability, or serviceability of the pipe in the opinion of the Engineer.
  - B. Extensive patching or painting of any surface of pipe.
8. Fittings shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved couplings shall be provided for transition to other types of pipe.
9. Pipe handling holes are permitted only on reinforced concrete pipe 21 inches or larger in diameter. The Owner reserves the right to prohibit handling holes where deemed undesirable.

#### Joints

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Joints for Concrete Pipe and Manholes, Using Rubber Gaskets **ASTM C443**
  - B. Joints for Concrete Box, Using Rubber Gaskets **ASTM C1677**
  - C. Elastomeric Seals (Gaskets) for Joining Plastic Pipe **ASTM F477**
  - D. Fiberglass Pipe Joints Using Flexible Elastomeric Seals **ASTM D4161**
  - E. Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals **ASTM D3212**
  - F. Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals **ASTM D3139**
  - G. Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings **AWWA C111**
  - H. Corrugated Steel Coupling Bands **AASHTO M36**
2. Elastomeric gaskets for non-pressure sanitary sewer pipes shall provide a continuous watertight conduit having an infiltration rate not exceeding 50 gallons per inch of pipe diameter per mile per day.
3. Provide nitrile gaskets when specified on the plans for areas with anticipated contaminated soil or groundwater.
4. Individual gaskets shall be legibly marked to identify them as to size and manufacturer of pipe and to distinguish oil-resistant types from other types. Raised, indented or indelible ink lettering is required. Color-coding or cross-section configuration shall not be acceptable as legible identification.

#### Reinforced Concrete Pipes (Round and Horizontal Elliptical)

1. Pipe class shall be as noted on the plans and/or specifications.
2. All reinforced concrete pipe shall be tongue and groove type or bell and spigot type with rubber gaskets.
3. Include joint ties where noted on the plans and/or in the specifications.
4. Pipe shall not be stacked more than two pipe segments high.

#### Reinforced Concrete Box Sections

1. Design table and depth of earth cover shall be as noted on the plans and/or in the Special Provisions.
2. Include joint ties where noted on the plans and/or in the specifications.

3. Box sections shown on plans and specified to have manhole risers above them shall be supplied with a 24 inch round opening cast in the roof.
4. Pipe shall not be stacked more than two pipe segments high.

#### Polyvinyl Chloride Pipes

1. Pipes shall be stored in the supplier's yard or on the project site in accordance with **AWWA M23** and manufacturer's recommendations.
2. Pipe will not be stacked higher than four feet or on the bell ends.
3. Cover PVC pipe, which is stored outside for a prolonged period, with an opaque material to protect it from the sun's ultraviolet radiation. PVC pipe that has been subjected to excessive ultraviolet radiation is identified by color fading or chalking and shall not be used. The determination as to the acceptability of the pipe rests solely on the Engineer's decision.
4. Pipe that has been contaminated in any way with petroleum products on the inside or outside of the pipe shall not be used.

#### Ductile Iron Pipes

1. Pipe shall be thickness class 52, unless specified otherwise.
2. Pipe shall be cement-mortar lined in accordance with **AWWA C104 (ANSI A21.4)**.
3. The exterior of the pipe shall have an asphaltic coating.
4. Pipe shall not be stacked higher than four feet in height.

#### Corrugated Steel Pipe and Pipe Arch

1. The pipe thickness shall be a minimum of 16-gauge for pipes 24 inches and smaller, 14-gauge for 30 and 36 inch pipes, 12-gauge for 42, 48, and 54 inch pipes, and 10-gauge for 60 inch pipes.
2. The pipe thickness for pipe arch shall be a minimum of 16-gauge for pipes with 21 inch equivalent diameter and smaller, 14-gauge for 28x20 inch and 35x24 inch pipes, 12-gauge for 42x29, 49x33, 57x38, and 64x43 inch pipes, and 10-gauge for 71x47 inch pipes.

#### Sanitary Sewer Pipe Materials

1. All sanitary sewer pipes with a diameter of 15 inches or less shall be SDR 35 PVC sewer pipe conforming to **ASTM D3034** unless indicated otherwise on the plans. All sanitary sewer pipes with a diameter larger than 15 inches shall be PS46 PVC sewer pipe conforming to **ASTM F679** unless indicated otherwise on the plans.
2. Alternate sanitary sewer pipe materials shall be permitted where the size of the sanitary sewer main is 30 inches or greater and the pipe material is not specified in the plan or profile. Qualifying quantities are labeled as "(Size) Sanitary Sewer Main" in the schedule of prices. The costs for a larger diameter manhole shall be included in the prices bid for sanitary sewer main whenever the use of an alternate material will require a manhole of a larger diameter than that required for SDR 35 PVC pipe. The accepted alternative materials are limited to reinforced concrete, fiberglass reinforced polymer mortar pipe, and triple wall polypropylene pipe. Reinforced concrete pipes may only be used where specifically indicated on the plans.
3. SDR 35 PVC pipes shall not be used where the height of cover from the top of pipe to the existing ground elevation or proposed subgrade, whichever is less, is less than two feet.
4. SDR 35 PVC sewer pipe shall not be used when bury depths exceed twenty feet. If depths exceed 20 feet, then a SDR 26 PVC or PS115 PVC sewer pipe or concrete pipe shall be used.

#### Storm Sewer Pipe Materials

1. All storm sewer pipes shall be reinforced concrete of the class listed on the plans or schedule of prices unless otherwise specified.



2. Alternate storm sewer pipe materials shall be permitted where there is a minimum of four feet of cover to finished grade over entire lengths of pipe from structure to structure. Qualifying quantities are labeled as “(Size) Storm Sewer Pipe” in the schedule of prices. The accepted alternative materials are limited to:
  - A. SDR 35 PVC sewer pipe and fittings
  - B. PS46 PVC sewer pipe and fittings
  - C. Polyvinyl chloride corrugated exterior, smooth interior sewer pipe and fittings
  - D. Fiberglass reinforced polymer mortar pipe
  - E. Corrugated polyethylene with smooth inner liner pipe
  - F. Double wall polypropylene pipe
  - G. Triple wall polypropylene pipe
3. All storm sewer culvert pipes shall be corrugated steel or reinforced concrete of the class listed on the plans or schedule of prices unless otherwise specified.
4. Provide storm sewer trash guards on endwalls when shown on the plans.
5. SDR 35 PVC sewer pipe shall not be used when bury depths exceed twenty feet. If depths exceed 20 feet, then a SDR 26 PVC or PS115 PVC sewer pipe or concrete pipe shall be used.
6. Corrugated polyethylene pipe shall not be used when the pipe slope is less than 0.5%.

#### Culvert End Markers

1. All culvert end markers shall use a product found on the WisDOT approved products list for pavement marking, delineators, and markers.
2. Culvert end markers shall meet the requirements of Section 633 of the *Standard Specifications for Highway and Structure Construction*.

### Construction

#### General

1. The Contractor shall verify the location, elevation, material, and size of all connections to existing upstream structures and pipes prior to installing new sanitary and storm sewer pipes to allow for any necessary adjustments to the planned pipe slope so that the pipe is not back pitched at the upstream connection point(s). Excavations to verify existing pipes shall be backfilled or adequately fenced or barricaded to protect pedestrians and vehicular traffic as directed by the Engineer.
2. Excavate trenches and tunnels for all sanitary and storm sewers as described in the specifications for trenching.

#### Connection to Existing Sanitary Sewer

Before constructing a sanitary sewer, the Contractor shall plug or provide a bulkhead in the existing sewer immediately downstream of the point of connection except as needed to maintain existing active sewers. This bulkhead shall be left in place until the new sewer has been cleaned of accumulated water and debris and has been accepted.

#### Constructing Foundation

Construct foundations for all sanitary and storm sewers as described in the specifications for trenching.

#### Laying Polypropylene and Polyethylene Pipes

Polypropylene and polyethylene pipes shall be installed per manufacturer’s specifications.

Round and Horizontal Elliptical Reinforced Concrete Pipe Joints

1. The Contractor shall use rubber gaskets conforming to the requirements of **ASTM C433**. The gasket shall be placed over the spigot end or tongue of the entering pipe.
2. Immediately before making the joint, the outside of the gasket and the inside of the bell or groove of the last pipe shall be lubricated with an approved lubricant. Care should be taken that the gasket and ends of the pipe are clean and free of sand or gravel. The spigot or tongue of the pipe being laid with the gasket in place shall be introduced into the bell or groove of the previously-laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home. The Engineer may order the use of a jack or "come-along", if deemed necessary to insure that the joint is completely tight.

Reinforced Concrete Box Sections Joints

1. The Contractor shall use rubber gaskets conforming to the requirements of **ASTM C1677**. The gasket shall be placed over the tongue of the entering pipe.
2. Immediately before making the joint, the outside of the gasket and the inside of the groove of the last pipe shall be lubricated with an approved lubricant. Care should be taken that the gasket and ends of the pipe are clean and free of sand or gravel. The tongue of the pipe being laid with the gasket in place shall be introduced into the groove of the previously-laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home. The Engineer may order the use of a jack or "come-along", if deemed necessary to insure that the joint is completely tight.
3. Additional measures may be taken by the Contractor to ensure a watertight system.

Polyvinyl Chloride Pipe Joints

1. PVC pipes shall have watertight joints conforming to the requirements of **ASTM D3212**. The Contractor shall use factory-installed elastomeric gaskets conforming to the requirements of **ASTM F477**. PVC pressure pipe shall use rubber gaskets conforming to the requirements of **ASTM D3139**.
2. The outside of the gasket and the inside of the bell or groove of the pipe shall be lubricated with an approved lubricant. The spigot or tongue of the pipe being laid shall be introduced into the bell or groove end of the previously laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

Fiberglass Reinforced Polymer Mortar Pipe Joints

1. Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain water tightness. Joints at tie-ins, when needed, may utilize gasket-sealed closure couplings. The elastomeric seals shall meet the requirements of **ASTM D4161**.
2. Clean ends of pipe and couplings components. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer. The pipes shall be carefully set to line and grade.

Polypropylene Pipe Joints

1. Polypropylene pipes shall have watertight joints conforming to the requirements of **ASTM D3212**. Gaskets shall meet the requirements of **ASTM F477**. The spigot of each pipe shall have two factory-installed flexible elastomeric seals.

2. The outside of the gasket and the inside of the bell or groove of the pipe shall be lubricated with an approved lubricant. The spigot or tongue of the pipe being laid shall be introduced into the bell or groove end of the previously-laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

#### Polyethylene Pipe Joints

1. Polypropylene pipes shall have watertight joints conforming to the requirements of **ASTM D3212**. Gaskets shall meet the requirements of **ASTM F477**. The spigot of each pipe shall have factory-installed flexible elastomeric seals.
2. The outside of the gasket and the inside of the bell or groove of the pipe shall be lubricated with an approved lubricant. The spigot or tongue of the pipe being laid shall be introduced into the bell or groove end of the previously-laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

#### Ductile Iron Pipe Joints

1. Ductile iron pipes shall use rubber gaskets conforming to the requirements of **AWWA C111**.
2. Immediately before making the joint, the gasket and the pipe shall be lubricated with an approved lubricant. Care should be taken that the gasket and ends of the pipe are clean and free of sand or gravel. Be sure that the plain end is beveled. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

#### Corrugated Steel Pipe and Pipe Arch Joints

1. Corrugated steel pipe and pipe arch joints shall have coupling bands conforming to the requirements of **AASHTO M36** and shall be made of the same base metal as the pipe.
2. The bands shall not be less than seven inches wide for diameters of eight inches to 30 inches, inclusive; not less than 12 inches wide for pipe with diameters 36 inches to 60 inches, inclusive; and not less than 24 inches wide for pipe with diameters greater than 60 inches. Such bands shall be constructed as to lap on an equal portion of each of the pipe sections to be connected, and preferably shall be connected at the ends by galvanized angles having minimum dimensions of 2x2x0.1875 inches.
3. The seven inch band shall have at least two galvanized bolts not less than ½ inch diameter. The 12 inch band shall have three, ½ inch diameter galvanized bolts. The 24 inch band shall have at least five, ½ inch diameter galvanized bolts. Other equally effective methods of connecting the pipe may be used if approved by the Engineer. Couplings bands may be two numerical thicknesses lighter than that used for the pipe but not less than 0.052 inches thick (18 gauge).

#### Placing Apron Endwalls

1. Excavate the foundation for the apron endwall to the required width and grade. For metal aprons with toe plates, excavate a trench to allow placing the toe plate against the inner face of the trench if the apron is in its final position. After securing the apron to the pipe, backfill and firmly compact the trench.
2. Place the concrete apron endwall with its tongue or groove fully entered in the groove or tongue of the pipe.
3. Use the same backfill for the apron as required for the pipe unless the Engineer directs otherwise.

### Storm Sewer Trash Guards

1. Use prefabricated grates with  $\frac{3}{4}$  inch bars for endwalls spanning less than 24 inches, 1 inch bars for endwalls spanning 27 inches to 48 inches inclusive, and  $1\frac{1}{4}$  inch bars for endwalls spanning greater than 48 inches. The bars shall be welded to  $\frac{3}{8}$  x 2 inch connector plate. The connector plate shall be connected at three points to the endwall on pipes 30 inches or less and at four points on pipes 36 inches and greater. Anchor bolts shall be  $\frac{3}{8}$  inches.
2. Trash guards shall be galvanized or epoxy coated. The epoxy system shall consist of a prime or shop coat of organic or inorganic zinc-rich paint, an intermediate shop coat of high-build epoxy paint and a protective shop coat of urethane paint. Structural steel which is to be welded shall not be coated before welding is complete. The color of the epoxy shall be white and the urethane coating materials shall be a dark green.

### Concrete Masonry Endwalls

Concrete masonry endwalls shall be constructed in accordance with Section 504 of the *Standard Specifications for Highway and Structure Construction*.

### Culvert End Markers

1. Provide flexible culvert end markers at the locations the plans show. Use white posts and apply black non-reflective sign tape to both sides of the top nine inches.
2. Install posts in front of the object being marked as referenced from the direction of travel by the approaching roadway traffic. Use only one marker where two or more apron endwalls are adjacent to each other.

### Bulkhead Sewers

The Contractor shall construct a bulkhead at each exposed end of pipes stubbed for future service consisting of an 8 inch cement brick and mortar wall or a waterproof cap or plug.

### Separation Distances

1. Sanitary and storm sewer mains and manholes shall be laid at least eight feet horizontally from any existing or proposed water main. The distance shall be measured center to center. Should specific conditions prevent this separation, the Contractor shall notify the Engineer for specific instructions regarding the treatment of the separation. It may be necessary to install **AWWA C900** PVC pressure pipe, joints, and fittings or **AWWA C151** ductile iron pipe, joints, and fittings with a minimum pressure class of 150 psi for the congested areas and perform the low pressure air test.
2. Whenever a sanitary or storm sewer crosses a water main, it should be laid at least 18 inches below the main, six inches above the water, or the water main should be re-laid with fittings to cross over the sewer. The distance shall be measured from the top of the bottom pipe to the bottom of the top pipe.

### Backfill

Backfill all sanitary and storm sewers as described in the specifications for trenching.

### Basis of Payment

1. The sanitary and storm sewer items shall be measured separately by the linear foot completed and accepted. This measurement equals the distance along the centerline of the pipe from structure to structure; to the end of apron endwalls excluding the length of the apron endwall; or to the end of the installed pipe. Structures include catch basins, manholes, inlet, other drainage structures or

- junctions. The measurement shall be from inside wall of structure to inside wall of structure. The measurement does not include any construction through catch basins, manholes, and inlets.
2. Payment for the sanitary and storm sewer bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for removing, abandoning, and sealing existing structures, pipes, and appurtenances within the limits of excavation or trenching operations; for providing and removing sheeting and shoring; for bypass pumping; for providing bedding material and granular backfill material; for constructing the foundation; for laying pipe; for sealing joint; for joint ties; for backfilling; for replacing pipe made unusable by contractor operations; for cleaning out; and for restoring the work site.
  3. Apply contract unit prices, without adjustment, to the quantities of sanitary and storm sewer pipes constructed at elevations not greater than one foot below what the plans show. If the Engineer orders the construction of the sewer pipes or portions of the pipes at elevations greater than one foot below what the plans show, then the Owner will pay for this work as specified extra work. If the Engineer orders the construction of the sewer pipes or portions of the pipes at elevations greater than one foot above what the plans show, then the Owner may request an adjustment to the contract prices for this work.
  4. Work performed one foot or less below the pipe bottom to form a satisfactory foundation as specified is incidental to the work. The Owner will pay for work required at depths greater than one foot below the pipe bottom as extra work.
  5. All new pipe connections to existing sanitary sewer pipe with a diameter of 12 inches or less and within five feet of a proposed manhole shall be incidental to the new manhole bid items. All sanitary sewer pipes with a diameter of more than 12 inches or more than five feet from the wall of a proposed manhole shall be paid for with the corresponding bid item for sanitary sewer pipe.
  6. All new pipe connections to existing storm sewer pipe within five feet of the wall of a proposed structure shall be incidental to the catch basin, manhole, and inlet bid items. All storm sewer pipes more than five feet from the wall of a proposed structure shall be paid for with the corresponding bid item for storm sewer pipe.
  7. Connections to existing pipes, catch basins, manholes, and inlets shall be paid as indicated in the specifications for sewer connections.
  8. No additional compensation will be provided for relaying pipe or any other work necessary to provide an adequate slope and connection to the existing pipe caused by a failure to adequately verify the location, elevation, material, and size of all connections to existing upstream structures and pipes.
  9. The sanitary sewer spot repair item shall be measured separately by the linear foot completed and accepted. This measurement equals the distance along the centerline of the pipe from connection point to existing pipe to connection point to existing pipe. Payment for the sanitary sewer spot repair bid item is full compensation for providing all necessary labor, equipment, and materials; for excavating; for providing and removing sheeting and shoring; for bypass pumping; for providing bedding material and granular backfill material; for constructing the foundation; for laying pipe; for sealing joint; for making connections to the existing pipe; for backfilling; and for restoring the work site.
  10. The apron endwall items shall be measured separately by each individual unit for the various sizes and types completed and accepted. Payment for the apron endwall bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for providing and removing sheeting and shoring; for bypass pumping; for providing bedding material and granular backfill material; for constructing the foundation; for laying endwalls; for sealing joint; for joint ties; for backfilling; for cleaning out; and for restoring the work site.
  11. The concrete masonry endwall item shall be measured separately by each individual unit for the completed and accepted. Payment for concrete masonry endwalls is full compensation for

excavating; materials, including reinforcement; forms; placing, including reinforcement; finishing, curing, protecting and heating.

12. The culvert end marker item shall be measured by each individual unit completed and accepted. Payment for culvert end markers is full compensation for providing the marker including non-reflective tape and soil anchor.
13. The bulkhead sewer items shall be measured by each individual unit for the various sizes and types completed and accepted. Payment for the bulkhead sewer bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for sealing the open ends of sewer pipes; for providing granular backfill material; for backfilling; and for cleaning out and restoring the site of the work.

## FORCE MAINS

### Scope

This section describes excavating required trenches or tunnels, laying or constructing sanitary sewer and storm sewer force mains inside, and then backfilling and cleaning out as necessary.

### General Requirements

The Contractor shall submit manufacturer's data for the pipe, fittings, gaskets, and appurtenances. Provide the pressure rating and recommended minimum bending radius for PVC pressure pipe and ductile iron pipes.

### Materials

#### General

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Polyvinyl Chloride Pressure Pipe and Fittings **AWWA C900**
  - B. Ductile Iron Pipe **AWWA C151**
2. Sewer pipes shall be clearly marked as follows at intervals of five feet or less:
  - A. Manufacturer's name or trademark.
  - B. Nominal pipe size.
  - C. Pipe classification.
  - D. The legend, i.e. "SDR-35 PVC Sewer Pipe".
  - E. ASTM designation.
  - F. Extrusion date, period of manufacture, or lot number.
3. Packaging, handling, and shipment of sewer pipes shall be in accordance with manufacturer's instructions and specifications. Any pipe damaged in shipment shall be replaced as directed by the Engineer.
4. Pipes shall be stored in the supplier's yard or on the project site in accordance with manufacturer's recommendations.
5. The Contractor shall install all sewer pipes per the manufacturer's recommended bury depth chart.
6. Pipe shall be subject to rejection for failure to conform to any of the specification requirements or for any of the following reasons:
  - A. Any visible damage; fractures; cracks; chips; defects that indicate imperfect proportioning, mixing, or molding; variations in alignment; damaged ends or gaskets; or misplaced reinforcement; which are sufficient to impair the strength, durability, or serviceability of the pipe in the opinion of the Engineer.

- B. Extensive patching or painting of any surface of pipe.
- 7. Fittings shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved couplings shall be provided for transition to other types of pipe.

#### Joints

- 1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals **ASTM D3139**
  - B. Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings **AWWA C111**
- 2. Bolts for mechanical joints shall be high strength low-alloy steel.
- 3. Joint deflection shall not exceed manufacturer recommendations.
- 4. Provide nitrile gaskets when specified on the plans for areas with anticipated contaminated soil or groundwater.
- 5. Individual gaskets shall be legibly marked to identify them as to size and manufacturer of pipe and to distinguish oil-resistant types from other types. Raised, indented or indelible ink lettering is required. Color-coding or cross-section configuration shall not be acceptable as legible identification.

#### Ductile Iron Pipe Restrained Joints

- 1. Restrained joints shall meet the applicable requirements of **ANSI A21.11 (AWWA C111)**. The joint shall provide for a minimum deflection of not less the five degrees for pipes 12 inches in diameter and smaller and three degrees for pipes 14 inches in diameter through 30 inches in diameter. The joint shall be capable of providing full restraint for the thrust generated at the rated working pressure of the pipe. Restrained joints shall be Griffin Snap-Lok; American Fastite, Flex-Ring, or Lok-Ring Joint; or U.S. Pipe TR FLEX or Bolt-Lok.
- 2. Restrained joint gaskets shall be U.S. Pipe MJ Field-Lok Gasket or Field Lok 350.

#### Polyvinyl Chloride Pipe Restrained Joints

- 1. PVC restrained pipe joints shall consist of a PVC coupling with beveled edges, two sealing gaskets, and two restraining grooves, plain end pipe with a restraining groove at each end, and nylon splines for each groove. The joint shall be capable of providing full restraint for the thrust generated at the working pressure of the pipe. PVC restrained pipe joints shall be CertainTeed Certa-Lok AWWA C900/RJ PVC pipe.
- 2. Restrained joint gaskets shall be JM Eagle-Loc 900.

#### Ductile Iron Fittings

- 1. Fittings with mechanical and push-on joints shall meet the requirements of **AWWA C110 (ANSI A21.10)** or **AWWA C153 (ANSI A21.53)**.
- 2. Fittings shall have the same lining and coating as the pipe.
- 3. Fittings shall be ductile iron 350 psi pressure rating, unless specified otherwise.
- 4. Fittings shall be Tyler/Union, American Flow Control, or Sigma.

#### Polyvinyl Chloride Pipes

- 1. Pipe shall be DR 25, unless specified otherwise. The pipe shall have the same outside diameter as ductile iron pipe.
- 2. Pipes shall be stored in the supplier's yard or on the project site in accordance with **AWWA M23** and manufacturer's recommendations.
- 3. Pipe will not be stacked higher than four feet or on the bell ends.

4. Cover PVC pipe, which is stored outside for a prolonged period, with an opaque material to protect it from the sun's ultraviolet radiation. PVC pipe that has been subjected to excessive ultraviolet radiation is identified by color fading or chalking and shall not be used. The determination as to the acceptability of the pipe rests solely on the Engineer's decision.
5. Pipe that has been contaminated in any way with petroleum products on the inside or outside of the pipe shall not be used.

#### Ductile Iron Pipes

1. Pipe shall be thickness class 52, unless specified otherwise.
2. Pipe shall be cement-mortar lined in accordance with **AWWA C104 (ANSI A21.4)**.
3. The exterior of the pipe shall have an asphaltic coating.
4. Pipe shall not be stacked higher than four feet in height.

#### Thrust Blocking

Thrust blocks shall be constructed with solid 16 inch x 8 inch x 4 inch cement blocks (half course solids) or poured in place concrete having a minimum 28-day compressive strength of 2,000 psi. The minimum cement content shall be 4.5 bags of cement per cubic yard of concrete. The allowable slump shall be four to five inches. The bearing area of the thrust blocking shall be as shown on the drawings or as required by the Engineer.

#### Mechanical Joint Restraint

Mechanical joint restraint shall consist of multiple gripping wedges incorporated into a single restraint/gland ring for use in place of the standard mechanical joint retainer gland. Mechanical joint restraints shall be Megalug Series 1100 for ductile iron pipe and Megalug Series 2000PV for PVC pipe as manufactured by EBAA Iron Sales, Inc.

#### Push-On Joint Restraint

Push-on joint restraint shall consist of the two **ASTM A536** ductile iron restraint rings and high strength, low alloy steel connection rods. One ring shall be mounted to the spigot pipe end with second ring mounted just behind the bell end of the pipe. The two restraint rings shall be fastened together using the low alloy steel connection rods. Push-on joint restraints shall be Megalug Series 1700 for ductile iron pipe or Megalug Series 1600 or Megalug Series 2800 for PVC pipe as manufactured by EBAA Iron Sales, Inc., or Series 1390 Joint Restraint System as manufactured by Uni-Flange Corporation.

#### Polyethylene Wrap and Tape

Polyethylene wrap shall meet the requirements of **AWWA C105 (ANSI A21.5)**. Wrap shall be linear low-density polyethylene film with a minimum tensile strength of 3,600 psi and a nominal thickness of 8 mils. Tape for securing the wrap shall be a thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, asphaltic coating and polyethylene. Tape shall have minimum thickness of 8 mils and a minimum width of one inch.

### Construction

#### General

1. Excavate trenches and tunnels for all force mains as described in the specifications for trenching.
2. Unless otherwise indicated, force main and fittings shall have push-on joints.
3. Fittings shall be set on hardwood blocking 2 x 6 x 18 inch with the long side of the block set perpendicular to the force main.



4. Mechanical joint pipe and fittings shall be used where specified or when accepted by the Engineer.
5. Unless otherwise indicated exposed ductile iron pipe and fittings shall have grooved or flanged joints.

#### Constructing Foundation

Construct foundations for all force mains as described in the specifications for trenching.

#### Polyvinyl Chloride Pipe Joints

1. PVC pressure pipe shall use rubber gaskets conforming to the requirements of **ASTM D3139**. The Contractor shall use factory-installed elastomeric gaskets conforming to the requirements of **ASTM F477**.
2. The outside of the gasket and the inside of the bell or groove of the pipe shall be lubricated with an approved lubricant. The spigot or tongue of the pipe being laid shall be introduced into the bell or groove end of the previously laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

#### Ductile Iron Pipe Joints

1. Ductile iron pipes shall use rubber gaskets conforming to the requirements of **AWWA C111**.
2. Immediately before making the joint, the gasket and the pipe shall be lubricated with an approved lubricant. Care should be taken that the gasket and ends of the pipe are clean and free of sand or gravel. Be sure that the plain end is beveled. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

#### Thrust Restraint Systems

All pressure piping shall be provided with a thrust restraint system to prevent movement caused by hydraulic thrust and pressure. Exposed pressure piping shall have restrained joints. Horizontal buried pressure piping, unless noted otherwise, shall be restrained by thrust blocking. Thrust blocks shall be cast against solid undisturbed ground and shall be installed so as to prevent contact or interference with pipe or fitting joints. Fittings shall be wrapped in plastic to prevent the concrete from bonding to the surface of the fitting. If adequate support against undisturbed soil cannot be obtained, restrained joints shall be used. Vertical buried pressure piping shall have an acceptable type of restrained joint.

#### Protection of Buried Metal Surfaces

Unless specified otherwise, all ductile iron pipe, fittings, valves, and appurtenances installed underground shall be protected from corrosion by use of two layers of polyethylene wrap installed in accordance with AWWA C105 (ANSI A21.5). Metal surfaces must be kept clean of mortar, cement, clay, sand or other foreign material.

#### Backfill

Backfill all force mains as described in the specifications for trenching.

#### Basis of Payment

1. The force main items shall be measured separately by the linear foot completed and accepted. This measurement equals the distance along the centerline of the pipe. Payment is full compensation for providing all necessary labor, equipment, and materials; for excavating; for removing, abandoning,

and sealing existing structures, pipes, and appurtenances within the limits of excavation or trenching operations; for providing and removing sheeting and shoring; for bypass pumping; for providing bedding material and granular backfill material; for constructing the foundation; for laying pipe; for sealing joint; for backfilling; for replacing pipe made unusable by contractor operations; for cleaning out; and for restoring the work site.

2. No additional compensation will be provided for installing fittings, caps, bends, tracer wire, tracer wire terminal boxes, thrust blocking or joint restraint for force mains.
3. Apply contract unit prices, without adjustment, to the quantities of sanitary and storm sewer pipes constructed at elevations not greater than one foot below what the plans show. If the Engineer orders the construction of the sewer pipes or portions of the pipes at elevations greater than one foot below what the plans show, then the Owner will pay for this work as specified extra work. If the Engineer orders the construction of the sewer pipes or portions of the pipes at elevations greater than one foot above what the plans show, then the Owner may request an adjustment to the contract prices for this work.
4. Work performed one foot or less below the pipe bottom to form a satisfactory foundation as specified is incidental to the work. The Owner will pay for work required at depths greater than one foot below the pipe bottom as extra work.
5. Connections to existing pipes shall be paid as indicated in the specifications for sewer connections.
6. No additional compensation will be provided for relaying pipe or any other work necessary to provide an adequate slope and connection to the existing pipe caused by a failure to adequately verify the location, elevation, material, and size of all connections to existing upstream structures and pipes.

## CATCH BASINS, MANHOLES, AND INLETS

### Scope

This section describes constructing or reconstructing manholes, catch basins, and inlets and similar structures made of concrete, concrete masonry, or concrete block with necessary reinforcement, metal frames, grates and lids, including required excavation and backfilling.

### General Requirements

1. The Contractor shall submit manufacturer's data and shop drawings for the manholes, catch basins, inlets, frames, and covers. All shop drawings shall include a "plan view", a "section view", and a list of materials (base section, riser sections, cone section, adjustment, casting, etc.) necessary to construct the structure in the field. Elevations shall be listed for rim and all pipe inverts, showing only a measurement from either the top or bottom of the structure is insufficient to allow for proper review of the drawings. Shop drawings not conforming to these requirements will be rejected by the Engineer without review.
2. Structures delivered to the site that do not comply with approved shop drawings will immediately be rejected by Engineer.
3. All catch basins, manholes, and inlets shall be precast concrete unless specified otherwise.

### Materials

#### Concrete

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Precast Concrete Manholes **ASTM C478**
  - B. Precast Square and Rectangular Structures **ASTM C913**

C. Precast Field Inlets **ASTM C478 and ASTM C76**

D. Concrete Brick and Block Masonry Units **ASTM C139**

2. All precast catch basins, manholes, and inlets shall be manufactured at a facility on the WisDOT pre-qualified list for precast concrete fabricators.
3. Precast reinforced concrete sanitary manhole base, wall, and flat top thicknesses shall be as shown in the standard detail drawings.
4. Precast sanitary manholes shall be the eccentric cone type. Flat tops may be used only with the permission of the Engineer. Precast storm manholes shall be the eccentric cone type, whenever possible. Flat tops may be utilized when eccentric cones are not feasible.
5. The top of the precast eccentric cone shall have a minimum three inch vertical ring integrally cast with the cone.
6. Each precast reinforced concrete manhole riser and top section shall be clearly marked with the name or trademark of the manufacturer and the date of manufacture. This marking shall be indented into the manhole section or shall be painted on with waterproof paint.
7. Precast reinforced concrete manhole risers and flat top sections shall be subject to rejection for failure to conform to any of the specification requirements. In addition, individual sections of manhole risers and tops may be rejected because of any of the following reasons:
  - A. Fracture cracks passing through the walls, except for a single end crack that does not exceed the depth of the joint.
  - B. Defects that indicate imperfect proportioning, mixing, or molding.
  - C. Surface defects indicating honey-combed or open texture.
  - D. Damaged ends, where such damage would prevent making a satisfactory joint.
  - E. Manhole steps out of line or improperly spaced.
  - F. The interval diameter of the manhole section shall not vary more than one percent of the nominal diameter.
  - G. Any continuous cracking having a surface width of 0.01" or more and extending for a length of twelve inches or more, regardless of the position in the section wall.
8. All concrete blocks shall be a product on the WisDOT approved products list for unit concrete masonry and brick.
9. Concrete block for manholes shall be 7¾ inches thick, curved to fit a four foot inside diameter manhole, notched to fit manhole steps, and with corbel blocks to fit manhole ring as shown in the standard detail drawings. Mortar shall be one part portland cement and two parts mortar sand.
10. Concrete block for the entire manhole may only be used where specified or with permission of the Engineer. A one-half inch cement mortar back-plaster shall be used.
11. When the size or number of connections precludes the practical use of a precast bottom section, concrete block may be used up to approximately eight inches above the top of the pipe.

Cast in Place Structures

1. Cast in place catch basins, manholes, inlets or endwalls may only be used where specified or with permission of the Engineer.
2. Cast in place structures shall meet the requirements of Section 504 and Section 611 of the *Standard Specifications for Highway and Structure Construction*.

Clay or Shale Bricks

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Brick **ASTM C32 Grade MS**

2. All bricks shall be a product on the WisDOT approved products list for unit concrete masonry and brick.

#### Mortar

1. Use a bagged mortar mix unless permission is granted by the Engineer. All bagged mortar mixes shall use a product found on the WisDOT approved products list for prepackaged utility mortar.
2. When non-bagged mortar mixes are allowed they shall meet the requirements of Section 519 of the *Standard Specifications for Highway and Structure Construction*.

#### Joints

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Butyl Rubber Sealant **ASTM C443**
  - B. Butyl Rubber Gasket **ASTM C443, ASTM C478, and ASTM C497**
2. When an embedded bell gasket manhole is used it shall have bell and spigot style joints with an embedded gasket. The embedded gasket shall have wedge shaped ribbed rubber material that is cast into the inner portion of the bell of the manhole.
3. The gasket shall be of a proper volume to fill the annular space of the joint and be placed firmly against the lower third of the vertical slope of the joint.
4. Preformed butyl rubber sealants shall be one inch high by 1½ inches wide or sized according to manufacturer's recommendations for the type of application.

#### Steps

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Copolymer Polypropylene **ASTM D4101 Type II Grade 49108**
  - B. Steel Bar **ASTM A615 Grade 60**
2. Manhole steps shall be made with an approved plastic such as copolymer polypropylene reinforced with a deformed ½ inch diameter reinforcing bar.
3. All manhole steps shall be approved by the Owner and OSHA.

#### Sanitary Pipe to Manhole Connectors

1. Use a molded rubber boot of appropriate size conforming to **ASTM C923** and listed below:
  - A. Kor-N-Seal by Trelleborg Pipe Seals Milford, Inc.
  - B. Quik-Lok by A-Lok Products, Inc.
2. All connectors shall come complete with all required stainless steel hardware.

#### Adjustment Rings

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Precast Concrete Adjustment Rings **ASTM C478**
  - B. Polyethylene Adjustment Rings **ASTM D4976**
  - C. Expanded Polypropylene Adjustment Rings **ASTM 3575 and ASTM 4819**
  - D. Rubber Adjustment Rings **ASTM D573**
2. The high density polyethylene rings shall be Ladtech, Inc. manhole adjustment and grade rings.
3. The expanded polypropylene rings shall be Cretex Pro-Ring manhole adjustment and grade rings. Use with manufacturer recommended sealant.
4. The rubber rings shall be EJ INFRA-RISER manhole adjustment and grade rings. Use with manufacturer recommended polyurethane sealant.

5. All concrete adjustment rings shall be manufactured at a facility on the WisDOT pre-qualified list for precast concrete fabricators.
6. The Contractor shall provide the mix design, testing results, and certifications of any concrete rings used on the project.

#### Manhole Frames and Covers

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Gray Iron **ASTM A48 Class 35B**
  - B. Ductile Iron **ASTM A536 Grade 80-55-06**
2. Castings shall be true to pattern in form dimensions, free from pouring faults, sponginess, cracks, blowholes, and other defects in positions affecting strength and value for the service intended. Castings shall be boldly filleted at angles and the risers shall be sharp and perfect. Castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.
3. Sanitary sewer manhole frames and covers shall be Neenah R-1550 frames with a solid Type B lid, with concealed pick holes, and shall be self-sealing with a continuous flat "T" seal gasket, which fits securely in a machined bearing surface. Non-rocking covers are not allowable.
4. Storm sewer manhole frames and covers shall be Neenah R-1550 frames with a solid Type B lid and open pick holes. Non-rocking covers are not allowable.
5. Storm sewer manhole frames and covers which are specified on the plans as "open grate" or "OG" shall be Neenah R-2050 frames with a type D grate. Non-rocking covers are not allowable.
6. Type-H catch basin frames shall be Neenah Foundry R-3067 and the Type-A catch basin frames shall be Neenah Foundry R-3235. Type-H catch basin frames shall use a 5.75 inch curb box with a two inch radius (R-3067-7007). Catch basins located in driveways or immediately adjacent to a curb ramp shall use a Neenah Foundry R-3067-C frame. All catch basins shall include the diagonal type-R grate except where a different grate is shown on the plans. Each R-3067 frame shall include Neenah EnviroNotice lettering "Dump No Waste - Drains to Fresh Water" and "loon and fish logo" cast into the top of the curb box.
7. Two foot diameter field inlet frames shall be Neenah Foundry R-5901-E with type G grate. 2.5 foot diameter field inlet frames shall be Neenah Foundry R-5901-G with type G grate. Field inlets with beehive grates shall be Neenah Foundry R-2560-E.
8. Manhole frames and covers, which are not Neenah Foundry, must be approved by the Engineer, shall have equivalent dimensions, and shall meet all of the requirements of this section.

#### Non-Shrink Grout

All non-shrink grout shall use a product found on the WisDOT approved products list for non-shrink grout.

#### Chimney Seals

Unless otherwise called for in the plans and specifications, chimney seals will not be required.

#### Liquid Bonding Admixture

Liquid bonding admixtures shall be Akkro-7T.

### Construction

#### General

1. Excavate trenches for all catch basins, manholes, and inlet bases as described in the specifications for trenching.
2. The excavation shall be limited to the size required for the structure to be constructed and shall be sheathed and braced as necessary to protect the workman and prevent loss of ground.
3. The proposed elevations for the structures, as shown on the plans, are subject to revisions in order to fit field conditions, and the Engineer may adjust the grades from those shown on the plans.
4. Manholes shall be installed at the end of each line, at all changes in grade, size or alignment, and at all pipe intersections.
5. Manholes shall be located at intervals not greater than 400 feet for sanitary sewers with diameters of 15 inches or less and not less than 500 feet for sanitary sewers between 18 inches and 30 inches. See plans for actual locations.
6. All manhole inverts shall be cast for full height flow and all side connecting mains shall have full sweep curvature into main line flow. No variation will be allowed from this requirement.
7. Install steps in all manholes in excess of four feet deep. Manhole steps shall be installed in true vertical alignment at intervals of 16 inches with an allowable tolerance of one inch plus or minus.
8. All manhole steps shall be embedded into the riser or eccentric cone wall a minimum of three inches and shall project uniformly from the inside face of the wall five inches to the centerline of the step.
9. Surfaces which will be exposed to the flow of water or sewage inside the manhole shall be given a smooth troweled finish.
10. Dead end manholes shall include a minimum of four foot length, full depth manhole invert with one inch slope.
11. All storm structures shall have a minimum depth of four feet from top of base to flow line of grate unless indicated otherwise. Structures with sumps shall be filled with concrete to the lowest invert elevation unless indicated otherwise.

#### Constructing Foundation

Construct foundations for all catch basin, manhole, or inlet bases as described in the specifications for trenching.

#### Manhole Bases

1. **Precast Manhole with Integral Base:** The excavation shall be deep enough so that after the bottom has been placed thereon, set to grade and plumbed, there remains a six inches minimum depth of bedding material below the bottom of the base. The annular space between the manhole excavation and the outside wall of the manhole section shall be backfilled with bedding material up to the spring line of the incoming pipe. The invert shall not be poured until the manhole is completely built and backfilled. The flow channel shall be the same diameter as the larger of the adjoining sewers and shall be shaped as shown in the standard detail drawings.
2. **Field Poured Base for Precast Manholes:** The precast manhole bottom barrel section shall be set on solid concrete blocks with a minimum of 12 inches of clearance between existing sewer pipes and stone bedding. The manhole base of Class C concrete shall then be poured. The concrete base shall be a minimum of 12 inches and four inches of the barrel section shall extend into the base.
3. **Field Poured Base for Concrete Block Manholes:** The concrete base of Class C concrete shall have a minimum thickness of twelve inches below the invert of the outlet sewer. The manhole base shall substantially conform to the required shape and dimensions; the excavation shall be back formed, if necessary, to achieve this end. If excavation in stable soil has been carried below

the required depth, such excess depth shall be filled with concrete. Excess concrete shall not be deposited around the manhole in such a manner that will interfere with future connections. The pipe shall be supported on brick or solid concrete blocks for the pouring of the concrete base. The concrete of the base shall be extended under flexible pipe to where it rests in undisturbed soil. This concrete support for rigid pipe shall end in a vertical plane flush with the face of the bell.

#### Concrete Walls and Chimneys

##### 1. Precast Concrete Manholes:

- A. Set manhole base on graded bedding material per specifications making sure that boots or pipe connections match design elevations. Level top of manhole base section in both directions.
- B. The manhole walls shall be constructed at the specified diameter as shown on the plans and schedule of prices. The minimum allowed inside diameter is 48 inches.
- C. Use appropriate lifting slings that will adequately lift weight of units. The use of an appropriately rated spreader bar is preferred. When lifting manhole bases and risers, make sure chain or cable lengths are long enough to prevent contact with tongue and groove area, and are kept at appropriate lifting angles. Use wooden blocks between sling and manhole wall, if necessary.
- D. Clean and inspect tongue and groove surfaces. Surfaces should be clean from all dust and debris. On tongue-up manholes, place butyl material next to the vertical surface or tongue. Wrap material completely around unit overlapping ends. Knead the ends together to form a uniform splice. Make sure all protective paper is removed. Lower bell end of the next section making sure steps are aligned into final position. If bell is up, place butyl material next to vertical surface of groove and follow above procedure. All sections, as shown on the shop drawings, should be completed in this manner.
- E. Concealed pick holes are required for manhole barrel sections. Lifting holes penetrating through the manhole sidewalls are not permitted. Lifting holes shall be sealed by inserting a rubber plug or other approved material into the hole, and filling it with non-shrink mortar.
- F. Backfill around manhole equally to prevent tipping. Compact fill in lifts same as the standard trench procedures, as stated in these specifications.

##### 2. Concrete Block Manholes:

- A. The manhole wall constructed of concrete block shall be constructed at the specified diameter as shown on the plans and schedule of prices up to the beginning of the corbel section. From this point, the manhole shall be corbelled in at approximately one-half inch horizontal to one inch vertical to the diameter of the manhole frame. The face of the manhole in which the steps are installed shall be kept vertical.
- B. In the construction of manholes, care shall be taken to provide walls with smooth interior faces, the masonry being laid up in a workmanlike manner. Concrete block masonry shall be constructed in horizontal courses with vertical joints broken, and where concrete manhole block are used in manholes having inside diameters greater than four feet, such block shall be 12 inches long (rather than the usual 16 or 18 inches) to produce more regular inside walls. Concrete block sidewalls shall be laid with full mortar joints. Joints on interior walls shall be struck smooth. Concrete block manholes, from the base to the top of the cone, shall be back-plastered with a mortar coat one-half inch thick. Such mortar coat shall be placed on the outside face of the walls.
- C. Backfill around manhole equally to prevent tipping. Compact fill in lifts same as the standard trench procedures, as stated in these specifications.

### Doghouse Manholes

1. Doghouse manholes are only allowed at locations shown on the plans or where approved by the Engineer.
2. Provide a field poured concrete base or a precast concrete base on a compacted granular bed.
3. Existing sewer pipes shall be cleaned of all debris where the manhole is to be placed.
4. Existing sanitary pipes shall be wrapped with neoprene gasket material and sealed with pipe silicone to create a watertight barrier prior to placement of concrete base. A liquid bonding admixture shall be used immediately prior to the placement of the concrete base.
5. An invert and bench shall be constructed as shown in the standard detail drawings.
6. Provide precast concrete manhole walls and chimneys. Concrete block walls are only allowed with the approval of the Engineer.
7. The Contractor shall provide construction details and material submittals for review and approval by the Engineer prior to construction.

### Sanitary Manhole to Pipe Connections

1. Kor-N-Seal and Quik-Lok connectors shall be cast into the precast concrete manhole base section whenever possible. The connector shall be located in the manhole section to allow for a minimum of two inches of concrete below the bottom of the sewer main. The connector shall be sized specifically for the type of pipe being used and shall be installed in accordance with the recommendations of the manufacturer.
2. When the connection is made out in the field, the concrete manhole section must be cored per manufacturer's installation instructions. The seal between the connector and the pipe shall be made by compressing the connector against the outside circumference of the pipe by means of a stainless steel take down band.

### Pipe Connections

1. Pipe placed in masonry for inlet or outlet connections shall be flush on the inside of the structure wall. Carefully construct the masonry around pipes to prevent leakage around their outer surfaces.
2. Pipe shall extend through the walls and beyond the outside surfaces of the walls a sufficient distance to allow for connections with sewers.
3. Adequate provisions shall be made to support pipe outside the structure walls to prevent shearing off of said pipe after backfilling and tamping is completed.

### Drop Pipe

1. An outside drop pipe shall be provided for a sanitary sewer entering a manhole where the invert elevation of the entering sewer is two feet or more above the spring line of the outgoing sewer.
2. The drop pipe shall be the same diameter as the incoming sewer unless otherwise specified.
3. The bottom of the drop shall utilize a 90 degree elbow fitting with a spigot end unless the plans or Engineer specifies the use of a wye fitting with a spigot end and a 45 degree bend.
4. When an outside drop connection is to be made on an existing manhole, the footing of the drop shall be the same thickness as the manhole base and connected by means of a minimum four ½ inch diameter reinforcing bars drilled into the existing manhole base. An additional four ¼ inch diameter reinforcing bars shall be placed as dowels into the new footing and extended as the vertical part of the drop is constructed of monolithic concrete. In addition, the drop shall be tied to the existing manhole with ½ inch diameter reinforcing bars or steel strapping at a maximum spacing of two feet with a minimum of two ties to prevent any separation of the drop from the manhole wall. The entire drop connection shall be encased with a minimum four inch thick envelope of Class C concrete.



5. The Contractor shall provide construction details and materials submittals for review and approval by the Engineer prior to construction.

#### Manhole Chimneys and Adjustment Rings

1. New manholes shall use plastic or rubber rings.
2. The adjustment rings shall conform to pavement slope using wedge shapes, and other thickness adjustment rings as required. Wedge rings shall be installed at the top of the ring stack. A maximum ¼ inch thick solid adjustment shim ring may be used over the wedge ring.
3. Catch basin and field inlet adjustment rings may be plastic or rubber rings. Catch basin adjustment rings shall be installed such that 1½ inches to two inches of concrete may be vibrated under the frame during the installation of the curb and gutter.
4. Secure grade riser rings and adjustment rings with Engineer-approved butyl rubber sealant or using the manufacturer's recommended method.
5. For polyethylene rings, a ⅝ inch diameter, continuous bead of butyl rubber adhesive is required to be installed between each ring. A double ring of sealant is required between the concrete manhole and adjacent ring. A double ring of sealant is also required between the casting and adjacent rings unless concrete is to be vibrated between the casting and rings for concrete paving. For concrete paving, the ring adjustment shall include a double ring of adhesive, ¼ inch thick, between the top solid shim ring and the first polyethylene ring below the shim.
6. Where asphalt pavement is constructed, adjustment rings shall be adjusted so the manhole casting rim is no more than ¼ inch below pavement grade, as measured with a ten foot straight edge, and conforming to the pavement slope.
7. The adjustment rings and frame shall not exceed a total height of 21 inches.

#### Manhole Frames and Covers

1. Set sanitary manhole frames on flexible joint sealant. Adjust to required alignment and grade while adjacent concrete is plastic. Hand vibrate concrete adjacent to fixtures to fill voids and openings between fixtures and support structures. Fill remaining voids beneath the base of these fixtures with an Engineer-approved non-shrink grout before opening to traffic.
2. Set storm structure frames on flexible joint sealant or on full mortar beds. Adjust to required alignment and grade while adjacent concrete is plastic. Hand vibrate concrete adjacent to fixtures to fill voids and openings between fixtures and support structures. Fill remaining voids beneath the base of these fixtures with an Engineer-approved non-shrink grout before opening to traffic.
3. Set the frames, grates, and lids accurately so the complete installation will be at the correct elevation required to fit the adjoining surfaces. Make sure the grates or lids are not in place while striking off and finishing the adjoining concrete.
4. Surfaces of contact between frames and covers shall be sufficiently true so that no rattling occurs when vehicles pass over the cover. If rattling does occur, the cover shall be removed and machined so as to eliminate the rattling.

#### Adjust Catch Basin, Manhole, and Inlet Covers

1. Adjust existing covers, including frames, grates, or lids to the required elevation.
2. All of the adjustment rings shall be removed to the existing precast or block structure unless directed otherwise by the Engineer. When adjusting brick structures remove all adjustment rings and remove all bricks as needed to provide a solid surface for the frame.
3. One precast concrete ring may be used when adjusting existing manholes if the required adjustment exceeds 12 inches. Concrete rings shall be a minimum of six inches thick and a minimum of six inches of plastic rings shall be used at all adjustments.

4. Adjustment shall include replacement of up to 18 inches of concrete rings and mortar with plastic rings. Manhole adjustments greater than 18 inches will be considered rebuilding the manhole.
5. The existing cover at a proposed adjust shall be protected and reused by the Contractor unless indicated otherwise. If the existing cover is broken, at no fault of the Contractor, then the Contractor shall replace the cover with a new cover meeting Owner specifications at no cost to the Contractor.
6. A new cover, including frames, grates, or lids shall be provided when indicated on the plans.

#### Rebuild Existing Manholes

Existing manholes shall be rebuilt as indicated on the plans. Rebuilding manholes includes removal of the existing cover, adjustment rings, bricks, blocks, and precast barrel sections, cone sections or flat tops as necessary. Rebuilding manholes also includes the addition of new precast barrel sections, cone sections, and flat tops; replacement of existing precast barrel sections, cone sections or flat tops as necessary to meet the elevations shown on the plans; adjustment rings; cover; reconnecting existing pipes; and repairing existing blocks as necessary.

#### Salvage and Move Catch Basins

If the plans show, salvage existing catch basin, frame, and grate and move to proper location indicated by Engineer to align with the proposed curb and gutter. Excavate and backfill and provide any adjustment rings necessary to meet the elevations shown on the plans, as well as including any removal of existing pipe.

#### Clean Out

All catch basins, manholes, and inlets shall be thoroughly cleaned of an accumulation of soil, debris or foreign matter of any kind, and shall be clear of such accumulations at the time of final inspection.

#### Basis of Payment

1. The catch basins, manholes, and inlets items shall be measured separately by each individual unit for the various sizes and types completed and accepted. Payment for the catch basins, manholes, and inlets bid items is full compensation for providing materials, including masonry, sealant, conduit and sewer connections, steps, and other fittings; for installing drop pipes; for providing new covers, including adjustment rings, frames, grates or lids, and other required materials and for installing and adjusting each cover; for excavating, backfilling, and disposing of surplus material, and for cleaning out and restoring the work site.
2. The adjust catch basin, manhole, and inlet covers items shall be measured separately by each individual unit for the various types completed and accepted. Payment for the adjust catch basin, manhole, and inlet covers bid items is full compensation for providing required materials, including frames and grates or lids when the existing cover will not be reinstalled; and for removing, installing or reinstalling covers, and adjusting the covers. The Contractor shall replace covers rendered unusable by the Contractor's operations, at no expense to the Owner.
3. The rebuild manhole items shall be measured separately by each individual unit for the various types completed and accepted. Payment for rebuilding manholes is full compensation for providing required materials, including masonry and fittings; for salvaging and reinstalling existing manhole sections and covers, including frames, grates, or lids; for necessary excavation, backfilling, disposing of surplus material, and for cleaning out and restoring the work site.
4. The salvage and move catch basin item shall be measured separately by each individual unit completed and accepted. Payment is full compensation for removing the existing catch basin and

cover including frames, grates, or lids; for cleaning, transporting, and storing; for installing and adjusting; and for providing other required materials. If additional pipe is needed it shall be paid under the pertinent bid item for storm sewer pipes.

## **LATERALS**

### Scope

This section describes excavating required trenches or tunnels, laying or constructing sanitary sewer and storm sewer lateral pipe inside, and then backfilling and cleaning out as necessary.

### General Requirements

The Contractor shall submit manufacturer's data for the pipe, fittings, gaskets, and appurtenances.

### Materials

#### General

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Polyvinyl Chloride Sewer Pipe and Fittings **ASTM D3034**
  - B. Polyvinyl Chloride Pressure Pipe and Fittings **AWWA C900**
2. Sewer pipes shall be clearly marked as follows at intervals of five feet or less:
  - A. Manufacturer's name or trademark.
  - B. Nominal pipe size.
  - C. Pipe classification.
  - D. The legend, i.e. "SDR-35 PVC Sewer Pipe".
  - E. ASTM designation.
  - F. Extrusion date, period of manufacture, or lot number.
3. Fittings shall be clearly marked as follows:
  - A. Manufacturer's name or trademark.
  - B. Nominal size.
  - C. The material designation.
  - D. ASTM designation.
4. Packaging, handling, and shipment of sewer pipes shall be in accordance with manufacturer's instructions and specifications. Any pipe damaged in shipment shall be replaced as directed by the Engineer.
5. Pipes shall be stored in the supplier's yard or on the project site in accordance with manufacturer's recommendations.
6. Pipe shall be subject to rejection for failure to conform to any of the specification requirements or for any of the following reasons:
  - A. Any visible damage; fractures; cracks; chips; defects that indicate imperfect proportioning, mixing, or molding; variations in alignment; damaged ends or gaskets; or misplaced reinforcement; which are sufficient to impair the strength, durability, or serviceability of the pipe in the opinion of the Engineer.
  - B. Extensive patching or painting of any surface of pipe.

#### Storm and Sanitary Lateral Materials

All laterals shall be SDR 35 PVC sewer pipe conforming to **ASTM D3034** unless indicated otherwise on the plans.

### Joints

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Elastomeric Seals (Gaskets) for Joining Plastic Pipe **ASTM F477**
  - B. Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals **ASTM D3212**
  - C. Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals **ASTM D3139**
2. Elastomeric gaskets for non-pressure sanitary sewer pipes shall provide a continuous watertight conduit having an infiltration rate not exceeding 50 gallons per inch of pipe diameter per mile per day.
3. Provide nitrile gaskets when specified on the plans for areas with anticipated contaminated soil or groundwater.

### Polyvinyl Chloride Pipes

1. Pipes shall be stored in the supplier's yard or on the project site in accordance with **AWWA M23** and manufacturer's recommendations.
2. Pipe will not be stacked higher than four feet or on the bell ends.
3. Cover PVC pipe, which is stored outside for a prolonged period, with an opaque material to protect it from the sun's ultraviolet radiation. PVC pipe that has been subjected to excessive ultraviolet radiation is identified by color fading or chalking and shall not be used. The determination as to the acceptability of the pipe rests solely on the Engineer's decision.
4. Pipe that has been contaminated in any way with petroleum products on the inside or outside of the pipe shall not be used.

### Pipe to Pipe Connectors

1. Use a molded rubber boot and PVC hub of appropriate size and listed below:
  - A. Inserta Tee by Advanced Drainage Systems, Inc.
2. Use a molded rubber boot of appropriate size and listed below:
  - A. Kor-N-Tee by Trelleborg Pipe Seals Milford, Inc.
3. All connectors shall come complete with all required stainless steel hardware.
4. The lateral insertion shall be contoured to conform to the shape of the inside of the sewer main.

### Cleanout Frames and Covers

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Gray Iron **ASTM A48 Class 35B**
2. Castings shall be true to pattern in form dimensions, free from pouring faults, sponginess, cracks, blowholes, and other defects in positions affecting strength and value for the service intended. Castings shall be boldly filleted at angles and the risers shall be sharp and perfect. Castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.
3. Cleanout frames and covers shall be Neenah R-1792-AL frames with a solid lid.
4. Manhole frames and covers, which are not Neenah Foundry, must be approved by the Engineer, shall have equivalent dimensions, and shall meet all of the requirements of this section.

## Construction

### General

1. The Contractor shall verify the location, elevation, material, and size of all connections to existing upstream structures and laterals prior to installing new sanitary and storm sewer

laterals to allow for any necessary adjustments to the planned slope so that the lateral is not back pitched at the upstream connection point(s). Excavations to verify existing laterals shall be backfilled or adequately fenced or barricaded to protect pedestrians and vehicular traffic as directed by the Engineer.

2. Excavate trenches and tunnels for all sanitary and storm laterals as described in the specifications for trenching.
3. The Contractor shall be responsible for dye testing to determine which laterals are active and shall provide for tracing the existing lateral with a Metrotech or equal, a lateral launched camera, potholing, or other approved method.
4. The Contractor shall be responsible for determine the point of connection to the existing lateral so that the new lateral may be laid perpendicular to the sewer main without extra horizontal deflections.
5. The Contractor shall determine the location of the existing sanitary laterals at locations where the new sanitary sewer laterals will be laid to a new sanitary sewer main located in a different location than the existing sanitary sewer main using a Metrotech or equal, a lateral launched camera, potholing, or other approved method to determine the point of connection to the existing lateral so that the new lateral shall be laid perpendicular to the sanitary sewer main without extra horizontal deflections. The location of the existing lateral shall be determined prior to installing the sewer main. The Contractor is responsible for coordinating with homeowners if it is necessary to enter their house to locate existing laterals.
6. The Contractor shall separate any sanitary sewer laterals serving more than one lot and shall provide a lateral for each lot.

#### Constructing Foundation

Construct foundations for all sanitary and storm laterals as described in the specifications for trenching.

#### Laying Lateral Pipes

1. The minimum size of sanitary and storm laterals shall be six inches in diameter.
2. Sanitary laterals shall be laid perpendicular to the sanitary main without horizontal deflections.
3. Sanitary sewer laterals will be laid at a minimum of ¼ inch per foot, unless otherwise approved by the Engineer.
4. Storm sewer laterals will be laid at ⅛ to ¼ inch per foot, unless shown otherwise on the plans or otherwise approved by the Engineer.
5. New sanitary sewer laterals shall have a minimum depth of nine feet at a location two feet behind the property line or proposed sidewalk. If the sanitary main is not sufficiently deep enough to give this depth, then the laterals shall be laid to a minimum grade of ⅛ inch per foot.
- 6.elayed sanitary sewer laterals shall have a minimum depth of nine feet at a location two feet behind the back of curb or road shoulder. If the sanitary main is not sufficiently deep enough to give this depth, then the laterals shall be laid to a minimum grade of ⅛ inch per foot.
7. Storm laterals shall be laid to two feet behind the curb and gutter unless shown otherwise.
8. No sanitary sewer laterals shall discharge directly into a manhole unless approved by the Engineer.
9. Sanitary sewers 12 inches or less shall use factory wyes. Lateral connections for 15 inch diameter and larger sanitary sewers may be made using factory wyes or an Inserta Tee. Wyes shall point downstream and enter the sanitary main at an angle of not less than five degrees and no more than 45 degrees off horizontal.
10. For all existing sanitary sewer mains which are twelve inches or less in diameter, the Contractor shall cut out a section of the existing sanitary main and install a factory wye or tee with a

minimum two-foot piece of PVC pipe on each side of the factory wye and use a shielded coupling on each end to attach to the existing sanitary main. In existing sanitary sewer mains where there is an extremely high flow, the Engineer may approve an alternate method for lateral connection.

11. Storm sewer laterals shall use factory wyes, factory tees, or a pipe to pipe connector. Laterals installed perpendicular to the spring line of the main may use Inserta Tee or Kor-N-Tee pipe to pipe connectors. Laterals installed vertically or at a 45 degree angle may use Inserta Tee pipe to pipe connectors.
12. Make connections to existing laterals as described in the specifications for sewer connections.
13. Unconnected sanitary and storm laterals shall be plugged with a waterproof cap or plug. Except in existing developed areas, the location of the end of the lateral shall be marked with a wooden 2 x 4 inch board extending at least two feet above the ground surface and shall be painted green.

#### Polyvinyl Chloride Pipe Joints

1. PVC pipes shall have watertight joints conforming to the requirements of **ASTM D3212**. The Contractor shall use factory-installed elastomeric gaskets conforming to the requirements of **ASTM F477**. PVC pressure pipe shall use rubber gaskets conforming to the requirements of **ASTM D3139**.
2. The outside of the gasket and the inside of the bell or groove of the pipe shall be lubricated with an approved lubricant. The spigot or tongue of the pipe being laid shall be introduced into the bell or groove end of the previously laid pipe. The pipe shall be carefully set to line and grade and then shall be pushed or jacked home. Care should be taken that the entering pipe is completely home.

#### Inserta Tee Connections

1. The Contractor shall core the proper size into the sewer.
2. The Contractor shall insert the rubber sleeve into the cored hole with the gold line on the rubber sleeve perpendicular to the main line sewer. The upper segment should be on top of the wall and the lower segment should be on the inside of the pipe.
3. Apply Inserta Tee solution to the inside of the rubber sleeve and the outside of the PVC hub adaptor. Caution, using pipe lubricant may cause the hub adaptor to pop out.
4. Insert the PVC hub adaptor into the rubber sleeve. Make sure the red line on the PVC hub adaptor is in line with the gold line on the rubber sleeve.
5. Place a 4 x 4 inch board on top of the PVC hub adaptor.
6. The red horizontal line at the top of the hub adaptor is a depth mark. Using a board and hammer, drive the PVC hub adaptor into the rubber sleeve to where the red horizontal line on the PVC hub adaptor meets the top of the rubber sleeve.
7. Place the stainless steel band around the top of the rubber sleeve and tighten down.
8. Install pipe in normal manner.

#### Kor-N-Tee Connections

1. The Contractor shall core a hole into the sewer main consistent with the model number for the lateral pipe outside diameter.
2. Inspect the inside surface of the cored hole. If there is porosity or wire to cement separation, use patching or hydraulic cement to smooth the surface.
3. Insert the Kor-N-Tee assembly into the hole and expand the wedge or toggle Korband.
4. Insert the lateral until it bottoms on the positive stop of the Kor-N-Tee.

5. Install the lateral pipe clamp in the molded groove and tighten to 60 inch pounds using a T-handle torque wrench.

#### Cleanouts

1. A concrete pad is required when cleanouts are installed within a paved vehicular traffic area.
2. Upon installation and backfilling, the Contractor will ensure each frost sleeve cap or frame and lid is flush with the ground surface and fully exposed. If it is determined the cleanout has not been installed correctly and to grade, the Contractor will replace or adjust cleanout and/or frost sleeve to the correct elevation.

#### Backfill

Backfill all sanitary and storm sewers as described in the specifications for trenching.

#### Basis of Payment

1. The sanitary and storm laterals items shall be measured separately by the linear foot completed and accepted. This measurement equals the distance along the centerline of the pipe, from centerline of the sewer main, to which the lateral is connected, to the end of the installed lateral or to the connection to the existing lateral.
2. Payment for the sanitary and storm lateral bid items is full compensation for providing all necessary labor, equipment, and materials (including all necessary bends and fittings); for excavating; for removing, abandoning, and sealing existing structures, pipes, and appurtenances within the limits of excavation or trenching operations; for providing and removing sheeting and shoring; for bypass pumping; for providing bedding material and granular backfill material; for constructing the foundation; for laying pipe; for constructing risers; for sealing joint; for backfilling; for replacing pipe made unusable by contractor operations; for cleaning out; and for restoring the work site. Payment for sanitary sewer laterals also includes all labor, equipment, and materials necessary to connect to existing laterals. Payment for new laterals also includes furnishing and installing plugs on the end of the lateral and marker posts when required.
3. The vertical riser items shall be measured by the linear foot that is completed and accepted or by each individual unit that is completed and accepted. The measurement equals the distance along the centerline of the pipe, from the top of the sewer main (on which the riser is built) to the top of the tee connection for laterals. Payment for the vertical riser bid items is full compensation for providing all necessary labor, equipment, and materials (including all necessary bends and fittings); for excavating; for providing and removing sheeting and shoring; for bypass pumping; for providing granular backfill material; for constructing the foundation; for laying pipe; for sealing joint; for backfilling; for replacing pipe made unusable by contractor operations; for cleaning out; and for restoring the work site. The horizontally laid portion of the lateral shall be measured and paid under the sanitary and storm lateral bid items.
4. Apply contract unit prices, without adjustment, to the quantities of sanitary and storm sewer laterals constructed at elevations not greater than one foot below what the plans or details show. If the Engineer orders the construction of the sewer laterals or portions of the laterals at elevations greater than one foot below what the plans or details show, then the Owner will pay for this work as specified extra work. If the Engineer orders the construction of the sewer pipes or portions of the pipes at elevations greater than one foot above what the plans show, then the Owner may request an adjustment to the contract prices for this work.
5. Work performed one foot or less below the pipe bottom to form a satisfactory foundation as specified is incidental to the work. The Owner will pay for work required at depths greater than one foot below the pipe bottom as extra work.

6. Connections to existing pipes, laterals, catch basins, manholes, and inlets shall be paid as indicated in the specifications for sewer connections.
7. The locate existing sanitary lateral item shall be measured separately by each individual lateral located. Payment for the locate existing sanitary lateral bid item is full compensation for providing all labor, equipment, and materials to perform the work and restore the work site. Payment will only be made at locations where the new sanitary sewer laterals will be laid to a new sanitary sewer main located in a different location than the existing sanitary sewer main. Payment will not be made if the location of the new lateral can be determined during installation of the new sanitary sewer main.
8. No compensation will be provided for relaying laterals or any other work necessary to provide an adequate slope and connection to the existing lateral caused by a failure to adequately verify the location, elevation, material, and size of all connections to existing upstream structures and pipes.
9. The cleanout items shall be measured separately by each individual unit for the various types completed and accepted. The cleanout items include the wye and vertical pipes to the top of the frame or cap. Payment for the cleanout bid items is full compensation for providing materials, including all necessary bends and fittings; for excavating; for providing and removing sheeting and shoring; for constructing foundation; for completing any necessary connections to the existing or proposed lateral; for providing and installing a frost sleeve and cap; for providing and installing frame and lid; for backfilling; for compacting; for cleaning out; for concrete pad; and for restoring the work site. The horizontally laid portion of the lateral shall be measured and paid under the sanitary and storm lateral bid items.

## SEWER CONNECTIONS

### Scope

This section describes constructing connections to existing sanitary and storm sewer mains and laterals by means of couplings, concrete collars, or coring into existing manholes, including all necessary excavating and backfilling.

### General Requirements

The Contractor shall submit manufacturer's data for the fittings, couplings, connectors, bands, appurtenances, and mix designs.

### Materials

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Flexible Couplings **ASTM D5926 and ASTM C1173**
  - B. Shielded Couplings **ASTM D5926 and ASTM C1173**
  - C. Repair Couplings **ASTM D3034, ASTM F769, and ASTM F1336**
  - D. Flexible Pipe to Manhole Connectors **ASTM C923**
  - E. Concrete Collars **Class C Concrete**
  - F. External Sealing Band **ASTM C877**
2. Shielded couplings shall be Strong Back RC 1000 Series Couplings by Fernco or MAXADAPTOR couplings by Gripper Gasket LLC.
3. Flexible couplings used to connect sanitary laterals, storm sewer mains, and storm laterals to existing pipes shall be stock couplings, large diameter couplings, or shielded couplings by Fernco or MAXADAPTOR couplings by Gripper Gasket LLC.
4. Flexible pipe to manhole connectors shall come complete with all required stainless steel hardware and shall be listed below:



- A. Kor-N-Seal by Trelleborg Pipe Seals Milford, Inc.
- B. Quik-Lok by A-Lok Products, Inc.
- 5. All non-shrink grout shall use a product found on the WisDOT approved products list for non-shrink grout.

## Construction

### General

1. Excavate trenches for all sewer connections as described in the specifications for trenching.
2. All new sanitary sewer pipe connections to existing manholes shall be cored. All connections shall be equipped with a pipe to manhole connector.
3. Pipe placed in masonry for inlet or outlet connections shall be flush on the inside of the structure wall. Carefully construct the masonry around pipes to prevent leakage around their outer surfaces.
4. Pipe shall extend through the walls and beyond the outside surfaces of the walls a sufficient distance to allow for connections with sewers.
5. Adequate provisions shall be made to support pipe outside the structure walls to prevent shearing off of said pipe after backfilling and tamping is completed.
6. Connect new sanitary sewer pipe to existing pipe through the use of a bell and spigot, shielded coupling, flexible coupling, repair coupling, or concrete collar, or other method of connection approved by Engineer, so as to achieve a watertight connection where inverts of pipe are held at the same elevation. Use a bell and spigot connection of similar pipe materials whenever possible. Use repair couplings to connect new PVC pipe to existing PVC pipe whenever a bell and spigot connection is not possible. Use shielded couplings in other situations to connect a new sanitary sewer main to an existing main. Use concrete collars only when approved by the Engineer and when other connections are impractical.
7. Use shielded couplings or flexible couplings to connect new pipe to existing sanitary sewer laterals. Use repair couplings to connect new PVC laterals to existing PVC laterals.
8. Connect new storm sewer pipe to existing pipe through the use of a bell and spigot, shielded coupling, flexible coupling, repair coupling, PVC fittings, concrete collar, or other method of connection approved by Engineer, so as to achieve a watertight connection where inverts of pipe are held at the same elevation. Use a bell and spigot connection of similar pipe materials whenever possible. Use repair couplings to connect new PVC pipe to existing PVC pipe whenever a bell and spigot connection is not possible. Use shielded couplings in other situations to connect a new storm sewer main to an existing main. Use concrete collars only when approved by the Engineer and when other connections are impractical.
9. Use shielded couplings or flexible couplings to connect new pipe to existing storm sewer laterals. Use repair couplings to connect new PVC laterals to existing PVC laterals. Use concrete collars only when approved by the Engineer and when other connections are impractical.

### Constructing Foundation

Construct foundations for all pipes as described in the specifications for trenching.

### Connect to Existing Sanitary Manhole Openings

1. Use existing holes only when the existing pipe to manhole connector in good condition, at the correct invert elevation, and is the appropriate size.
2. Remove any existing pipes.
3. Slide the pipe into the connector.
4. Check for proper alignment and grade.

5. Tighten the stainless steel clamps.

#### Connect to Existing Storm Structure Openings

1. Use existing holes in storm structures when feasible.
2. Remove any existing pipes.
3. Adjust the size of the hole to an adequate size.
4. Connect pipes and construct masonry around the pipes.

#### Core into Existing Sanitary Manholes

1. The Contractor shall core the proper size hole into the existing manhole.
2. Manhole inverts shall be provided with full flow height and all side connecting mains shall have full sweep curvature into the main flow line. A minimum of two inches of concrete shall be recast into the reconstructed invert. Bench modification includes removing or otherwise performing significant adjustment of existing manhole benches.
3. The Contractor shall install a pipe to manhole connector in accordance with the recommendations of the manufacturer.
4. Slide the pipe into the connector.
5. Check for proper alignment and grade.
6. Tighten the stainless steel clamps.

#### Core into Existing Storm Structures

1. The Contractor shall core the proper size hole into the existing manhole.
2. Existing block manholes shall have entire existing blocks removed.
3. Manhole inverts shall be provided with full flow height and all side connecting mains shall have full sweep curvature into the main flow line. A minimum of two inches of concrete shall be recast into the reconstructed invert. Bench modification includes removing or otherwise performing significant adjustment of existing manhole benches.
4. Connect pipes and construct masonry around the pipes.

#### Flexible & Shielded Couplings to Existing Pipes

1. Reconnect all existing live sewer pipes to the proposed sewer. When a new pipe is connected to an existing pipe, a watertight joint using a flexible or shielded coupling is required.
  - A. Use the following installation instructions for Fernco couplings:
    - a. Loosen the stainless steel clamps. Do not remove clamps from coupling.
    - b. Slide coupling over one pipe end. Insert second pipe. Center pipe ends inside of coupling.
    - c. Tighten clamps to 60 inch-lbs. of torque.
    - d. Pressure test before backfilling or concealing joint. Bed and backfill properly.
  - B. Use the following installation instructions for MAXADAPTOR couplings:
    - a. Tighten both sides of the coupling; alternating back and forth.
    - b. Slide coupling over one pipe end. Insert second pipe. Ensure gasket is centered and properly engaged inside securing cage.
    - c. Tighten clamps to 80 inch-lbs. of torque.

#### Repair Couplings

1. Cut out and remove the existing pipe as required. Take care to cut as straight as possible.
2. Lay the proper bedding.
3. Clean the pipe sections so they are clean from any dirt or debris.
4. Align and slide the repair coupling onto both ends of pipe.

### Concrete Collars

1. Provide a watertight joint by wrapping the connection with an external sealing band. Place the concrete collar containing Class C concrete around the connection.
2. The collar should be six inches thick by 24 inches in width.
3. Remove any projections at the connection that might cut or damage the sealing band. Take special care when backfilling around the sealing band to help prevent disturbance to the connection.

### Basis of Payment

1. The connect to existing manhole or structure items and the core and connect to existing manhole or structure items shall be measured separately by each individual unit for the various sizes and types completed and accepted. Payment for the connect to existing manhole or structure bid items is full compensation providing all necessary labor, equipment, and materials; for excavating; for sheeting and shoring; for by-pass pumping; for forming foundation; for flexible connector or masonry; for bench modifications; for providing granular backfill material, including bedding material; for backfilling; for removing sheeting and shoring; and for cleaning out and restoring the site of work.
2. The connect to existing main items shall be measured separately by each individual unit for the various types completed and accepted. Payment for the connect to existing main bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for sheeting and shoring; for by-pass pumping; for forming foundation; for couplings; for providing granular backfill material, including bedding material; for backfilling; for removing sheeting and shoring; and for cleaning out and restoring the site of work.
3. The connect to existing storm lateral item shall be measured separately by each individual unit for the various types completed and accepted. Payment for the connect to existing main bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for sheeting and shoring; for by-pass pumping; for forming foundation; for couplings; for providing granular backfill material, including bedding material; for backfilling; for removing sheeting and shoring; and for cleaning out and restoring the site of work.
4. The concrete collar items shall be measured separately by each individual unit for the various types completed and accepted. Payment for the concrete collar bid items is full compensation for providing all necessary labor, equipment, and materials; for excavation; for sheeting and shoring; for by-pass pumping; for forming foundation; for concrete collars; for providing granular backfill material, including bedding material; for backfilling; for removing sheeting and shoring; and for cleaning out and restoring the site of work.
5. The connect to existing manhole, structure, pipe, and lateral items do not include the costs of any pipes. Pipes and laterals shall be paid as indicated in the specifications for pipes and laterals.
6. The connect to existing sanitary sewer main item shall only be paid at connections to pipes greater than five feet from a manhole or connections to pipes 15 inches or greater in diameter.
7. No separate payment shall be made for connections paid under the sanitary sewer spot repair item.
8. No separate payment shall be made for connecting new sanitary sewer laterals to existing laterals.

## **BORING & JACKING**

### Scope

This section describes furnishing and installing casing pipes and carrier pipes of various sizes using boring and jacking.

### General Requirements

1. The Contractor shall submit manufacturer's data for the pipe, fittings, gaskets, and appurtenances.
2. The Contractor shall submit a jacking plan for all boring and jacking operations. The plan shall identify the method and equipment to be used, the location and size of the jacking pits, and the limits of the proposed jacking.

## Materials

### General

1. Use materials conforming to the requirements for the class of the material named and specified below:
  - A. Steel Casing Pipes **ASTM A53 Grade B or ASTM A 139**
  - B. Fiberglass Reinforced Polymer Mortar Pipe **ASTM D3262**
2. Unless otherwise tested or approved by the Owner, only use encasement pipe or uncased carrier pipe that is new and has smooth interior and exterior walls.

### Carrier Pipe

The carrier pipe to be installed within casing pipe shall conform to the same requirements as pipe to be installed by open cut excavation unless noted otherwise.

### Casing Pipe

The minimum inside diameter of the casing shall not be less than four inches larger than the maximum diameter of the carrier pipe. The minimum wall thickness shall be as required by permit requirements or the Contractor's method of construction, whichever is greater, but in no case shall it be less than the values in **Table 11**.

**Table 11**

**Casing Pipe Wall Thickness**

Nominal Casing Diameter (Inches)	Nominal Wall Thickness (Inches)
6	Use 6" Ductile Iron AWWA C151 Pipe
8	Use 8" Ductile Iron AWWA C151 Pipe
10	Use 10" Ductile Iron AWWA C151 Pipe
12	Use 12" Ductile Iron AWWA C151 Pipe
15	Use 15" Ductile Iron AWWA C151 Pipe
18	0.3125 (5/16)
20	0.375 (3/8)
24	0.375 (3/8)
30	0.469 (15/32)
36	0.531 (17/32)
42	0.625 (5/8)
48	0.688 (11/16)
54	0.781 (25/32)
60	0.844 (27/32)
66	0.938 (15/16)
72	1.000 (1)
84	1.156 (1-5/32)
96	1.312 (1-5/16)

### Lumber

All lumber permanently incorporated in the work shall be treated Douglas Fir or Southern Pine meeting the requirements of Section 507 of the *Standard Specifications for Highway and Structure Construction*.

#### Sand Slurry

1. Sand slurry shall be composed of fly ash, sand, and water proportioned as specified. Fly ash shall be Class C or F conforming to the requirements of **ASTM C618**. Sand shall conform to **ASTM C33** and shall be graded so that 100 percent by weight will pass a standard No. 8 mesh sieve, and at least 45 percent by weight will pass a standard No. 40 mesh sieve. Air-entraining admixture shall be Darex AEA by GCP Applied Technologies and shall conform to **ASTM C260**. Slurry shall be used for filling the space between the casing and carrier pipes.
2. **Design Mix:** Sand slurry shall be a mixture of five parts sand, one part fly ash, air entrainment (one ounce per 430 pounds of sand), and water (one gallon per 37.5 pounds of sand).

#### Casing Spacers

1. Casing spacers shall be designed to support the carrier pipe in the casing pipe. Standard casing spacers shall consist of 14 gauge **AISI Type 304** stainless steel attachment band with a PVC liner and not less than four 10 gauge **AISI Type 304** stainless steel risers. Each riser shall be equipped with a removable ultra-high molecular weight polymer or glass-reinforced plastic runner. Attachment hardware shall be **AISI Type 304** stainless steel. Spacer shall have a minimum width of eight inches.
2. Use a casing spacer listed below:
  - A. Cascade Waterworks Manufacturing Model CCS
  - B. Pipeline Seal and Insulator, Inc. Model S8G

### Construction

#### General

The Contractor shall construct a jacking pit of sufficient size to accommodate the backstop, jacks, pushing frame and pipe to be jacked. The pit shall have guide rails or timbers to keep the pipe in alignment and on grade. A push frame shall be provided to evenly distribute the jacking pressure to protect the ends of the pipe being jacked. A minimum of two hydraulic jacks shall be used. The casing pipe shall be fitted with a hardened steel cutting edge. The casing shall be jacked up grade, if possible, to facilitate drainage. All pipe shall be on site before starting jacking. Investigate all sites for the possibility of having to manage groundwater problems that may occur due to seasonal changes or natural conditions.

#### Casing Installation

The casing shall be pushed into place as the soil is excavated from the inside of the pipe. The excavation shall not precede the leading edge of the casing unless it is necessary to remove a large obstruction. Excavation for small diameter casing shall be accomplished by a boring auger. Excavation for large diameter casings shall be accomplished by hand or mechanical means. Once the jacking operation is started it shall be continued without interruption until completion. Do not exceed forces recommended by the manufacturer for joining or pushing pipe. The casing pipe in its final position shall be straight and true in alignment and grade. There shall be no space between the earth and the outside of the casing. If it is necessary to over excavate, the location shall be identified and pressure grouted after the casing is in place. The final alignment of the casing pipe shall be within three inches of the line and grade.

Steel Casing Pipe Joints

Steel casing pipes shall be jointed with a continuous weld for the full circumference. The welded joints shall be capable of resisting all jacking stresses. A qualified welder must perform all welding.

Fiberglass Reinforced Polymer Mortar Pipe Joints

Clean ends of pipe and joint components. Apply joint lubricant to the bell interior surface and the elastomeric seals. Use only lubricants approved by the pipe manufacturer.

Tracer Wire

Attach a minimum of two separate and continuous tracer wires either externally or integral with the product. Ensure the conductors are located on the opposite sides when installed externally.

Augering Fluids

Use a mixture of bentonite clay or other approved stabilizing agent mixed with potable water with a minimum pH of 6.0 to create the drilling fluid for lubrication and soil stabilization. Vary the fluid viscosity to best fit the soil conditions encountered. Do not use other chemicals or polymer surfactant in the drilling fluid without written consent of the Engineer. Certify in writing to the Engineer that any chemicals to be added are environmentally safe and not harmful or corrosive to the facility. Identify the source of water for mixing the drilling fluid. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds, or fire hydrants. Any water source used other than potable water may require a pH test.

Excess Material and Fluids

Monitor the pumping rate, pressures, viscosity, and density of the boring fluids to ensure adequate removal of soil cuttings and the stability of the bore hole. Contain excess drilling fluids, slurry, and soil cuttings at entry and exit points in pits until they are recycled or removed from the site. Ensure all boring fluids are disposed of or recycled in a manner acceptable to the appropriate local, state, and federal regulatory agencies. When jacking and boring in suspected contaminated ground, test the boring fluid for contamination and dispose of appropriately. Remove any excess material upon completion of the bore. If it becomes evident the soil is contaminated, contact the Engineer immediately. Do not continue boring without the Engineer's approval.

Boring Failure

If any obstruction is encountered, which prevents completion of the installation in accordance with the design location and specifications, the pipe may be taken out of service and left in place at the discretion of the Engineer. Immediately fill the product left in place with excavatable, flowable fill. Submit a new installation procedure and revised plans to the Engineer for approval, before resuming work at another location. If damage is observed to any property, cease all work until a plan of action to minimize further damage and restore damaged property is submitted and approved by the Engineer.

Carrier Pipe Installation

After the casing has been installed and accepted by the Engineer, the carrier pipe shall be installed. The positioning of spacers shall adequately support the carrier pipe throughout the casing. A casing spacer shall be installed within one foot of each end of the casing, on each side of each pipe joint, and at a maximum spacing of 6 feet, as a minimum. Assembly and location of casing spacers shall be in strict accordance with manufacturer's recommendations. The casing spacers shall be sized such that the carrier pipe will meet the line and grade as indicated on the drawings and be centered as close as possible in the casing.

The carrier pipe shall be pushed and pulled into place in such a manner that there is no opportunity for a joint to be opened or over inserted. The carrier pipe length shall be adjusted so that the end extends past the end of the casing 12 to 18 inches. After the carrier pipe is installed the end of the casing shall be sealed with two inch thick planks and the space between the casing and carrier shall be filled with a sand slurry.

#### Sand Slurry Application

Sand slurry shall be pumped or poured into the void between the casing and carrier pipe by means of a filler pipe. The filler pipe shall be installed at the top of the seal at the low end of the casing and a vent pipe shall be installed at the seal on the other end of the casing. The filler and vent pipes shall be PVC and extend up to an elevation above the highest part of the casing or to ground level. The top of the filler pipe shall be located at an elevation approximately six inches higher than the vent. Sand slurry shall be added to the void between the casing pipe and carrier pipes until the slurry flows from the vent pipe. After 24 hours, the filler and vent pipes shall be removed at the end seals.

#### Pressure Grouting

Pressure grouting, where required, shall be done by qualified mechanics under supervision of experienced foremen. The apparatus for mixing and placing cement grout shall be of a type acceptable to the Engineer and shall be capable of effectively mixing and stirring the grout and forcing it into the holes or grout connections in a continuous, uninterrupted flow at any specified pressure up to a maximum of 15 pounds per square inch. Gauges shall be provided, with an accurate meter reading in cubic feet to tenths of a cubic foot, for controlling the amount of mixing water used in the grout. In addition to the grout mixer, holdover mechanical agitator tanks shall be provided. All grout shall be pumped with a duplex piston-type pump.

Prior to grouting, systems and holes to be grouted shall be thoroughly washed clean. No washing will be required for grouting soil voids outside pipe cylinders or casing pipes. Grouting once started shall be completed without stoppage. In case of breakdown of equipment, the Contractor, at the Engineer's option, shall wash out the grouting system. Grout pressure shall be maintained until grout has set.

#### Testing

When there is any indication the installed product has sustained damage and may leak, stop the work, notify the Engineer, and investigate damage. The Engineer may require a pressure test and reserves the right to be present at the test. Perform pressure test within 24 hours, unless otherwise approved by the Engineer. Furnish a copy of the test results to the Engineer for review and approval. The Engineer shall be allowed up to 72 hours to approve or determine if the product installation is not in compliance with specifications. The Engineer may require non-compliant installations to be filled with excavatable, flowable fill.

#### Basis of Payment

1. The lump sum price for mobilization and demobilization of boring and jacking equipment is full compensation for providing all necessary labor, equipment, and material; for installing and removing the boring and jacking equipment; for providing access to the site; for maintaining site drainage; for providing dust abatement; for providing construction utilities; for excavating the boring pit and receiving pit; for providing and removing sheeting and shoring; for granular backfill material; for backfilling; and for restoring the work site. After the equipment is set up and ready for

use 60 percent of the amount shall be paid. The remaining 40 percent of the amount shall be paid after the equipment is removed from the site and clean up is completed.

2. The casing pipe items shall be measured separately by the linear foot for the various sizes and types completed and accepted. This measurement equals the distance along the centerline of the pipe. Payment for the casing pipe bid items is full compensation for providing all necessary labor, equipment, and materials; for dewatering; for removing and disposing excess material; for laying pipe; for filling the space between casing and carrier pipe; for furnishing and installing stainless steel casing pipe spacers; for end seals; for cleaning out; and for restoring the work site.
3. The carrier pipe items shall be measured separately by the linear foot for the various sizes and types completed and accepted. This measurement equals the distance along the centerline of the pipe. Payment for the carrier pipe bid items is full compensation for providing all necessary labor, equipment, and materials; for laying pipe; for sealing joint; for cleaning out; for testing pipe; and for restoring the work site.
4. If conditions warrant removal of any materials installed during a failed bore path, as determined by the Engineer, it will be at no cost to the Owner.

## **DIRECTIONAL DRILLING**

### Scope

This section describes installing sewer pipes and appurtenances of various sizes using directional drilling.

### General Requirements

1. The Contractor shall submit a drilling plan for each installation.
2. The Contractor shall record the ground elevation at the point of measurement and the alignment and depth of the pipeline every ten feet and at all changes in direction and changes in grade. All depth measurements shall be referenced to the center line of the pulling head. The alignment and depth information shall be documented on a set of as-built drawings. Depth measurements shall be converted to elevations using the project vertical datum.

### Construction

#### Drilling Plan

The drilling plan shall include the following information:

1. A detailed schedule.
2. Working plans showing the general arrangement of the Contractor's work areas, storage areas, and laydown areas showing locations of drill entry and exit work shafts, slurry work shafts and plants, drilling equipment, and pollution prevention measures among other features. The working plans shall show the layout profile and supports for any work shafts, trenches, or other excavations required to drill and install the pipe.
3. Composition and plan for safe disposal of drilling fluids and additives.
4. Methods for maintaining borehole stability and for controlling seepage and lost ground at the borehole junctures with work shaft walls.
5. A contingency plan detailing the Contractor's proposed response to obstructions encountered along the hole alignment, unanticipated conditions, changes, and other problems arising due to the selected construction procedure or other conditions to ensure completion of the project accordingly.
6. Record information of the pilot hole drilling.

#### Guidance System



The Contractor shall use a manufactured guidance system that provides a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance system shall be capable of tracking the drill head at all depths up to 50 feet and in any soil condition. The guidance system shall provide immediate information on the tool face, azimuth and inclination. The guidance system shall be calibrated to the manufacturer's specifications. The guidance system shall be accurate at sensing the drill head's position within plus or minus one foot horizontally and plus or minus 0.25 foot vertically. The Contractor shall not proceed with directional drilling unless the guidance system is operating correctly. The Contractor shall calibrate the guidance system in the presence of the Engineer. The Contractor shall dig a verification pit 10' from the initial point of entry, unless a different location is approved by the Engineer. The depth and alignment shall be measured at the verification pit and shall meet the guidance system accuracy requirements.

#### Site Survey

The entire directional drill route shall be accurately surveyed. The entry and exit locations shall be marked as shown on the Contractor's directional drilling plan. The Contractor shall field verify the location and elevation of all existing utilities that will be crossed during the directional drilling operation. The directional drill route shall be surveyed for any surface geo-magnetic variations or abnormalities if the Contractor is using a magnetic guidance system.

#### Trenchless Installation

A pilot hole shall be drilled at the alignment and grade shown on the construction drawings. Readings shall be taken with the guidance system after each successive drill pipe but not more than ten feet. At no time shall the deflection radius of the drill pipe exceed the maximum specified deflection of the sewer pipe to be installed. Upon approval of the pilot hole location, the pilot hole shall be reamed larger. The pilot hole shall be reamed to the diameter recommended by the pipe manufacturer or a maximum of 1.5 times larger than the largest outside diameter of pipe, whichever is smaller. The Contractor shall select the drilling fluid based on the existing soils. The drilling fluid shall be acceptable to the pipe manufacturer.

The pipe shall be pulled through the drilled hole using constant tension throughout the operation. The pulling device shall have a direct reading gauge to indicate the pulling tension. The Contractor shall select wall thickness for the pipe that will withstand the pulling forces exerted on the pipe. The minimum wall thickness for the pipe shall be listed in the piping system specifications. The actual tension shall never exceed the safe pulling tension of the pipe. High density polyethylene pipe shall be allowed to relax for 24 hours prior to making the final connections.

#### Tracer Wire

Tracer wire shall be attached to the pulling eye and the top of the sewer pipe. Ensure the conductors are located on the opposite sides when installed externally.

#### Borehole Abandonment

Boreholes, installed and/or partially installed pipe that fails to meet the requirements of these specifications shall be abandoned and backfilled with grout. Rejection criteria includes failure to drill the borehole to within the required tolerances, failure to maintain the borehole open for insertion of the pipe, and failure to install the pipe properly without damage, collapse or parting the joints.

Abandoned boreholes and pipe shall be completely grouted with a sand-cement grout mix conforming to the following requirements and approved by the Engineer: Grout shall consist of a mixture of water and Portland cement, with mineral fillers or admixtures as necessary to achieve a

non-shrink, non-bleed, flowable grout. The grout shall have a minimum 28-day compressive strength of 5,000 psf.

Sand for grout shall be clean natural silica sand, graded such that 100 percent of the material passes the No. 20 sieve and not more than 20 percent passes the No. 200 sieve.

Grout shall be injected into the borehole through drill rods or pipes extending to the end of the borehole or pipe. Grout shall be injected at a pressure sufficient to overcome the hydrostatic pressure of the drilling fluid, but not high enough to cause heave or damage to the overlying or adjacent structures. Grout shall be injected until the borehole or pipe is flushed of all drilling fluid and the return flow at the collar of the boring or pipe shows undiluted grout. The boring or pipe shall then be plugged to maintain the grout in the boring or casing until the grout has set. Additional grout shall be injected as necessary to fill voids left as a result of shrinkage or bleeding of the grout.

#### Basis of Payment

No separate payment will be made for work specified in this section. All costs involved with directional drilling work for the sewer installation shall be included in the unit price for the work it is associated with. Any damage resulting from any drilling fluid-induced blow out or any drilling fluid leak shall be the Contractor's responsibility.

### **TESTING**

#### Scope

This section describes the testing of sanitary and storm sewer pipes, laterals, force mains, manholes and other appurtenances, including low pressure air tests, water infiltration tests, exfiltration tests, deflection tests, closed circuit televising, and hydrostatic tests.

#### General Requirements

1. All sanitary sewers, except relays with active connected buildings' sewers, shall be required to pass a leakage test before they are accepted by the Owner. The permitted leakage tests for sewers 36 inches or less in nominal size are the water infiltration test or the low pressure air test. The Contractor may perform either of these tests. The permitted leakage test for sewers larger than 36 inches is the water infiltration or the water exfiltration test.
2. A visual inspection and test shall be conducted on all completed sewers larger than 36 inches when they are submerged by groundwater. All sanitary sewers larger than 36 inches not submerged by groundwater shall be visually inspected and tested for exfiltration or by low pressure air testing of individual joints.
3. All tests shall be performed by the Contractor under the observation of the Engineer unless the Special Provisions call for owner provided testing. The Owner shall notify the Contractor not less than 24 hours in advance if testing is to be done by the Owner.
4. The water infiltration or exfiltration test may be substituted for the low pressure air test when testing pressure pipe used for gravity service if the pressure pipe fails the low pressure air test.
5. The groundwater height above the installed pipe may be determined by attaching a transparent plastic tube to the provided opening in the manhole and using the plastic tube as a manometer.
6. The ends of branches, laterals, tees, wyes and stubs to be included in the test should be plugged to prevent leakage. When the lateral is connected to a saddle fitting installed on the main line under the same contract, that section of the main sewer shall be included in the lateral test.
7. Any section of sewer which fails to meet the test requirements shall be repaired or replaced and retested.

8. The Contractor is required to repair all visible leaks, defective joints, and defective pipe even if the leakage test requirements are met.
9. The Contractor shall furnish the testing device and all labor, equipment, and materials for performing all tests.

### Procedure

#### Low Pressure Air Test

1. This test method is applicable to all gravity sewer lines made of thermoplastic pipe, reinforced thermosetting resin (RTRP) pipe, and reinforced plastic mortar (RPM) pipe. The apparatus for the low pressure air test shall be set up per the standard detail drawing Low Pressure Air Test. The air test will be based upon an allowable leakage rate of 0.0015 cubic feet per minute per square foot of internal surface area.
2. Pipe diameters of 36 inches and above will not be accepted by means of the low pressure air test. In all cases, the length of the laterals shall be ignored.
3. Only after the sanitary sewers, including appurtenances and sanitary laterals, have been installed, backfilled, and cleaned, shall the Contractor proceed with an air test on the installed facilities.
4. The procedure is as follows:
  - A. The section of sewer line to be tested should be flushed and cleaned prior to conducting the low pressure air test.
  - B. Isolate the section of the sewer line to be tested by means of inflatable stoppers or other suitable plugs. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. One of the plugs should have an inlet tap, or other provisions for connecting a hose to a portable air control source.
  - C. If the test section is below the groundwater level, determine the height of the groundwater above the top of the pipe at the upstream end of the test section. If the groundwater is two feet above the top of the pipe at the upstream end, then the air pressure test cannot be used. For every foot of groundwater above the pipe spring line, increase the gauge test pressures by 0.43 pounds per square inch.
  - D. Connect the air hose to the inlet tap and portable air control source. The air equipment should consist of necessary valves and pressure gauges to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. Also testing apparatus should be equipped with a pressure relief device set no higher than 9.0 psig to prevent the possibility of loading the test section with the full capacity of the compressor.
  - E. Add air slowly to the test section until the pressure inside the pipe is raised to 4.0 psig greater than the average back pressure of any groundwater that may be over the pipe. Do not exceed 9.0 psig.
  - F. After the pressure of 4.0 psig is obtained, regulate the air supply so the pressure is maintained between 3.5 and 4.0 psig (above the average groundwater back pressure) for a period of two minutes. This allows the temperatures to stabilize in equilibrium with the temperature of the pipe walls. The pressure will normally drop slightly until temperature equilibrium is obtained. During this period, all plugs should be checked with a soap solution to detect any plug leakage.
  - G. Determine the rate of air loss by the time pressure drop method. After the two minute air stabilization period, air is slowly introduced into the section of pipe to be tested until the pressure is raised to approximately 4.0 psig. The air supply is then disconnected and the test pressure is allowed to decrease to 3.5 psig. The time required for the pressure to drop from

3.5 psig to 2.5 psig is determined by means of a stopwatch and this time interval is then compared to the specification from **Table 12**, to determine if the rate of air loss is within the allowable time limit. If the time is equal or greater, than the times indicated in the table, the pipe line shall be deemed acceptable.

- H. Upon completion of the test, the bleeder valve is opened and all air is allowed to escape. Plugs should not be removed until all the air pressure in the test section has been released. No one should be allowed in the trench or manhole while the pipe is being decompressed.

**Table 12**  
**Minimum Specified Time Required for a 1.0 Psig Pressure Drop for Size and Length of Pipe Indicated**

Pipe Diameter (Inches)	Minimum Time (Min:Sec)	Length for Minimum Time (Feet)	Time for Longer Length (Sec)	Specification Time for Length (L) Shown (Min:Sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.694L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

#### Water Infiltration Test

1. The water infiltration test shall not be considered a valid leakage test unless the top surface of the groundwater is at least two feet above the top of the pipe for the entire test length of the tested section during the test measurement. The Contractor may simulate this condition, at no cost to the Owner by flooding the trenches, with prior approval of the Engineer.
2. The rate of infiltration of water into the sewer project, including manholes, shall not exceed 50 gallons per day, per inch diameter, per mile of sewer.
3. The maximum infiltration rate for manholes tested separately and independently shall be 0.1 gallons per foot of diameter per foot of head per vertical foot of manhole per hour.
4. The maximum allowable infiltration, expressed in gallons per hour, is shown in **Table 13** for various pipe sizes.

**Table 13**  
**Allowable Limits of Infiltration Based on 50 Gal./In. Dia./Mile**

Diameter of Sewer (Inches)	Infiltration Per Ft. Per Hr. (Gallons)	Diameter of Sewers (Inches)	Infiltration Per Ft. Per Hr. (Gallons)
4	0.0016	21	0.0083
6	0.0024	24	0.0095
8	0.0032	27	0.0107
10	0.0039	30	0.0118
12	0.0047	36	0.0142
15	0.0059	42	0.0166

18	0.0071	48	0.0189
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Water Exfiltration Test

1. The water exfiltration test shall only be used if the existing groundwater level is less than two feet above the crown of the pipe measured from the highest elevation of the sewer section being tested.
2. Any arrangement of testing equipment which will provide observable and accurate measurement of water leakage under the specified conditions will be permitted. The rate of exfiltration of water out of the sewers, including manholes and appurtenances, shall not exceed 50 gallons per day, per inch diameter, per mile of sewer.
3. The maximum exfiltration rate for manholes tested separately and independently shall be 0.1 gallons per foot diameter per vertical foot of manhole per foot of head per hour.
4. The sewer test section shall be filled a minimum of four hours and up to a maximum of 72 hours prior to the time of exfiltration testing to permit normal absorption into the sewer walls to take place. After the absorption period, the pipe shall be re-filled to a minimum of two feet above the crown of the pipe or at least two feet above existing groundwater, whichever is higher.
5. The maximum allowable exfiltration, expressed in gallons per hour, is the same as for the infiltration test and is shown in **Table 13**. The minimum test period is 15 minutes and the maximum shall not exceed 24 hours.
6. The Engineer reserves the right to waive the exfiltration test on any section of sewer based on his/her evaluation of the results of previous tests of the project. When exfiltration tests are waived, a credit will be taken.

Deflection Test

1. Deflection tests shall be performed on the entire length of all PVC, fiberglass reinforced polymer mortar, polypropylene, and polyethylene main line pipe installed using an approved go-no-go device. This device shall conform substantially to that shown on the standard detail drawing Mandrel for Deflection Tests. The dimensions of the testing device shall be shown in **Table 14, Table 15, and Table 16**, located at the end of this section. **NOTE:** The base inside diameter (I.D.) is a minimum pipe I.D. derived by subtracting a statistical tolerance package from the pipe's average I.D. The tolerance package is defined as the square root of the sum of squared standard manufacturing tolerances.

$$\text{Ave ID} = \text{Ave OD} - 2(1.06)t$$

$$\text{Tolerance Package} = (A^2 + B^2 + C^2)^{1/2}$$

Where:

A = OD Tolerance (**ASTM D3034** for 8" - 15") & (**ASTM F679** for 18" - 27")

B = Excessive Wall Thickness Tolerance = 0.06t

C = Out of Roundness Tolerance (**ASTM D3034** for 8" - 15") & (**ASTM F679** for 18" - 27")

T = Minimum Wall Thickness (**ASTM D3034** for 8" - 15" solid wall)

(**ASTM F679** for 18" - 27") & (**ASTM F949** for 8" - 10" corrugated)

2. The test shall be conducted after all backfill has been placed and consolidated but before paving is constructed. If testing occurs within 30 days of placement of final backfill, deflection shall not exceed five percent. When testing occurs after 30 days of placement of final backfill, the deflection shall not exceed 7.5%.
3. For acceptance, the device must pass through the entire section between manholes in one pass when pulled by hand without the use of excessive force.

**Table 14****Testing Device Dimensions for Polyvinyl Chloride Pipe**

Nominal Size (Inches)	SDR 35 D3034 Minimum Diameter (Inches)		
	Base Inside Diameter	5% Deflection	7.5% Deflection
8	7.67	7.28	7.09
10	9.56	9.08	8.85
12	11.36	10.79	10.51
15	13.90	13.20	12.85
18	16.98	16.13	15.70
21	20.00	19.00	18.50
24	22.48	21.54	20.79
Nominal Size (Inches)	F949 Minimum Diameter (Inches)		
	Base Inside Diameter	5% Deflection	7.5% Deflection
8	7.66	7.27	7.08
10	9.55	9.07	8.83
12	11.34	10.77	10.49
15	13.86	13.17	12.82
18	16.96	16.12	15.69
21	20.16	19.16	18.65
24	22.63	21.50	20.94
30	28.20	26.79	26.08
36	34.18	32.47	31.61
Nominal Size (Inches)	F679 PS46 12454C Minimum Diameter (Inches)		
	Base Inside Diameter	5% Deflection	7.5% Deflection
18	16.98	16.13	15.70
21	20.00	19.00	18.50
24	22.48	21.36	20.79
27	25.33	24.06	23.43
Nominal Size (Inches)	F679 PS46 12364C Minimum Diameter (Inches)		
	Base Inside Diameter	5% Deflection	7.5% Deflection
18	17.06	16.20	15.78
21	20.10	19.09	18.59
24	22.59	21.46	20.89
27	25.45	24.17	23.54

**Table 15****Testing Device Dimensions for Polyethylene Pipe**

Nominal Pipe Diameter (Inches)	Base Inside Diameter (Inches)	Inside Diameter with 5% Deflection	Inside Diameter with 7.5% Deflection
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8	7.76	7.37	7.17
10	9.69	9.21	8.97
12	11.63	11.05	10.76
15	14.54	13.82	13.45
18	17.45	16.58	16.14
24	23.27	22.10	21.52
30	29.08	27.63	26.90
36	34.90	33.16	32.28
42	40.72	38.68	37.66
48	46.54	44.21	43.05

**Table 16**  
**Testing Device Dimensions for Polypropylene Pipe**

Pipe Type	Pipe Diameter (Inches)	Minimum Inside Diameter	Inside Diameter with 5% Deflection	Inside Diameter with 7.5% Deflection
Dual Wall	12	11.90	11.31	11.01
	15	14.85	14.11	13.74
	18	17.93	17.03	16.59
	24	23.90	22.71	22.11
	30	29.79	28.30	27.56
Triple Wall	30	29.62	28.14	27.40
	36	35.40	33.63	32.75
	42	41.31	39.24	38.21
	48	47.31	44.94	43.76
	60	59.30	56.34	54.85

#### TV Inspection

1. The intent of the TV inspection is to observe and record the conditions of the sewer sections being inspected. The location of all laterals shall be documented on the report.
2. Sanitary sewer main televising shall occur after installation of all laterals and at least two weeks prior to paving.
3. If the Owner deems the televising of the sanitary sewer mains is not of good quality, the Contractor will redo the section at his/her expense.
4. **EQUIPMENT:** The camera, television monitor, and other components of the video system shall be capable of producing a quality color picture. The television camera used for the inspection shall be one specifically designed and constructed for such inspection and shall be capable of radial view for inspection of the entire pipe, including lateral connections. The camera shall be mounted on adjustable skids, or self-propelled, and positioned in the center of the pipe. Lighting of the camera shall be supplied by a lamp on the camera and shall be capable of lighting the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions and shall have a minimum of 650 lines of resolution. The view seen on by the televising camera shall be transmitted to a monitor of not less than 17 inches.
5. **PROCEDURES:** A minimum of one pass with a jet shall be made prior to televising. The television camera shall be moved through a sewer at a uniform rate, stopping when necessary to insure properly documentation of the sewer. The television camera shall not be pulled at a speed greater than 30 feet per minute.

During the inspection operation, if the television camera will not pass through the entire sewer section, the Contractor shall reset his equipment in a manner so the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire section, the Contractor shall excavate and repair or replace the defective section.

If the camera becomes submerged due to a sag in the pipe, a high velocity jet will be utilized to pull water away from the camera lens. If the Engineer deems the sag is not acceptable, the Contractor will excavate and repair or replace the defective section of pipe at his/her own expense.

If the camera becomes trapped within the sewer, it is the responsibility of the Contractor to remove the camera. All costs for removal, including possible excavation and restoration are the responsibility of the Contractor.

6. **INSPECTION LOGS:** The logs shall be computer printed. One copy in a PDF format shall be supplied to the Owner. Television inspection logs must include the following:
  - A. Date, time, city, street, basin, sewer section, reference manhole number, name of operator, inspector, and weather conditions.
  - B. Pipe diameter, pipe material, section length, depth of pipe, length between joints, and corresponding video recording identification.
  - C. Location of each point of leakage and estimate of flow.
  - D. Location of each service connection.
  - E. Location of any damaged sections, nature of damage, and location with respect to pipe axis (such as mineral deposits, cracked pipe, sags, etc.).
7. **RECORDINGS:** The purpose of video recording is to supply a visual record and audio record of the condition of sewers. Recording playback shall be done at the same speed that it was recorded. Upon final payment of the work, all video recording shall become the property of the Owner, and shall be in a digital format. A complete video and audio recording shall be made of each line televised. Recordings and packages shall be labeled with location information and inspection date. Television inspection reports shall include the following:
  - A. Visual (On screen in corner)
    - a. Report number.
    - b. Date of television inspection.
    - c. Sewer section and number.
    - d. Current distance along reach (tape counter footage).
  - B. Audio:
    - a. Date and time of television inspection, operator name, name of overlaying or adjacent street, and manhole numbers.
    - b. Verbal confirmation of sewer section and televising direction in relation to the direction of flow.
    - c. Verbal description of pipe size, type, and pipe joint length.
    - d. Verbal description and location of each service connection and pipe defect.
    - e. Type of weather during inspection.

#### Hydrostatic Test

1. All force mains shall be tested and shall successfully pass a hydrostatic test composed of a pressure test and a leakage test. Pressure testing shall be run at 150% of the design operating pressure as specified by the Engineer, but not less than 50 psi.



2. Water shall not be added during the pressure test. No pipe section will be accepted if the test pressure drops more than five psi within the two-hour test duration.
3. The leakage is the amount of water required to bring the pressure back up to the starting pressure once the pressure test passes.
4. Hydrostatic tests shall be conducted on sections of main recommended as ready by the Contractor and approved by the Engineer. No section shall be less than 400 feet unless conditions warrant such testing of smaller sections.
5. Following the testing, the Contractor shall drain and dispose test water and remove any temporary fittings, valves, and plugs.

#### Basis of Payment

No separate payment shall be made for the testing of sanitary and storm sewer pipes, laterals, force mains, and manholes or for any required repairs necessary to meet the test requirements. All costs involved in testing shall be included in the unit price of the work it is associated with.

### **ABANDONMENTS**

#### Scope

This section describes the abandoning of existing sanitary structures, sanitary sewer pipe, storm sewer structures, and storm sewer pipe, either through crushing, filling, or removal of the existing structure or pipe.

#### General Requirements

1. Existing structures and pipes shall be abandoned and sealed at locations outside excavation or trenching operations as shown on the plans.
2. The Engineer will determine at the time of construction if certain manholes, catch basins, or pipes are to be abandoned, filled, or if complete removal is required.

#### Construction

##### Abandon Manholes and Catch Basins

1. All abandoned manholes and catch basins shall be removed to a depth of three feet below the proposed or established grade or existing street grade, whichever is lower.
2. The manhole structure base shall be cracked to allow drainage.
3. All pipe or laterals or sewer mains entering or leaving such structure shall be sealed off. The manhole, catch basin, or other structure being abandoned shall be backfilled in the same manner and with the same materials as sewer trenches are backfilled, with due care taken to accomplish adequate compaction.
4. All castings on such abandoned structures are the property of the Owner and shall be salvaged by the Contractor and delivered as directed or disposed as directed by the Engineer.

##### Seal Existing Sewers

1. The Contractor shall construct a bulkhead at each exposed end of abandoned pipes consisting of an eight inch cement brick and mortar wall.
2. Where trenching or excavating operations for this contract intersect or cut through old sanitary sewer, storm sewer, or water lines which the Engineer determines are inactive or are being abandoned, such lines shall be sealed off on both sides of the trench or excavation before backfilling operations are commenced.

3. All those locations at which inactive pipe or pipes to be abandoned are likely to be encountered will be noted on the plans, insofar as existing records and field surveys indicate. However, the omission of any note regarding the requirement of such plugs or the existence of some unknown pipe requiring such plugging shall not absolve the Contractor of his responsibility to seal all those pipes so encountered when directed by the Engineer to do so.

#### Abandoned Sewer Fill

1. All sewers, 15 inches in diameter or greater, which are to be abandoned and have not been removed shall be filled with sand or cellular concrete. Service shall be maintained in such sewers and drains until the Engineer shall order manholes, catch basins, and catch basin leads that are no longer in use shall be bulkheaded and abandoned.
2. The Contractor shall provide adequate access points to completely fill the pipe.
3. Backfill and compact any resulting trenches with granular backfill conforming to the requirements for sewer pipe installation.
4. For all abandonment, the Contractor will have the option to completely remove the existing sewer and backfill trench with appropriate backfill material. This will be paid at the same amount as abandoned sewer fill except where the plans specifically indicate that the sewer shall be removed.

#### Remove Sewer

1. All abandoned sewer pipes shall be excavated and removed from the roadway as shown on the plans or ordered by the Engineer.
2. Backfill and compact any resulting trenches with granular backfill conforming to the requirements for sewer pipe installation.
3. Any sealing of pipe at locations within excavation or trenching operations, such as main or lateral installation, is incidental.

#### Basis of Payment

1. The abandon manhole and catch basin items shall be measured separately by each individual unit for the various types of abandonment completed and accepted. Payment for the abandon manhole and catch basin bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for breaking down or removing existing manhole or catch basin; for the sealing of all open ends of sewer pipes entering or leaving the manholes or catch basins being abandoned; for providing granular backfill material; for backfilling; and for cleaning out and restoring the site of the work.
2. The seal existing sewer items shall be measured separately by each individual unit for the various types of sealing at each location completed and accepted. Payment for the seal existing sewer bid items is full compensation for providing all necessary labor, equipment, and materials; for excavating; for sealing the open ends of sewer pipes; for providing granular backfill material; for backfilling; and for cleaning out and restoring the site of the work.
3. The abandoned sewer fill items shall be measured by the cubic yard for the various types of fill completed and accepted. Payment for the abandoned sewer fill bid items is full compensation for providing all necessary labor, equipment, and materials to excavate, to remove, to break down, to seal ends, and to slurry or sand fill existing sewer pipes. It also includes providing granular backfill material, for backfilling, and for cleaning out and restoring the site of the work.
4. The remove sewer items shall be measured by the lineal foot for the various types of removal completed and accepted. Payment for the remove sewer bid item is full compensation for providing all necessary labor, equipment, and materials to remove existing sewer pipes. It also includes providing granular backfill material, for backfilling, for compacting, and for cleaning up and restoring

the site of the work. Removal of structures shall be included in the unit price bid for removing sewer.

5. Payment for abandoning and sealing existing structures and removing and sealing pipes at locations within excavation or trenching operations shall be included in the unit prices bid for new sewer and manholes.