Part V - Sewers and Sewer Structures

ARTICLE 501 - GENERAL

501.1 Description.

Storm and Sanitary Sewer Construction shall consist of excavating the required trenches and tunnels; furnishing and laying therein pipe or monolithic concrete masonry sewers and required structures and appurtenances; backfilling the trenches; and restoring the site of the work; at the locations and to the required lines and grades; all as shown on the plan and provided by the contract.

The Concrete used in the construction and installation of sewers, sewer access structures, catchbasins, inlets, and other structures and appurtenances shall conform to the requirements for "Concrete and Concrete Materials" as specified in Part 3, Article 301 of these Specifications, unless otherwise specified.

All work done in the vicinity of any tree located in the terrace shall be completed in accordance with section 107.13 Tree Protection Specification.

501.2 Equipment.

Equipment and tools necessary for performing all parts of the work shall be satisfactory as to design, capacity, and mechanical condition for the purposes intended, and any equipment which is not maintained in full working order, or which as used by the Contractor is inadequate to obtain the results prescribed, shall be repaired, improved, replaced or supplemented to obtain the progress and workmanship contemplated by the contract.

501.3 Inspection and Testing.

501.3(a) General.

For all tests, the Contractor shall install, backfill and clean all sewer mains, sewer laterals, and any related appurtenances prior to performing the tests. All water main and services shall be installed prior to testing the sanitary sewer.

The cost of all testing by the Contractor shall be included in the unit price bid for the various sizes and types of sewer pipe installed. All testing by the Contractor shall be performed in the presence of the Engineer. Any testing not observed by the Engineer shall not be considered for acceptance by the City.

All delivered pipe shall be inspected. All material found to have cracks, flaws, or other defects will be rejected by the Engineer, and the Contractor shall promptly remove such defective material from the site of the work.

501.3(b) Sanitary Sewer Gravity Main.

All gravity sanitary sewers shall be required to pass a leakage test, mandrel test and inspection by a closed circuit internal television system prior to acceptance by the City. The leakage test may be either a water infiltration test or a low pressure air test. The Contractor shall furnish all equipment, materials, labor and other work necessary to complete the tests. The Contractor may perform either the water infiltration test or low pressure air test, except as specified below.

Water Infiltration Test

After completion of pipe lines laid below the groundwater level and groundwater conditions have returned to normal, the line shall be tested for water infiltration. The water infiltration test shall be performed with a minimum positive head of two (2) feet. The length of the test shall be no less than one (1) hour in duration. The infiltration shall not exceed the rate of two hundred (200) gallons per day per mile of line per inch diameter of pipe being tested for any section of the system. Tests shall be performed for each run of pipe between sewer access structures, after groundwater conditions have returned to normal.

Low Pressure Air Test

The section of sewer line to be tested shall be isolated by inflatable stoppers or other suitable test plugs. Air shall be added slowly to the test section until the pressure reaches 4.0 psig. After a pressure of 4.0 psig is obtained, the pressure shall be allowed to stabilize between 3.5 psig and 4.0 psig for at least two (2) minutes.

The test shall begin once the air supply is disconnected and the pressure decreases to 3.5 psig. The time for the pressure to drop 1.0 psig between 3.5 psig and 2.5 psig shall be recorded and compared to the total required test time as found in Table 1 - Low Pressure Air Test Times to determine if the rate of actual air loss is within the allowable limit. In computing the total required test time from Table 1, the required test time for the length and pipe size of any service connections (i.e. laterals) in the test section shall be added to the required test time for the length and pipe size of mainline sewer being tested.

If the total required test time elapses before the 1.0 psig pressure drop occurs, the test section shall be accepted. If the total required test time does not elapse before the 1.0 psig pressure drop occurs, the air loss rate in the test section shall be considered excessive and the section of pipe shall be considered to have failed the test. If the line fails the test, the Contractor shall, at his expense, locate and repair the source of leaks and retest the test section prior to acceptance.

It shall be noted that the aforementioned test pressures assume no groundwater is present over the pipe. If groundwater is present, the test pressures must be increased 0.43 psi for every foot of groundwater depth to offset the depth of groundwater over the sewer line. If the groundwater level is two (2) or more feet above the top of pipe at the upstream end of the section, or if the required test pressure is greater than 9 psig, the air test method should not be used and the water infiltration test shall be used in its place.

TABLE 1
Low Pressure Air Test Times

Minimum allowable times (Min:Sec) for loss of air pressure from 3.5 psig to 2.5 psig for size and length of pipe indicated. (Based on 0.003 cfm per square foot with a minimum loss of 2.0 cfm and a maximum of 4.5 cfm.)

TEST LENGTH (FT.)	PIPE DIAMETER (INCHES)								
	4	6	8	10	12	15	18	21	24
25	0:05	0:10	0:18	0:28	0:40	1:03	1:31	2:03	2:41
50	0:09	0:20	0:36	0:56	1:20	2:05	3:01	4:06	5:21
75	0:14	0:30	0:53	1:23	2:00	3:08	4:32	6:09	8:02
100	0:18	0:40	1:11	1:51	2:40	4:10	6:02	8:12	10:42
125	0:23	0:50	1:29	2:19	3:20	5:13	7:33	9:55	11:20
150	0:27	1:00	1:47	2:47	4:00	6:15	8:30	9:55	11:20
175	0:32	1:10	2:04	3:14	4:40	7:05	8:30	9:55	11:20
200	0:36	1:20	2:22	3:42	5:20	7:05	8:30	9:55	11:20
225	0:41	1:30	2:40	4:10	5:40	7:05	8:30	9:55	11:20
250	0:45	1:40	2:58	4:38	5:40	7:05	8:30	9:55	11:53
275	0:50	1:50	3:15	4:43	5:40	7:05	8:30	10:02	13:04
300	0:54	2:00	3:33	4:43	5:40	7:05	8:30	10:57	14:15
325	0:59	2:10	3:47	4:43	5:40	7:05	8:43	11:52	15:26
350	1:03	2:20	3:47	4:43	5:40	7:05	9:24	12:47	16:38
375	1:08	2:30	3:47	4:43	5:40	7:05	10:04	13:41	17:49
400	1:12	2:40	3:47	4:43	5:40	7:24	10:44	14:36	19:00
425	1:17	2:50	3:47	4:43	5:40	7:52	11:24	15:31	20:11
450	1:21	2:50	3:47	4:43	5:40	8:20	12:04	16:26	21:23
475	1:26	2:50	3:47	4:43	5:40	8:47	12:45	17:20	22:34
500	1:30	2:50	3:47	4:43	5:55	9:15	13:25	18:15	23:45

Mandrel Test

At the request of the Engineer, pipe 8-inches and larger shall be tested for acceptance with an approved go/no-go mandrel not less than thirty (30) days after the pipe has been installed, the backfill compacted, and other underground utilities within close proximity (such as water main) have been installed and backfilled but before paving is constructed. For acceptance, the mandrel must pass through the entire section between sewer access structures in one pass when pulled by hand without the use of excessive force.

The City shall supply a testing mandrel in conformance with the specifications of Standard Detail Drawing 5.1.1, Mandrel Detail, and the specifications of this section. The Contractor shall furnish the equipment and labor for making this acceptance test. The mandrel shall be of a shape similar to that of a true circle enabling the gauge to pass through a satisfactory pipeline with little or no resistance. The mandrel shall be of a design to prevent it from tipping from side to side and to prevent debris build-up from occurring between the channels of the adjacent fins or legs during operation. Each end of the core of the mandrel shall have fasteners to which the pulling cables can be attached. The mandrel shall have nine various sized fins or legs of appropriate dimensions for various diameter pipes. Each fin or leg shall have a permanent marking that states its designated pipe size and percent

deflection allowable. The diameter of the mandrel shall be equal to ninety-five (95) percent of the base inside diameter of the pipe. The Contractor shall furnish the engineer a table showing the base inside diameter and the five (5) percent deflection mandrel dimension for each pipe diameter called for in the plans. The base inside diameter shall be the minimum pipe inside diameter derived by subtracting the statistical tolerance package (defined below) from the pipe's average inside diameter.

For corrugated PVC pipe: Average inside diameter = average inside diameter.
For corrugated PE pipe: Average inside diameter = nominal inside diameter.

Tolerance package = $(A^2 + B^2 + C^2)^{1/2}$

Where: A = outside diameter tolerance (ASTM 949) for corrugated PVC pipe and inside diameter tolerance (AASHTO M294) for corrugated PE pipe.

B = excess wall thickness tolerance = 0 for both corrugated PVC pipe and corrugated PE pipe.

C = out-of-roundness tolerance (ASTM 949) for corrugated PVC pipe and 3% of nominal inside diameter for corrugated PE pipe.

Any section of completed pipe failing to pass this deflection test shall be repaired or replaced and retested at the Contractor's expense.

Closed Circuit Internal Television System

In the event defects in the sewer are detected by the closed circuit television inspection, the Contractor shall correct such defects prior to acceptance and final payment for sewers completed.

501.3(c) Sanitary Sewer Force Main.

All completed sections of force main shall be hydrostatically field tested for exfiltration of water. The Contractor shall furnish the water necessary for the testing as well as all equipment, materials, labor and other work necessary to conduct the field tests and to make any necessary repairs or replacement.

The Contractor shall completely fill the pipe with water and expel all air from the pipe prior to testing. The test section shall be isolated through valves and/or watertight test plugs at each end.

During the test, the test section shall be subjected to a pressure of approximately 100 pounds per square inch gauge pressure (psig) at the point of highest elevation of the pipe under test. The length of the test shall be a minimum of one (1) continuous hour.

Leakage shall be defined as the quantity of water that needs to be supplied into the newly laid pipe, or any valved section of it, during the test in order to maintain the specified leakage test pressure.

Leakage shall not exceed the number of gallons per hour as determined by the following formula:

$$GPH = \frac{ND\sqrt{P}}{7400}$$

where,

GPH = gallons per hour
N = number of joints under test
D = nominal diameter of pipe in inches
P = average pressure in pounds per square inch gauge during the test

In the event that the section under test contains joints of different diameters, the allowable leakage shall be the sum of the computed leakage for each size of joint.

Should any test section fail the leakage test, the Contractor shall, at his own expense, determine the source of the leakage, repair or replace all defective materials and/or workmanship to the satisfaction of the Engineer, and retest the section until a successful leakage test is obtained.

501.3(d) Storm Sewer Main.

The following section applies to corrugated polyethylene with smooth inner liner and corrugated polyvinyl chloride storm pipe as described in Section 504.2 - Materials of these Specifications.

At the request of the Engineer, pipe 8-inches and larger shall be tested for acceptance with an approved go/no-go mandrel after the pipe has been installed and the backfill compacted, and other underground utilities within close proximity have been installed and backfilled but before paving is constructed. For acceptance, the mandrel must pass through the entire section between sewer access structures or other structures in one pass when pulled by hand without the use of excessive force.

The City shall supply a testing mandrel in conformance with the specifications of Standard Detail Drawing 5.1.1, Mandrel Detail, and the specifications of this subsection. The Contractor shall furnish the equipment and labor for making this acceptance test. The mandrel shall be of a shape similar to that of a true circle enabling the gauge to pass through a satisfactory pipeline with little or no resistance. The mandrel shall be of a design to prevent it from tipping from side to side and to prevent debris build-up from occurring between the channels of the adjacent fins or legs during operation. Each end of the core of the mandrel shall have fasteners to which the pulling cables can be attached. The mandrel shall have nine various sized fins or legs of appropriate dimensions for various diameter pipes. Each fin or leg shall have a permanent marking that states its designated pipe size and percent deflection allowable.

For PVC storm pipe the diameter of the mandrel shall be equal to ninety-five (95) percent of the base inside diameter of the pipe. The Contractor shall furnish the engineer a table showing the base inside diameter and the five (5) percent deflection mandrel dimension for each pipe diameter called for in the plans. The base inside diameter shall be the minimum pipe inside diameter derived by subtracting the statistical tolerance package (defined below) from the pipe's average inside diameter.

For corrugated PVC pipe: Average inside diameter = average inside diameter.

Tolerance package = $(A2 + B2 + C2)^{1/2}$

Where: A = outside diameter tolerance (ASTM 949) for corrugated PVC pipe.

B = excess wall thickness tolerance = 0 for corrugated PVC pipe.

C = out-of-roundness tolerance (ASTM 949) for corrugated PVC pipe.

For HDPE, the following size, 9 point madrells shall be used by the Contractor for testing:

Nominal Size	Mandrell Size
12 inch Diameter	11.04 inches
15 inch Diameter	13.80 inches
18 inch Diameter	16.57 inches
24 inch Diameter	22.08 inches

These mandrells shall be provided by the City.

Any section of completed pipe failing to pass this deflection test shall be repaired or replaced and retested at the Contractor's expense.

501.3(e) Sewer Access Structures.

Sewer access structures shall be individually tested for infiltration when directed by the Engineer. The rate of infiltration shall not exceed two hundred (200) gallons per day per mile of vertical height (wall only) per inch internal diameter (or maximum horizontal dimension of structure). Two hundred (200) gallons per day per mile of vertical height per inch internal diameter equals to the following rates:

Maximum allowable sewer access structure infiltration:

48" dia. sewer access structure = 0.0758 gallons per vertical foot per hour
60" dia. sewer access structure = 0.0947 gallons per vertical foot per hour
72" dia. sewer access structure = 0.1136 gallons per vertical foot per hour

In the event the water infiltration or the loss of air exceeds the rates specified, the Contractor shall locate the point or points of leakage and repair the pipe line or sewer access structure as directed by the Engineer at the expense of the Contractor. All visible leaks in sewer access structures shall be repaired even though the leakage test requirements are met. Acceptance and final payment for sewers completed shall not be made until any leakage, which exceeds the rate specified, has been corrected.

501.4 Finishing Work and Maintenance.

The Contractor shall maintain all trenches, keeping them well filled and in a safe condition for travel, and shall deliver to the City, at the time of acceptance, a finished job with all trenches in a condition satisfactory to the Engineer.

All concrete, asphalt, and gravel pavements; stone flagging or paving; sidewalks; curbs and gutters; culverts; fences; or other structures; which may have been damaged or displaced by the Contractor in constructing the sewer shall be rebuilt or relaid properly to the original line and grade in accordance with pertinent parts of these Specifications, or in the absence of applicable specifications, to the original condition of the structure.

The Contractor shall maintain all asphalt and gravel surfaces, restored and replaced as above, in first class condition until final acceptance of the project is made by the Common Council. Failures

occurring during the required guarantee period shall be repaired by the Contractor at no additional cost to the City.

All new or relaid sewers and structures shall be cleaned of any accumulations of silt, debris, and other foreign matter, and prior to acceptance, such installations shall be tested with water or by other approved methods, and under such tests unimpeded flow shall be indicated.

The area along the whole sewer shall be left clean and graded in a condition satisfactory to the Engineer.

Unless otherwise provided, costs of the work included in this Section shall be at the expense of the Contractor, and shall be included in the unit prices bid for the contract items with which such work is associated. Final payment will be withheld until such work is done in a manner satisfactory to the Engineer.

501.5 Measurement and Payment.

Only that work will be measured for payment which is completed and accepted in accordance with the terms of the contract.

The contract prices for the various items shall include all equipment, tools, labor and incidentals necessary to complete the work as specified.

501.6 Repairs and Replacement.

501.6(a) Pipes.

When compliance with these Specifications require, all pipe repairs shall be made by replacement of the defective pipe section with new, equal quality pipe. Alignment, grade, bedding and backfilling shall be done in accordance with these Specifications.

All field cuts of all types of pipe, except reinforced concrete pipe and corrugated metal pipe, shall be made with an approved mechanical pipe cutter or with a power saw in order to make a straight, true cut without chipping and cracking the pipe.

For joining the replacement sections, approved compression couplings conforming to the requirements of Compression Couplings for Vitrified Clay Plain-End Pipe, ASTM Designation: C425, Type A, with shear bands shall be used whenever possible. In no case will concrete encasement of defective pipe be allowed. A Poly (Vinyl Chloride) (PVC) Repair Coupling shall be used to repair a cracked or broken section of PVC pipe per Standard Detail Drawing 5.3.3 – Coupling Details as approved by the Engineer. All repairs involving pipe connections 8” in diameter or larger than 8” in diameter shall use the FERNCO RC Strong Back or equal repair coupling (ASTM C1173). These repairs shall include total and complete restoration of any disturbed surface to original or better than original condition which existed before the repair, regardless of improvements on lands where the repair is required. Unless otherwise provided, all cost of the work included in this Subsection shall be at the expense of the Contractor.

501.6(b) Reinforced Concrete Box Culverts.

Reinforced concrete box culverts (RCBC) roof repairs shall include the removal of the rectangular casting and reconstruction of the roof to provide a new 24 inch diameter opening for a nine (9) inch casting as specified in Section 507.2 – Castings of these Specifications. The RCBC Roof Repair shall be measured as each completed and accepted unit. The RCBC Roof Repair shall be either TYPE I or TYPE II as described below and further detailed in Standard Detail Drawing 5.1.2, RCBC Repair Type I or Type II:

TYPE I: A Type I repair is intended for any structure that has enough cover to fit the new eight (8) inch roof (placed on top of the existing roof), adjustment and nine (9) inch casting. It is the Contractor's responsibility to verify all access points to determine the type of repair needed prior to completing the work. The existing roof access point shall be left in place. Any structural defects shall be sawcut and removed to a clean edge.

A new reinforced concrete roof (eight (8) inches minimum thickness) shall have #4 rebars placed six (6) inches on center, both ways, and shall have a minimum of three (3) inches of clear space from the edge of concrete. A minimum of eight (8) inches of overlap longitudinally from the existing roof cutout shall be provided with the new roof. The new roof shall be flush with the vertical walls of the box culvert.

The roof shall be poured and cured on a flat surface prior to being placed on top of the existing box. SealTight Cold Plastic Sewer Joint compound (as manufactured by W.R. Meadows or approved equal) shall be applied to the top of the box and the roof shall be placed on top of the existing cutout to for a tight seal. All joints shall be sealed with mortar or mastic. The box culvert shall be cleaned and free of debris prior to placing the mortar or mastic.

TYPE II: A Type II repair is intended for any structure that will not have enough cover to fit the new eight (8) inches roof (placed on top of the existing roof), adjustment and nine (9) inch casting. It is the Contractor's responsibility to verify all access points to determine the type of repair needed prior to completing the work. The existing roof shall be sawcut and removed, at the location shown on the plans or as directed in the field by the Engineer, to remove the existing rectangular opening and any structural defects to a clean edge.

The reinforced concrete shall have #4 rebars spaced approximately six (6) inches on center, both ways, as detailed in the plans. The dowels shall be a minimum of three (3) inches clear of the edge of the repair rot o the exposed edge of the box. #6 smooth rebars, 12 inches on center, shall be doweled longitudinal a minimum of six (6) inches into the existing box culvert roof. All dowels shall be grouted into place with epoxy mortar. The roof shall match the existing box culvert roof thickness (8-10 inches, typical).

If the roof is poured in place it is anticipated that falsework would be required. Falsework supporting concrete structures shall remain in place a minimum of three (3) days for spans of new concrete of twelve (12) feet or less, and for six (6) days for spans of twelve (12) feet or greater, which shall be exclusive of days in which the concrete has been exposed to temperatures below 40 degrees F. Backfilling may

proceed after three (3) days. Falsework shall be constructed and placed to support the new concrete roof as it is poured in place. High early strength concrete with a cure time of three (3) days shall be used for all repairs. Sandbag diversions or pumping may be utilized at the Contractor's discretion while the falsework is in place. Any sandbags or pumping shall be considered incidental to accomplish the work as described. The Contractor shall be responsible for removing all falsework and sandbag diversions at the end of the cure time. Any damage incurred as a result of not removing these items shall be at the Contractor's expense. Repairs shall not be deemed acceptable until all falsework and/or sandbag diversions removed.

If the new roof is constructed separately from the box, the roof shall be poured and cured on a flat surface prior to being placed on top of the existing box. SealTight Cold Plastic Sewer Joint compound (as manufactured by W.R. Meadows or approved equal) shall be applied to the top of the box and the roof shall be placed on top of the existing cutout to form a tight seal. The new roof shall fit tightly onto the existing box and the new roof. The gap between the new roof and the existing roof shall be filled with SealTight Cold Plastic Sewer Joint compound and an eight (8) inch wide ¼ inch steel plate shall be placed across the entire width of the box, centered over the joint. If the new roof is poured separately, longitudinal dowel bars shall not be required.

All repair joints shall be sealed with SealTight Cold Plastic Sewer Joint compound in the interior and exterior of the box culvert to ensure a watertight seal. The box culvert shall be cleaned and free of debris prior to placing the mortar and mastic.

Any temporary plating required to accomplish the work as described above shall be incidental to this item.

501.6(c) Sanitary Sewer Access Structures.

Reconstruct Bench and Flowline(s) shall include the reconstruction of an existing sanitary sewer access structure bench and flowline(s) to accommodate changes in pipe sizes, alignments and/or grades of the incoming and outgoing pipes when it is determined by the Engineer that the existing structure shall remain in place. Work shall be done such that the structure and structure floor remain structurally sound after the reconstruction. If it is determined either during a tap or a reconstruction of the bench and flowline(s) that the structure does not have a solid, structurally sound floor, the work shall include the placement of a new structure floor. Work shall include excavating one foot minimum below the invert of the outgoing pipe, placement of a six (6) inch minimum compacted granular material base, and placement of a new poured concrete floor. All work shall be measured and paid for as each completed unit. Finished flowlines shall have a smooth troweled finish. Brushed flowlines will not be accepted.

ARTICLE 502 - TRENCH EXCAVATION, BEDDING, AND BACKFILL

502.1 Description.

502.1(a) Trench Excavation.

Unless otherwise provided in the contract or permitted by the Engineer, the work of constructing sewers and allied works shall be done in open trenches and in a manner to protect the pipe lines or sewers from unusual stresses. When provided in the contract or permitted by the Engineer, the construction of sewers may be done by tunneling and/or jacking in lieu of open trenching; details of construction shall be indicated on the plan, specified in the contract, or established by the Engineer prior to beginning the work of tunneling and/or jacking. All of the work of constructing sewers shall be done in accordance with the applicable provisions of the "Wisconsin Administrative Code".

The trenches shall be excavated in conformity with the required alignment and grades as shown on the plans and as laid out in the field by the Engineer. It shall be understood that the elevations for sewers, as shown on the plans, are subject to such revisions as may be necessary to fit field conditions and that the Engineer reserves the right to adjust the profile grades from those shown on the plan. No adjustment in compensation will be made for the grade adjustments not in excess of one (1) foot above or below the elevations shown on the plans.

The Contractor shall remove all vegetation along the trench line to the width of the proposed trench before beginning excavation. Vegetation removed shall not be used as backfill in the trench, but shall be disposed of by the Contractor at no additional cost to the City. If the trench line is finished with pavement or other structures, removal of those items shall be completed as specified in Article 203 – Removal of Miscellaneous Structures with the exception that the sawcut shall be incidental to the trench excavation.

The materials excavated from the trench shall be deposited on the sides of the trenches and excavations, beyond the reach of slides, or transported to spoil banks. For pipe sewers, the width of the trench shall be such as to leave a clear space of not less than six (6) inches nor more than twelve (12) inches between the earth wall, or the supporting sheeting or bracing where such is used, and the sides of the pipe. The trench width established by this pipe clearance, measured at the spring line, shall be applicable to that portion of the trench from one (1) foot above the top of the pipe to the bottom of the trench. On streets opened to traffic, on restricted easements, and in such other locations as the Engineer directs, the width of the trench at the surface of the ground shall be limited to the outside diameter of the pipe plus two (2) feet plus the amount necessary for sheeting or bracing.

Surplus material shall be considered to include vegetation from the trench line, excavated rock or boulders larger than six (6) inches in diameter, and all other material from excavation not needed or suitable for backfilling trenches. Unless otherwise specified, surplus material shall be the property of the Contractor, and shall be disposed of at no additional cost to the City.

Unless otherwise provided, the Contractor shall provide all the sheeting or bracing needed to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. Such sheeting and bracing shall be according to the Contractor's design and shall comply with the "Wisconsin Administrative Code". Removal of any sheeting or bracing from the trench shall be accomplished in such a manner as to fulfill the above requirements. Sheeting and bracing shall be removed unless specific permission is given by the Engineer to leave it in place. Costs of this work shall be at the Contractor's expense.

The Engineer reserves the right to limit the extent of excavation in advance of pipe laying and backfilling depending on the nature of the soil and other conditions affecting the work.

The Engineer reserves the right to order additional excavation where unsuitable foundation conditions exist. When this condition arises, the excavation shall be carried to such depth as directed by the Engineer. The maximum width of the extra trench excavation shall be the outside of the proposed structure plus two (2) feet plus the amount necessary for sheeting or bracing. Mechanically compacted crushed stone and/or washed gravel shall be installed to replace the excavated materials to subbase grade.

When directed by the Engineer, the Contractor shall uncover utility lines within the proposed construction limits in advance of the construction as specified in Article 508. Work necessary to expose existing underground facilities that are part of the Contractor's statutory obligation during the normal storm sewer, sanitary sewer, electrical conduit or water main installation shall be considered as incidental to those respective items and will not be paid for as utility line openings.

502.1(b) Rock Excavation.

Rock excavation shall include all hard, solid rock in ledges, bedded deposits and unstratified masses and all conglomerate deposits or any other material so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that, as determined by the Engineer, it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Power shovels as referred to above shall be taken to apply to a modern power shovel or backhoe of not less than three-quarters cubic yard manufacturer's rated capacity, having adequate power and being in good running condition in the hands of an experienced operator. Rock excavation shall also include all rock boulders necessary to be removed having a volume of one (1) cubic yard (9 cubic feet) or more. Rock excavation shall not apply to plain or asphaltic bound bases or surface courses of macadam, gravel, or broken stone.

Rock excavation shall be carried to a depth of six (6) inches below the outside of the sewer, and to a width limited to the outside diameter of the pipe plus two (2) feet. Rock excavation shall be carried to a depth of eight (8) inches below the outside of the sewer for sewer access structures up to ten (10) feet deep and twelve (12) inches below the outside of the sewer for sewer access structures over ten (10) feet deep. The horizontal limit for rock excavation shall be the outside dimensions of the sewer access structure plus two (2) feet.

502.1(c) Dewatering.

The Contractor shall provide and maintain ample means and devices with which to promptly remove all water entering excavations, trenches, and other parts of the work and shall keep said excavations dry until the structures to be built therein are completed. No masonry shall be installed in water nor shall water be allowed to rise over masonry and concrete until the mortar and concrete have attained final set. In no event shall water be allowed to rise over masonry or concrete if there is danger of flotation or of setting up unequal pressures in the concrete until the concrete has set at least twenty-four (24) hours and any danger of flotation has been removed. Dewatering shall be either TYPE I or TYPE II as described below:

TYPE I: TRENCH DEWATERING AND POINTS/WELLS DEWATERING WITH PUMP RATES LESS THAN 70 GALLONS PER MINUTE (AGGREGATE TOTAL).

If the Contractor chooses to use trench dewatering techniques (no limit on pump rates) or a point/well system that in total pumps <70 g.p.m., the permitting of these activities is covered by the City of Madison's Construction Site General Permit obtained from the Wisconsin Department of Natural Resources (WDNR) for the project. As such, the Contractor shall be responsible for complying with the erosion control requirements listed in the Table 2 - Dewatering Practice Selection Matrix.

TYPE II: POINTS/WELLS WITH PUMP RATES GREATER THAN OR EQUAL TO 70 GALLONS PER MINUTE (AGGREGATE TOTAL).

If the Contractor chooses to dewater the site with points/wells with total pump rates equal to or greater than 70 g.p.m., the Contractor shall obtain a permit for installation of groundwater control well/s from the Wisconsin Department of Natural Resources (WDNR) in accordance with paragraph 144.025(2)(e), Wisconsin Statutes. All wells shall be drilled and sealed in accordance with requirements of the WDNR for installing and abandoning wells. The address for obtaining well permits is:

Wisconsin Department of Natural Resources
Private Water Supply Section
Box 7921
Madison, Wisconsin 53707

When the Contractor chooses to obtain a water supply permit for dewatering, he/she shall provide erosion control at the discharge point as required to meet the conditions of the permit. At a minimum the Contractor shall provide silt fence, riprap, sedimentation basins or other approved means to minimize erosion and dissipate energy from the discharge point of pumped water.

Further, where the discharge (as permitted by the private water supply permit) has the potential to cause an adverse impact on the quality of the receiving water, a Wisconsin Pollutant Discharge Elimination System (WPDES) permit may be required by the WDNR. If a WPDES permit is required the Contractor shall file for this permit with the WDNR, and comply with any and all requirements of that permit. If discharge testing is required by the WPDES permit the Contractor shall:

(1) Arrange for independent testing laboratory to sample and analyze discharge water for particulates at frequency indicated within WPDES permit. Where particulates exceed specified limits, the Contractor shall take such measures as are required to improve water quality to meet standards.
(2) Construct any sedimentation basins used to meet the requirements of the WPDES discharge permit to meet the requirements of "Wisconsin Construction Site Best Management Handbook" or its' successors.

The Contractor shall be solely responsible for choosing a method of groundwater control, which is compatible with the constraints defined herein. The Contractor shall be responsible for the adequacy of the groundwater control system and shall take all necessary measures to ensure that the groundwater control operation will not endanger or damage any existing adjacent utility or structure.

The Contractor shall submit in writing to the Engineer his proposed method of dewatering for this project prior to its use.

The method or methods shall be designed, installed and operated in such a manner to provide satisfactory working conditions and to maintain the progress of work. The methods and systems shall be designed so as to avoid settlement or damage to adjacent property in accordance with the applicable legislative statutes and judicial decisions of the State of Wisconsin. All required pumping, drainage and disposal of groundwater shall be done without damage to adjacent property or structures, or to the operations of other Contractors and without interference with the access rights of public or private parties.

The dewatering system must remain in place until all excavation, backfilling and compaction is completed.

The Contractor shall be responsible for adhering to all requirements of the dewatering permit including reporting requirements.

TABLE 2 - Dewatering Practice Selection Matrix

Type of Dewatering Practice	**Soil and Texture Classification**		**Notes**
	Silty Soils	**Clay Soils**	
Geotextile Bags			
Type I	……		See Table 3 for Bag Specifications & Sizing
Type II	oooooooooooooo	……	See Table 3 for Bag Specifications & Sizing
Gravity Based Settling			
Sediment Tank (Dumpster with no screens)	……		
Sediment Trap (Temporary)	……		Use SOC Standards 1063 or 1064
Sediment Basin (Temporary)	oooooooooooooo	……	Use SOC Standards 1064
Wet Detention Basin (Permanent)	oooooooooooooo	oooooooooooooo	Use SOC Standards 1001
Passive Filtration			
Filter Tank (Dumpster with screens)	oooooooooooooo	……	See Table 3 Notes for Screen Requirements
Filter Basin	……		
Vegetative Filter	oooooooooooooo	oooooooooooooo	Effectiveness depends upon the width of the filter and the runoff rate of flow. See Standard 1054 for design guidelines for sizing information. Not appropriate for pumping without primary treatment via a geotextile bag of sediment tank.

Key:

Effective range of device ooooooooooooo
Effective range with addition of polymer …….

Notes:
(1) The effectiveness of many practices can be enhanced through the use of polymer mixture.
(2) Soils classification shall be done in accordance to USDA method.
(3) Standard 1063 Sediment Trap
(4) Standard 1064 Sediment Trap
(5) Standard 1054 Vegetated Buffer for Construction Sites
(6) Standard 1001 Wet Detention Basin
(7) Discuss alternate options with the regulatory authority
(8) SOC = Standards Oversight Council - www.dnr.STATE.wi.us/org/water/wm/nps/stormwater/techSTDS.htm

Note:
Type of soil expected shall be noted in the contract. Contractor shall recognize that if clay soil is expected, only a Type II bag or filter fabric tank with the addition of polymer, is an accepted treatment method.

TABLE 3: Properties for Geotextile Bags

		WDOT Type R	WDOT Type HR
Property	**Test Method**	**Type I Value**	**Type II Value**
Maximum Apparent Opening Sizes	ASTM D-4751	0.212 mm	0.212 mm
Grab Tensile Strength	ASTM D-4632	200 lbs.	300 lbs.
Mullen Burst	ASTM D-3786	350 psi	580 psi
Flow Gallon/min/sf	ASTM D-4491	50	30
Fabric	Nominal Representative Weight	8 oz	12 oz

Table 3 Notes:

1) Sizing on filter bags shall be done as follows. The smallest acceptable bag regardless of the following shall be a minimum of 3 ft wide 1 ft in vertical depth (measured at the center of bag) and a minimum of 6 ft long. Bag sizing shall be the larger of either the City minimum above or the length * width of the proposed bag * the flow rate of fabric per square foot divided by 2 to calculate the acceptable flow to that size bag.

2) Filter tanks shall have a minimum of one (1) screen in place prior to discharge. This screen shall be made of WDOT Type HR Fabric. Once the screen is “over topping”, the screen shall be changed, the pump rate decreased or a second/larger dumpster with filter screen shall be added to the treatment system.

502.1(d) Bedding of Sewer Pipes.

The bedding, or foundation, for sewer pipes shall be constructed to prevent settlement of the pipes and to avert excessive pressure on the pipes in order to avoid rupture, leakage or deformation of the pipes. Unless otherwise specified in the Special Provisions of the contract, all sanitary and storm sewer pipes, including sanitary sewer laterals and storm sewer leads, shall be constructed with the

type of bedding that is specified for the type of pipe installed, as shown on the Standard Detail Drawing 5.2.1, Storm and Sanitary Sewer Beddings.

The width of the bedding shall be equal to the width of the trench. The depth of the bedding shall extend from an elevation at least six (6) inches below the bottom of the pipe to an elevation at least twelve (12) inches above the top of the pipe. All bedding shall be mechanically compacted, including crushed stone and washed gravel.

Sand or limestone screenings used for bedding shall conform to the following gradation:

Passing 3/4" sieve	100%
Passing #200 sieve	0-10%

Washed gravel and crushed stone used for bedding shall conform to the following gradation:

Passing 1" sieve	100%
Passing 1/2" sieve	35-60%
Passing #200 sieve	0-10%

Washed gravel or crushed stone shall be used for all pipe sizes over ten (10) inches in diameter, and for smaller sizes when directed by the Engineer. With the approval of the Engineer, the maximum size of the washed gravel or crushed stone may be increased, and screened crushed stone may be substituted for washed gravel.

502.1(e) Backfilling Excavations and Compaction of Backfill.

Unless otherwise provided, all trenches and excavations shall be backfilled immediately after the sewers and appurtenances have been constructed therein. In covering the sewers and filling around structures, the backfill material shall be brought up evenly on all sides so that no unbalanced pressure is brought to bear upon the pipe and masonry.

The Contractor shall be required to backfill all excavations to the original ground elevation unless otherwise specified in the contract or ordered by the Engineer. In the event of a shortage of material to perform this work, including replacement as may be required by rock excavation or removal of boulders, the Contractor shall provide the necessary material at no additional cost to the City.

Walking or working on the completed pipe sewers, except as may be necessary in compacting and backfilling, shall be prohibited until the trench has been backfilled to an elevation at least two (2) feet above the top of the pipe. No trucks, vehicles, or other equipment shall be allowed within the limits of the trench prior to the completion of the backfilling operations, unless authorized by the Engineer for compaction or other purposes.

Backfill material hauled to the project shall be dumped along the top of the trench beyond the reach of slides and placed in the trench with the proper backfilling equipment. Backfill material may be dumped directly into the trench from trucks when the amount of material to be dumped is controlled by partially opening the tailgates, and only when authorized by the Engineer.

Trenches shall be hand backfilled to an elevation at least one (1) foot above the top of the pipe. The material for this portion of the backfill shall not contain stones, or hard or frozen lumps of earth. For plastic sewer pipes, this material shall be the same classification as the bedding. The equivalent of

hand backfill may be accomplished by lowering a clam bucket or material to a point immediately above and approximately one (1) foot from the sewer and slowly releasing the fill; for reinforced concrete pipe or corrugated metal pipe, the material may be deposited on a slope, equal to the angle of repose of the material, and allowed to flow progressively forward in such a manner as to avoid impact on the pipe and to avoid uneven pressures on either side of the pipe which may disturb its grade or alignment. Backfill material shall not be taken from trench walls below an elevation of two (2) feet above the top of the pipe. The remainder of the trench shall then be filled carefully in a manner satisfactory to the Engineer. The compaction sections are detailed in Standard Detail Drawing 5.2.2, Typical Trench Compaction & Standard Detail Drawing 5.2.3, Typical Trench Compaction (Greenway/Park).

All corrugated metal culverts shall be hand backfilled and mechanically tamped to an elevation at least one (1) foot above the top of the culvert. Extreme care shall be taken so as to assure complete filling and compaction under the culvert and between the culvert and the walls of the trench. If trucks or other heavy equipment used on the project are to travel over the newly installed culvert, then the Contractor shall place a minimum cover of twelve (12) inches of fill over the culvert to protect it during this period. This protective layer of fill shall be thoroughly mechanically compacted.

In the event that excavations have been sheathed or braced, the Contractor shall carefully draw and remove the sheathing and bracing in a manner which will not disturb the completed work. All openings left in removing sheathing and bracing shall be carefully filled with approved backfill material and properly compacted.

The backfilling of structures shall conform to the requirements specified in Section 301.8 - Protection of the Concrete of these Specifications.

The backfilling of tunnels and shafts for tunneling and jacking operations shall be in accordance with the requirements specified in the contract. Where not specified in the contract, such backfilling shall be as directed by the Engineer.

Where the grade of the sewer is such that, in the opinion of the Engineer, the top surface of the sewer shall require protection, an embankment of earth or other material, satisfactory to the Engineer, shall be constructed over the sewer by the Contractor. The height of the embankment shall be one (1) foot above the top of the pipe unless otherwise specified or directed by the Engineer. The width at the top of the embankment shall be not less than two (2) feet wider than the external width of the sewer. The sides of the embankment shall slope from the top of the embankment to the existing ground surface in a ratio of not less than two (2) feet horizontally to one (1) foot vertically. The material used to construct the embankment shall be such surplus material excavated from trenches as shall be approved by the Engineer. Such selected material shall be furnished and placed in the embankment by the Contractor at no extra cost to the City. Should more material be needed to complete the embankment than can be obtained from surplus material excavated, such material shall be furnished by the Contractor, and will be paid for as provided herein. The material shall be compacted as provided in Subsection 202.3(b) – Standard Compaction of these Specifications.

All material used for backfilling trenches and other excavations shall be subject to the approval of the Engineer. Unless otherwise specified or directed by the Engineer, the Contractor shall backfill trenches and other excavations with materials excavated in the course of the work. Whenever specified in the contract or directed by the Engineer, trenches and other excavations shall be backfilled with Select Fill. Vegetation and stones or fragments of broken rock in excess of six (6) inches in any dimension shall not be included in the backfill. In the event the Engineer rejects the

excavated materials for backfilling due to the character of the material, including excess moisture content, gradation, composition, frozen material, or for whatever cause, the Contractor shall backfill the trenches and other excavations in the specified manner with Select Fill. In the event of lack of moisture in the backfill materials, the Contractor shall add water in quantities deemed necessary to secure the required compaction. In the event the excavated materials contain excess moisture, the Contractor shall, as directed by the Engineer:

1. Suspend all work on the project for that period of time as may be necessary to allow the backfill materials to dry sufficiently prior to backfilling and compacting the backfill material, during which time work days shall not be charged against the Contractor, or

2. Replace the excavated materials, in whole or in part, with Select Fill.

Where the moisture content of the excavated materials is such that drying or adding water is necessary prior to backfilling and compaction, the Contractor may furnish acceptable materials for the backfill and dispose of the excavated materials, all at no additional cost to the City.

Select Fill for backfilling trenches and other excavations shall be material as defined in Subsection 202.2(b) – Select Fill of these Specifications and shall be measured and paid as defined in Subsection 502.2(g) – Select Backfill for Sewer of these Specifications. Excess excavated material resulting from the above work may be used in backfilling other trench areas, unless the material is declared unsuitable for backfill by the Engineer, in which case the material shall be considered surplus material and shall be disposed of by the Contractor at no additional cost to the City.

Unless otherwise specified or directed by the Engineer, the backfill in all trenches and excavations shall be mechanically compacted in such a manner as to thoroughly consolidate the backfill material and not injure or disturb the pipe or other structure. The compaction of the backfill material shall be in accordance with the following requirements:

1. The material for the backfill shall be deposited, spread and leveled, as herein before provided, in layers generally not exceeding twelve (12) inches in thickness before compaction, except that when the material being compacted is of a granular nature and the compacting equipment is adaptable for the purpose, the thickness of the layer may be increased to a maximum of twenty-four (24) inches provided the required density is obtained. Each layer of the spread and leveled material shall be compacted, by means of suitable compaction equipment, to not less than the specified density before the succeeding layer is placed.

2. All Pipe Trenches shall be compacted in conformance of Standard Detail Drawings 5.2.2 Typical Trench Compaction and 5.2.3 Typical Trench Compaction (Greenway Park). Compaction of the backfill material shall not begin until the depth of the backfill material is two (2) feet above the top of the pipe. In the case of structures, compaction of the backfill material shall begin with the placing of the first layer of backfill material. Backfills of three (3) feet or less in depth below the proposed or existing subgrade shall be compacted to at least ninety-five (95) percent of maximum density for their full depth.

   In city right of ways or as called for by the construction engineer, backfills over three (3) feet in depth below the proposed or existing subgrade shall have the top three (3) feet below the proposed or existing subgrade compacted to not less than ninety-five (95) percent of

maximum density, and those portions more than three (3) feet below the proposed or existing subgrade shall be compacted to at least ninety (90) percent of maximum density.

In greenways and parks, in accordance to Standard Detail Drawing 5.2.3, backfills over three (3) feet in depth below the proposed or existing subgrade shall be compacted to at least ninety (90) percent of maximum density. If the proposed pipe is located horizontally within 15' of an existing or proposed asphalt or concrete surface, then the pipe compaction shall be completed in conformance of Standard Detail Drawing 5.2.2.

3. The maximum density shall be determined in accordance with the Standard Method of Test for the Moisture-Density Relations of Soils, ASTM Designation: D 1557, Method D, with replacement of the fraction of material retained on 3/4-inch sieve with No. 4 to 3/4-inch material. The density of compacted backfill material shall be determined in accordance with the Test for Density of Soil-in-Place by the Sand-Cone Method, ASTM Designation: D 1556, the Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods, ASTM Designation: D 2922, or by other approved methods.

4. In the event the material in the density sample differs in percentage of aggregate retained on a No. 4 sieve from that in the sample upon which maximum density was determined, the maximum density shall be adjusted in accordance with approved procedure.

5. The foregoing density requirements will not apply to portions of backfills constructed of materials which, because of numerous large stones or high percentages of material retained on the No. 4 sieve, cannot in the determination of the Engineer be accurately tested in accordance with the above procedures for determining maximum or in place dry density.

Whenever the work of installing sewers takes place during cold weather, the specifications for trench compaction above shall be followed if practicable. If the specified compaction cannot be achieved, and the Engineer directs that the work may not be suspended until more favorable weather conditions exist, then the following procedures shall be followed:

1. All frozen material in the trench shall be removed before beginning the day's work. As a method to achieve this, trenches shall be closed overnight.

2. Materials shall be unfrozen when being compacted.

3. The material shall be compacted in six (6) inch lifts in a manner normally done during warm weather construction and to a minimum density of ninety (90) percent compaction below the three (3) foot depth.

4. If the top three (3) feet of material does not meet ninety-five (95) percent compaction, then pit run sand (hauled in if necessary) shall be compacted in the normal manner using six (6) inch lifts.

5. The Engineer will have tests performed as necessary to provide uniformity of compaction.

6. As a guideline, construction should cease when the temperatures are too cold to achieve the above. At least 15°F and rising is a reasonable temperature if it is not extremely windy.

502.1(f) Utility Trench Patches.

Whenever shown on the plans, or directed by the Engineer, the Contractor shall restore existing pavements through which new utility installations pass in accordance with the Standard Detail Drawing 5.2.4, Typical Pavement Patch Sections, for the type of pavement patch specified and installed. The asphalt pavement material in utility trench patches greater than six (6) feet in either direction shall be compacted with a self-propelled vibratory roller capable of meeting the yields specified in Section 402.3 - Asphalt Pavement of these Specifications. Utility trench patches shall be classified and identified as follows:

TYPE I: Nine (9) inch reinforced concrete pavement, to be installed in existing concrete pavements.

TYPE II: Seven (7) inch plain or reinforced concrete base or asphaltic base, where specified or directed by the Engineer, overlaid with asphalt pavement, to be installed in pavements with concrete bases surfaced with asphalt pavements.

TYPE III: Ten (10) inch crushed stone base overlaid with asphalt pavement equal in thickness to the existing asphalt pavement, 3” minimum thickness and maximum 5 1/ 4” thickness, to be installed in pavements with crushed stone bases surfaced with asphalt pavements. The pavement along the patch shall be sawcut, full depth, and incidental to the trench patch. The edges of the existing asphaltic pavement shall be free of loose stones or pavement material.

TYPE IV: Nine (9) inch crushed stone pavement to be installed in unpaved or un-surfaced streets.

TEMPORARY: Seven (7) inch concrete pavement, to be installed when the existing ground or pavement in the area of the patch is frozen or contains frost. Temporary patches shall not be constructed of crushed stone and/or asphaltic materials unless specifically authorized by the Engineer.

During the construction of the patch, the area shall be plated, barricaded, or otherwise protected as directed by the Engineer, until the patch is complete and can be opened to traffic.

Patches shall be restored on the same day the pavement is removed on streets classified as arterial or collector. Patches shall be restored within three (3) calendar days from when the pavement was removed on streets classified as local.

Asphalt mixtures shall not be placed when the air temperature approximately three (3) feet above ground at the site of the work, in the shade and away from the effects of artificial heat, is less than 32°F.

If an excavation in the roadway encounters filter fabric, the Contractor will not be required to replace the filter fabric if the excavation removes all of the soft soils down to stable soils. If the excavation does not extend to stable soils, the Contractor shall replace the filter fabric. The Contractor shall carefully cut the fabric along the center line of the trench and fold back during the excavating process. When the excavation is backfilled to the level of the filter fabric, the fabric shall be folded back down on the compacted backfill material and a new layer of filter fabric shall be placed over the

existing fabric. The new fabric shall be overlapped a minimum of twelve (12) inches on each side. The new filter fabric shall meet or exceed the specifications for the existing fabric.

In the event that the filter fabric is destroyed during the excavation procedure the Contractor shall replace the filter fabric on the entire trench. The excavation over the existing fabric shall be widened to provide for a twelve (12) inch overlap of the existing fabric.

502.2 Measurement and Payment

502.2(a) Trench Excavation.

All trench excavation necessary for the construction of sanitary or storm sewer systems shall be included in the item that requires the excavation.

502.2(b) Additional Excavation, Including Undercut.

Any work involved in forming a satisfactory foundation at depths of one-half (1/2) foot or less below the bottom of the pipe will be considered as incidental. Additional excavation, including undercut beyond one-half (1/2) foot, shall be measured in the field and the volume in cubic yards shall be computed from those measurements and paid for as extra work. The maximum width of the additional excavation or undercut, shall be the outside dimension of the pipe or structure plus two (2) feet plus the amount necessary for sheeting and bracing.

The contract price shall include excavation; installation and removal of sheeting and bracing; removal of water from the excavation; disposal of surplus material from the excavation; and furnishing, placing and compacting the specified material required to replace the materials excavated.

502.2(c) Rock Excavation.

Rock excavation shall be measured in the field and the volume in cubic yards shall be computed from those measurements. The vertical measurements shall extend from the surface of the rock to an elevation six (6) inches below the bottom of the pipe or structure; the horizontal measurements shall be limited to the outside width of the pipe or structure plus two (2) feet. Boulders one-half (1/2) cubic yard or more in volume shall be measured individually and the volume of each boulder computed from average dimensions taken in three directions.

Rock excavation for sewer access structures shall be determined by the size of the sewer access structure to be installed. The vertical measurement shall extend from the surface of the rock to an elevation of eight (8) inches below the outside of the sewer for sewer access structures up to ten (10) feet deep and twelve (12) inches below the outside of the sewer for sewer access structures over ten (10) feet deep. The horizontal measurements shall be limited to the outside dimension of the sewer access structure plus two (2) feet.

The contract price shall include excavation of the rock; disposal of surplus material from the excavation; replacement with approved material of any shortage of backfill material resulting from rock excavation; and all other work incidental to rock excavation.

502.2(d) Removal of Excess Amounts of Boulders.

When it is deemed, by the Engineer, that the amount of boulders encountered on a sewer project are excessive, then the Contractor shall be paid six dollars ($6.00) per cubic yard of boulders hauled from the project and disposed of by the Contractor. This shall not relieve the Contractor from any responsibility to remove, at no expense to the City, a usual amount of boulders; pay rock excavation; pay size boulders; and other excess materials from the project; as more fully described herein.

502.2(e) Dewatering.

All costs associated with TYPE I Dewatering shall be considered incidental to the project. TYPE II Dewatering shall be measured and paid by the lump sum for the completed work.

502.2(f) Bedding of Sewer Pipes.

The cost of bedding, including excavation for bedding material and bedding material furnished and compacted in place, shall be included in the unit price bid for sanitary and storm sewer pipe laid complete.

502.2(g) Select Backfill for Sewer.

Select Backfill for Sewer shall be measured by length in feet, measured along the centerline of the trench, for each type of sewer pipe specified. The quantity of Select Backfill for Sewer to be paid for shall not include materials excavated as part of this contract.

The contract price shall include furnishing, hauling, placing and compacting the specified material; and disposal of surplus material from the excavation displaced by the Select Backfill for Sewers.

502.2(h) Additional Fill for Embankments Over Sewers.

Additional fill for embankments over sewers shall be measured in cubic yards based on tickets received by the Engineer for each load of additional fill material. Payment for additional fill will not be made for any additional fill not substantiated by a ticket received by the Engineer.

The contract price shall include furnishing, hauling, placing and compacting the additional fill material; and all other work incidental to the installation of additional fill for embankments over sewers.

502.2(i) Tunneling and Jacking Sewer Pipe.

The measurement and payment for tunneling and jacking operations shall be in accordance with the Special Provisions covering such work in the contract.

502.2(j) Utility Trench Patches.

Utility trench patches shall be measured by length in feet, measured along the centerline of the trench, or by area in square yards for each type of patch installed.

The contract price shall include furnishing all materials necessary to restore the pavement, but shall not include the Select Fill material required to backfill the trench; and includes placing, consolidating

and compacting the materials used to restore the pavement; and all other work incidental to the installation of utility trench patches.

ARTICLE 503 - SANITARY SEWER PIPES AND LATERALS

503.1 Description.

Unless otherwise shown on the plans or specified in the contract, the materials furnished and installed in the work shall conform to the requirements specified herein for the type and class of material named.

Unless otherwise directed by the Engineer, all pipe and accessories shall be unloaded at the point of delivery, and hauled to and distributed at the site of the work by the Contractor. The materials shall at all times be handled with care to avoid damage. The material shall not be dropped or bumped against the ground, other pipe and accessories already on the ground, or any other object on the ground.

The Contractor shall furnish random lengths of pipe for each contract as may be required for the proper placement of fittings or structures. The costs of random lengths of pipe shall be included in the contract unit prices for the respective sizes and types of pipe.

Unless otherwise specified, references to various standard specifications and test methods shall be understood to mean the specification or test method which is current on the date of advertisement for bids.

503.2 Materials.

When plastic pipe of any type is used, the plastic pipe manufacturer shall be one whose pipe and joint have been accepted for use in Wisconsin by the Municipal Wastewater Section of the Department of Natural Resources. All pipe and fittings used on a project shall be supplied by the same manufacturer and shall be of the same type.

503.2(a) Solid-Wall Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

Solid-Wall Poly (Vinyl Chloride) (PVC) sewer pipe and fittings, labeled as “PVC” on the plans, shall conform to the requirements of the Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, ASTM D 3034, SDR-35 or SDSR-26. Joints shall be elastomeric or solvent cement and shall be made as recommended by the manufacturer.

503.2(b) Corrugated-Wall Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

Corrugated-Wall Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, labeled as “CW PVC” on the plans, shall conform to the requirements of the Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings, ASTM F 949. Joints shall be elastomeric or solvent cement and shall be made as recommended by the manufacturer. Each saddle (or wye) shall be attached to the sewer main with solvent cement and two stainless steel bands.

503.2(c) Poly (Vinyl Chloride) Pressure Pipe.

Pressure pipe and fittings, labeled as “PVC PRESSURE” on the plans, shall conform to the requirements of AWWA Standard for Poly (Vinyl Chloride) (PVC) Pressure Pipe and Fabricated Fittings, four (4) inches through twelve (12) inches, for Water Distribution, Pressure Class 150 (DR 18), AWWA C900. The joints shall be integral bell with elastomeric gaskets, or couplings with elastomeric gaskets.

The fittings for PVC pressure pipe shall conform to the requirements of American National Standard for Ductile-Iron and Gray-Iron Fittings, three (3) inch through forty-eight (48) inch, for Water and Other Liquids, ASA A21.10 (AWWA C110).

503.2(d) Reinforced Concrete Pipe.

The pipe, fittings, and accessories, labeled as "RCP" on the plans, shall be of reinforced concrete and shall conform to the requirements of the Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM C 76. Unless otherwise specified, sewer pipe shall be Class III (ASTM C 76).

Joints for sanitary sewer pipe shall be designed for the use of confined "O"-ring type rubber gaskets.

503.2(e) Sanitary Lateral Electronic Markers.

Effective Dec. 31, 2006, Act 425, Chapter 182.0175 (2r) of the Wisconsin State Statutes requires that all non-metallic building sewers (including sanitary laterals, private sanitary sewers and storm sewer laterals) installed within the City Right of Way, shall be accompanied by a means of locating the newly installed underground pipe. Sewer mains that have manhole or inlet structures on both ends within the City Right of Way are considered exempt from this legislation.

The City of Madison has selected a marker system that includes the installation of extended range ball markers over the sanitary sewer facilities, which after construction provide a signal that can be located by the city's utility locator after construction is complete.

The 3M ScotchMark Electronic Ball Marker System Extended Range Marker (model #1404-XR) http://solutions.3m.com/wps/portal/3M/en_US/Telecom/Home/Solutions/Utilities shall be considered an acceptable marker device for this specification. If an alternate equivalent marker is selected, contractor shall provide specifications and data sheets of the selected device to City Engineering prior construction in order for the City to confirm that the proposed marker device is compatible with the City's marking equipment.

503.2(f) Sanitary Sewer Force Main Tracer Wire and Box.

Effective Dec. 31, 2006, Act 425, Chapter 182.0715(2r) of the Wisconsin State Statutes requires that all non-metallic building sewers (including sanitary laterals, private sanitary sewers and storm sewer laterals) installed within the City Right of Way, shall be accompanied by a means of locating the newly installed underground pipe. All new force mains (pressure sewer systems) shall be in accompanied by tracer wire location system.

The conductor shall be a minimum of 12 gauge solid copper wires with a plastic coating to prevent corrosion. The conductor itself will be one continuous loop with the two wire ends shall be connected to the to the tracer wire access box.

The covered access device (tracer wire access box) may be a terminal box, valve box, a small diameter PVC conduit or a cleanout. Within the covered access device, the contractor shall provide an extra 18 inches of wire. The lid of the covered access device shall have "SEWER" permanently engraved on it by the manufacturer. The lids shall be cast iron accompanied with connection holes

where the contractor shall connect the tracer wire with stainless steel terminal bolts. The lid shall be bolted with a standard pentagonal head key.

The Valco Tracer Wire Access Box www.cptest.com and the Bingham & Taylor Cathodic Test Box www.binghamandtaylor.com/cathodic.htm are considered acceptable devices for this specification.

503.3 Construction Methods.

503.3(a) General.

Whenever shown on the plan, or directed by the Engineer, the Contractor shall install sanitary sewer main, laterals, build wyes into the sanitary sewer mains for the installation of sanitary sewer lateral connections, and set risers into wyes.

503.3(b) Laying Pipe.

The pipe, fittings and accessories shall be of the size, class, type, and design; and shall be laid at the locations and to the required lines and grades; all as shown on the plans, required by the contract, or directed by the Engineer. Wherever the word “pipe” appears in this Subsection, it shall be understood to include pipe, fittings, and accessories.

The proper installations of structures and fittings, whose locations are shown on the plans and laid out by the Engineer shall be accomplished by the use of random lengths of pipe furnished by the Contractor. All field cuts of all types of pipe, except reinforced concrete pipe, shall be made with an approved mechanical pipe cutter or with a power saw in order to make a straight, true cut without chipping and cracking the pipe. In the event the Contractor is unable to obtain a certain size pipe, as specified on the plans or in the contract, the Contractor shall promptly inform the Engineer, and with the approval of the Engineer, the Contractor will be allowed to furnish and install a larger size pipe. In such case, the additional cost resulting from such substitution shall be at the Contractor’s expense and no adjustment in compensation will be allowed.

A flexible watertight connections shall be used for plastic sewer pipe connections to structures as detailed in Standard Detail Drawing 5.7.31, Flexible Pipe to SAS Connector. For concrete pipe connections, a mechanical vibrator shall be used during placement of the concrete collar to assure complete exterior seal of concrete pipes to the new structure.

The laying of pipes in finished trenches shall commence at the lowest point and shall proceed towards the upper end, and the pipe shall be laid so that the spigot or tongue ends point in the direction of flow.

Jointing surfaces shall be carefully cleaned before pipes are lowered into trenches. The pipes shall be lowered so as to avoid unnecessary handling in the trench. Each section shall have a firm bearing throughout its length and shall be true to the line and grade required.

The method of shoving or pulling the pipes together shall be such that there will be no injury to the pipes, and the joints will be properly adjusted and will not be excessively large. The pipes shall be fitted and matched so that when set firmly to line and grade they will form a sewer with a smooth and uniform invert.

After the pipe is installed, lift holes shall be sealed with suitable concrete or other approved plugs.

The pipe shall not be laid within ten (10) feet of the excavating nor within forty (40) feet of blasting operations. The pipe shall not be laid in water or on frozen trench bottoms, or when, in the opinion of the Engineer, the trench conditions or weather are unsuitable for the proper performance of the work.

No length of pipe shall be laid until the previously laid length of pipe has been sufficiently backfilled to hold it securely in place during the jointing operation. If, in making a joint, any previously laid pipe is disturbed, such pipe shall be removed and relaid. Adequate backfill shall be placed on the pipe to prevent floating. Any pipe which has been floated shall be removed and relaid at the expense of the Contractor.

The Contractor shall furnish suitable lifting and handling devices designed to distribute the weight of the pipe over the length of the pipe and prevent high stresses over small areas.

All water must be kept out of the bell hole of the pipe until the joint is completed and water shall not be allowed to rise in or about the pipe until the trench is filled at least one (1) foot above the top of the pipe.

Before leaving the work for the night, or during a storm, or for any reason, care must be taken that the unfinished end of the sewer is securely closed with a tightly fitting iron or wooden plug. Any earth or other materials that may find entrance into the sewer shall be removed by the Contractor at no additional cost to the City.

503.3(c) Sanitary Sewer Laterals.

1. General.

Installation of sanitary sewer laterals shall comply with all the requirements set forth herein for the installation of the sewer main, including excavation, backfilling, bedding, laying and jointing pipe. Sanitary sewer laterals shall be laid with a maximum grade of one-half (1/2) inch per foot and a minimum grade of one-fourth (1/4) inch per foot. Unless otherwise specified, sanitary sewer laterals shall be of the same material as the sewer main pipe. Where laterals are to be connected to risers the Contractor shall furnish and install the required fittings.

The typical locations of sanitary sewer laterals to be installed in new developments are detailed in Standard Detail Drawing 5.3.2, Location of Sanitary Laterals. A separate sanitary sewer lateral shall be installed between the public sewer main and the property line to each unit of a split two-family dwelling (i.e., duplex unit).

For reconstruction of existing sanitary sewer, the connection of a lateral to a new structure shall be completed under Sanitary Tap and to a new main under Reconnect. For those laterals to be reconnected to a main, the first five (5) feet of the lateral and backfill from the main shall be included in the Reconnect and shall not be included in this item. The trench shall be backfilled with select backfill and shall be completed under Select Backfill for Sewers.

For laterals that are in close proximity to terrace trees (as determined by the Engineer), the situation shall be reviewed on a case by case basis by the Engineer and the City Forester. The Contractor shall use construction methods and equipment to minimize tree damage as directed by the Engineer and in accordance with section 107.13 Tree Protection Specification. In extreme cases the Engineer may elect to terminate lateral installation prior to conflict with the tree.

The estimated location of the laterals will be marked by the City of Madison on the sidewalk; however, Contractors are encouraged to start at the sanitary main. If the Contractor elects to start at the property line, it shall be at their own risk. No Utility Line Openings will be granted for the inability to locate the lateral at the property line.

2. Size.

When the lateral size is not specified, the following guidelines shall be used:

- For the installation of new lateral in the public right-of-way, unless otherwise specified in the plans or directed by the Engineer, the size of a newly constructed sanitary sewer lateral to be installed between the public sanitary sewer main and the property line shall be four (4) inches in diameter. The Engineer may require the size of the lateral to be six (6) inches or greater depending on the lot size or proposed land use.

- For the reconstruction, repair or replacement of sanitary sewer laterals in the public right-of-way, unless otherwise specified in the plans, when a portion of a sanitary sewer lateral in the public right-of-way is to reconstructed, repaired or replaced, the inside diameter of the new lateral to be installed shall match that of the lateral which is being replaced. For purposes of this requirement, all five (5) inch laterals shall be considered to be six (6) inches in diameter. It shall not be permissible, in any event, to decrease the diameter of a sanitary sewer lateral in the direction of flow.

3. Alignment.

Where a sanitary sewer lateral is being relaid in the public right-of-way and bends are required to reconnect the new lateral to the ends of the existing lateral or sewer main, the Contractor may use standard Poly (Vinyl Chloride) (PVC) bends that provide a change in the direction of flow of 22.5 degrees or less. Bends placed in a lateral shall be separated by straight pieces of pipe such that any two bends are separated by a distance of two (2) feet or more, measured from the center of each bend. The use of 45 degree bends shall be allowed only in connecting to a 45 degree wye at the sewer main in order to orient the lateral perpendicular to the sewer main.

4. Couplings.

Where a lateral is being relaid in the public right-of-way and connected to pipes of differing materials and/or sizes, standard flexible couplings shall be used. The couplings to be used shall provide for a tight fit around the outside diameter of each pipe and shall be securely fastened with two stainless steel clamps at each pipe end. Couplings which reduce the pipe cross sectional area in the direction of the flow shall not be allowed.

5. Reconnect.

Reconnect shall include reconstructing sanitary sewer lateral connections that shall be reconnected to the sanitary sewer main. This item shall include necessary wyes or fittings and PVC pipe, 4” or larger, for the connection of the lateral and shall not exceed a length of five (5) feet. All new laterals shall be a minimum of four (4) inches in diameter. Under no circumstances shall the new lateral be smaller than the existing. The select backfill and bedding required for the reconnection are included in this item. Sewer laterals that are to be reconnected to new sewer access structures shall be

completed as a Sanitary Tap as specified in Subsection 507.3(d) – Sewer Connections. The Contractor shall be responsible for maintaining the normal flow of wastewater during reconnection of the laterals.

6. Sanitary Lateral Electronic Markers.

Each sanitary lateral shall have a minimum of 2 electronic markers: one shall be located above the wye on the sewer main and one shall be located above the lateral at the property line. Additional markers shall be placed at each change in horizontal direction. Markers shall be installed per manufacturer's written instruction. The key constraint is the maximum depth of the marker. The signal range of the 3M™ Electronic Marker System (EMS) 4" EXTENDED RANGE 5' BALL MARKER - WASTEWATER (MODEL 1404-XR) is 5 feet.

The City shall provide the Contractor with the required number of electronic markers for City bid public works contracts. The Contractor shall be responsible for picking up the markers at the Engineering Service Building, 1602 Emil Street in Madison, Wisconsin.

Upon completion, the City will test each electronic marker to confirm that it is installed and functioning properly. If it is determined that the marker has not been installed correctly and/or is not functioning properly, the contractor will be responsible for the all work associated with the installation of a properly functioning marker.

503.3(d) Sanitary Sewer Wyes.

Unless otherwise specified, the openings in the wyes for lateral connections and riser pipes shall be of the same size as the sanitary sewer lateral to be installed. In the event that a sanitary sewer lateral is not being installed coincident with the wye, the size of the wye shall meet the sizing requirements set forth for sanitary sewer laterals in Subsection 503.3(c) - Sanitary Sewer Laterals of these Specifications.

All wyes shall be of the same material as the sewer main. When the sewer main is constructed of Poly (Vinyl Chloride) (PVC) sewer pipe, the wyes shall be injection molded Poly (Vinyl Chloride) (PVC) wyes installed along with the sewer main construction. At the discretion of the Engineer, the use of saddle type wyes installed along with the sewer lateral construction may be permitted when the sewer main is constructed of Poly (Vinyl Chloride) (PVC) sewer pipe. All saddle type wyes for Poly (Vinyl Chloride) (PVC) sewer pipe installations shall be manufacturer's approved and shall be attached to the sewer main with a rubber gasket, solvent cement and two stainless steel clamps.

Wye openings, except those that are to be used for riser connections, shall be closed watertight with covers of the same material as the wye, well cemented in. When wyes are set in concrete encased pipe lines, their locations shall be marked by iron rods set in the concrete so that the rods shall project at least six (6) inches above the top of the encasement.

503.3(e) Sanitary Sewer Risers.

The top of riser pipes shall be brought to a point between nine (9) and ten (10) feet below the proposed finished street grade. The method as shown on Standard Detail Drawing 5.3.1, Riser Detail shall be indicated on the plans or by the engineer.

Unless otherwise specified, the riser pipes shall be of the same size and material as the sanitary sewer lateral to be installed. In the event that a sanitary sewer lateral is not being installed coincident with the riser pipe, the size of the riser pipe shall meet the sizing requirements set forth for sanitary sewer laterals in Subsection 503.3(c) - Sanitary Sewer Laterals of these Specifications.

For those instances in which a sanitary lateral is not being installed coincident with the riser pipe, a vertical reinforcing rod, one-half (1/2) inch in diameter, shall be strapped to the riser pipe and extended to within eighteen (18) inches of the proposed finished street grade for the case of future location by the City. In backfilling the trench, special care must be used at the location of riser pipes to tamp the backfill material about the entire length of the risers in such a way as to maintain them in a vertical position and not to disturb them.

503.3(f) Joints.

1. New Pipe to New Pipe.

Jointing materials shall conform to the requirements specified in Section 503.2 – Materials of these Specifications, for the type of pipe being installed.

Joints shall not be made until the pipe is in the trench and set to true line and grade. Lengths of pipe which are joined together outside of the trench shall be removed from the project immediately.

Prior to making joints, the jointing surfaces shall be inspected for chips, cracks, or other defects in the joints and jointing materials. The jointing surfaces shall be carefully cleaned and lubricated with a vegetable lubricant or a lubricating adhesive. Lubricant shall be applied to both the bell and spigot surfaces of the joint. The lubricant shall be that recommended by the gasket manufacturer for the particular type of gasket being installed.

Care shall be taken when shoving or pulling the pipes together in order not to damage the pipe or the joints and jointing materials. The pipes shall be in proper alignment and to the proper grade prior to applying the pressure necessary to make the joint.

Rubber gaskets for reinforced concrete storm sewer pipe shall be assembled as follows:

1. When air temperature is below 32°F, gaskets shall be applied one and one-half (1-1/2) hours before installation of the pipe.

2. When air temperature is above 32°F, gaskets shall be applied fifteen (15) minutes before installation of the pipe.

The temperature referred to pertains to the prevailing air temperature at the point of application of the gaskets. This shall be taken to mean the air temperature, either indoor or outdoor, at the time and place the gaskets and cement are being applied to the pipe. It does not refer to the temperature in the trench, or of the bonding cement, or of the pipe.

In making mechanical joints, the bolts shall be installed with the heads in reverse direction. The nuts shall be turned on only as far as they can be by using the wrench with one hand, with no extensions on the wrench to give greater leverage. Care shall be taken not to over-tighten the bolts. The bolts shall be tightened equally and diametrically in order to apply the proper pressure on the gasket and joint.

2. New Pipe to Existing Pipe.

A compression coupling shall be required at the junction of a new pipe to an existing pipe as specified on the plan set or as required in the field by the Engineer. It is expected that the Contractor shall saw cut the existing main at the location shown to accommodate a clean joint for the installation of the compression couplings. If the Contractor for his/her convenience deems it more suitable to remove the existing pipe to a full joint, the additional pipe required to connect the new pipe is to be the Contractors responsibility and shall not be compensated. The compression coupling shall be placed as shown on the plan or as directed by the Engineer and shall be constructed per Standard Detail Drawing 5.3.3, Coupling Details.

503.3(g) Wastewater Control.

Wastewater Control shall include all equipment, labor, materials, coordination, and incidentals required to control or divert, to the Engineer's satisfaction, sanitary sewer flows during reconstruction of the sanitary sewer. This shall include pumps with adequate capacity of 100 g.p.m. and all associated equipment required to maintain a functioning sanitary sewer system during construction. At no time shall the normal flow of wastewater in sanitary sewer service laterals be disrupted without prior approval from the Engineer. This condition shall also hold at the time of connection of an existing lateral to the new sewer main.

If the Contractor elects to use bypass pumping as a means of wastewater control, the methods, equipment, type of hose, etc. shall be subject to approval by the Engineer. Hoses crossing streets, driveways, parking areas, etc., are to be ramped over to prevent damage to hoses. Spillage of wastewater is to be contained within the trenches and disposed of downstream to previously installed sewer piping. No spillage of wastewater to adjacent streets, lawns, etc. shall be tolerated. If any such spillage should occur, all construction operations shall cease. Cleanup shall commence immediately and be completed to the satisfaction of the Engineer prior to the resumption of any construction operations.

503.3(h) Sanitary Sewer Force Main Tracer Wire and Box.

A pipe locator conductor (tracer wire) shall be installed on all new sanitary sewer force mains (pressure sewer mains). The conductor shall be placed along the top of the sanitary force main taped to the pipe at minimum 10-ft. intervals. Wrapping tracer wire around the pipe is prohibited. Below grade splices are prohibited.

The Tracer wire shall be brought to the surface at the property line or at a location directed by the Engineer within a covered access device (tracer wire access box).

Each tracer wire shall be field tested after installation is complete.

503.4 Measurement and Payment.

503.4(a) Sanitary Sewer Pipes.

Sanitary sewer pipes shall be measured to the nearest whole foot of each of the various types, classes and sizes of pipe installed at the various depths, measured along the centerline of the pipe center to center of junctions and fittings. The quantity to be paid for includes construction through sewer

access structures, from center of sewer access structure casting to center of sewer access structure casting. Main extensions continuing through sewer access structures shall be measured from center of sewer access structure casting to the end of pipe. There shall be no deductions from the measured lengths for wye installations.

The contract price shall include furnishing all materials, including wyes, necessary to perform the work; excavation of the trench, except tunneling and jacking; installation and removal of sheeting and bracing; disposal of surplus material from the trench; backfilling the trench and compaction of the backfill material; embankment over the sewer using surplus material from the excavation of the trench; bedding the pipe; laying the pipe and installing the fittings and accessories; jointing and sealing of joints in pipe, fittings and accessories; encasement, where specified; connections to new structures; cleaning out the sewer; restoring the site; and all other work incidental to the installation of sanitary sewers.

503.4(b) Sanitary Sewer Laterals.

1. Laterals.

Sanitary sewer laterals shall be measured by length in feet of each of the various types, classes and sizes of pipe installed, measured along the centerline of the pipe from the wye opening to the end of the lateral pipe, or from the top of the riser to the end of the lateral pipe, whichever the case may be.

The contract price shall include furnishing all materials, including required fittings where laterals are connected to risers, necessary to perform the work; excavation of the trench; installation and removal of sheeting and bracing; backfilling the trench; and compaction of the backfill material; bedding the pipe; laying the pipe and installing the fittings; jointing and sealing of joints in pipe and fittings; encasement, where specified; cleaning out the lateral; restoring the site; and all other work incidental to the installation of sanitary sewer laterals.

Where the water service is installed in the same trench as the sanitary sewer lateral, the Contractor shall backfill the sanitary sewer lateral trench to the proper elevation for the installation of the water service; after installation of the water service, the Contractor shall complete the backfilling of the trench, all at no extra cost to the City. The labor, materials and tools necessary to make the taps, lay the water services and set the valve boxes shall be furnished by either the Water Utility or the Contractor, as specified in the contract.

2. Reconnect.

Reconnect shall be measured and paid as each reconstruction is completed and accepted and shall include necessary fittings and PVC pipe, 4” or larger, for the connection of the lateral and shall not exceed a length of five (5) feet. If the lateral replacement exceeds a length of five (5) feet, the quantity of pipe in excess of five (5) feet shall be paid for under the corresponding sanitary sewer lateral bid item.

3. Sanitary Lateral Electronic Markers.

Sanitary Lateral Electronic Markers shall be measured by each properly installed and functioning marker. No additional compensation will be provided for additional markers installed at the same location. The contract price shall be full payment for all work, materials (except electronic markers supplied by the City of Madison) and incidentals required to complete the work in accordance with

the description. The Contractor shall be responsible for picking up the markers at the Engineering Service Building, 1602 Emil Street in Madison, Wisconsin.

503.4(c) Sanitary Sewer Risers.

1. Riser Detail.

   Measure and pay for Riser Detail per section 503.4(b).

2. Alternate Method A & B.

   Sanitary sewer risers shall be measured by length in vertical feet of each of the various types and sizes installed, measured from the invert of the sewer main to the top of the riser.

   The contract price shall include furnishing all materials, including fittings, necessary to perform the work; concrete encasement, including any additional excavation required; special backfilling precautions as specified; and all other work incidental to the installation of risers.

503.4(d) Joints.

All new pipe to new pipe joints shall be included in the sewer item as specified in Section 503.4 – Measurement and Payment. Compression Couplings required for new pipe to existing pipe joints shall be measured and paid as each completed unit as installed in the field.

503.4(e) Wastewater Control.

Wastewater control shall be measured and paid by the lump sum for the completed work.

503.4(f) Sanitary Sewer Force Main Tracer Wire and Box.

Sanitary sewer Force Main Tracer Wire and Box shall be measured by the lineal foot. Contractor will only be compensated for tracer wire installed in full working order. The contract price shall be full payment for all work, materials and incidentals required to complete the work in accordance with the description.

ARTICLE 504 - STORM SEWER PIPES, APRON ENDWALLS AND OTHER STORM WATER CHANNELS

504.1 Description.

Unless otherwise shown on the plans or specified in the contract, the materials furnished and installed in the work shall conform to the requirements specified herein for the type and class of material named.

Unless otherwise directed by the Engineer, all pipe and accessories shall be unloaded at the point of delivery, and hauled to and distributed at the site of the work by the Contractor. The materials shall at all times be handled with care to avoid damage. The material shall not be dropped or bumped against the ground, other pipe and accessories already on the ground, or any other object on the ground.

The Contractor shall furnish random lengths of pipe for each contract as may be required for the proper placement of fittings or structures. The costs of random lengths of pipe shall be included in the contract unit prices for the respective sizes and types of pipe.

Unless otherwise specified, references to various standard specifications and test methods shall be understood to mean the specification or test method which is current on the date of advertisement for bids.

Other storm water channels include flumes and drainage ways. Flumes are further detailed in the Standard Detail Drawings. Drainage ways consist of small ditches to large scale greenways. Construction of drainage ways shall be done so in accordance with Article 200 – Earthwork. Typical greenway cross sections are included as Standard Detail Drawing 5.4.11, Typical Greenway Section (Grassed-flowline) and Standard Detail Drawing 5.4.12, Typical Greenway Section (Stabilized-flowline).

504.2 Materials.

When a material type is not specified and a pipe is called out as a “Storm Sewer Pipe” on plans and specifications, the pipe supplied shall be of a type of pipe as follows excluding metal storm pipes.

All pipe and fittings not covered by this specification shall be approved by the Engineer seven (7) days prior to the bid letting.

504.2(a) Reinforced Concrete Pipe.

Reinforced concrete pipe, fittings, and accessories, labeled as “RCP” on the plans, shall conform to the requirements of the Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM C 76. Reinforced concrete elliptical pipe, fittings and accessories, labeled as “HERCP” on the plans, shall conform to the requirements of the Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe, ASTM C 507. Unless otherwise specified, reinforced concrete culvert and storm drain shall be Class III (ASTM C 76) and reinforced concrete elliptical culvert and storm drain shall be Class HE-III (ASTM C 507).

Joints for storm sewer pipe shall be designed for the use of rubber gaskets, flexible plastic gaskets, cold plastic sewer joint compound, external sealing bands, or a combination of the above. Unless otherwise specified, circular reinforced concrete pipe shall be installed with rubber gasket joints,

flexible plastic gaskets, cold plastic sewer joint compound, external sealing bands, or a combination of the above, at the Contractor's option.

Rubber gaskets shall conform to the requirements of the Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, ASTM C 443. Flexible plastic gaskets shall conform to the requirements of the Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets, Type B Flexible Plastic Gaskets, AASHTO M 198. Cold plastic sewer joint compound shall be SealTight Cold Plastic Sewer Joint Compound as manufactured by W.R. Meadows, Inc., or approved equal. External sealing bands shall be Mac Wrap External Joint Collars as manufactured by Mar-Mac Manufacturing Company, Inc., or approved equal.

504.2(b) Corrugated Polyethylene with Smooth Inner Liner Pipe.

High density polyethylene corrugated exterior/smooth interior pipe shall conform to the specifications in this Subsection. Four- through ten-inch diameters shall meet all the requirements of Specification for Corrugated Polyethylene Drainage Tubing, 3- to 10-Inch Diameter, AASHTO M252, Type S, with the addition that the pipe have a smooth interior liner. 12 to 60 inch diameters shall conform to ASTM F2306. The pipe shall consist of a corrugated exterior and an essentially smooth interior wall.

Pipe joints shall meet ASTM 2306 as water tight. Water tight joints shall meet a 10.8 laboratory test per ASTM D 3212 and utilize a bell and spigot design with a gasket meeting ASTM F477.

Fittings supplied by the manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

504.2(c) Corrugated Polyvinyl Chloride Pipe.

The thermoplastic material shall be a rigid PVC (polyvinyl chloride) plastic and shall meet or exceed the Specifications for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, ASTM D1784, for a minimum cell classification of 12454B or 1245C. The fittings shall be made of PVC plastic having a cell classification of 12454B, 1245C, or 13343C as defined in ASTM D1784.

Gasketed pipe joints shall show no leakage when tested in accordance with ASTM D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM Specification F477. Joints shall meet soil tightness requirements of AASHTO 26.4.2.4(e).

PVC sewer pipe shall be manufactured per Specifications for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings, ASTM F949-93A with a minimum pipe stiffness (tested in accordance with ASTM D2412) of 50 psi. There shall be no evidence of splitting, cracking, or breaking when pipe is tested in accordance with ASTM D2412 at 60 percent flattening. Pipe dimensions shall meet the requirements given in ASTM F949-93a when measured in accordance with ASTM D2122.

504.2(d) Annular Corrugated Profile Wall Polyethylene Pipe.

High density Polypropylene corrugated exterior/smooth interior pipe shall conform to the specifications in this Subsection. 2 to 60 inch diameters shall conform to ASTM F2648/ F2648M.

The pipe shall consist of a corrugated exterior and an essentially smooth interior wall. Pipe joints shall meet ASTM 2306 as water tight. Water tight joints shall meet a 10.8 laboratory test per ASTM D 3212 and utilize a bell and spigot design with a gasket meeting ASTM F477. Fittings supplied by the manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

504.2(e) Polypropylene Corrugated Pipe with Smooth Inner Liner Pipe.

High density Polypropylene corrugated exterior/smooth interior pipe shall conform to the specifications in this Subsection. 6 to 30 inch diameters shall conform to ASTM F2736. 30 to 60 inch diameters shall conform to ASTM F2764. The pipe shall consist of a corrugated exterior and an essentially smooth interior wall. Pipe joints shall meet ASTM 2306 as water tight. Water tight joints shall meet a 10.8 laboratory test per ASTM D 3212 and utilize a bell and spigot design with a gasket meeting ASTM F477. Fittings supplied by the manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

504.2(f) Poly (Vinyl Chloride) Pressure Pipe.

Pressure Pipe shall conform to the requirements of American Water Works Association (AWWA) C905 Standard for Poly (Vinyl Chloride) (PVC) Pressure Pipe and Fabricated Fittings, four (4) inches through twelve (12) inches, for Water Distribution, Pressure Class 150 (DR18), AWWA C900. The joints shall be integral bell with elastomeric gaskets, or couplings with elastomeric gaskets. The fittings for PVC pressure pipe shall conform to the requirements of American National Standard for Ductile-Iron and Gray-Iron Fittings, three (3) inch through forty-eight (48) inch, for Water and Other Liquids, ASA A21.10 (AWWA C110).

504.2(g) Triple Walled Polypropylene Pipe.

The polypropylene compound shall be an impact modified copolymer and shall conform to the specifications in this subsection. Twelve (12) through Thirty (30) inch diameters shall meet all the requirements of ASTM F 2736 Standard Specifications for Polypropylene (PP) Corrugated Pipe. The pipe shall consist of a smooth interior with a corrugated exterior and have a minimum pipe stiffness of 46 pii. Thirty six (36) through Sixty(60) inch diameters shall meet all the requirements of ASTM F 2764 Standard Specifications for Polypropylene (PP) Triple Wall Pipe and Fittings. The pipe shall consist of smooth interior and exterior surfaces with annular inner corrugations and have a minimum pipe stiffness of 46 pii.

Pipe Joints shall be water-tight per ASTM F 2736 for twelve (12) through thirty (30) inch diameters and ASTM F 2764 for thirty six (36) through sixty (60) inch diameters. Water tight joints shall meet a 10.8 laboratory test per ASTM D 3212 and utilize a bell and spigot design with a gasket meeting ASTM F 477.

Fittings supplied by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

504.2(h) Storm Sewer Wyes, Tees, Angle-Sections, and Other Special Precast Sections.

Whenever shown on the plans, or directed by the Engineer, the Contractor shall furnish and install elbows, tees, wyes, reducers, or other prefabricated fittings for reinforced concrete pipe or corrugated metal pipe sewer installation. Fittings shall conform to Subsection 504.2(a) - Reinforced Concrete

Pipe and Subsection 504.2(e) - Corrugated Metal Pipe. Elbows shall be fabricated to a tolerance of five (5) degrees, plus or minus of the angle of intersection (I) shown on the plans.

504.2(i) Concrete Apron Endwalls for Concrete Pipe Sewers.

Concrete Apron Endwalls for concrete pipe sewers, labeled as "RCP AE" on the plans, shall be manufactured with reinforcement and concrete conforming to the pertinent requirements for Class II, Wall B, reinforced concrete pipe as specified in the Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM C 76. Concrete Apron Endwalls for concrete elliptical pipe sewers, labeled as "HERCP AE" on the plans, shall be manufactured with reinforcement and concrete conforming to the pertinent requirements for Class HE-III reinforced concrete elliptical pipe as specified in the Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe, ASTM C 507. Apron endwalls shall be in accordance with the designs, dimensions, and details shown on the Standard Detail Drawing 5.4.1, Apron Endwalls for Pipes and Pipe Arches.

504.2(j) Metal Apron Endwalls for Corrugated Metal Pipe and Pipe-Arches.

Metal apron endwalls for corrugated metal pipe and pipe-arches shall be manufactured in accordance with the pertinent requirements specified in Subsection 504.2(e) - Corrugated Metal Pipe of these Specifications. Apron endwalls shall be in accordance with the designs, dimensions, and details shown on the Standard Detail Drawing 5.4.1, Apron Endwalls for Pipes and Pipe Arches.

504.2(k) Joint Ties.

Joint ties shall be installed at the last two (2) downstream joints on any pipe run ending in an apron endwall that is constructed with reinforced concrete pipe or horizontal elliptical reinforced concrete pipe of any size.

504.2(l) Storm Sewer Electronic Markers.

Storm Sewer Marker Disks shall be provided where non-metallic storm sewer pipe is installed in the public Right of Way, and where no access or inlet structures are available on the surface to allow the pipe to be visually located. Storm Sewer Electronic Markers shall meet the specifications of Article 503 for sanitary sewer.

504.2(m) Precast Reinforced Concrete Box Culvert.

All precast storm sewer boxes shall be constructed in accord with ASTM C-850.

504.3 Construction Methods.

504.3(a) General.

504.3(b) Laying Pipe.

The pipe, fittings and accessories shall be of the size, class, type, and design; and shall be laid at the locations and to the required lines and grades; all as shown on the plans, required by the contract, or directed by the Engineer. Wherever the word "pipe" appears in this Subsection, it shall be understood to include pipe, fittings, and accessories.

The proper installations of structures and fittings, whose locations are shown on the plans and laid out by the Engineer shall be accomplished by the use of random lengths of pipe furnished by the Contractor. All field cuts of all types of pipe, except reinforced concrete pipe and corrugated metal pipe, shall be made with an approved mechanical pipe cutter or with a power saw in order to make a straight, true cut without chipping and cracking the pipe. In the event the Contractor is unable to obtain a certain size pipe, as specified on the plans or in the contract, the Contractor shall promptly inform the Engineer, and with the approval of the Engineer, the Contractor will be allowed to furnish and install a larger size pipe. In such case, the additional cost resulting from such substitution shall be at the Contractor's expense and no adjustment in compensation will be allowed.

For concrete pipe connections, a mechanical vibrator shall be used during placement of the concrete collar to assure complete exterior seal of concrete pipes to the new structure as detailed in the Standard Detail Drawings. A flexible watertight connections shall be used for plastic sewer pipe connections to structures as detailed in Standard Detail Drawing 5.7.31, Flexible Pipe to SAS Connector.

The laying of pipes in finished trenches shall commence at the lowest point and shall proceed towards the upper end, and the pipe shall be laid so that the spigot or tongue ends point in the direction of flow.

Jointing surfaces shall be carefully cleaned before pipes are lowered into trenches. The pipes shall be lowered so as to avoid unnecessary handling in the trench. Each section shall have a firm bearing throughout its length and shall be true to the line and grade required.

The method of shoving or pulling the pipes together shall be such that there will be no injury to the pipes, and the joints will be properly adjusted and will not be excessively large. The pipes shall be fitted and matched so that when set firmly to line and grade they will form a sewer with a smooth and uniform invert.

After the pipe is installed, lift holes shall be sealed with suitable concrete or other approved plugs.

The pipe shall not be laid within ten (10) feet of the excavating nor within forty (40) feet of blasting operations. The pipe shall not be laid in water or on frozen trench bottoms, or when, in the opinion of the Engineer, the trench conditions or weather are unsuitable for the proper performance of the work.

No length of pipe shall be laid until the previously laid length of pipe has been sufficiently backfilled to hold it securely in place during the jointing operation. If, in making a joint, any previously laid pipe is disturbed, such pipe shall be removed and relaid. Adequate backfill shall be placed on the pipe to prevent floating. Any pipe which has been floated shall be removed and relaid at the expense of the Contractor.

The Contractor shall furnish suitable lifting and handling devices designed to distribute the weight of the pipe over the length of the pipe and prevent high stresses over small areas.

All water must be kept out of the bell hole of the pipe until the joint is completed and water shall not be allowed to rise in or about the pipe until the trench is filled at least one (1) foot above the top of the pipe.

Before leaving the work for the night, or during a storm, or for any reason, care must be taken that the unfinished end of the sewer is securely closed with a tightly fitting iron or wooden plug. Any

earth or other materials that may find entrance into the sewer shall be removed by the Contractor at no additional cost to the City.

504.3(c) Joints.

The joint ties shall be installed in accordance with the Standard Detail Drawing 5.4.6, Concrete Pipe Joint Ties.

The following outlines specifications for new pipe to new pipe and new pipe to existing pipe connections.

1. New Pipe to New Pipe.

Jointing materials shall conform to the requirements specified in Section 504.2 – Materials of these Specifications, for the type of pipe being installed.

Joints shall not be made until the pipe is in the trench and set to true line and grade. Lengths of pipe which are joined together outside of the trench shall be removed from the project immediately.

Prior to making joints, the jointing surfaces shall be inspected for chips, cracks, or other defects in the joints and jointing materials. The jointing surfaces shall be carefully cleaned and lubricated with a vegetable lubricant or a lubricating adhesive. Lubricant shall be applied to both the bell and spigot surfaces of the joint. The lubricant shall be that recommended by the gasket manufacturer for the particular type of gasket being installed.

Care shall be taken when shoving or pulling the pipes together in order not to damage the pipe or the joints and jointing materials. The pipes shall be in proper alignment and to the proper grade prior to applying the pressure necessary to make the joint.

Rubber gaskets for reinforced concrete storm sewer pipe shall be assembled as follows:

- When air temperature is below 32°F, gaskets shall be applied one and one-half (1-1/2) hours before installation of the pipe.

- When air temperature is above 32°F, gaskets shall be applied fifteen (15) minutes before installation of the pipe.

The temperature referred to pertains to the prevailing air temperature at the point of application of the gaskets. This shall be taken to mean the air temperature, either indoor or outdoor, at the time and place the gaskets and cement are being applied to the pipe. It does not refer to the temperature in the trench, or of the bonding cement, or of the pipe.

In making mechanical joints, the bolts shall be installed with the heads in reverse direction. The nuts shall be turned on only as far as they can be by using the wrench with one hand, with no extensions on the wrench to give greater leverage. Care shall be taken not to over-tighten the bolts. The bolts shall be tightened equally and diametrically in order to apply the proper pressure on the gasket and joint.

2. New Pipe to Existing Pipe.

A concrete collar or compression coupling shall be required at the junction of a new pipe to an existing pipe as specified on the plan set or as required in the field by the Engineer. The joints shall be clean and may require sawcutting the existing pipe for a clean edge. If the Contractor for his/her convenience deems it more suitable to remove the existing pipe to a full joint, the additional pipe required to connect the new pipe is to be the Contractors responsibility and shall not be compensated.

The concrete collar shall be constructed per Standard Detail Drawing 5.4.5, Concrete Collar and may include a change in horizontal or vertical direction. The compression coupling shall be constructed per Standard Detail Drawing 5.3.3, Coupling Details and shall not include a horizontal or vertical defection between the two pipes.

504.3(d) Storm Sewer Electronic Markers.

Storm Sewer Electronic Markers shall comply with 503.3(c)6.

504.3(e) Storm Sewer Electronic Markers.

Storm Sewer Electronic Markers shall be paid in accord with 503.4(b)3.

504.3(f) Precast Box Culvert.

The Contractor shall be responsible for all work and coordination necessary to provide, coordinate deliver, unloading and other incidentals associated with the box culvert installation.

1. The sub-grade for the boxes shall have WDOT TYPE HR filter fabric placed on all exposed sub-grade areas prior to placement of the bedding stone for the boxes.

2. One (1) foot of three (3) inch clear stone shall then be placed on the geotextile fabric as bedding stone. Three (3) inch clear stone for box culvert bedding is included in the price of box culvert installation.

3. Pipe backfill above the bedding stone shall be in accord with SDD 5.2.2

4. The joints of the box culvert shall be sealed with seal-tight across the inside bottom and up the entire length of the inside vertical walls. Sealwrap shall be placed across the outside top of the box and completely down the outside vertical sides of the box. Provision and installation of all joint material is included in the price of the box culvert.

504.4 Measurement and Payment.

504.4(a) Storm Sewer Pipes/Boxes.

Storm sewers shall be measured to the nearest whole foot of each of the various types, classes and sizes of pipe installed at the various depths, measured along the centerline of the pipe center to center of junctions and fittings. The quantity to be paid for includes construction through sewer access structures, catchbasins, inlets and other structures, from center of structure casting to center of structure casting. The quantity to be paid for does not include the lengths of apron endwalls. There shall be no deductions from the measured lengths for the installations of wyes, tees, angle-sections and special sections required to join pipes of dissimilar sizes, shapes and types.

The contract price shall include furnishing all materials necessary to perform the work, including fittings and accessories, but not including wyes, tees, angle-sections and special precast sections required to join pipes of dissimilar sizes, shapes and types and apron endwalls; excavation of the trench, except tunneling and jacking; installation and removal of sheeting and bracing; disposal of surplus material from the trench; backfilling the trench and compaction of the backfill material; embankment over the sewer using surplus material from the excavation of the trench; bedding the pipe; laying the pipe and installing the fittings, accessories, wyes, tees, angle-sections and special sections; jointing and sealing of joints in pipe, fittings, wyes, tees, angle-sections and special sections; encasement, where specified; connections to new structures; cleaning out the sewer; restoring the site; and all other work incidental to the installation of storm sewers.

504.4(b) Storm Sewer Wyes, Tees, Angle-Sections, and Other Special Precast Sections.

Storm sewer wyes, tees, angle-sections, and other special precast sections required to join pipes of dissimilar sizes, shapes, and types shall be measured separately as units of each of the various sizes and types of each installed.

The contract price shall include the additional cost per wye, tee, angle-section or other special precast section over the cost of the sewer main. All costs of installing wyes, tees, angle-sections and other special precast sections shall be included in the contract prices for the sewer main.

504.4(c) Apron Endwalls.

Apron endwalls shall be measured separately as units of each of the various types, classes and sizes of each installed.

The contract price shall include furnishing all materials necessary to perform the work; excavation; installation and removal of sheeting and bracing; disposal of surplus material from the excavation; backfilling the excavation and compaction of the backfill material; embankment over apron endwalls using surplus material from the excavation; bedding the apron endwalls, laying the apron endwalls; jointing and sealing of joints between storm sewer pipes and apron endwalls; encasement, where specified; cleaning out the apron endwalls; restoring the site; and all other work incidental to the installation of apron endwalls.

504.4(d) Joints.

All new pipe to new pipe joints shall be included in the sewer item as specified in Section 504.4 – Measurement and Payment.

Concrete Collars required for new pipe to existing pipe joints shall be measured and paid as each completed unit as installed in the field. Concrete collars shall not be measured as a separate item when included in another item such as a Storm Sewer Tap. This item shall only be measured and paid where specifically called for in the plan or as needed to resolve unforeseen circumstances encountered in the field.

Compression Couplings required for new pipe to existing pipe joints shall be measured and paid as each completed unit as installed in the field.

Joint ties required for apron endwalls as specified in Subsection 504.2(i) – Joint Ties of these Specifications shall be considered as incidental to the cost of the apron endwall. All other joint ties shall be measured and paid for each joint requiring ties.

504.4(e) Tracer Wire & Box.

Tracer Wire & Box shall be paid in accord with 503.4(b)3.

ARTICLE 505 - BOX CULVERTS AND WINGWALLS

505.1 Description.

Unless otherwise shown on the plans or specified in the contract, the materials furnished and installed in the work shall conform to the requirements specified herein for the type and class of material named.

Unless otherwise directed by the Engineer, all box culverts and accessories shall be unloaded at the point of delivery, and hauled to and distributed at the site of the work by the Contractor. The materials shall at all times be handled with care to avoid damage. The material shall not be dropped or bumped against the ground, other materials and accessories already on the ground, or any other object on the ground.

Unless otherwise specified, references to various standard specifications and test methods shall be understood to mean the specification or test method which is current on the date of advertisement for bids.

505.2 Materials.

505.2(a) Box Culverts.

Box culverts shall be precast reinforced concrete box sections, labeled as "RCBOX" on the plans, shall conform to the requirements of the Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewer, ASTM C 1433.

505.2(b) Joint Material.

The joints of the box culverts shall be sealed with a combination of cold plastic sewer joint compound and external sealing bands.

Cold plastic sewer joint compound shall be SealTight Cold Plastic Sewer Joint Compound as manufactured by W.R. Meadows, Inc., or approved equal. External sealing bands shall be Seal Wrap External Joint Collars as manufactured by Mar-Mac Manufacturing Company, Inc., or approved equal.

505.3 Construction Methods.

505.3(a) Box Culverts.

The Contractor shall abide by the following guidelines when installing box culverts:

1. The subgrade for the boxes shall have riprap filter fabric placed on all exposed subgrade areas prior to placement of the bedding stone for the boxes.

2. Eight (8) inches of three (3) inch clear stone shall be placed as bedding stone.

3. Box backfill shall be completed with select fill as specified. Compaction shall be required in eight (8) inch maximum lifts. Providing and placing of the select fill follow the requirements of Article 502 – Trench Excavation, Bedding, and Backfill.

4. The joints of the box culverts shall be sealed with a cold plastic sewer joint compound across the inside bottom and up two (2) feet on the vertical walls. The remainder of the box culvert joints shall be sealed with external sealing bands.

For multiple, parallel box installations, a three (3) inch horizontal separation shall be maintained between the boxes along the entire run. The void between the boxes shall be filled with TYPE A Slurry Mix as specified in Section 301.9 of these Specifications.

505.3(b) Box Culvert Wingwalls.

Box Culvert Wingwalls shall be constructed as depicted in Standard Detail Drawing 5.5.1, Box Culvert Wingwall, at the locations specified on the plan set.

505.4 Measurement and Payment.

505.4(a) Box Culverts.

Box Culvert shall be measured to the nearest whole foot of each of the various types, classes and sizes of box culvert installed at the various depths, measured along the centerline of the box culvert center to center of junctions and fittings. The quantity to be paid for does not include the lengths of wingwalls and construction through sewer access structures, catchbasins, or other structures. There shall be no deductions from the measured lengths for the installations of wyes, tees, angle-sections and special sections required to join boxes of dissimilar sizes, shapes and types.

The contract price shall include all materials necessary to perform the work, including fittings and accessories, but not including wyes, tees, angle-sections and special precast sections required to join pipes of dissimilar sizes, shapes and types and wingwalls; excavation of the trench, except tunneling and jacking; installation and removal of sheeting and bracing; disposal of surplus material from the trench; backfilling the trench and compaction of the backfill material; embankment over the sewer using surplus material from the excavation of the trench; laying the box; jointing material and sealing of joints in the box; filling the separation between multiple box installations; connections to existing structures; cleaning out the sewer; restoring the site; and all other work incidental to the installation of storm sewers.

Bedding including the required filter fabric and backfill with select backfill, if required, shall not be included in this item and shall be compensated under the respective items.

505.4(b) Box Culvert Wingwalls.

Box Culvert Wingwalls shall be measured and paid as each unit as completed and accepted in the field

The contract price shall include furnishing all materials necessary to perform the work; excavation; installation and removal of sheeting and bracing; disposal of surplus material from the excavation; backfilling the excavation and compaction of the backfill material; preparation of the foundation; construction of the structure, including connections; restoring the site; and all other work incidental to the installation of the box culvert wingwall.

ARTICLE 506 - STORM SEWER GATES

506.1 Description.

Storm Sewer Gates shall include steel gates to be installed on reinforced concrete pipe apron enwalls, reinforced concrete elliptical pipe apron endwalls, and box culvert wingwalls as specified in the plans.

506.2 Materials.

506.2(a) Storm Sewer Gates.

Storm sewer gates for reinforced concrete pipe apron endwalls, labeled as "RCP AE GATE" shall be constructed per Standard Detail Drawings 5.6.1, RCP AE Gate and storm sewer gates for reinforced concrete elliptical pipe apron endwalls, labeled as "HERCP AE GATE" shall be of a similar construction. Storm sewer gates for the box culvert wingwalls shall be "INLET" or "OUTLET" gates and constructed as detailed in Standard Detail Drawing 5.6.2, Box Culvert Inlet Gate (Upstream) or Standard Detail Drawing 5.6.3, Box Culvert Outlet Gate (Downstream), respectively.

All storm sewer gates shall be painted as specified in Subsection 506.2(b), Structural Steel Paint-Epoxy System.

506.2(b) Structural Steel Paint-Epoxy System.

The following paint system shall be used on all storm sewer gates. At the discretion of the Contractor, a galvanized storm sewer gate may be provided. The galvanized gate shall conform to the specifications of the State of Wisconsin Standard Specifications for Highway and Structure Construction.

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 complete. If it is to be welded only in the fabricating shop and subsequently erected by bolting, it shall be given one coat of weldable primer or other approved protective coating after shop welding and shop fabrication is completed.

1. Coating System.

The Contractor shall select a complete coating system. The color of the epoxy shall be white and the urethane coating materials shall be a dark green. The Contractor shall supply the Engineer with the product data sheets before any coating is applied. The product data sheets shall indicate the mixing and thinning directions, the recommended spray nozzles and pressures, the minimum drying time for shop applied coats, the recommended procedures for painting zinc coated bolts, nuts and washers, the telephone number for technical service and other pertinent information.

2. Organic or Inorganic Zinc Rich Primer.

After the entire surface to be coated has been cleaned and approved by the Inspector, the primer shall be applied so as to produce a uniform even coating bonded to the metal.

The color of the primer must be such that a definite contrast which is readily apparent exists between it and the color of the blasted surface. The fabricator will be required to submit color samples of the primer to the Engineer for approval.

All areas shall have a minimum dry film thickness above the surface profile 0.076 mm (3.0 mils).

If the application of the coating at the required thickness in one coat produces runs, bubbles or sags, the coating shall be applied in two, wet, even coats using a fifty (50) percent overlap with minimum dry or overspray. Where excessive coating thickness produces mud-cracking, such coating shall be removed back to soundly bonded coating and the area recoated to the required thickness.

In areas of deficient primer thickness, the areas shall be cleaned thoroughly with power washing equipment as necessary to remove all dirt; the areas then shall be brushed with a non-rusting tool, vacuumed and recoated.

3. Epoxy System (Intermediate and Protective Coats).

On all areas the white intermediate coat shall have a minimum dry film thickness of 0.089 mm (3.5 mils) and the protective coat shall have sufficient thickness to provide a uniform color and appearance, but in no case less than 0.025 mm (1.0 mils).

506.3 Measurement and Payment.

Storm Sewer Gates shall be measured and paid as each unit of the various types, classes and sizes installed and accepted and shall include the fabrication, painting and installation of the gate.

ARTICLE 507 - SEWER STRUCTURES

507.1 Description.

Work under this section shall apply to sewer access structures, cleanouts, catchbasins and inlets for sanitary and storm sewer connections.

507.2 Castings.

507.2(a) General.

Gray iron castings used in the work shall conform to the requirements of the Specifications for Gray Iron Castings, ASTM A 48, Class 30 except as noted.

The castings for sewer access structures, catchbasins, and inlets shall be in accordance with the designs, dimensions, and details shown on the Standard Detail Drawings for the installation named, unless otherwise specified. Frames and lids for sewer access structures and catchbasins shall be machined and fitted so that rocking and chattering will be eliminated. The lids installed on sanitary sewers shall have the self-sealing gaskets firmly glued in place at the factory. All cleanouts shall conform to the requirements in the Wisconsin Plumbing Code. The type of cleanout cap shall be approved in advance by the field engineer.

507.2(b) Sewer Access Structures.

The following lists of Neenah Foundry castings are acceptable for City construction and are further detailed in Standard Detail Drawing 5.7.16, SAS Frame and Cover. Substitutions shall be approved by the Engineer prior to delivery to the job site.

1.	R-1550	Heavy-duty, w/logo lid 1550-0054, nine (9) inch high, non-rocking sewer access structure frame and Type “B” non-rocking self-sealing sewer access structure lids with concealed pick holes.
2.	R-1689	Heavy-duty, w/logo lid 1550-0054, four (4) inch high, non-rocking sewer access structure frame and Type “B” non-rocking self-sealing sewer access structure lids with concealed pick holes.
3.	R-1920	Heavy-duty, sewer access structure frame and self-sealing lid with Type “F” locks and concealed pick holes.

507.2(c) 3’x3’ Catchbasins.

The following lists of Neenah Foundry castings are acceptable for City construction. Substitutions shall be approved by the Engineer prior to delivery to the job site.

1.	R-1878-A10G	Heavy-duty, four (4) inch high, catchbasin frame with open grate.
2.	R-1878-A10L	Heavy-duty, four (4) inch high, catchbasin frame with solid lid.
3.	R-1879-A10F	Light-duty, four (4) inch high, catchbasin frame with solid lid.

4.	R-1879-A10L	Light-duty, four (4) inch high, catchbasin frame with solid lid.

507.2(d) Inlets.

The following lists of Neenah Foundry castings are acceptable for City construction and are further detailed in the Standard Detail Drawings. Substitutions shall be approved by the Engineer prior to delivery to the job site.

1.	R-3067 -7004	Heavy-duty curb inlet frame, curb box with two (2) inch radius and "Dump No Waste - Drains to Lake" logo, and diagonal openings grate (Neenah Foundry Type R Inlet Grate). May be used with vane grate (Neenah Foundry Type V Inlet Grate) denoted with a **–V**. For use with Type "H" Inlets in Type 'A', Type 'B' or Type 'H' Concrete Curb and Gutter.
2.	R-3067 -7009	Heavy-duty curb inlet frame, slanted curb box with openings, and diagonal openings grate (Neenah Foundry Type R Inlet Grate). May be used with staggered longitudinal vane grate (Neenah Foundry Type L Inlet Grate) denoted with a **–L**. For use with Type "H" Inlets in Type 'A' Mountable Concrete Curb and Gutter.
3.	R-3290 -A	Heavy-duty curb inlet frame and custom grate. No curb box required. For use with Type "H" Inlets in Driveway Section Type 'A' Concrete Curb and Gutter.
4.	R-1878 -B7G	Heavy-duty frame and flat open grate for use with Type "H" Inlets and in grassed areas. No curb box required.
5.	R-1878 -B7L	Heavy-duty frame and flat closed cover for use with Type "H" Inlets. No curb box required.
6.	R-3281-A	Heavy-duty curb inlet frame, curb box with two (2) inch radius. May be used with diagonal openings grate denoted with **–AL** (left) or **–AR** (right) or with staggered longitudinal vane grate denoted with a **-B**. For use with Type "S" Inlets in Type 'G' Concrete Curb and Gutter.
7.	R-3382	Casting to be installed on inlets constructed in alleys with "v" style ribbon curb - see SDD 5.7.33 for installation details.
8.	R-3067-7000	Casting to be used when an existing "H" inlet is located at a new or proposed driveway location. In this application, the curb head section of the casting shall be removed from the existing inlet and replaced with this "plate" casting. This allows the existing inlet frame to used without removal and replacement of the existing curb & gutter section surrounding the inlet to replace with our standard driveway casting R-3290-A.
9.	R-3067-C	Narrowed Casting (no casting in the curb head area) to be used as an alternate to R-3067-7000 in drive way areas.

10. R-3808-0005 — Component number for all version of Terrace Inlets (SDD 5.7.12) shall be made of DUCTILE IRON – this requires a special order from Neenah Foundry. Standard Gray Iron castings shall not be allowed for use.

507.2(e) Special Castings

1. R-3262-2 — Stormwater Curb Opening for 6" curb heads – this casting is used to allow the discharge of roof drains, sump pumps or small parking areas to the curb line where no storm sewer is available for connection.

2. R-3262-6 — Stormwater Curb Opening for 9" curb heads – this casting can be installed as part of a terrace rain-garden/bioretention system to take water from the curb line to the garden. Where this casting is used the flow-line of the curb shall be depressed 3 inches to direct the runoff from small events directly to the garden system.

3. R-3268 — Stormwater Curb Opening for 8" curb heads – this casting can be installed as part of a terrace rain-garden/bioretention system to take water from the curb line to the garden. Where this casting is used the flow-line of the curb shall be depressed 2 inches to direct the runoff from small events directly to the garden system. This casting shall be used when rain-garden/bioretention systems are in areas with significant tree canopies.

507.3 Construction Methods.

507.3(a) General.

The construction of concrete sewer access structures, catchbasins, and inlets shall conform to the pertinent portions of Part 3, Concrete and Concrete Structures of these Specifications, and the applicable Standard Detail Drawings for the structure involved. Sewer access structures, cleanouts, catchbasins and inlets shall be of a size and type specified in the contract, and shall be constructed at the location and to the elevation shown on the plans, or as directed by the Engineer. Cleanouts shall be constructed in accordance to the Wisconsin Plumbing Code.

Unless otherwise specified, all sanitary sewer access structures shall be constructed of precast units of reinforced concrete provided they meet all the precast requirements. Sewer access structures and inlets for storm sewers may be either cast-in-place or precast concrete structures. If the plans specifically require a field poured structure, then the structure shall be cast-in-place with no exception. If the structure is not specifically required to be field poured, a precast structure may be substituted for a cast-in-place structure provided they meet all the precast requirements and approval is granted by the Engineer.

Cast-in-place structures shall be constructed as detailed in the Standard Detail Drawings. The bases of all structures which are cast-in-place shall be poured prior to pouring the walls of the structures, unless otherwise ordered or allowed by the Engineer.

For all cast-in-place structures constructed in greenways, retention basins, ponds and infiltration basins, XYPEX ADMIX C-500 shall be included in the concrete used for the construction of these

structures. XYPEX ADMIX C-500 is a waterproofing agent. It is expected that structures this will affect include box culvert aprons, multiple cell pipe aprons, outlet structures, control structures, and other miscellaneous structures. Where this ADMIX is used the Contractor shall not be required to use epoxy coated rebar for the reinforcement within these structures. XYPEX ADMIX C-500 shall be used in the concrete mix at the ratio recommended by the manufacture and documentation of the ADMIX being included in the concrete mix shall be provided to the Construction Engineer.

Various layout requirements for storm sewer inlets are included in the Standard Detail Drawings.

507.3(b) Precast Requirements.

Precast Sewer Access Structures (SAS) and inlets, generally referred to as precast structures, shall be of reinforced concrete and shall conform to the specifications of Precast Reinforced Concrete Manhole Sections, ASTM C 478. Joints shall meet the requirements for circular reinforced concrete pipe as specified in these Specifications.

Precast structures for storm sewer may be furnished with steps. Precast structures for sanitary may be furnished with steps in the barrel sections only. If steps are used in the cone sections to facilitate construction, they shall be removed prior to acceptance.

Precast structures of reinforced concrete may be substituted for cast-in-place structures provided they can meet all of the following criteria and the conditions of the contract and approval is granted from the Engineer. No precast structures shall be brought to the job site until approval is granted from the Engineer. Any precast structure not meeting these criteria shall be replaced by a cast-in-place structure or a precast structure satisfying these criteria at the Contractor's expense.

The following procedure shall be followed prior to approval of precast structures:

1. The Contractor shall complete all required utility line openings as detailed in Subsection 508.1(a), Utility Line Opening,

2. The Engineer will review the data provided and make any necessary design changes,

3. Upon completion of any redesign the Contractor shall make a request and submit shop drawings of any precast structures to the Engineer,

4. The Engineer shall have two (2) days to review the request and provide a decision to the Contractor.

The following precast requirements are specific for sanitary sewer and storm sewer precast structures.

1. Sanitary Sewer.

The following precast requirements shall be met for all precast SAS for sanitary sewers:

- Precast SAS shop drawings for public works reconstruction projects shall be approved prior to fabrication and delivery to the site.

- Precast SAS shop drawings for private developments are not required.

- Spreader bars shall be used if "lift eyes" are utilized for movement and placement of the precast structure.

- Each precast structure on the plan shall be custom manufactured with factory-made cores for sanitary sewer connections.

- The total height of adjustment shall be a minimum of three (3) inches and a maximum of nine (9) inches.

- The base shall be precast integral to the precast structure. The invert and bench may be either field poured concrete or precast and shall be such that the invert provides positive flow through the structure and the height of the bench shall match the top of the discharge pipe.

A base section with a precast bench and invert may be provided, subject to the following requirements:

- The concrete of all inverts shall be finished with a steel trowel to produce a smooth flowline. Inverts which are brushed and/or have a rough flowline may be rejected by the Engineer in the field.

- The Contractor shall provide for a tight joint between all pipes entering or leaving the structure and the precast invert such that there is no abrupt change in the grade of the flowline through the joint. Any grinding or grouting of the invert which is required to produce a tight joint shall be considered incidental to the installation of the precast structure.

- The precast bench shall extend to a height of 3/4 of the diameter of the pipe, at a minimum.

- All inlet flowlines shall be poured with gentle sweeps through the structure towards the outlet flowline such that cleaning and televising equipment can pass easily along the flowlines.

2. Storm Sewer.

The following precast requirements shall be met for all precast SAS for storm sewers:

- Pick holes on a barrel sections with no base shall be utilized with extreme care. Pick holes shall not be utilized as a method to place the bottom sections. Pick holes shall be sealed on the inside and the outside of the precast structure prior to backfilling the excavation.

- Each precast structure on the plan shall be custom manufactured with factory-made cutouts for storm sewer connections. Cutouts shall not extend into the groove of the bottom section or barrel section(s). There shall be a minimum of twelve (12) inches of the inside wall of the precast structure present between the cutouts for the pipes. A minimum of two (2) inches of the precast structure must be present between the top of the knockout and the bottom of the adjustment rings. No removal of the precast structure above the precast knockout will be allowed.

- The total height of adjustment shall be a minimum of three (3) inches and a maximum of nine (9) inches.

- The base shall be precast integral to the precast structure. The invert and bench may be either field poured concrete or precast and shall be such that the invert provides positive flow through the structure and the height of the bench shall match the springline of the discharge pipe.

- No drain holes shall be provided. This practice has been replaced with the use of underdrains. Reference Standard Detail Drawing 5.7.14, Underdrain, for the acceptable locations for underdrain connections.

The following requirements are specific to all precast inlets for storm sewers:

- Pick holes shall be sealed on the inside and outside of the precast inlet prior to backfilling of the excavation.

- Each precast inlet shall be custom manufactured with factory-made knockouts and/or cutouts. Factory stock inlets will not be accepted. A minimum of two (2) inches of concrete is required from the edge of the cutout measured horizontally to the inside edge of the inlet box. Maximum pipe sizes allowed when a precast inlet is used are: twenty-one (21) inch out of the three (3) foot side, and twelve (12) inch out of the two (2) foot side.

- The total height of adjustment shall be a minimum of 2 ¼ inches and a maximum of eight (8) inches.

- The base shall be precast integral to the precast structure. The inlet invert and bench shall then be field poured such that the invert provides positive flow through the structure and the height of the bench matches the invert elevation of the discharge pipe.

- If precast inlets with multiple knockouts are permitted by the Engineer, the Contractor shall be aware that any “dog house” areas of the structure which are not used to connect a pipe at the structure or any excess area of the “dog house” where a pipe is connected shall be filled with Grade “A” concrete such that the “dog house” area of the structure is flush with the outside wall of the inlet structure.

507.3(c) Castings.

Castings shall be installed to the grades shown on the plans or as directed by the Engineer. Sewer Access Structure (SAS) castings shall be installed 1/4 inch below the final grade. SAS castings that are 3/4 inch, or more, below the final grade shall be repaired. Inlet castings shall be set to grade prior to and separate from the pouring of the concrete curb and gutter. It is expected and required that three (3) feet of concrete curb and gutter on either side of the inlet shall be poured by hand, not through the use of a curb machine. The inlet casting shall be set to grade on a bed of mortar, which shall be a minimum of 2-1/4 inches thick. The inlet shall be placed on the mortar bed and shall be adjusted to grade by applying direct pressure to the casting. Once the casting adjustment is complete, three (3) feet of curb and gutter on either side of the inlet casting shall be poured by hand. The inlets shall be placed in accord with the appropriate Standard Detail Drawing. The acceptable offset criteria are detailed in Standard Detail Drawing 5.7.29, Inlet Casting Offset Criteria for H Inlets. Unless otherwise specified, allowance shall be made for a nine (9) inch high catchbasin or sewer access structure frame and adjustment rings or blocks in accord with Standard Detail Drawing 5.7.5, 5.7.6, or 5.7.15, whichever is applicable. All frames and adjustment rings shall be constructed in accord

with Standard Detail Drawings 5.7.5, 5.7.6, or otherwise secured as shown on the plan set. Solid concrete adjusting blocks or bricks may be substituted for precast adjusting rings in accord with Standard Detail Drawing 5.7.15, SAS Chimney and Casting. The mortar shall be air-entrained, type M or S. Any precast inlets or structures not meeting the casting grade requirements will not be accepted and shall be replaced with a cast-in-place structure or a precast structure meeting these specifications at the cost of the Contractor.

Internal Chimney Seals shall be installed on all sanitary sewer access structures located within 100 feet of a street low point, in greenways and where indicated on the plans or in the field. Internal chimney seals shall be either rubber with metal bands or a low density polyethylene insert conforming to Standard Detail Drawing 5.7.17 – SAS Internal Chimney Seal or other internal chimney seal products as approved by the Engineer.

Existing castings that conform to the Standard Specifications on the job site may be salvaged and reused on new structures for that project as approved by the Engineer. Otherwise, all excess salvaged castings shall be delivered to the Engineering Service Building as specified in Part II of these Specifications.

507.3(d) Sewer Connections.

The connections of new pipes at new structures are detailed in the respective sewer type Sections with the exception of sanitary sewer drop inlets which are defined in this Subsection.

When a structure is to be constructed at an existing pipe, the Contractor shall sawcut the existing pipe in the required location to accommodate the placement of the new structure. If the Contractor deems it more suitable to remove the existing pipe to a full joint, the additional pipe and connection required to reconnect the sewer shall be the Contractor’s responsibility.

The following requirements are specific for sanitary sewer and storm sewer connections.

1. Sanitary Sewer.

Whenever shown on the plans, or directed by the Engineer, the Contractor shall install outside drop inlets in conjunction with the installation of sanitary sewer access structures as detailed in the Standard Detail Drawings. The pipe and fittings to be used in the construction of the outside drop inlets shall be of the same material as the sewer main. The pipe and fittings shall be securely anchored to the sewer access structure to prevent displacement during the placement of the concrete encasement. Where allowed, an inside drop may be constructed as detailed in Standard Detail Drawing 5.7.30 - Inside Drop for Sanitary Lateral.

A Sanitary Sewer Tap shall include the connection of an existing lateral or main to a new structure. A flexible connector shall be provided and used by the Contractor to connect the existing pipe to any new pipe that is required to make the connection to the structure as detailed in Standard Detail Drawing 5.7.31, Flexible Pipe to SAS connector. Any new pipe that is installed by the Contractor to reconnect the existing sewer main or lateral shall be considered incidental to this bid item. The newly installed pipe shall match the existing pipe’s diameter or be of the next larger diameter. If the existing lateral is to be replaced, the new pipe shall be compensated under the corresponding sanitary sewer lateral bid item. The pouring and construction of concrete benches and flowlines in new sewer access structures for the inlet or outlet pipes shall not be considered a part of this work. The construction of concrete benches and flowlines shall be considered incidental to the installation of the

sewer access structure. The Contractor shall be responsible for maintaining the normal flow of wastewater during tapping of the sewer access structure.

2. Storm Sewer.

A Storm Sewer Tap shall include all work, materials and incidentals required to connect a new pipe of the size and type specified in the contract to an existing structure or pipe. The pipe being used shall be paid separately under the appropriate item. The new connection shall be made in a workmanship like manner to assure the structural integrity of the tapped structure or pipe once the connection is made. A Storm Sewer Tap/Connection shall be completed in accord with the type of pipe material being connected and the type of material being connected to.

Where a new reinforced concrete pipe is being tapped into an existing concrete structure or pipe the connection shall be made in a workmanship like manner to assure the structural integrity of the tapped structure or pipe once the connection is made. It is required, and this item includes, the use and provision of a concrete collar to complete and seal the connection between the existing structure or pipe and the new pipe. The work completed shall be in accord with Standard Detail Drawing 5.7.32, Storm Sewer Tap Detail.

Where a new plastic pipe is being connected into an existing concrete pipe or concrete structure the contractor shall field core the existing structure or pipe and provide a Core-n-T, Core-n-Seal boot, or approved equal to connect the new pipe to the existing pipe or structure as detailed in Standard Detail Drawing 5.7.31, Flexible Pipe to SAS Connector. Where the connection is being made to an existing plastic pipe, a preformed fitting, from the manufacture of the existing plastic pipe, shall be utilized. The work under this item shall include all necessary work to provide the field core and all necessary fittings.

When a new private connection is being made to the public system all construction shall comply with the conditions above, and shall additionally utilize Table 3 - Private Connections to determine if a new structure rather than a tap/connection shall be required.

TABLE 3
Private Connections

PIPE BEING CONNECTED		PIPE BEING CONNECTED TO		TYPE OF CONNECTION REQUIRED
SIZE	TYPE	SIZE	TYPE	
6”	PLASTIC	>= TO 12”	RCP/PLASTIC	TAP / FITTING
8” & 10”	PLASTIC	<= TO 12”	RCP/PLASTIC	STRUCTURE
8” & 10”	PLASTIC	> THAN 12”	RCP/PLASTIC	TAP / FITTING
12”	PLASTIC	<= TO 15”	RCP/PLASTIC	STRUCTURE
12”	PLASTIC/RCP	>= TO 18”	RCP/PLASTIC	TAP / FITTING
15”	PLASTIC/RCP	<= TO 21”	RCP/PLASTIC	STRUCTURE
15”	PLASTIC/RCP	> THAN 21”	RCP/PLASTIC	TAP / FITTING
18”	PLASTIC/RCP	<= TO 27”	RCP/PLASTIC	STRUCTURE
18”	PLASTIC/RCP	> THAN 27”	RCP/PLASTIC	TAP / FITTING
21”	PLASTIC/RCP	< = TO 30”	RCP/PLASTIC	STRUCTURE
21”	PLASTIC/RCP	> THAN 30”	RCP/PLASTIC	TAP / FITTING
>= TO 24”	PLASTIC/RCP	ANY SIZE	ANY TYPE	STRUCTURE

NOTES:

1. No plastic pipe is allowed under the pavement of a public street. Effectively, this reduces plastic pipe connections to structures or pipes in the curb line or terrace.

2. Where any type of pipe is being connected to a horizontal elliptical pipe (HERCP) and that connection is not occurring with matching spring lines, a new structure shall be required for the connection. Further, if the pipe being connected to the existing HERCP has an inside diameter greater than one half the inside vertical diameter of the existing HERCP, a new structure shall be required for the connection.

3. Where any type of pipe is being connected to a box culvert a tap/connection may be utilized.

4. The method of connection to existing clay pipe, or any type of pipe not specifically discussed above shall be at the discretion of the Construction Engineer.

507.4 Measurement and Payment.

507.4(a) Sanitary Sewer Access Structures.

Sanitary sewer access structures shall be measured separately as units of each of the various types and sizes of each installed at the various depths. The depths of installation shall be measured in feet from the invert of the lowest outlet pipe to the bottom of the cast-iron sewer access structure frame.

The contract price shall include furnishing all materials necessary to perform the work, including castings unless specified to include a salvaged casting; excavation; installation and removal of sheeting and bracing; disposal of surplus material from the excavation; backfilling the excavation and compaction of the backfill material; preparation of the foundation; construction of the structure,

including connections; cleaning out the structure; restoring the site; and all other work incidental to the installation of sanitary sewer access structures.

507.4(b) Storm Sewer Access Structures, Catchbasins and Inlets.

Storm sewer access structures, catchbasins and inlets shall be measured separately as units of each of the various types and sizes of each installed. Unless otherwise specified, thru sewer access structures shall be considered to be six (6) feet in length.

The contract price shall include furnishing all materials necessary to perform the work, including castings unless specified to include a salvaged casting; excavation; installation and removal of sheeting and bracing; removal of water from the excavation; disposal of surplus material from the excavation; backfilling the excavation; backfilling the excavation and compaction of the backfill material; preparation of the foundation; construction of the structure, reconnection of all existing pipes, connection of new pipes, including connections; cleaning out the structure; restoring the site; and all other work incidental to the installation of storm sewer access structures, catchbasins and inlets.

507.4(c) Internal Chimney Seals.

Internal Chimney Seals shall be measured as each unit installed.

The contract price shall include furnishing all materials, including required accessories, necessary to perform the work and work incidental to the installation of an internal chimney seal.

507.4(d) Sanitary Drop Inlets.

Outside drop inlets and inside drop inlets shall be measured by length in vertical feet of each inlet installed, measured from the invert of the entry tee to the springline of the sewer main.

The contract price shall include furnishing all materials, including required fittings and accessories, necessary to perform the work; concrete encasement required; cleaning out the inlet; and all other work incidental to the installation of outside drop inlets.

507.4(e) Sewer Taps.

Sanitary Sewer Taps and Storm Sewer Taps shall be measured as a completed unit as installed in the field.

507.4(f) Sanitary Sewer Cleanouts.

Sanitary sewer cleanouts shall be measured as a completed unit as installed in the field.

ARTICLE 508 - UTILITY CROSSINGS

508.1 Description.

508.1(a) Utility Line Opening.

Utility Line Opening, ULO, shall include all work, materials, coordination, equipment, and incidentals required to locate and expose an existing utility at the location indicated on the plan and as directed in the field using open cut methods or vacuum technology.

1. Open Cut Methods

   A single ULO shall include a trench up to a maximum of five (5) feet long, as measured at the trench bottom, and of any depth required to locate the intended utility. Multiple utilities may be uncovered with no additional compensation.

2. Vacuum Technology

   A single ULO shall include the use of vacuum excavation investigation technology to locate the marked utility at its proposed / existing crossing with the City of Madison utility. Should the number of vacuum excavations exceed five (5) and the utility is still not located, a second ULO shall be paid by the City. Multiple utilities may be uncovered with no additional compensation.

The Engineer or his/her agent shall be notified of this work so that they may be present when the utility is exposed. The grades of the utility lines shall be determined by the Engineer, and the utility companies will be advised by the Engineer as to their adjustment required. The Contractor shall then backfill and maintain the openings. This work shall be completed a minimum of three (3) days prior to any work being anticipated in the immediate area of the ULO, to allow sufficient time for redesign of the affected utility if so required.

Work necessary to expose existing underground facilities that are part of the Contractor's statutory obligation during the normal storm sewer, sanitary sewer, electrical conduit or water main installation shall be considered as incidental to those respective items and will not be paid for as utility line openings.

Work to restore the site after completion of the ULO shall be the responsibility of the Contractor and is included in the price of this item.

The standard for restoration will vary project by project and be dependent on the relative time during the project that the ULO is completed. Regardless, it is the Contractor's responsibility to restore the ULO site to a safe condition commensurate with the condition of the construction site at the time the ULO is completed.

508.1(b) Concrete Supports.

Whenever shown on the plans, or directed by the Engineer, the Contractor shall install pipe supports in accordance with the Standard Detail Drawing 5.8.1, Concrete Supports. Pipe supports shall be installed under a new sewer pipe when such sewer pipe crosses over an existing utility line within twelve (12) inches.

508.1(c) Reinforced Concrete Beam Support.

Whenever shown on the plans, or directed by the Engineer, the Contractor shall install a utility line support, in accordance with the Standard Detail Drawing 5.8.2, Reinforced Concrete Beam Support. A beam support shall be installed under an existing utility line when a new sewer installation crosses under such utility line and the existing utility line is considered to be in danger of damage or failure.

508.1(d) Encasement.

Whenever shown on the plans, or directed by the Engineer, sewer pipes shall be concrete encased so that a thickness of six (6) inches of concrete surrounds the entire pipe, and the base width of the encasement is twelve (12) inches plus the outside diameter of the pipe from the earth foundation to the spring line of the pipe. The bottom of the encasement shall be a flat surface parallel to the grade of the sewer. The concrete used for encasement shall have a minimum compressive strength of 2,000 psi.

508.1(e) Utility Crossing.

When reviewing utility information for conflicts with proposed storm sewer, the design engineer will determine if there is sufficient clearance for the carrier pipe and the outside wall thickness excluding the bell. As the design engineer cannot be responsible for bell locations on the pipe run, adjustment of the pipe sections to avoid bells at the utility crossing shall be the responsibility of the Contractor. No additional compensation shall be provided to the Contractor for this adjustment and all necessary work to achieve this result shall be considered to be incidental to the Utility Line Opening.

508.2 Measurement and Payment.

508.2(a) Utility Line Openings.

A single ULO by open cut methods shall include a trench up to a maximum of five (5) feet long, as measured at the trench bottom, and of any depth required to locate the intended utility and may uncover multiple utilities. A single ULO by Vacuum Technology shall include up to five (5) vacuum excavations of any depth required to locate the intended utility and may uncover multiple utilities. The Contractor shall not be compensated more than once for a single utility line opening which uncovers multiple utilities provided the utilities are within the five (5) foot trench length as measured at the trench bottom or within five (5) vacuum excavations. The contract price shall include all work, materials, coordination, equipment, and incidentals required to locate and expose the utility at the location indicated on the plan and as directed in the field using open cut methods, backfill the excavation, compact the backfill material, restore and maintain the site as needed.

Where utility line openings are not listed as an item on which to submit unit prices, it shall be understood and agreed that the Contractor shall be paid three hundred dollars ($300.00) up to six (6) feet in depth and ($500) over six (6) feet in depth for each unit excavated and backfilled in accordance with these Specifications.

508.2(b) Concrete Supports.

Concrete supports shall be measured as a unit for support of the sewer pipe.

The contract price shall include furnishing all materials necessary to perform the work; excavation and disposal of surplus material from the excavation; constructing the pipe supports; and all other work incidental to the installation of pipe supports.

508.2(c) Reinforced Concrete Beam Support.

Reinforced concrete beam support shall be measured as each support installed.

The contract price shall include furnishing all materials necessary to perform the work; excavation and disposal of surplus material from the excavation; and all other work incidental to the installation of a reinforced concrete beam utility line support.

ARTICLE 509 - CURED-IN-PLACE PIPE (CIPP) REHABILITATION OF SANITARY SEWERS

509.1 Description.

The work under this section provides for the trenchless rehabilitation of sanitary sewers by the installation of a Cured-in-Place Pipe (CIPP) within the existing, deteriorated pipe. The rehabilitation of the sanitary sewer main shall be done by the installation of a resin-impregnated flexible fabric tube which, when cured, shall be continuous and tight-fitting throughout the entire length of the original pipe and provide a structurally sound, jointless and water-tight new pipe within a pipe.

All live service connections shall be reinstated without excavation, utilizing a remote controlled cutting device, monitored by a video TV camera. Reinstated service connections shall be tested and sealed with a chemical grout designed to eliminate infiltration.

509.2 Referenced Documents.

This specification references ASTM standards and other related standards, which are made a part hereof by reference and shall be the ***latest edition*** thereof.

ASTM Standard F 1216	Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
ASTM Standard F 1743	Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and Inflate and Curing of a Resin-Impregnated Tube
ASTM Standard F 2019	Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM Standard D 543	Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM Standard D 638	Test Method for Tensile Properties of Plastics
ASTM Standard D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM Standard D 903	Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM Standard D 1600	Terminology for Abbreviated Terms Relating to Plastics
ASTM Standard D 3567	Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D 3839	Guide for Underground Installation of “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe
ASTM Standard D 5813	Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
ASTM Standard E 797	Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method
ASTM Standard F 412	Terminology Relating to Plastic Piping Systems
	National Association of Sewer Service Companies (NASSCO) "Recommended Specifications for Sewer Collection Rehabilitation"

509.3 Submittals.

The Contractor shall not install materials or equipment, which requires submittals, until reviewed by the Engineer. The Engineer’s review will be completed as quickly as possible, but may require up to ten (10) working days from the date the submittals are received until they are sent to the Contractor.

The Contractor shall submit the following materials to the Engineer:

509.3(a) Product Data.

1. Manufacturer's product literature and application, installation and recommended repair (patching) requirements for materials used in liner.

2. Manufacturer's product certification of conformance to ASTM Standards for materials used in liner.

3. Manufacturer's Wet Out Report including raw resin data for each liner to be installed and the Manufacturer's recommended curing procedure.

4. Two (2) copies of Liner Pipe Thickness Design Calculations. The design calculations shall be in accordance with Appendix X.I of ASTM F 1216. The liner thickness calculations shall assume the physical properties stated in Section 509.5(d) of these specifications. Proposed CIPP flow capacity calculations.

5. Test results from previous field installations of the same resin system and tube materials as proposed for the actual installation.

No liner will be approved for installation until the City has returned one (1) set of approved design calculations to the Contractor.

Compensation for all work required for the submittal of product data shall be considered incidental to the project.

509.3(b) Digital Video.

1. Submit digital video of cleaned pipes in pre-lining condition.
2. Submit digital video of pipes in post-lining condition showing reinstated and grouted service connections.

509.3(c) Sewage Bypassing Plan.

Submit proposed plan for bypassing sanitary sewage during liner installation. Plan shall be to scale and shall show location of existing City sewer access structures.

509.3(d) Traffic Control Plan.

Submit proposed plan for Traffic Control during liner installation. Plan shall be to scale, shall show location of existing City sewer access structures, and be in accordance to the Contract document requirements.

509.3(e) Public Notifications.

Submit proposed public notification letter and door hangers. Notifications shall be in accordance to Section 509.4(e) Public Notification.

509.4 Requirements of Contractor.

509.4(a) Safety.

The Contractor agrees to perform all work under this contract in accordance with local, state and federal safety regulations. This includes, but is not limited to, evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen prior to entering access areas such as sewer access structures and performing inspection or cleaning operations and the use of confined entry equipment for all entries.

509.4(b) Bypassing Pumping.

The Contractor shall provide for the continuous flow of sewage around the sections of sewer line designated for lining. A bypass shall be installed by plugging the line at an existing upstream sewer access structure and pumping or directing the flow to a downstream sewer access structure. The pump(s) and bypass lines shall be of adequate capacity and size to handle the flow. Raw sewage shall be routed back to the sanitary sewerage system or hauled and disposed of as approved by the City.

Bypass pumping shall be limited to the regular hours of work as provided by the City unless necessitated by an emergency beyond the Contractor's control. A representative of the Contractor must be on-site at all times that bypass pumping is in operation.

If the Contractor elects to use bypass pumping as a means of sewerage control, the methods, equipment, type of hose, etc., shall be subject to approval by the City Engineer. Hoses crossing streets, driveways, parking areas, etc., are to be ramped over to prevent damage to the hoses.

No spillage of wastewater to adjacent streets, lawns, etc., shall be tolerated. If any such spillage should occur, all construction operations shall cease and cleanup shall commence immediately and be completed to the satisfaction of the Engineer prior to the resumption of any construction operations.

Contractor shall familiarize himself with the City's sanitary sewerage facilities and develop an adequate bypassing plan. A written plan shall be submitted to the City Engineer for approval prior to the start of work.

509.4(c) Water for Cleaning and Inversion/Installation of CIPP.

The Contractor shall furnish water for cleaning and flushing the existing sewer pipe and for inversion and installation of the CIPP. Contractor shall obtain water from the City of Madison Water Utility. All hydrant use must be pre-approved by Madison Water Utility. Contractor shall obtain a permit from Madison Water Utility and shall properly utilize back-flow prevention and/or other hydrant access device supplied by and installed onto hydrant by Madison Water Utility. The Contractor shall pay all costs associated with coordinating and obtaining water for the cleaning, flushing and inversion operations, including the cost of any cold-weather insulation required at the hydrant access device.

509.4(d) Disposing of Debris.

Contractor shall be responsible for disposing of debris removed from sewers at a licensed disposal facility (i.e., Dane County Landfill or Madison Prairie Landfill). The Contractor shall pay all costs associated with the transport and disposal of such debris.

509.4(e) Public Notification.

Contractor shall make every effort to maintain service usage throughout the duration of the project. In the event that a service needs to be taken out of service, the maximum amount of time allowed for the service interruption shall be 8 hours for any property served by the sewer. The Contractor shall implement a public notification program that shall, at a minimum, require the Contractor to be responsible for contacting all tenants and owner of each home or business connected to the sanitary sewer and informing them of the work to be conducted and the date, time and length of service interruption.

The Contractor shall prepare and submit written notice describing the work to be performed for the Engineer to review. Upon acceptance by the Engineer, the notice shall be delivered to each home or business a minimum of seven (7) days prior to the beginning of work being conducted on the pipe section. Door hangers shall also be placed at effected properties between no later than 24 hours and no earlier than 72 hours prior to the sewer service interruption. All notices shall also contain a local (or toll free) telephone number of the Contractor that property owners can use to discuss the project or any problems that arise during installation of the liner. Contractor shall also arrange meetings with any occupants whose service cannot be reinstated within the time referenced in the written notice. Any related costs such as hotel expenses or residential bypass pumping are the responsibility of the Contractor.

The City shall provide the Contractor with names and addresses of effected property owners and tenants within the project limits.

509.5 Materials.

509.5(a) General Requirements.

The resins, fabric tube, tube coatings, or other materials shall produce CIPP that meets the requirements of these specifications.

All materials, shipped to the project site, shall be accompanied by test reports certifying that the material conforms to the ASTM standards listed herein. Each tube to be installed shall be accompanied by the manufacturer's Wet Out Report detailing the raw resin data and the recommended curing procedure. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, or ultra-violet (UV) degradation. All damaged materials shall be promptly removed from the project site at the Contractor's expense and disposed of in accordance with all current applicable agency regulations

509.5(b) Tube.

For Heat Cure CIPP systems, the tube material shall meet the requirements of ASTM F 1216 and ASTM D5813, or better. The tube shall consist of one or more layers of flexible needled felt or an

equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube shall be compatible with the resin system used. The material shall be able to stretch to fit irregular pipe sections and negotiate bends. The outside layer of the tube shall be plastic coated with a material that is compatible with the resin system used. The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. Allowance shall be made for circumferential stretching during inversion.

Seams in the tube shall be stronger than the non-seamed material.

For Ultraviolet Light Cure CIPP systems, the tube material shall be made of non corrosion material and shall be free from tears, holes, cuts, foreign materials and other surface defects. The fiberglass tube shall be constructed to withstand installation pressures as required by the Manufacturer's recommendations. The interior and exterior foil shall be styrene resistant along with the ability to protect and contain the resin within the liner, with the exterior foil being impermeable to light. The liner should be seamless and spirally wound in its cured state to ensure homogenous physical properties around the circumference of the cured liner. The nominal fiberglass tube wall thickness shall be constructed to the nearest 0.5 mm increment, rounded up from the design thickness for that section of installed CIPP. The fiberglass tube shall be manufactured to a size that when installed will tightly fit the internal circumference and the length of the original conduit. The tube shall be able to stretch to fit irregular pipe sections and negotiate bends.

For any tube installed, the wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

509.5(c) Resin.

For Heat Cured CIPP Systems, the resin system shall meet the structural and chemical resistance requirements of ASTM F 1216 and/or ASTM F 1743, or better. A general purpose, unsaturated, styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible with the inversion process shall be used. The resin must be able to cure in the presence of water and the initiation temperature for cure shall be less than 180°F (82.2°C).

For Ultraviolet Light Cure CIPP Systems, the resin used to impregnate the seamless fiberglass tube shall produce a cured liner pipe resistant to shrinkage, corrosion, and abrasion and shall have a proven resistance to municipal wastewater. The resin shall be a chemically resistant isophthalic based polyester thermoset resin and catalyst system, or epoxy resin and hardener that are compatible with the installation process. The resin should be able to cure with ultraviolet light. When properly cured the resin/liner system shall meet the structural and chemical resistance requirements of ASTM F 2019.

509.5(d) Structural Requirements: Cured-in-Place Pipe (CIPP).

The required structural CIPP wall thickness shall be in accordance with the Design Equations in Appendix XI of ASTM F 1216 and based on the following physical properties:

i) Existing pipe is a "fully deteriorated pipe"
ii) Minimum ovality of host pipe shall be 5%
iii) Enhancement factor (K) shall not be greater than 7.0

iv) Minimum design safety factor shall be 2.0
v) Flexural modulus of elasticity shall be reduced by 50% to account for long term.
vi) Creep retention factor 33%
vii) Minimum service life 50 years

The CIPP design shall assume no bonding to the original pipe wall.

The Contractor must have performed long-term testing for flexural creep of the CIPP material installed by his/her Company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D 790 testing) shall be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, shall be verified by this testing. Values in excess of 50% shall not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in Design.

The bond between the layers of the cured CIPP shall be strong and uniform. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence shall cause rejection of the work.

Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

The CIPP system shall have as a minimum the initial structural properties as listed below.

TABLE 4: Minimum Physical Properties

Property	**Test Method**	**Cured Composite** ***(min. per ASTM F1216)***	**Cured Composite** ***(400,000 psi Resin)***
Flexural Modulus	ASTM D-790	250,000 psi	400,000 psi
Flexural Strength	ASTM D-790	4,500 psi	4,500 psi

These physical strength properties shall be determined in accordance with Section 509.7.

509.5(e) Grout: Chemical Grout to Seal Service Connections.

The chemical grout shall be of a type, which has a documented record of satisfactory performance in sewer usage. All grouting materials shall be delivered to the job site in the original, labeled, and unopened containers.

The chemical grout(s) selected by the Contractor is/are subject to approval of the Engineer. Grouts shall be either 3M Scotch Seal #5619 Polyurethane, DeNeef Multigel Polyurethane, Avanti International AV118 Duriflex or approved equal.

509.5(f) Testing Requirements.

1. Chemical Resistance - The CIPP shall meet the chemical resistance requirements of ASTM F 1216. CIPP samples for testing shall be of the same tube and resin system as that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical-testing requirements.

2. Hydraulic Capacity - The Contractor shall provide calculations that demonstrate that the liner pipe shall have at least 100% of full flow capacity of the original pipe before rehabilitation in a full gravity flow condition. Calculated capacities may be derived using a commonly accepted roughness coefficient for the original pipe material. A typical roughness coefficient of the liner pipe shall be as verified by third party test data.

3. Field Samples - The Contractor shall submit test results from previous field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Table 1 of 509.5(d) have been achieved in previous field applications.

509.6 Construction Methods.

509.6(a) Cleaning of Sewer Lines.

It shall be the responsibility of the Contractor to completely clean each sanitary sewer prior to lining. The work shall consist of providing all labor, materials, power, utilities and equipment necessary to thoroughly clean identified sewers and restore them to 95% of their original carrying capacity.

Sewer cleaning shall be conducted in accordance with "Recommended Specifications for Sewer Collection Rehabilitation," published by the National Association of Sewer Service Companies (NASSCO). Cleaning Equipment is to be truck-mounted combination jetter/vaccum machines able to thoroughly remove dirt, grease, roots, encrustations, rocks, sand and other materials and thoroughly clean the sewer lines prior to installation of the pipe liner. The cleaning equipment shall move debris to the downstream manhole of the line being cleaned. All material resulting from the cleaning operation shall be removed by vacuum at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section shall not be permitted. If any debris is passed downstream, the Contractor shall clean the affected section(s) of sewer main at no additional cost to the City.

It shall be the responsibility of the Contractor to clear the line of all obstructions such as solids or roots that can be removed by conventional sewer cleaning equipment. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, the Contractor shall immediately notify the Project Engineer. The Project Engineer shall determine if the obstruction is able to be removed by sewer cleaning equipment and, if not, if the particular section of main shall be repaired by the City or deleted from the contract. In the event the Engineer determines that a repair shall be made the contractor shall proceed with work on other sections of main and return to the obstructed main after the City has completed necessary repair(s). No additional compensation shall be made to the Contractor as a result of any delays necessitated by such repairs.

509.6(b) Inspecting and Televising Pipelines.

It is the responsibility of the Contractor to inspect all sanitary sewers to be lined using closed-circuit television prior to installation of the CIPP and again following the reinstatement and grouting of all service connections. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection. The interior of the pipeline shall be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and significant reductions in the cross sectional area. The Contractor shall immediately notify the Project Engineer of any conditions that prevent the proper installation of the CIPP.

The Contractor shall utilize a closed-circuit television video system that is capable of capturing, producing and recording color digital video of the sewer inspection. The Contractor shall provide color digital video for each sanitary sewer segment designated by the project plans. The video system shall have the capability of capturing or transferring the color video to an MPEG digital format compatible with personal computers.

All inspections shall follow the Pipeline Assessment and Certification Program (PACP) protocol as established by the National Association of Sewer Service Companies (NASSCO). The inspecting, televising and video recording equipment used on the project shall be the Contractor's choice provided it meets the following minimum requirements:

- The camera, transporter and winch system shall have the ability to continuously inspect and televise at least 600 linear feet of pipe. The inspecting, televising and video recording equipment shall be mounted in a self-propelled van or truck that is capable of moving from location to location. The van or truck shall have markings painted on it indicating the name of the Contractor.

- The camera head shall have pan and tilt capabilities in order to examine pipe defects. The camera shall have an adequate lighting system that clearly illuminates the entire circumference of the pipe segment under inspection. The equipment shall have hardware and software that is compatible with the camera and capable of electronically recording and saving pipe inspection information with software that follows NASSCO PACP inspection protocol.

A digital video and corresponding log (hard copy and electronic format compatible with other NASSCO PACP certified software) of the conditions present in the pipe sections before installation of the liner shall be made and kept for later reference and delivery to the City.

Each digital video segment shall be named according to the “upstream structure number–downstream structure number.mpg” format. The digital video shall document in a clear and continuous manner the condition of the sewer segment from the upstream structure to the downstream structure. No interruptions or missing segments shall be allowed unless noted in writing by the City's Project Engineer. The City will reject any digital video that has foggy or static conditions on it. The video shall display on a continuous basis the sanitary sewer pipe footage, continuous video footage along total length, street or address of the sewer segment, the upstream and downstream manhole number for the sewer segment being televised, the sewer pipe diameter and the date of the televising.

509.6(c) Installation.

The CIPP installation shall be in accordance with ASTM F 1216 for Heat Cure CIPP systems. Ultraviolet Light Cured systems shall be installed in according to the manufacturer's specifications and applicable ASTM F 2019 standards.

1. Resin Impregnation.

A certified Wet Out Report shall be completed, signed, and submitted for each liner delivered to the site. The Wet Out Report shall include, but is not limited to, wet-out date, resin identification, resin weight, resin admixtures, fabric tube length, diameter, and thickness.

For Heat Cure CIPP systems, the tube shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the tube material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin volume compared to the volume of the felt to compensate for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

For Ultraviolet Light Cure CIPP systems, the (wet-out) fiberglass tube shall meet ASTM F 2019 as applicable, and shall have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

2. Tube Insertion.

The wet out tube shall be positioned in the pipeline using either inversion (ASTM F 1216) or a pull-in method (ASTM F 1743), Ultraviolet Light Cure CIPP systems must use a pull-in method (ASTM F 1743). If pulled into place, a power winch shall be utilized and care shall be exercised not to damage the tube as a result of pull-in friction. The tube shall be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

A. Inversion (ASTM F 1216)

1. Using Hydrostatic Head - The wet-out tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole or termination point. The tube shall be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, the tube shall be turned inside out and attached to the standpipe so that a leakproof seal is created. The inversion head shall be adjusted to be of sufficient height to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections. Care shall be taken during the inversion so as not to over-stress the felt fiber.

2. Using Air Pressure - The wet-out tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of air pressure sufficient to fully extend it to the next designated manhole or termination point. The tube shall be connected by an attachment at the upper end of the guide chute so that a leakproof seal is created and with the impermeable plastic membranes

side out. As the tube enters the guide chute, the tube shall be turned inside out. The inversion air pressure shall be adjusted to be of sufficient pressure to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections. Care shall be taken during the inversion so as not to overstress the woven and nonwoven materials.

3. Required Pressures - Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube. Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed.

B. Pull-in Method (ASTM F 1743)

1. Perforation of Resin-Impregnated Tube—Prior to pulling the resin-impregnated fabric tube in place, the outer impermeable plastic coating may optionally be perforated. When the resin-impregnated fabric tube is perforated, this shall allow resin to be forced through the perforations and out against the existing conduit by the force of the hydrostatic head or air pressure against the inner wall of the calibration hose.

The perforation shall be done after fabric tube impregnation with a perforating roller device at the point of manufacture or at the jobsite. Perforations shall be made on both sides of the lay-flat fabric tube covering the full circumference with a spacing no less than 1.5 in. (38.1 mm) apart. Perforating slits shall be a minimum of 0.25 in. (6.4 mm) long.

2. Pulling Resin-Impregnated Tube into Position—The wet-out fabric tube shall be pulled into place using a power winch. The saturated fabric tube shall be pulled through an existing manhole or other approved access to fully extend to the next designated manhole or termination point. Care shall be exercised not to damage the tube as a result of friction during pull-in, especially where curvilinear alignments, multilinear alignments, multiple offsets, protruding services, and other friction-producing host pipe conditions are present. Once the fabric tube is in place, it shall be attached to a vertical standpipe so that the calibration hose can invert into the center of the resin-impregnated fabric tube. The vertical standpipe shall be of sufficient height of water head to hold the fabric tube tight to the existing pipe wall, producing dimples at side connections. A device such as a dynamometer or load cell shall be provided on the winch or cable to monitor the pulling force. Measure the overall elongation of the fabric tube after pull-in completion. The acceptable longitudinal elongation shall not be more than 5 % of the overall length measured after the calibration hose has been installed, or exceed the recommended pulling force.

C. Lubricant During Installation

The use of a lubricant during installation is recommended to reduce friction during inversion. This lubricant shall be poured into the fluid in the standpipe in order to coat the calibration hose during inversion. When air is used to invert the calibration hose, the lubricant shall be applied directly to the calibration hose. The lubricant used shall be a nontoxic, oil-based product that has no detrimental

effects on the tube or boiler and pump system, and will not adversely affect the fluid to be transported.

3. Curing.

For Heat Cure CIPP systems, curing shall be accomplished by utilizing circulating heated water or steam under hydrostatic pressure in accordance with ASTM F 1216 and the manufacturer's recommended cure schedule. For Ultraviolet Light Cure CIPP systems, curing shall be accomplished by utilizing air pressure and ultraviolet light in accordance with ASTM F 2019 and the manufacturer's recommended cure schedule.

A. Curing Method

1. Circulating Heated Water

After inversion is completed, a suitable heat source and water recirculation equipment are required to circulate heated water throughout the pipe. The equipment shall be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin. Water temperature in the line during the cure period shall be as recommended by the resin manufacturer.

The heat source shall be fitted with suitable monitors to gage the temperature of the incoming and outgoing water supply. Another such gage shall be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure.

2. Using Steam

After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe. The equipment shall be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin. The temperature in the line during the cure period shall be as recommended by the resin manufacturer.

The steam-generating equipment shall be fitted with a suitable monitor to gage the temperature of the outgoing steam. The temperature of the resin being cured shall be monitored by placing gages between the impregnated tube and the existing pipe at both ends to determine the temperature during cure.

Steam curing systems shall include an elevated steam discharge. The City of Madison Construction Inspector shall monitor and record styrene levels at this point for each liner curing. At direction of the Construction Inspector any steam condensate or styrene residue shall be cleaned and disposed at the Contractor's expense.

3. Using Ultraviolet Light

After inversion is completed, the fiberglass liner shall be cured with ultraviolet light sources at a constant inner pressure. The ultraviolet light sources shall be assembled according to the Manufacturer's specifications for the liner. The defined parameters

for curing speed, inner air pressure, exothermic temperatures, and wattage are to be controlled, measured, and documented during the entire curing process to be submitted to the Engineer with the post CCTV inspection. The inner film material should be removed and discarded after curing to provide optimal quality of the final product.

B. Initial Cure

Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature shall be raised to post-cure temperatures recommended by the resin manufacturer. The post-cure temperature shall be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the boiler or distribution and control of steam to maintain the temperature continues. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

C. Required Pressure

The estimated maximum and minimum pressure required to hold the flexible tube tight against the existing conduit during the curing process shall be provided by the manufacturer and shall be increased to include consideration of the external ground water, if present. Once the cure has started and dimpling for laterals is completed, the required pressures shall be maintained until the cure has been completed. The pressure shall be maintained within the estimated maximum and minimum pressure during the curing process. If the steam pressure or hydrostatic head drops below the recommended minimum during the cure, the CIPP shall be inspected for lifts or delaminations and evaluated for its ability to fully meet the applicable requirements of these specifications and ASTM F 1216 or ASTM F 2019.

D. Cool-Down

1. Using Cool Water After Heated Water Cure—The new pipe shall be cooled to a temperature below 100°F (38°C) before relieving the static head in the inversion standpipe. Cool-down may be accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed pipe.

2. Using Cool Water After Steam Cure— The new pipe shall be cooled to a temperature below 113°F (45°C) before relieving the internal pressure within the section. Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end. Care shall be taken in the release of the air pressure so that a vacuum will not be developed that could damage the newly installed pipe.

4. Sealing Liner at Sewer Access Structures.

The Contractor shall provide a watertight seal between the host pipe and liner pipe at the connection to the sewer access structure. Seals shall be made with an epoxy or resin mixture compatible with the liner/resin system. Hydraulic cements and quick-set cement products are not acceptable.

The Contractor shall reconstruct benches and channels in manholes with grout to match new invert elevations.

5. Reinstatement of Service Connections.

The Contractor shall be responsible for confirming the locations of all service connections prior to installing and curing the CIPP. All service connection shall be reconnected unless otherwise directed by the Engineer. Service connections shall not be out of service for more than 8 hours during the lining process.

The Contractor shall reinstate all service connections to buildings without excavation, utilizing a remote controlled cutting device, monitored by a video TV camera. The Contractor shall certify he/she has a minimum of 2 complete working cutters plus spare key components on the site before each inversion. The operator of the remote controlled cutting device shall have at least 2 years experience with such equipment.

Service connections shall be reestablished to a minimum of 95% of the flow capacity. Any service connection opened to greater than 100% of its original diameter shall have a “Top Hat” system installed at the Contractor’s Expense. The “Top Hat” type liner shall be Amerik Supplies, Inc. Top Hat, or equal. The Top Hat must extend at least 18-inches into lateral and create at least a 3-inch brim molded flat against lined mainline pipe with a Manufacturer approved adhesive to ensure a tight bond against the CIPP.

Liner shall be sufficiently tight so that there is no annular space between the connection and the liner.

No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

6. Chemical Grouting of Service Connections.

The intent of lateral connection sealing is to test and seal sewer lateral connections using a specialized chemical grout packer. The purpose of this procedure is the elimination of infiltration into sewers that are otherwise structurally sound.

The Contractor shall proof test each reinstated service connection via an air test or other approved method. Service connections shall be air tested by isolating the area to be tested with the packer and applying positive pressure into the isolated “void” area. A sensing unit shall be used for continuous monitoring of the “void” pressure. This sensing unit shall be located within the “void” area and accurately transmit pressure readout to the control panel. The test procedure shall consist of applying air pressure into each isolated VOID area. To isolate a VOID, the lateral sealing packer shall be positioned straddling the service connection. The operator shall inflate the packer ends to isolate the service connection and insert an inflatable inversion tube. The service connection shall be tested with a gauge pressure of one-half (1/2) psi per foot of depth of sewer or a minimum of four (4) psi,

whichever is larger. The VOID pressure shall be observed during this test for a minimum of 10 seconds. If the VOID pressure drop is greater than 1 psi in 10 seconds, the service connection is considered to have failed the air test. If no pressure can be built up, the connection will also have failed the test. Any connection failing the test shall be sealed and retested utilizing the same method and procedures until it does pass the test. The cost of retesting lateral connections shall be considered incidental and included in the cost of sealing sanitary sewer lateral connection.

Active leaks at reinstated service connections and reinstated connections that do not pass a proof test shall be sealed by chemical grout or other method approved by the Engineer. Seals shall extend from sanitary sewer main into the service connection for a minimum of 18 inches. Grout shall be 3M Scotch Seal #5619 Polyurethane, DeNeef Multigel Polyurethane and Avanti International AV118 Duriflex or equal.

509.7 Inspection and Testing.

509.7(a) CIPP Samples.

The Contractor shall furnish all samples for product testing to the Project Engineer. The Project Engineer shall take possession of the samples for testing and shall maintain the chain of custody, deliver the samples to an approved laboratory and pay for all material and product testing performed under this contract.

The samples shall be prepared and physical properties tested in accordance with ASTM F 1216. The flexural properties must meet or exceed the values listed in Table 1, Section 509.5(d).

For each inversion length, the preparation of two CIPP samples is required, one from each of the following two methods:

1. The sample shall be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.

2. The sample shall be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the downtube when circulating heated water is used and in the silencer when steam is used.

Each sample shall be large enough to provide five specimens for flexural testing and tensile testing.

The following test procedures shall be followed after the sample is cured and removed.

Short-Term Flexural (Bending) Properties - The initial tangent flexural modulus of elasticity and flexural stress shall be measured for gravity and pressure pipe applications in accordance with Test Methods D 790 and shall meet the requirements of Table 1, Section 509.5(d).

Tensile Properties - The tensile strength shall be measured for pressure pipe applications in accordance with Test Method D 638 and must meet the requirements of Table 1, Section 509.5(d).

Gravity Pipe Leakage Testing - Gravity pipes shall be tested using an exfiltration test method where the CIPP is plugged at both ends and filled with water. This test shall take place after the CIPP has cooled down to ambient temperature. This test is limited to pipe lengths with no service laterals and

diameters of 36 in. or less. The allowable water exfiltration for any length of pipe between termination points shall not exceed 50 U.S. gallons per inch of internal pipe diameter per mile per day, providing that all air has been bled from the line. During exfiltration testing, the maximum internal pipe pressure at the lowest end shall not exceed 10 ft (3.0 m) of water or 4.3 psi (29.7 kPA) and the water level inside of the inversion standpipe shall be 2 ft (0.6 m) higher than the top of the pipe or 2 ft higher than the groundwater level, whichever is greater. The leakage quantity shall be gaged by the water level in a temporary standpipe placed in the upstream plug. The test shall be conducted for a minimum of one hour.

Delamination Test - If required by the owner in the contract documents or purchase order, a delamination test shall be performed on each inversion length specified. The CIPP samples shall be prepared in accordance with 509.7(a)2, except that a portion of the tube material in the sample shall be dry and isolated from the resin in order to separate tube layers for testing. Delamination testing shall be in accordance with Test Method D 903, with the following exceptions:

1. The rate of travel of the power-actuated grip shall be 1 in. (25 mm)/min.

2. Five test specimens shall be tested for each inversion specified.

3. The thickness of the test specimen shall be minimized, but shall be sufficient to adequately test delamination of nonhomogeneous CIPP layers.

4. The peel or stripping strength between any nonhomogeneous layers of the CIPP laminate shall be a minimum of 10 lb/in. (178.60 g/mm) of width for typical CIPP applications.

CIPP Wall Thickness - The method of obtaining CIPP wall thickness measurements shall be determined in a manner consistent with 8.1.2 of Specification D 5813. Thickness measurements shall be made in accordance with Practice D 3567 for samples prepared in accordance with 509.7(a)2. Make a minimum of eight measurements at evenly spaced intervals around the circumference of the pipe to ensure that minimum and maximum thicknesses have been determined. Deduct from the measured values the thickness of any plastic coatings or CIPP layers not included in the structural design of the CIPP.

The average thickness shall be calculated using all measured values and shall meet or exceed minimum design thickness as agreed upon between purchaser and seller. If the average thickness does not meet or exceed the minimum design thickness but is still determined to be acceptable, the bid item payment may be reduced by the percentage difference in thickness for the subject lining segment. The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness as agreed upon between purchase and seller.

An alternative method for measuring the wall thickness may be performed within the installed CIPP at either end of the pipe by the ultrasonic pulse echo method as described in Practice E 797. A minimum of eight (8) evenly spaced measurements shall be made around the internal circumference of the installed CIPP within the host pipe at a distance of 12 to 18 in. from the end of the pipe. For pipe diameters of fifteen (15) in. or greater, a minimum of sixteen (16) evenly spaced measurements shall be recorded. The ultrasonic method to be used is the flaw detector with A-scan display and direct thickness readout as defined in 6.1.2 of E 797. A calibration block shall be manufactured from the identical materials used in the installed CIPP to calibrate sound velocity through the liner.

Calibration of the transducer shall be performed daily in accordance with the equipment manufacturer's recommendations. The average thickness shall be calculated using all measured values and shall meet or exceed minimum design thickness as agreed upon between purchaser and seller. The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness.

CCTV Inspection and Acceptance - The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, after installation of the CIPP liner and reconnection and grouting of the service connections. The camera shall be panned 360 degrees around the circumference of the pipe and along the wall of the finished pipe at 10 foot intervals. The finished liner shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks and other defects. Unedited digital documentation of the inspection shall be provided to the Owner within ten (10) working days of the liner installation. The data shall note the inspection date, location of all reconnected service connections, debris, as well as any other defects in the liner, including, but not limited to, gouges, cracks, bumps, or bulges. If post installation inspection documentation is not submitted within ten (10) working days of the liner installation, the City may at its discretion suspend any further installation of CIPP until the post installation documentation is submitted. As a result of this suspension, no additional working days will be added to the contract, nor will any adjustment be made for increase in cost. Immediately prior to conducting the closed circuit television inspection, the Contractor shall thoroughly clean the newly installed liner removing all debris and buildup that may have accumulated.

The installation shall be inspected by closed-circuit television No infiltration of groundwater shall be observed. All live service entrances shall be accounted for and be unobstructed. CCTV inspection of the CIPP liner shall be in accordance with ASTM F 1216 and Section 509.6(b).

If the Engineer's review of the final CCTV submittal identifies repairable defects, the Contractor may be requested to submit a manufacturer reviewed/approved repair plan rather than reinstalling the entire defective CIPP. Any such repairs shall include an extended warranty by the Contractor for one (1) additional year from the expiration of the Contract warranty.

The following repair methods for common defects are considered acceptable:

- Defect: Wrinkles/ridges exceeding 5% of pipe diameter outside of 120-degree invert arc – OR – wrinkles/ridges exceeding 2% of pipe diameter inside of the 120-degree invert arc.
  - Repair: Grind to within required tolerance, coat ground area with manufacturer's approved resin. Point repair may be required if minimum thickness is affected by repair.
  - Rejection Criteria: The Engineer may reject the work if wrinkles or ridges exceed 10% of pipe diameter.
- Defect: Holes, tears, soft spots, lifts, delamination, blisters/bubbles.
  - Repair: Point repairs under manufacturer's approved recommendations.
  - Rejection Criteria: If defective areas cover greater than 5% of the surface area the Engineer reserves the right to reject the work.
- Defect: CIPP thickness less than calculated minimum thickness.
  - Repair: If the Engineer determines that the CIPP is acceptable, payment may be reduced by the percentage below the design minimum thickness. In some cases, a second CIPP within the first may be allowed.
  - Rejection Criteria: If the actual thickness is less than 87.5% of the design minimum thickness, the Engineer reserves the right to reject the work.

- Defect: Service reinstated to greater than 100% of original flow capacity.
  - Repair: A "Top Hat" system must be installed at the Contractor's Expense. The "Top Hat" type liner shall be Amerik Supplies, Inc. Top Hat, or equal. The Top Hat must extend at least 18-inches into lateral and create at least a 3-inch brim molded flat against lined mainline pipe with a Manufacturer approved adhesive to ensure a tight bond against the CIPP.
  - Rejection Criteria: The Engineer reserves the right to reject any improperly installed Top Hat repairs.

Additional defects may be identified, and will be handled on a case-by-case basis.

509.8 Measurement and Payment.

509.5.1 Bid Item 50901 - Furnish and Install CIPP to Rehabilitate 6-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing a cured-in-place pipe within various existing 6-inch diameter clay sewers located throughout the City of Madison. All equipment, tools, labor, materials, and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor and materials referenced in these specifications; mobilizing and preparing site; televising existing sanitary sewer main before and after liner installation; cleaning existing sewer main prior to lining; placing cured-in-place-pipe; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning the site and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.2 Bid Item 50902 - Furnish and Install CIPP to Rehabilitate 8-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing a cured-in-place pipe within various existing 8-inch diameter clay sewers located throughout the City of Madison. All equipment, tools, labor, materials and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor and materials referenced in these specifications; mobilizing and preparing site; televising existing sanitary sewer main before and after liner installation; cleaning existing sewer main prior to lining; placing cured-in-place-pipe; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning the site and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.3 Bid Item 50903 - Furnish and Install CIPP to Rehabilitate 10-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing a cured-in-place pipe within various existing 10-inch diameter clay sewers located throughout the City of Madison. All equipment, tools, labor, materials, and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor and materials referenced in these specifications; mobilizing; preparing site; televising the existing sanitary sewer main before and after liner installation; cleaning the existing sewer main prior to lining; placing the CIPP; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing of liner material; cleaning operations and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.4 Bid Item 50904 - Furnish and Install CIPP to Rehabilitate 12-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing cured-in-place-pipe within various existing 12" clay sewers located throughout the City of Madison. All equipment, tools, labor, materials and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of the sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials referenced in these specifications; mobilizing; preparing the site; televising the existing sanitary sewer main before and after liner installation; cleaning the existing sewer main prior to lining; placing the CIPP; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning operations and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.5 Bid Item 50905 - Furnish and Install CIPP to Rehabilitate 15-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing cured-in-place-pipe within various existing 15" clay sewers located throughout the City of Madison. All equipment, tools, labor, materials and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of the sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials referenced in these specifications; mobilizing; preparing the site; televising the existing sanitary sewer main before and after liner installation; cleaning the existing sewer main prior to lining; placing the CIPP; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning operations and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.6 Bid Item 50906 - Furnish and Install CIPP to Rehabilitate 18-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing cured-in-place-pipe within various existing 18" clay sewers located throughout the City of Madison. All equipment, tools, labor, materials and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of the sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials referenced in these specifications; mobilizing; preparing the site; televising the existing sanitary sewer main before and after liner installation; cleaning the existing sewer main prior to lining; placing the CIPP; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning operations and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.7 Bid Item 50907 - Furnish and Install CIPP to Rehabilitate 21-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing cured-in-place-pipe within various existing 21" clay sewers located throughout the City of Madison. All equipment, tools, labor, materials and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of the sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials referenced in these specifications; mobilizing; preparing the site; televising the existing sanitary sewer main before and after liner installation; cleaning the existing sewer main prior to lining; placing the CIPP; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning operations and all other general

requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.8 Bid Item 50908 - Furnish and Install CIPP to Rehabilitate 24-Inch Diameter Sanitary Sewer Mains.

Description.

Work under this item shall include furnishing and installing cured-in-place-pipe within various existing 24" clay sewers located throughout the City of Madison. All equipment, tools, labor, materials and procedures shall conform to the requirements set forth in these specifications.

Method of Measurement.

This item shall be measured in units of linear feet for each section of sanitary sewer main successfully lined. The sanitary sewer main shall be measured on a straight horizontal line along the centerline of the sewer. The distance through sanitary access structures shall not be included in the measurement.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials referenced in these specifications; mobilizing; preparing the site; televising the existing sanitary sewer main before and after liner installation; cleaning the existing sewer main prior to lining; placing the CIPP; bypassing sanitary sewage around the section undergoing lining; controlling traffic to facilitate lining operations and/or sewage bypassing; testing liner material; cleaning operations and all other general requirements and incidental work pertaining to these specifications. NOTE: The reinstatement and reconnection of all wye openings in the existing sewer main is a separate bid and payment item.

509.5.9 Bid Item 50909 - Reinstate and Reconnect Service Openings.

Description.

Work under this item shall include reinstatement and reconnection of all service openings in the existing sewer main lined under this contract. Service connections to buildings shall be reopened by the Contractor without excavation, utilizing a remote controlled cutting device, monitored by a closed circuit television camera. Unless otherwise directed by the City, all openings in the main shall be reinstated.

No additional payment shall be made for excavations for the purpose of reopening connections and the Contractor shall be responsible for all costs and liability associated with such excavation and restoration work.

Method of Measurement.

This item shall be measured in units of each for each successfully reinstated and reconnected wye for liner installed in the existing sewer main.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials referenced in Section 500 of this specification and all other general requirements and incidental work pertaining to Section 500 of this specification. Please note that this includes proof testing of each service connection.

509.5.10 Bid Item 50910 - Chemical Grout Sealing of Sanitary Sewer Service Connections.

Description.

Work under this item shall include the testing and sealing of for all reinstated sanitary sewer service connections.

Method of Measurement.

This item shall be measured in units of each for each successfully tested and grouted and sealed service connection to the existing sewer main.

Basis of Payment.

The contract unit price shall include furnishing all equipment, tools, labor, and materials and all other general requirements and incidental work pertaining to the testing and sealing of each connection.