

TABLE OF CONTENTS

PART 00400 - DRAINAGE AND SEWERS

Section 00405 - Trench Excavation, Bedding and Backfill

00405.00	Scope.....	245
00405.01	General.....	245
00405.02	Definitions.....	245
00405.03	Lines, Grades, and Cross Sections.....	246
00405.10	General.....	246
00405.11	Trench Foundation.....	246
00405.12	Bedding.....	246
00405.13	Pipe Zone Material.....	246
00405.14	Trench Backfill.....	246
00405.15	Quality Control.....	247
00405.30	Quality Control Personnel.....	247
00405.40	General.....	247
00405.41	Trench Excavation.....	247
00405.42	Rock Excavation.....	248
00405.43	Dewatering.....	248
00405.44	Trench Foundation.....	248
00405.45	Pipe Bedding.....	249
00405.46	Backfilling.....	249
00405.48	Surface Removal.....	250
00405.80	Trench Excavation and Trench Backfill.....	251
00405.81	Saw Cutting.....	251
00405.82	Rock and Boulder Excavation.....	251
00405.83	Trench Protection.....	252
00405.84	Trench Foundation.....	252
00405.85	Pipe Bedding.....	252
00405.86	Pipe Zone Material.....	252
00405.87	Imported Topsoil.....	252
00405.90	General.....	252
00405.92	Incidental Basis.....	253

Section 00406 - Tunneling, Boring and Jacking

00406.00	Scope.....	254
00406.01	Descriptive Terms.....	254
00406.10	Pipe Bedding and Pipe Zone Material.....	254
00406.11	Pipe.....	254
00406.12	Casing.....	254
00406.13	Grout.....	254
00406.14	Sand.....	254
00406.40	Excavation.....	254
00406.41	Required Submittals.....	255
00406.42	Tunneling.....	255
00406.43	Boring and Jacking.....	255
00406.44	Concrete Pipe.....	255
00406.45	Smooth Steel Casing.....	256
00406.46	Grouting Voids Outside Casing.....	256
00406.47	Cradles for Cased or Tunneled Pipe.....	256
00406.48	Placing Fill in Casing.....	256

00406.49	Railroad Crossings.....	256
00406.80	Length Basis	256
00406.90	General	257

Section 00420 - Salvaging Pipe

00420.00	Scope.....	258
00420.10	General	258
00420.40	Trench Excavation	258
00420.41	Removal of Pipe.....	258
00420.42	Stockpiling.....	258
00420.43	Relaying.....	258
00420.80	General	258
00420.90	General	258

Section 00430 - Subsurface Drains

00430.00	Scope.....	260
00430.01	Descriptive Terms	260
00430.02	Contractor's Options	260
00430.03	Size Determination.....	260
00430.10	General	260
00430.11	Granular Drain Backfill Material	260
00430.12	Reclaimed Glass.....	261
00430.40	General	261
00430.41	Foundations in Unyielding Material	261
00430.42	Laying Pipe	261
00430.43	Joining Pipe	261
00430.44	Contact Surfaces, Aluminum to Concrete	261
00430.45	Inspection.....	262
00430.46	Backfilling.....	262
00430.80	Trench Excavation and Backfill	262
00430.81	Geotextiles	262
00430.82	Installation Under Pavement.....	262
00430.83	Drain Pipe	262
00430.84	Special Sections	262
00430.85	Special Filter Material and Granular Drain Backfill Material	262
00430.86	Delineators.....	262
00430.87	Subsurface Drain Outlet.....	262
00430.90	Trench Excavation and Backfill	262
00430.91	Geotextile.....	262
00430.92	Installation Under Pavement.....	262
00430.93	Drain Pipe	262
00430.94	Special Filter Material and Granular Drain Backfill Material	263
00430.95	Delineators.....	263
00430.96	Subsurface Drain Outlet.....	263

Section 00435 - Wick Drains

00435.00	Scope.....	264
00435.10	General	264
00435.11	Core	264
00435.12	Jacket	264
00435.13	Assembled Drain.....	264
00435.14	Acceptance Requirements	265
00435.20	General	265
00435.40	Wick Drain Installation Requirements	265

00435.41	Splicing	266
00435.80	Length Basis	267
00435.90	Length Basis	267

Section 00440 - Commercial Grade Concrete

00440.00	Scope.....	268
00440.10	General	268
00440.11	Proportioning of CGC Mixture	268
00440.12	Tolerance and Limits of CGC Mixtures	268
00440.13	Field-Mixed Concrete	268
00440.14	Acceptance Sampling and Testing.....	268
00440.15	Quality Control	269
00440.30	Quality Control Personnel	269
00440.40	General	269
00440.41	General Surface Finish	270
00440.42	Replacement or Price Reduction	270
00440.80	Measurement.....	270
00440.90	Payment.....	270

Section 00442 - Controlled Low Strength Materials

00442.00	Scope.....	271
00442.01	Definition.....	271
00442.10	General	271
00442.11	Fine Aggregates.....	271
00442.12	Proportioning of CLSM Mixture	271
00442.13	Compressive Strength	271
00442.14	Acceptance	271
00442.80	General	271
00442.90	General	271

Section 00445 - Sanitary, Storm, Culvert, Siphon and Irrigation Pipe

00445.00	Scope.....	272
00445.01	Definitions and Descriptive Terms	272
00445.02	Contractor's Options	273
00445.03	Size Determination.....	273
00445.10	General	273
00445.11	Materials	273
00445.12	Asphalt Mastic.....	274
00445.15	Quality Control	274
00445.30	Quality Control Personnel	274
00445.40	General	274
00445.41	Installing Pipe under Railroad	275
00445.42	Laying Pipe	275
00445.43	Placing and Joining Pipe.....	275
00445.44	Strutting Metal Pipe.....	276
00445.45	Backfilling.....	276
00445.46	Concrete Blocks.....	277
00445.47	Contact Surfaces, Aluminum to Concrete	277
00445.48	Tracer Wire	277
00445.70	General	277
00445.71	Requirements Prior to Tests	277
00445.72	Pipe Testing	278
00445.73	Deflection Testing for Flexible Pipe.....	280
00445.74	Television Inspection of Sanitary and Storm Sewers	280
00445.75	Repairs.....	280

00445.80	General	280
00445.81	Pipes and Appurtenances	281
00445.84	Television Inspection	281
00445.85	Acceptance Testing	282
00445.86	Installation Under Pavement	282
00445.88	Installation Under Railroad	282
00445.90	General	282
00445.91	Pipes and Appurtenances	282
00445.94	Television Inspection	283
00445.95	Acceptance Testing	283
00445.96	Installation Under Pavement	283
00445.98	Installation Under Railroads	283
00445.99	Incidental Basis	284

Section 00450 - Structural Plate Pipe, Pipe Arch and Arch

00450.00	Scope	285
00450.01	Definitions	285
00450.10	General	285
00450.40	Trench Work	285
00450.41	Installation in Paved Areas	286
00450.42	Erection	286
00450.44	Arch Substructures and Headwalls	287
00450.45	Strutting	287
00450.46	Backfilling	287
00450.47	Footings and Headwalls	287
00450.48	Contact Surfaces, Aluminum to Concrete	287
00450.49	Work Quality	287
00450.80	Trench Work	288
00450.81	Installation Under Pavement	288
00450.82	Structures	288
00450.83	Reinforcement	288
00450.84	Concrete	288
00450.90	Trench Work	288
00450.91	Installation Under Pavement	288
00450.92	Structures	288
00450.93	Reinforcement	289
00450.94	Concrete	289

Section 00460 - Paved Culvert End Slopes

00460.00	Scope	290
00460.10	General	290
00460.40	General	290
00460.80	Area Basis	290
00460.90	Area Basis	290

Section 00470 - Manholes, Catch Basins and Inlets

00470.00	Scope	291
00470.01	Cast-in-Place and Precast Construction	291
00470.10	General	291
00470.11	Precast Concrete Manholes and Bases	291
00470.12	Cap Screws	292
00470.13	Inside Drop Manhole Connectors	292
00470.14	Pipe and Fittings	292
00470.15	Pipe Stubouts for Future Sanitary Sewer Connections	292
00470.16	Sanitary Sewer Manhole Carry-Through	292

00470.17	Sump Backfill	292
00470.18	Base Drain Backfill	292
00470.40	General	292
00470.41	Precast Concrete Manholes	293
00470.42	Precast Concrete Catch Basins and Inlets	293
00470.43	Cast-in-Place Concrete Construction	294
00470.45	Steps and Ladders	294
00470.46	Corrugated Pipe Slope Protectors	294
00470.48	Sump Backfill	294
00470.49	Concrete Inlet Base Drains	294
00470.70	Cleaning	294
00470.71	Sanitary Manhole Acceptance Testing	294
00470.80	General	296
00470.90	General	296

Section 00475 - Drain Wells

00475.00	Scope	297
00475.10	Well Casing	297
00475.40	General	297
00475.80	Drain Wells	297
00475.81	Extra for Drain Wells Deeper than 30 m (100 Feet)	297
00475.82	Steel Well Casing	297
00475.83	Testing Wells	297
00475.90	General	297
00475.91	Testing Wells	298

Section 00480 - Drainage Curbs

00480.00	Scope	299
00480.10	General	299
00480.11	Commercial Grade Concrete	299
00480.12	Asphalt Concrete	299
00480.40	Preparation of Base	299
00480.41	Bonding Material Application	299
00480.42	Commercial Grade Concrete Curbs	300
00480.43	Asphalt Concrete Curbs	300
00480.44	Line and Grade	300
00480.80	Length Basis	300
00480.90	Length Basis	300

Section 00490 - Work on Existing Sewers and Structures

00490.00	Scope	301
00490.01	Descriptive Terms	301
00490.10	General	301
00490.11	High Early Strength Concrete	301
00490.40	General	301
00490.41	Manholes over Existing Sewers	302
00490.42	Service Line Connections to Existing Sanitary Sewers	303
00490.43	Abandoning Pipe in Place	303
00490.44	Filling Abandoned Pipes, Manholes and Catch Basins	303
00490.45	Salvaging Manhole Frames, Covers and Grates	303
00490.46	Adjusting Manholes	303
00490.47	Adjusting Catch Basins and Inlets	305
00490.48	Adjusting Boxes, Cleanout Lids and Similar Structures	306
00490.49	Finish Grade	306

00490.80	Unit Basis.....	306
00490.81	Incidental Basis.....	306
00490.90	Unit Basis.....	306

Section 00495 - Trench Resurfacing

00495.00	Scope.....	308
00495.10	General	308
00495.40	General	308
00495.80	Area Basis.....	309
00495.90	Trench Resurfacing.....	309
00495.92	Incidental Basis.....	309

PART 00400 - DRAINAGE AND SEWERS

Section 00405 - Trench Excavation, Bedding and Backfill

Description

00405.00 Scope - This work consists of excavating trenches, constructing trench foundations, and placing bedding, pipe zone material and backfill.

00405.01 General - Excavate, backfill and dispose of excess excavated materials in connection with minor structures and conduits such as subsurface drain, culvert, siphon, irrigation and sewer pipe of nominal inside diameters of 100 mm (4 inches) or greater but not exceeding 1800 mm (72 inches). Perform excavation for structures, and conduits with a nominal inside diameter or width greater than 1800 mm (72 inches) according to Section 00510.

Trench excavation does not include earthwork covered under any other section, or any earthwork that may be specifically included and provided for as Incidental work in the Specifications for other pay items of the Contract. Dispose of excess excavated materials and perform other matters not covered in this Section according to Section 00330.

00405.02 Definitions:

Boulder Excavation - The removal, without drilling, blasting or splitting, of masses of rock having one or more dimensions of 1 m (3 feet) or greater.

Common Excavation - The removal of all material not classified as rock excavation.

Flexible Pipe - For the purpose of these Specifications, potable water pipes and pipes constructed of corrugated metal, PVC, and polyethylene are considered flexible pipes.

Pipe Bedding - Furnishing, placing and compacting specified materials on the trench foundation so as to uniformly support the barrel of the pipe to the springline.

Pipe Zone - The area from the top of the bedding to a point 200 mm (8 inches), minimum, above the top outside of the pipe barrel for the full width of the trench.

Rigid Pipe - For the purpose of these Specifications, pipes constructed of concrete and ductile iron are considered rigid pipes.

Rock Excavation - Excavation of solid ledge rock that, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging, barring or breaking up with power-operated tools.

The term "Rock Excavation" indicates a method of removal and not a geological formation.

Surface Removal - The removal of surface material such as topsoil, sod, pavement, sidewalks, or gravel, that requires different equipment or methods than those used for trench excavation.

Trench Backfill - Furnishing, placing, and compacting material other than Controlled Low-Strength Material (CLSM) in the trench, between the top of the pipe zone material and the bottom of the pavement base rock, ground surface or surface material.

Trench Excavation - The removal of all material encountered in the trench to the depths as shown or as directed. Trench excavation is classified as either common or rock excavation.

Trench Foundation - The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.

00405.03 Lines, Grades, and Cross Sections - Excavate trenches to the lines, depths, grades and cross sections shown on the plans or as established. Variations will be permitted only when necessary to ensure firm foundations and when such variations will not be detrimental to the work.

Materials

00405.10 General - Materials may be native or imported, as specified.

00405.11 Trench Foundation - Where additional excavation is required due to groundwater or other unstable conditions so that the native material cannot support the pipe, selected general backfill, selected granular backfill, selected stone backfill material or other approved material may be used for trench foundation.

00405.12 Bedding - If groundwater is present in the bedding zone, use 19 mm - 0 (3/4" - 0) aggregate bedding. If groundwater is not present, and unless otherwise specified in the Contract, provide one of the following materials for bedding the pipe:

- 9.5 mm - 0 (3/8" - 0) PCC fine aggregate conforming to 02690.30(h)
- Commercially available 19 mm - 0 (3/4" - 0) aggregate
- 2.00 mm - 0 (No. 10 - 0) sand drainage blanket material conforming to 00360.10
- Reasonably well graded, from maximum size to dust, sand with 100% passing the 9.5 mm (3/8 inch) sieve
- Commercially available 9.5 mm - 0 (3/8" - 0) or 2.00 mm - 0 (No. 10 - 0) sand
- Reclaimed glass (mixed waste cullet) conforming to Section 02695
- A continuous cradle of concrete conforming to Section 00440. Acceptance of the concrete will be by visual inspection.

00405.13 Pipe Zone Material - For flexible pipes, backfill the pipe zone with bedding material as described in 00405.12.

For rigid pipes, unless otherwise directed, use either:

- 25.0 mm - 0 (1" - 0) or 19.0 mm - 0 (3/4" - 0) base aggregate conforming to 02630.10, or
- Commercially available 25.0 mm - 0 (1" - 0) or 19.0 mm - 0 (3/4" - 0) aggregate

00405.14 Trench Backfill - Use the following materials where shown or required:

(a) Class A Backfill - Use native or common material that, in the opinion of the Engineer, meets the characteristics required for the specific surface loading or other criteria of the backfill zone.

(b) Class B Backfill - Use granular material consisting of gravel or crushed rock meeting the requirements of Section 00641. Designated size shall be 25.0 mm - 0 (1" - 0) or 19.0 mm - 0 (3/4" - 0).

(c) Class C Backfill - Use clean sand with no particle size larger than 6.3 mm (1/4 inch).

(d) Class D Backfill - Use pit run or bar run material, well graded from coarse to fine. The maximum dimension shall be 75 mm (3 inches).

(e) Class E Backfill - Use Controlled Low-Strength Material (CLSM) conforming to Section 00442.

00405.15 Quality Control - Provide quality control according to Section 00165.

Labor

00405.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CAgT
- CDT

Construction

00405.40 General - Perform all excavation and backfilling according to the following requirements:

(a) Limitation on Commencement - Do not commence excavation until the undisturbed or existing ground has been measured and the measurements have been approved by the Engineer.

(b) Natural Stream Protection - Hold to a minimum excavations in, or adjacent to, natural stream beds. Comply with 00290.30(a). Restore the streambed according to 00405.46(f).

(c) Partial Embankment Construction for Exposed Pipe - Construct partial embankment according to 00330.42(c-6) and the plans, before excavating trenches.

(d) Temporary Handling of Water or Other Conditions - Provide temporary measures according to 00405.43.

00405.41 Trench Excavation - Excavate trenches according to the following:

(a) Within Paved Areas to Be Preserved - Excavate trenches for pipe installation by the open excavation method, unless otherwise directed. Do not disturb the adjoining pavement more than necessary.

(b) Open Trench Limit - Limit the length of open trench to 30 m (100 feet), or as allowed. Related resurfacing shall be completed within 240 m (800 feet) of the open trench limit.

(c) Trench Width - Keep the trench width at the ground surface to the minimum necessary to install the pipe in a safe manner, but not less than 600 mm (24 inches). In all cases, make trenches of sufficient width to allow for shoring and to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Refer to the Standard Drawings for minimum trench widths for various diameter pipes. Make excavations for manholes and other structures wide enough to provide a minimum of 300 mm (12 inches) between the structure surface and the sides of the excavation. Keep the top of the trench within right-of-way or permit limits.

(d) Trench Grade - Excavate trenches to the lines and grades shown or as established, with proper allowance for pipe thickness, pipe bedding and foundation stabilization. Place pipe bedding on a firm, undisturbed, foundation, true to grade. If the trench is excavated below grade without authorization, restore to grade with material of the type specified for pipe bedding at no cost to the Agency. Place the material over the full width of the trench, in compacted layers not exceeding 150 mm (6 inches).

(e) Disposal of Excess Material - Place excavated material at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic, or interfere with the function of existing drainage facilities.

Make arrangements for and dispose of all excess material not required elsewhere on the Project in an approved manner, at no cost to the Agency, and according to 00310.43(d).

(f) Trench Protection - Provide the materials, labor and equipment necessary to protect trenches at all times. Provide safe working conditions in the trench and protect the work, existing property, utilities, pavement, and the public. The method of protection shall be according to the Contractor's design. The Contractor may elect to use any combination of shoring, overbreak, tunneling, boring, sliding trench shields or other methods of accomplishing the work, provided the method meets with the approval of the Engineer and complies with all applicable local, state, and federal safety codes.

Be responsible for damages resulting from improper removal of shoring or from failure to shore.

(g) Existing Abandoned Facilities - Remove and dispose of existing abandoned pipe, structures and other facilities as necessary to construct the trench according to 00310.41(c).

00405.42 Rock Excavation - Where rock excavation as defined in this Section is required, remove the rock to provide the minimum clearances shown on the Standard Drawings. Excavate and remove the overburden and expose the rock to allow the Engineer to measure the rock prior to removal.

If using explosives, comply with the requirements of 00170.94. Prior to blasting, obtain the approval of the Engineer and the appropriate permits. Provide all tools and devices required for loading and using explosives, blasting caps and accessories. When blasting rock in trenches, cover the area to be shot with blasting mats or other protective material to prevent the scattering of rock fragments outside of the excavation.

00405.43 Dewatering - Promptly remove and dispose of all water entering the trench during the time the trench is being prepared for the pipe laying, during the laying of the pipe and until the backfill at the pipe zone has been completed. Dispose of the water in an approved manner without damage to adjacent property.

Control groundwater to prevent softening of the bottom of excavations or formation of "quick" conditions or "boils". Design and operate dewatering systems to prevent removal of the natural soils and so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

When dewatering near a river, lake, or stream, conform to the requirements of 00290.30(a) and Section 00280. When the presence of water or other conditions in the excavated area would be detrimental to the purpose of the work, obtain approval of the Engineer for the temporary measures required to correct or care for the condition.

If water or other conditions encountered require permanent correction or care not anticipated by the Contract and not due to the Contractor's neglect or method of operation, perform the work according to 00140.60.

00405.44 Trench Foundation - Make the full length and width of completed trench bottoms firm. Do not place bedding material before the trench foundation is inspected and approved. If bell and spigot pipe is used, recess the trench bottom to accommodate the bell.

When, in the judgment of the Engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, excavate below grade, as directed. Replace the excavated material with imported

trench foundation material conforming to 00405.11. Place the backfill material in 150 mm (6 inch) layers and compact according to 00330.43. Bring the backfill material to the elevation established.

00405.45 Pipe Bedding - Spread the bedding smoothly to the proper grade so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length.

00405.46 Backfilling - Backfill with material conforming to 00405.13 and the details shown, or as directed.

(a) General - Begin backfilling when:

- The foundation has been prepared, if required
- The bedding has been prepared
- The drainage facilities and fittings are installed
- The installation has been inspected and approved

Thoroughly tamp and compact all trench backfill with machine or pneumatic operated tampers of a size and type that will obtain the required density.

Test for density according to 00330.43.

Backfill either to the top of the trench, the surrounding ground level, or the upper limit of excavation, as directed. Dispose of excess excavated material not used in backfill work according to Section 00330.

(b) Pipe Zone - Place the materials in the pipe zone in layers not greater than 150 mm (6 inches) thick and in a manner that equalizes pressure on the structure and minimizes stress. Before placing backfill material, condition, aerate, or wet the material so that the moisture content of each layer is within minus 4% to plus 2% of optimum moisture content.

As required under the haunches of pipe and in areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure intimate contact between the backfill material and the pipe or structure. Provide thorough compaction.

Ponding or jetting will not be permitted within the pipe zone.

(c) Trench Backfill - The following requirements apply in the trench backfill area and in the pipe zone, except where in conflict with the requirements of (b) above:

(1) General - Use Class B trench backfill unless otherwise specified or approved.

The Engineer may sample excavated material to determine the suitability of the Class A material for use as backfill. If the material is approved, the Contractor may elect to use the material in place of the specified backfill. Prevent excavated material from becoming saturated beyond the critical moisture limits, and replace any saturated Class A material with Class B, C or D material, as specified, at no additional cost to the Agency.

(2) Class A, B, C, or D Backfill - Backfill the trench above the pipe zone in successive lifts. Do not allow the backfill to free-fall into the trench until at least 1 m (3 feet) of cover is provided over the top of the pipe. Modify the method of compaction as necessary to protect the pipe.

Compact the top 1 m (3 feet) of trench backfill material within the roadway and shoulders, and within a 2V:1H slope line projected from each subgrade shoulder, to not less than 95% of maximum density. Compact all other trench backfill material to not less than 90% of maximum density.

Determine the maximum density by WAQTC TM 9. If the specified compaction is not obtained, the Contractor may be required to use a modified compaction procedure or reduce the thickness of lifts. If approved materials meeting the Specifications cannot be compacted to the required density regardless of compactive effort or method, the Engineer may reduce the required density or direct that alternate materials be used. Do not proceed with excavation and pipe laying operations until the backfill can be compacted to the satisfaction of the Engineer.

If the material is not density testable, the Engineer will observe each layer for deflection or reaction under the compaction equipment to verify that no soft or pumping areas remain. Compact until there is no perceptible deflection under the compaction equipment.

When the backfilling is complete, finish the surface area as specified. In paved or graveled areas, maintain the surface of the trench backfill level with the existing grade with 19.0 mm - 0 (3/4" - 0) crushed aggregate material, or asphalt concrete if directed, until final pavement replacement is complete and accepted.

(3) Class E Backfill - Backfill the trench above the pipe zone with CLSM material. If the CLSM is to be used as a temporary surfacing, backfill the CLSM to the top of the trench and strike it off to provide a smooth surface. If the CLSM is not to be used as a temporary surfacing, backfill the CLSM up to the bottom of the proposed resurfacing. No compaction of CLSM is allowed. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

(d) Ponding or Jetting of Backfill Materials - Ponding or jetting will not be permitted within roadbed lateral limits. Ponding or jetting will be permitted outside roadbeds when approved by the Engineer in writing.

Use Class C or D trench backfill material at the Contractor's expense. Provide drainage at the bottom of the trench to remove water from the jetting operation. Compact to the density and deflection requirements of 00405.45(a).

Furnish equipment that provides a minimum gauge pressure of 240 kPa (35 psi) at the discharge nozzle. Use a rigid pipe that will reach within 0.3 m (1 foot) of the bottom of the backfill. Insert the pipe at intervals not exceeding 1.2 m (4 feet) throughout the entire width and length of the trench backfill.

(e) Temporary Trench Plating - When temporary steel plates are installed over a street cut, they shall be capable of carrying at least an MS-18 loading. Place steel plates with a minimum of 300 mm (12 inches) bearing on all sides of a cut. Anchor steel plates to minimize shifting. Shim the edges of all steel plates with cold mix asphalt.

(f) Restoration of Streambeds - Comply with 00290.30(a) and Section 00280. Upon completion of the work:

- Restore the streambed to its former condition of resistance to scour.
- Remove all matter that has come into the stream due to the Contractor's activities.

00405.48 Surface Removal:

(a) General - For trench resurfacing see Section 00495.

(b) Topsoil - Where trenches cross lawns, garden areas, pastures, cultivated fields or other areas on which topsoil exists, remove the topsoil to a minimum 300 mm (12 inch) depth and place the material in a stockpile. Do not mix the topsoil with other excavated material. After the trench has been backfilled, replace the topsoil.

In lieu of stockpiling the topsoil, approved imported topsoil may be substituted, to a depth specified or approved, at no cost to the Agency.

Maintain the finished grade of the topsoil level with the area adjacent to the trench until final acceptance by the Engineer, and repair damage to adjacent topsoil caused by the Contractor's operations. Remove all rock, gravel, clay and other foreign materials from the surface. Regrade and add topsoil as required.

(c) Pavement, Curb, and Sidewalk - Use saws to cut portland cement concrete pavement, curbs and sidewalks, regardless of thickness. In bituminous pavement, when no pavement overlay will occur, saw-cut the pavement along each edge of the area to be removed. Saw cutting is not required in roadways that will receive a pavement overlay.

Upon completion of backfill and just prior to pavement re-surfacing, saw the surfacing on both sides of the trench a minimum of 150 mm (6 inches) wider than each top of the trench. In areas of any undermined or damaged surfacing, re-saw to a width outside these areas. When saw-cutting, follow lines parallel to the pipe centerline.

Where the width changes in areas of asphalt pavement re-surfacing, cut the transition between the different widths at 45 degrees. When the pipe line changes direction, or there is a connecting pipe line that requires the saw cut alignment to change at an angle greater than 60 degrees, make a minimum 600 mm (24 inch) transition saw cut. If there is damaged or undermined surfacing at the transition point, make the transition saw cut beyond the damaged or undermined surfacing. Make the transition saw cut angle half the angle change in the direction of the pipe line or connecting line.

If the asphalt surfacing is to be overlaid, the second saw cut will only be required to firm subgrade.

A second saw cut for concrete sidewalks, driveways and pavements will not be required unless needed to reach firm subgrade.

Remove and dispose of pavement lying within the limits of the cuts and from any adjoining areas damaged by the cutting and removal operations according to Section 00310.

Measurement

00405.80 Trench Excavation and Trench Backfill - No measurement will be made for trench excavation, trench backfill and trench saw cutting.

No measurement will be made for excavation required for the installation of manholes, inlets or other structures beyond the limits of the trench excavation, except as provided in 00405.82.

00405.81 Saw Cutting - Saw cutting will not be measured separately.

00405.82 Rock and Boulder Excavation:

(a) Rock Excavation - Rock excavation will be measured on the volume basis. Measurement will be of the actual dimensions of rock removed within the following limits.

The length will be the horizontal distance measured along the centerline of the trench. The measurement will exclude manholes and other structures, which will be measured separately. The width will be the width of the rock removed but not greater than the outside diameter of the pipe bell plus 300 mm (12 inches).

The depth of rock excavation will be measured at 10 m (30 foot) intervals, or as directed, along the centerline of the trench. The depth will not be more than 150 mm (6 inches) below the outside bell of the pipe.

00405.82(a)

Rock excavation quantities for manholes and other structures will be computed from the actual rock excavated to a depth 150 mm (6 inches) below the bottom of the structure and an area within a line parallel with, and 300 mm (12 inches) outside of, the actual dimensions of the manhole or structure.

The following will not be measured for payment:

- Soft or disintegrated rock
- Hardpan or cemented gravel that can be removed with a hand pick or power-operated excavator or shovel
- Loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere
- Rock outside of the minimum limits of measurement allowed, which may fall into the excavation

(b) Boulder Excavation - Boulders excavated will be measured in the field by the Engineer after removal from the excavation but prior to removal from the site. Boulders will be measured for length, width and height. The volume of each boulder will be defined as the product of 85% of each of the three measured dimensions. Boulder excavation will be paid on a volume basis.

00405.83 Trench Protection - Shoring, mobile trench shields, overbreak and other trench protection measures will be considered Incidental work.

00405.84 Trench Foundation - Trench foundation removed and replaced according to 00405.44 will be measured on either the mass (weight) basis or the volume basis, as directed.

(a) Mass Basis - Trench foundation may be measured on the mass (weight) basis. The quantity of replacement foundation material will be based on weigh tickets from scales meeting the requirements of Section 00190. Present weigh tickets to the Engineer for signature on the day the material is delivered.

(b) Volume Basis - Trench foundation may be measured on the volume basis, computed using the following dimensions:

(1) Length - According to 00405.80(b-1).

(2) Width - According to 00405.80(b-2).

(3) Depth - The depth will be the vertical distance from the top of the underlying surface (following excavation of unsuitable material) to the bottom of the pipe bedding. The depth will be measured at intervals of 10 m (30 feet), or as directed, along the centerline of the trench and the average depth between points will be used for the volume computation.

(c) Extra Work Basis - When not listed in the Schedule of Items, trench foundation will be paid for as Extra Work.

00405.85 Pipe Bedding - No measurement will be made for pipe bedding conforming to 00405.12.

00405.86 Pipe Zone Material - No measurement will be made for pipe zone material conforming to 00405.13.

00405.87 Imported Topsoil - Imported topsoil will be measured and paid for according to Section 01040.

Payment

00405.90 General - There will be no separate payment for trench excavation, trench backfill and trench saw cutting, as these will be considered Incidental to the appropriate pipe Pay Item.

The accepted quantities of rock excavation, boulder excavation and trench foundation will be paid for at the Contract price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Rock Excavation	m3 (Cubic Yard)
(b) Boulder Excavation	m3 (Cubic Yard)
(c) Trench Foundation	m3 (Cubic Yard)
(d) Trench Foundation.....	Mg (Ton)

Payment will be payment in full for furnishing, placing and compacting all materials, and providing all equipment, labor and Incidentals necessary to complete the work.

Item (a) includes any additional excavation required for installation of manholes, inlets, or other structures in rock. Other than as provided in 00405.82(a), such additional excavation is considered Incidental to the work and no separate or additional payment will be made.

Payment for item (c) and item (d) includes removal of unsuitable material and replacement as necessary to provide a stable foundation for the pipe.

00405.92 Incidental Basis - When there is no pay item in the Schedule of Items for trench excavation or trench backfill, perform the work as Incidental work for which no separate payment will be made.

Bedding, pipe zone material, and dewatering are Incidental work for which no separate payment will be made.

Excavation, bedding, and backfill for pipes 100 mm (4 inches) or less in diameter will be Incidental to the pipe pay item(s), and no separate payment will be made.

Section 00406 - Tunneling, Boring and Jacking

Description

00406.00 Scope - This work consists of installing conduits, pipes, casings, linings and sleeves by tunneling, boring and jacking without excavating the overlying surface.

00406.01 Descriptive Terms:

(a) Tunneling - Tunneling includes all methods by which an underground passageway is excavated and lining materials are brought in and placed.

(b) Boring - Boring includes all methods by which a conduit, casing, pipe or sleeve is pushed or pulled into place and in which the excavation method precludes the stationing of a worker within the conduit without stopping or removing the excavation equipment.

(c) Jacking - Jacking includes all methods by which a conduit, casing, pipe or sleeve is pushed or pulled into place with one or more workers inside to excavate and assist in keeping the conduit on the required grade and alignment.

Materials

00406.10 Pipe Bedding and Pipe Zone Material - Furnish pipe bedding and pipe zone material conforming to the requirements of Section 00405.

00406.11 Pipe - Furnish pipe materials conforming to the strength, class and type specified or as shown.

00406.12 Casing - Provide casing of a size to permit proper construction to the required lines and grades. Casing shall be of smooth steel pipe or concrete pipe suitable for the purpose intended. Optionally, the casing may be constructed of galvanized, standard-offset, tunnel liner plate with gauge and section modulus as approved.

The class of casing specified is based on the superimposed loads and not on the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the Contractor.

When pressure grouting is specified, equip jacked casings 900 mm (36 inch) diameter and larger with nipples installed at the springline and the crown, at 3 m (10 foot) centers.

00406.13 Grout - Grout for filling the annular space between the carrier pipe and the casing pipe shall be one part portland cement, five parts sand and seven parts 9.5 mm (3/8 inch) maximum size rounded aggregate by volume, or as approved.

Grout for pressure grouting outside jacked carrier or casing pipe shall be one part portland cement and three parts sand by volume, or as approved.

00406.14 Sand - Sand for filling the annular space between the carrier pipe and the casing pipe shall be clean, sharp and well graded so that 100% passes the 2.36 mm (No. 8) sieve, and between 10% and 35% passes the 300 μ m (No. 50) sieve, or as approved.

Construction

00406.40 Excavation - Excavation for work under this Section is unclassified and includes whatever materials are encountered to the depths shown or required.

00406.41 Required Submittals - Before beginning the work, submit the following to the Engineer according to 00150.35:

(a) Tunneling - Submit the following stamped working drawings:

- Tunnel shaft bracing design and dimensions
- Tunnel support details
- Method of backpacking tunnel supports
- Design of bracing to prevent lining from shifting or flotation
- Backfill material or pressure concrete mix design, placement method and equipment
- Poling plate dimensions and details, when required

(b) Boring and Jacking - Submit the following unstamped working drawings:

- Jacking pit construction
- Casing or conduit
- Jacking head
- Excavation method
- Tee or wye installation
- A substitute design for any part of the system that must be changed as a result of the jacking or boring operation
- Bracing to prevent pipe shift and flotation, if placed in a casing, and the materials, method and equipment for backfilling
- Backfill material or pressure grout mix, placement method and equipment

Submit for review the following stamped working drawings:

- Jacking pit bracing
- Any structure that is required because of the particular method or procedure used by the Contractor

00406.42 Tunneling - Construct the pipe on a firm subgrade, thoroughly compacted and true to grade. If the material in the bottom of the tunnel is ledge rock, extend excavation of the tunnel to a depth below the bottom of the pipe, and provide a bedding of crushed aggregate or concrete as specified in Section 00405. Restore to grade any excavation made below grade without approval by backfilling with approved bedding material, at no expense to the Agency.

00406.43 Boring and Jacking - Boring or jacking may be allowed in lieu of the open trench method or tunneling with approval of the Engineer. Jack or bore all conduit, casings, pipe or sleeves to the required line and grade.

Equip the leading section of pipe or casing with a jacking head. Perform all excavation entirely within the jacking head.

Should loss of surrounding material occur during the jacking or boring operation, backpack or grout the voids before the completion of the shift. Fill or backpack all voids with grout or granular material as approved.

00406.44 Concrete Pipe - Protect the driving ends of concrete pipe against spalling and other damage. Protect intermediate joints by the installation of sufficient bearing shims to properly distribute the bearing stresses. Remove all sections of conduit showing signs of failure and replace with new sections, or with approved cast-in-place sections, which are adequate to carry the loads imposed on them.

00406.45 Smooth Steel Casing - Join sections of smooth steel casing to be jacked or bored by welding the joints with a continuous weld for the full circumference, or by other approved means. Provide joints capable of resisting the jacking or boring forces.

Brace pipe installed in casing to prevent shifting or flotation. Fill the void between the casing and the pipe with grout or other material, as specified or approved.

00406.46 Grouting Voids Outside Casing - On pipes 900 mm (36 inch) or larger, fill completely the void space between the tunnel and the casing or liner plate with approved grout. After the casing or carrier pipe has been jacked or tunneled into position, fill with grout under pressure, through the grout holes provided, to fill all voids outside the pipe using the following sequence:

- Grout at the springline hole at one end and pump the grout until it appears in the grout hole at the crown.
- Grout through the opposite springline hole until the grout appears at the hole in the crown.
- Grout through the hole at the crown until the grout appears in the next set of holes along the pipe.
- Plug the holes at the starting point and move to the next set of holes.
- Repeat the sequence until the full length of the pipe has been grouted.

Provide a continuous color video recording of the grout placement, to provide documentation that grout was properly placed according to the above Specifications. On the video, identify the location of the grouting operation in relationship to the end of the casing, tunnel or liner plate.

00406.47 Cradles for Cased or Tunneled Pipe - Where cradles are shown, provide a strapped cradle under the barrel of the carrier pipe. The barrel shall bear continuously on the cradles.

00406.48 Placing Fill in Casing - Where shown, completely fill the annular space between the pipe and the casing, tunnel liner or tunnel wall with approved grout or sand to prevent pipe flotation. Pour or pump the fill from the two ends and from intermediate points as necessary. Complete grouting in a continuous operation without stopping. Perform sand filling using a gunite machine or other approved equipment.

00406.49 Railroad Crossings - Perform all work in railroad rights-of-way in compliance with the railroad permit.

Measurement

00406.80 Length Basis - Pipe installed by tunneling, boring or jacking will be measured on the length basis, from end to end along the neutral axis, or from center to center of manholes, inlets, or other structures, as applicable.

There will be no separate measurement of tunneling, boring or jacking, or for casing or conduit used to install the pipe.

Where tunneling, boring, jacking, or open trench excavation is used at the Contractor's option in lieu of another specified method, measurement will be made as originally bid.

Payment

00406.90 General - Accepted quantities of pipe placed by tunneling, boring, or jacking will be paid for at the Contract unit price per meter (foot) for the appropriate pipe pay item. There will no separate payment for casing or conduit used to install the pipe.

If tunneling, boring, jacking, or open trench excavation is used at the Contractor's option in lieu of another specified method, payment will be made as originally bid.

(a) Tunneling, Boring and Jacking - The additional effort required to place casing, pipe, liner or sleeve by tunneling, boring or jacking (other than under a railroad) will be paid for at the Contract lump sum price for the pay item "Tunneling, Boring, and Jacking". Payment will be payment in full for casing or conduit used to install the pipe and all materials, equipment, labor and Incidentals not included in the pipe pay item.

(b) Installation Under Railroads - Conduit, casing, pipe, liner or sleeve placed by tunneling, boring, or jacking under a railroad will be paid for according to 00445.91 and 00445.98.

Section 00420 - Salvaging Pipe

Description

00420.00 Scope - This work consists of removing, cleaning and stockpiling or relaying culvert pipe and other pipe.

Acceptable pipe, parts and special sections will be referred to as "salvaged".

Materials

00420.10 General - Use joint materials, connecting bands and other materials required in relaying pipe conforming to the Specifications for the type of pipe and materials involved. Salvaged material may be used if approved.

Construction

00420.40 Trench Excavation - Excavate and backfill trenches to remove pipe and to relay salvaged pipe according to Section 00405.

00420.41 Removal of Pipe - Excavate materials over the pipe, and remove, disassemble and clean the exposed pipe without damaging the pipe. Acceptable partial sections of pipe may be cut off for reuse.

00420.42 Stockpiling - Stockpile salvaged materials not used on the Project as directed.

00420.43 Relaying - Install salvaged materials at the locations, in the quantities designated, and conforming to Specifications for new installations. As directed, cut sections of salvaged pipe to obtain the length required for relaying. Make connections to new pipe, inlet and outlet structures, salvaged or new end sections, or other special sections as provided in the Specifications for new pipe installations.

Measurement

00420.80 General - The accepted quantities of salvaged pipe will be the length, regardless of size, kind or type that is removed, cleaned and stockpiled or relaid. Stockpiled pipe will be measured from end to end of each pipe. Relaid pipe will be measured according to Section 00445. There will be no separate measurement for excavation and backfill.

The maximum depth to flow line for each run of relaid pipe will be determined along the pipe centerline, by measuring vertically from the flow line to the surface of the original ground, paved surface or subgrade and slopes of other excavations, whichever is less.

Payment

00420.90 General - The accepted quantities will be paid for at the Contract unit price per meter (foot) for the following items:

- (a) Salvaging and Stockpiling _____ Pipe
- (b) Salvaging and Relaying _____ Pipe, _____ Depth

For item (a), the nominal diameter of pipe will be inserted in the blank. For item (b), the nominal

diameter of the pipe will be inserted in the first blank, and one of the following maximum flow line depths will be inserted in the second blank:

Maximum Depth to Flow Line

- 1.5 m (5 feet)
- 3 m (10 feet)
- 6 m (20 feet)
- over 6 m (20 feet)

Payment will be payment in full for removing, cleaning, transporting and stockpiling or relaying the pipe as directed. Payment includes all materials, equipment, labor, excavation, backfill and Incidentals necessary to complete the work as specified.

Section 00430 - Subsurface Drains

Description

00430.00 Scope - This work consists of constructing subsurface drains to the lines and grades shown or established using drain pipe, special filter material or granular drain material, and geotextile.

00430.01 Descriptive Terms - The terms used in designating drain pipe or when referring to them on the plans are as follows:

Aluminum - The base metal for aluminum sheets.

Concrete, Steel, Aluminum, Polyethylene, Polyvinyl Chloride - The basic material of the pipe.

Drain Pipe - Perforated pipe of specified material.

Metal - Aluminum and steel.

Steel - The base metal for galvanized or aluminum coated sheets.

Subsurface Drain - Drainage system beneath the base, usually with a perforated drain pipe, to collect and drain groundwater.

00430.02 Contractor's Options - If the Contractor has an option of using different kinds of pipe, the option and its limitations will be shown on the plans or on a "Pipe Data" sheet of the plans.

The limiting factors and requirements shown on the plans or on the Pipe Data sheet are minimums. The Contractor may substitute stronger, larger, and higher quality material at any installation site, provided the substitution meets the approval of the Engineer and is made at no additional cost to the Agency.

00430.03 Size Determination - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

Materials

00430.10 General - Use materials meeting the requirements of the following:

Delineators.....	00840
Geotextile.....	02320
Perforated Concrete Pipe.....	02410.10
Perforated Corrugated Aluminum Alloy Pipe.....	02420.50
Perforated Corrugated Polyethylene Pipe.....	02410.60
Perforated Corrugated Steel Pipe.....	02420.30
Perforated Polyvinyl Chloride Pipe.....	02410.70
Commercial Grade Concrete.....	00440
Protective Coatings.....	02420.20
Special Filter Materials.....	02610.10

Wire mesh shall be commercial quality 6.3 mm (1/4 inch) galvanized metal screening.

00430.11 Granular Drain Backfill Material - Granular drain backfill material shall be 37.5 mm - 19.0 mm (1 1/2" - 3/4"), 31.5 mm - 19.0 mm (1 1/4" - 3/4"), or 19.0 mm - 12.5 mm (3/4" - 1/2") crushed or uncrushed rock or gravel meeting the following gradation requirements:

METRIC

Sieve Size	Percent Passing (by mass) Designated Sizes (mm)		
	37.5 - 19.0	31.5 - 19.0	19.0 - 12.5
50 mm	100		
37.5 mm	95 - 100	100	
31.5 mm	-	90 - 100	
25.0 mm	-	-	100
19.0 mm	0 - 15	0 - 15	90 - 100
12.5 mm	0 - 2	0 - 2	0 - 15
6.3 mm	-	-	0 - 3

ENGLISH

Sieve Size	Percent Passing (by weight) Designated Sizes (inch)		
	1 1/2" - 3/4"	1 1/4" - 3/4"	3/4" - 1/2"
2"	100		
1 1/2"	95 - 100	100	
1 1/4"	-	90 - 100	
1"	-	-	100
3/4"	0 - 15	0 - 15	90 - 100
1/2"	0 - 2	0 - 2	0 - 15
1/4"	-	-	0 - 3

00430.12 Reclaimed Glass - Reclaimed glass (mixed-waste cullet) conforming to Section 02695 may be used as a substitute for backfill material.

Construction

00430.40 General - Excavate trench, prepare bedding, backfill, except as noted in 00430.46, and dispose of excavated materials according to Section 00330. If required, place geotextile according to Section 00350 before backfilling.

Install pipes in paved areas according to Section 00405.

Install a Type W-1 delineator at each outlet protection block as shown.

00430.41 Foundations in Unyielding Material - Excavate rock, hardpan or other unyielding materials a minimum of 75 mm (3 inches) below established grade of the pipe exterior to place special filter material or drain backfill material.

00430.42 Laying Pipe - Lay the pipe according to Section 00445. Place pipe with perforations down unless otherwise directed.

00430.43 Joining Pipe - Fasten pipes together with appropriate coupling fittings or bands as specified for the type of pipe used. Close upstream end of pipe with plugs suitable to prevent entry of soil materials.

00430.44 Contact Surfaces, Aluminum to Concrete - Coat aluminum pipe and aluminum coated steel pipe that contact portland cement concrete with asphalt mastic according to Section 00445.

00430.45

00430.45 Inspection - The installation will be inspected after the pipe is laid and joined and before backfilling. Remove and reinstall or replace any pipe found to be out of alignment, unduly settled or damaged.

00430.46 Backfilling:

(a) Special Filter Material - After the pipe is installed and inspected, place up to 300 mm (12 inches) of uncompacted special filter material above the top of the pipe. Above this, place approved backfill material or special filter material, as directed, and compact according to Section 00405.

(b) Granular Drain Backfill Material - Geotextile is required when using granular drain backfill material. Place granular drain backfill material according to (a) above and as shown.

Measurement

00430.80 Trench Excavation and Backfill - There will be no separate measurement for trench excavation and backfill.

00430.81 Geotextiles - Quantities of geotextiles will be measured according to Section 00350.

00430.82 Installation Under Pavement - Extra for pipe installed under pavement will be measured according to Section 00445.

00430.83 Drain Pipe - Quantities of subsurface drain pipes of the various kinds, types and sizes will be measured according to Section 00445.

00430.84 Special Sections - Quantities of special sections will be measured according to Section 00445.

00430.85 Special Filter Material and Granular Drain Backfill Material - There will be no separate measurement for special filter material and granular drain backfill material.

00430.86 Delineators - Quantities of delineators will be measured according to 00840.80.

00430.87 Subsurface Drain Outlet - Subsurface drain outlets will be measured for payment on a unit basis, per each, by actual count of units in place as specified.

Payment

00430.90 Trench Excavation and Backfill - There will be no separate payment for trench excavation and backfill.

00430.91 Geotextile - Geotextile will be paid for according to Section 00350.

00430.92 Installation Under Pavement - Extra for installation of pipe under pavement will be paid for according to Section 00445.

00430.93 Drain Pipe - The accepted quantities of subsurface drain pipe will be paid for at the Contract unit price per meter (foot) for the following pay item:

(a) _____ mm (Inch) Drain Pipe

The nominal diameter of pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing the pipe including all materials, equipment, labor and Incidentals necessary to complete the work as specified.

00430.94 Special Filter Material and Granular Drain Backfill Material - There will be no separate payment for special filter material or granular drain backfill material. Payment will be included in payment for the item " ____ mm (Inch) Drain Pipe".

00430.95 Delineators - Delineators will be paid for according to 00840.90.

00430.96 Subsurface Drain Outlet - The accepted quantities of subsurface drain outlets will be paid for at the Contract unit price per each for the item "Subsurface Drain Outlets". Payment will be payment in full for all materials, equipment, labor and incidentals necessary to complete the work, including:

- Furnishing and installing pipe
- Constructing outlet protection blocks
- Connecting pipe to inlets
- Excavating and disposing of excess materials

Section 00435 - Wick Drains

Description

00435.00 Scope - This work consists of furnishing and installing wick drains at locations and according to details shown or as directed.

Materials

00435.10 General - Use new wick drains from the QPL or that conform to these specifications.

00435.11 Core - Use a continuous plastic core material with grooved channels, a pattern of protruding studs, or mesh-type materials fabricated to promote drainage along the axis of the vertical drain.

00435.12 Jacket - The jacket material shall:

- Be a synthetic, non-woven geotextile capable of resisting all bending, punching and tensile forces imposed during installation
- Not crack, peel or otherwise become damaged during installation
- Be sufficiently rigid when embedded to withstand lateral earth pressures and to ensure vertical flow capacity through the core
- Allow free passage of pore water to the core without passage of soil material or piping

Test the jacket material in both saturated and dry conditions. It shall conform to the following:

Test	Requirement	
	Specification	Minimum Value
Grab Tensile	ASTM D 4632	355 N (80 pounds)
Trapezoidal Tear	ASTM D 4533	110 N (25 pounds)
Puncture Strength	ASTM D 4833	220 N (50 pounds)
Burst Strength	ODOT TM 814	900 kPa (130 psi)
Permeability	ASTM D 4491	0.05 mm/s

00435.13 Assembled Drain - The assembled drain shall:

- Be resistant against wet rot, mildew, bacterial action, insects, salts, acids, alkalis, solvents and any other significant ingredients in the groundwater
- Be band-shaped (rectangular cross section) with an aspect ratio (width divided by thickness) not exceeding 50
- Have a minimum equivalent diameter of 50 mm (2 inches) using the following definition of equivalent diameter:

$$d_w = \frac{(a+b)}{2}$$

d_w = diameter of a circular drain equivalent to the band shaped drain
 a = width of the band shaped drain
 b = thickness of the band shaped drain

00435.14 Acceptance Requirements - Each shipment of wick drain materials shall be accompanied by a manufacturer's Quality Compliance Certificate according to 00165.35.

Submit three samples of any proposed splices for approval at least 21 calendar days before the installation of any drains.

Identify the drain materials with labels or tags that include the manufacturer's name, lot or control number, individual roll number and date of manufacture.

Equipment

00435.20 General - Install wick drains using a mandrel or sleeve that:

- Has a maximum cross-sectional area of 6400 mm² (10 square inches)
- Is sufficiently stiff to prevent wobble or deflection during use
- Protects the wick drain material from tears, cuts and abrasion during installation
- Has an anchor plate or similar arrangement at the bottom to prevent soil from entering the drain during its installation, and to anchor the drain tip at the required depth at the time of withdrawal. Use anchors conforming to the dimensions of the mandrel or sleeve.

Construction

00435.40 Wick Drain Installation Requirements:

(a) Acquisition and Storage - During shipment and storage, wrap the drain in heavy paper, burlap or similar heavy-duty protective covering and protect it from sunlight, mud, dirt, dust, debris and other detrimental substances.

Material damaged during shipping, unloading, storing or handling will be rejected.

(b) Proposed Installation Details - Submit full details on the material, equipment, sequence and method proposed for wick drain installation to the Engineer for review at least 14 calendar days before beginning trial wick drain installation.

(c) Trial Installation - Before production installation of wick drains, demonstrate that material, equipment and methods produce a satisfactory installation, at permanent installation sites. Install at least five trial drains totaling approximately 75 m (250 feet) at locations designated.

(d) Production Installations - The Engineer's approval of the method or equipment used to install the trial drains does not necessarily constitute acceptance for the remainder of the Project. If at any time the Engineer determines that the method of installation or equipment does not produce satisfactory wick drains, alter the method or equipment as directed to comply with the plans and specifications.

(e) Installation Procedure - Wick drains will be located, numbered and staked by the Engineer.

- Preserve stakes and protect field instrumentation equipment. Stakes and instrumentation damaged by the Contractor will be repaired or replaced by Agency forces. The cost of repair or replacement will be deducted from monies due the Contractor. Do not work in the affected area until repair or replacement has been made.

- Locate the wick drains within 150 mm (6 inches) of the staked locations. Wick drains more than 150 mm (6 inches) from the staked locations, damaged or improperly installed, will be rejected and abandoned in place without payment.
- Install wick drains in the presence of the Engineer's representative.
- Provide the Engineer with a suitable means to determine the depth of the drains at any time during installation and the final length installed at each location.
- Plumb equipment for installing wick drains before installing each drain. Do not deviate from the vertical more than 60 mm in 3 m (0.2 foot in 10 feet) during installation of the drains.
- Install wick drains using a mandrel or sleeve inserted into the soil using a continuous push static mass (weight) or vibration while keeping disturbance of the subsoil to a minimum. Installation by driving will not be permitted. Jetting techniques will be permitted only after receiving written approval from the Engineer. The mandrel or sleeve penetration rate shall normally be between 0.15 m/s and 0.6 m/s (0.5 and 2 feet per second).
- Install the wick drains from the designated working surface to the depth shown or as directed.
- Perform the installation without damaging the drain while advancing or retracting the mandrel or sleeve. Alternately raising or lowering the mandrel while advancing will not be permitted. Retract the mandrel or sleeve after each drain is installed. Raising the mandrel will be permitted only after completing a drain installation.
- Cut off completed wick drains neatly 0.3 m (1 foot) above the designated working surface.

(f) Obstruction Clearance Procedures - Satisfactory installation may require clearing man-made or natural obstructions that prevent the proper insertion of the mandrel or sleeve and installation of wick drains.

Where obstructions are encountered:

- Immediately notify the Engineer before completing the drain and before installing other drains.
- Attempt to install a drain adjacent to the obstructed location.
- Based on the results of this attempt and when directed, attempt to install a second offset drain within 0.6 m (2 feet) horizontally of the obstructed drain, or if directed, implement obstruction clearance procedures and install the drain at the specified location.

The Contractor may use augering, spudding or other approved methods to loosen the soil and remove any obstruction material before installing wick drains. Do not penetrate more than 0.6 m (2 feet) into the underlying compressible soil.

If augering, use augers with a minimum outside diameter equal to the largest horizontal dimension of the mandrel, sleeve, shoe or anchor, whichever is greatest. The maximum outside diameter of the auger shall not be more than 75 mm (3 inches) greater than the minimum outside diameter.

00435.41 Splicing - Splice wick drain material by stapling to insure structural and hydraulic continuity of the drain. Overlap the jacket and core a minimum of 150 mm (6 inches) at each splice.

A maximum of one splice per drain installed is permitted.

Measurement

00435.80 Length Basis - The quantities of wick drains and obstruction clearance will be measured on the length basis.

(a) Wick Drains - The length of accepted drains will be the distance the installation mandrel tip penetrates below the specified surface plus the required cutoff length above the designated working surface.

(b) Obstruction Clearance - The length of accepted obstruction clearance will be the length from the designated working surface at the time of installation to the depth penetrated by the auger or spud, or if directed, to the bottom of the obstruction.

Obstruction clearance will be measured for payment only when authorized by the Engineer.

Payment

00435.90 Length Basis - The accepted quantities will be paid for at the Contract unit price for the following items:

Pay Item	Unit of Measurement
(a) Wick Drains.....	m (Foot)
(b) Obstruction Clearance	m (Foot)

Item (a) includes trial installations and splices.

Item (b) includes pre-augering, spudding or performing other acceptable methods to clear obstructions so that wick drains may be satisfactorily installed, including disposing of any surplus preaugered or obstruction clearance materials.

Payment will be payment in full for all materials, equipment, labor and Incidentals necessary to complete the work.

No payment will be made for the following:

- Unacceptable trial drain installations
- Drains that are not installed and anchored to the required depth
- Clearing obstructions caused by the Contractor or obstructions within 0.6 m (2 feet) of the specified surface
- Wick drains placed in excess of the designed length unless additional lengths are directed by the Engineer
- Wick drains installed more than 150 mm (6 inches) from the staked location, damaged or improperly installed

Section 00440 - Commercial Grade Concrete

Description

00440.00 Scope - This work consists of furnishing, placing and finishing commercial grade concrete (CGC).

Materials

00440.10 General - Proportioning, mixture, and acceptance of materials for CGC shall comply with 00440.11, 00440.12, 00440.13 and 00440.14. Use materials meeting the following requirements:

Bonding agents	02070
Chemical admixtures	02040
Concrete materials	02001.30 and 02001.50
Curing materials	02050
Fly ash	02030.10
Grout	02080

00440.11 Proportioning of CGC Mixture - Before using any CGC on the Project, furnish in writing to the Engineer, the proportions by mass (weight) of the following materials, when used:

- Air entraining admixtures
- Cement
- Each size of aggregate
- Fly ash
- Other admixtures
- Water

00440.12 Tolerance and Limits of CGC Mixtures - Provide a workable mixture of CGC that is uniform in composition and consistency, and has the following characteristics:

- **Minimum Cement Content** - Furnish CGC mixtures which have at least the minimum cement or (cement + fly ash) contents shown in 02001.30, Table 02001-1.
- **Entrained Air** - Furnish CGC mixtures that have entrained air contents according to the provisions of 02001.50 and Table 02001-2.
- **Slump** - Do not allow slump to exceed 130 mm (5 inches) , except as noted in Table 02001-3.
- **Compressive Strength** - Unless otherwise noted, CGC shall attain a 28-day compressive strength of at least 20 MPa (3,300 psi).
- **Temperature** - Mix CGC at a temperature between 10 °C (50 °F) and 32 °C (90 °F).

00440.13 Field-Mixed Concrete - Work items listed in 00440.14(a) may be either commercially mixed or field-mixed.

00440.14 Acceptance Sampling and Testing:

(a) General - Acceptance sampling and testing will be based on samples obtained at the site of placement before any pumping, unless provided otherwise. The QCT shall perform all required sampling and testing.

CGC mixture may be accepted visually for the following items of work:

Work Item	Section
Electrical Conduit Backfill.....	00960
Fence post footings	01050
Guardrail anchors	00810
Irrigation system thrust blocks	01120
Mailbox support footings	01070
Outlet Protection Blocks.....	00430

(b) Batch Masses - Send a batch ticket with each load recording and attesting to the source, day, time of batch(es), size of load and quantity of individual constituents in the load. A batch ticket will not be required for field-mixed concrete.

(c) Plastic CGC - Acceptance of plastic CGC will be based on tests performed by the QCT according to the MFTP and the tolerances and limits of 02001.50, Tables 02001-2 and 02001-3.

(d) Hardened CGC - Acceptance of the hardened CGC will be according to the provisions of 00540.16(d). Cast one set of cylinders per 20 m³ (20 cubic yards), with a maximum of one set per day.

00440.15 Quality Control - Provide quality control according to Section 00165.

Labor

00440.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CCT
- QCT

Construction

00440.40 General:

(a) Mixing - Mix CGC to the extent that ensures a uniform distribution of materials throughout the mass.

(b) Placing - Place CGC according to the following:

- Place using the best common practices to avoid segregation.
- Vibrate and spade to achieve a dense homogeneous concrete, free of voids and rock pockets.
- Place within 90 minutes after batching and mixing.

(c) Forms - Provide forms for CGC using the best common practice. Place to the lines and grades called for or as directed.

(d) Weather - Do not place CGC when the air temperature is below 2 °C (35 °F) without approval.

Protect from freezing if the air temperature is expected to drop below 2 °C (35 °F) during the first five calendar days after CGC placement.

(e) Curing - Cure CGC by covering with burlap, canvas, sand or other acceptable material, and keep moist for a minimum of seven calendar days.

00440.40(e)

Curing compounds may be used if not applied to the concrete surfaces or reinforcement that will come in contact with adjacent concrete pours. Use compounds according to the following:

Section	Item	Type 1 or 1-D Clear	Type 2 White-Pigmented
00480	drainage curbs	1	1
00599	slope paving curbs, and berm paving	Yes	No
00759	walks, sidewalk ramps, driveways, surfacings, curbs, and islands	1	1

¹ Use Type 2 except when the Engineer requires Type 1 or 1-D.

Application rate shall not be less than 0.25 L/m² (1 gallon per 150 square feet).

00440.41 General Surface Finish - Give the concrete surfaces a general surface finish, in accordance with 00540.53(a), in addition to the finish specified for a particular item of work.

00440.42 Replacement or Price Reduction - Remove concrete represented by cylinders that fail to meet the minimum strength requirement and replace at Contractor's expense. If the Engineer determines that the low-strength concrete is suitable for the purpose intended, the Contractor may accept a price reduction established by the Engineer instead of removal and replacement.

Measurement

00440.80 Measurement - There will be no separate measurement of CGC.

Payment

00440.90 Payment - There will be no separate payment for CGC, as the cost will be included in payment for the particular items of work using CGC.

Section 00442 - Controlled Low Strength Materials

00442.00 Scope - This work consists of furnishing and placing controlled low-strength materials (CLSM).

00442.01 Definition - Controlled low-strength material is highly flowable lean concrete mix; a mixture of fly ash, cement, fine aggregates, water and admixtures, if necessary.

Materials

00442.10 General - Materials shall meet the requirements of the following Part 02000 Sections of the Standard Specifications as well as modifications given in the Special Provisions:

Fly ash	02030.10
Portland cement.....	02010.10
Admixtures	02040

00442.11 Fine Aggregates - Fine aggregates shall be commercial quality concrete sand.

00442.12 Proportioning of CLSM Mixture - Furnish the following, to the Engineer, prior to using any CLSM on the Project:

- Written certification of proposed CLSM materials proportions and compressive strength.
- 28-day cylinder reports from a trial CLSM batch based on above certification. Include evidence that compressive strength requirements for specific applications are met.

00442.13 Compressive Strength - CLSM shall attain a 28-day compressive strength of 1.0 - 1.7 MPa (150 - 250 psi).

00442.14 Acceptance - Acceptance will be based on the Engineer's review and approval of written certification and trial batch cylinder reports as required by 00442.12.

Measurement

00442.80 General - The quantities of CLSM will be measured as specified for the application where CLSM is used.

Payment

00442.90 General - Payment for CLSM will be as specified for the application where CLSM is used.

Section 00445 - Sanitary, Storm, Culvert, Siphon and Irrigation Pipe

Description

00445.00 Scope - This work consists of constructing or reconstructing culvert, siphon, sanitary sewer, storm sewer, and irrigation pipe 1800 mm (72 inches) and less in diameter.

Install pipes in the kinds, sizes and lengths and at the locations shown on the plans or as directed to the lines and grades established. The work includes furnishing and constructing joints and connections to other drainage structures or systems, as necessary, for complete installation.

00445.01 Definitions and Descriptive Terms - The following terms have the meanings presented below when used in this Section:

Aluminum, Concrete, Steel and Polyethylene - The basic material of the pipe

Concrete Block - Encasements, thrust blocks, anchor blocks, plugs and cutoff diaphragms

Culvert - Concrete, corrugated metal, ductile iron or polyethylene pipe

Flexible Pipe - Pipes constructed of corrugated or spiral rib metal, PVC, and polyethylene. For the purposes of these Specifications, all potable water pipes are considered to be flexible pipes.

HDPE - High Density Polyethylene

Irrigation Pipe - Gravity or low-pressure transmission pipe. Refer to Section 01120 for sprinkler-type irrigation pipe.

Joint - The place where the ends of sections or modified sections of pipe contact one another

Metal - Aluminum and steel

Pavement - Pavement as defined in Section 00110, as well as driveways, curbs, gutters, walks, dikes, walls and other similar asphalt or portland cement concrete structures

Pipe - All pipe, regardless of kind, size, shape or use

Plain - Unreinforced concrete

PVC - Polyvinyl Chloride

Rigid Pipe - Pipes, other than potable water pipes, constructed of concrete and ductile iron

Sanitary Sewer Pipe - Concrete, PVC, solid wall HDPE or ductile iron pipe

SDR (Standard Dimensional Ratio) - The pipe's minimum outside diameter divided by its wall thickness

Section - The individual pieces in which the furnished pipe is manufactured

Siphon, Storm Sewer, and Irrigation Pipe - Concrete, PVC, HDPE, ductile iron or metal pipe

Steel - The base metal for galvanized sheets and aluminum coated sheets

00445.02 Contractor's Options - If the Contractor has an option of using different kinds of pipe, the option and its installation and other limits will be shown on the plans or on a "Pipe Data" sheet in the plans.

The limiting factors and requirements shown on the plans or on the Pipe Data sheet are minimums. The Contractor may substitute stronger, larger, and higher quality material at any installation site, provided the substitution is approved and is made at no additional cost to the Agency.

00445.03 Size Determination - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

Materials

00445.10 General - The manufacturer or fabricator shall furnish appropriate certification, based on the manufacturer's quality control tests, that the materials used in the production of the pipe meet these Specifications. Materials and strength shall be as specified for the particular kind of pipe and fittings required.

Use flexible elastomeric gasket joints on all pipes and fittings. Furnish caps or plugs with each fitting, outlet or stub as required, with the same type gasket or joint as the pipe.

For sanitary sewers provide tee or wye fittings in the main of the same materials as the pipe. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

Cap or plug all fittings and provide with gaskets of the same material as used in the pipe joint. Fit with an approved mechanical stopper, or install an integrally cast knockout plug. The cap or plug shall be capable of withstanding test pressures without leaking and, when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

00445.11 Materials - Use materials meeting the requirements of the following:

Corrugated or spiral rib aluminum alloy pipe.....	02420.40
Corrugated polyethylene pipe	02410.60
Corrugated or spiral rib steel pipe and pipe arches.....	02420.10
Ductile Iron pipe.....	02420.11
Metal reinforcement in blocks	02510.10
Commercial Grade Concrete in blocks	00440
Nonreinforced concrete pipe	02410.10
Polyvinyl chloride (PVC) pipe.....	02410.70
Protective coatings.....	02420.20
Reinforced concrete pipe	02410.10
Rubber gaskets	02440.40

(a) Pipe Anchors - Use pipe anchors conforming to the Standard Drawings and as shown. Metal bands shall conform to the material Specifications for the metal pipe to which they are attached.

(b) Slip Joints - Construct slip joints according to the details shown. The outer sleeve and tapered section shall conform to the material Specifications for the metal pipe with which they are installed.

(c) Safety End Sections - Use safety end sections conforming to 02420.10 and the Standard Drawings. Provide safety bars unless otherwise indicated on the plans.

(d) Cleanouts - Construct cleanouts of the same materials as the adjacent pipe.

00445.11(e)

(e) Tracer Wire - Use 12-gage stranded copper tracer wire with green THNN insulation.

(f) Fittings for Concrete Pipe - Where fittings are fabricated by inserting a stub into a hole cut in the pipe, grout with a non-shrinking grout. Coat surfaces to receive grout with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside of the sewer pipe.

00445.12 Asphalt Mastic - The asphalt mastic specified in 00445.47 for aluminum and concrete contact surfaces shall consist of a mixture of asphalt, mineral stabilizer, and fillers conforming to AASHTO M243.

00445.15 Quality Control - Provide quality control according to Section 00165.

Labor

00445.30 Quality Control Personnel - Provide certified technicians in the following fields:

- CEBT
- CDT

Construction

00445.40 General - Construct culvert, siphon, sanitary sewer, storm sewer, and irrigation pipe according to the following:

(a) Trench Work - Excavate trench, prepare bedding, pipe zone material and trench backfill, and dispose of excavated material according to Section 00405 for pipes 1800 mm (72 inches) and less in diameter and Section 00510 for pipes over 1800 mm (72 inches) in diameter.

(b) Line and Grade - Centerline and grade control will be established prior to the start of construction. The Special Provisions will indicate whether it will be done by the Agency or the Contractor.

Do not vary from established line and grade by more than 31 mm per m (1/32 inch per inch) of pipe diameter. Variance shall not exceed 13 mm (1/2 inch), subject to the following limitations:

- The variation does not result in a level or reverse sloping invert
- The variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed 16 mm per m (1/64 inch per inch) of pipe diameter, or 13 mm (1/2 inch) maximum.

(c) Pipe Distribution and Handling - Unload pipe only by approved means.

Inspect the pipe and fittings prior to lowering into the trench to insure no cracked, broken or otherwise defective materials are used. Clean the ends of the pipe thoroughly, remove foreign matter and dirt from the inside of the pipe, and keep the pipe clean during laying and joining.

(d) Laying Pipe on Curves - Lay pipe on horizontal or vertical curves as shown or approved. When deflecting the pipe from a straight line, either in the vertical or horizontal plane, or when long radius curves are shown, the amount of deflection allowed shall not exceed that recommended by the pipe manufacturer.

(e) Concrete Closure Collars - Use concrete closure collars only when approved, and only to make connections between dissimilar pipe or where standard rubber gasketed joints or transition couplings are not available. Place the collars using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Where concrete closure collars are necessary to join PVC pipe, first prepare the PVC surface for bonding to the concrete by applying a dense coating of clean mortar

sand to the pipe using PVC solvent cement. After the cement has cured, apply an approved commercial concrete bonding agent to the sand surface prior to placement of the concrete.

(f) Installation of Sanitary Sewer Service Tees and Wyes - Provide a compacted base of pipe bedding material under all tees, wyes and branch fittings, extending to the springline of the fittings.

Cap all service lines for sanitary sewers with watertight plugs or caps suitable for resisting the pressures of hydrostatic or air testing.

The maximum line or grade change accomplished with any one fitting shall not exceed 45 degrees and shall be accomplished with long radius curves or bends.

(g) Pipe Anchors - Construct metal or concrete pipe anchors as specified or as shown. Install anchors on runs of pipe located on slopes greater than 19%.

00445.41 Installing Pipe under Railroad - Prior to beginning any under-track work, submit plans of construction, and details of the methods and equipment proposed to be used, to the Engineer for submittal to the Railroad. Do not begin under-track work until Railroad approval is obtained.

Within the limits indicated on the plans, do not install the pipe under the railroad tracks by the open trench method. Within these limits install the pipe by tunneling, jacking, boring or similar methods, approved by the Railroad, as the Contractor elects, according to Section 00406. Install the pipe to the lines and grades established and backfill completely all voids around the installation with specified material, to the satisfaction of the railroad.

00445.42 Laying Pipe - Begin pipe laying at the downstream end of the pipe line with the lower segment of the pipe in contact with the shaped bedding throughout its full length and as follows:

- **Elliptical Pipe** - Place with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the pipe.
- **Flexible Pipe** - Place with longitudinal laps or seams at the sides. At circumferential lap joints, place pipe so that the downstream piece is outside.
- **Paved Invert or Partially Lined Pipe** - Place with longitudinal centerline of paved segment coinciding with flow line.
- **Rigid Pipe** - Place with bell or groove ends facing upstream.
- **Round Elliptically Reinforced Concrete Pipe** - Place so that the manufacturer's marks designating the top and bottom of the pipe are within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

00445.43 Placing and Joining Pipe:

(a) General - Lay pipe proceeding upgrade with spigot ends in the direction of flow. Assemble joints in accordance with the recommendations of the manufacturer for the type of joint used. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

Prevent excavated or other foreign material from getting into the pipe. Plug or close off pipes that are stubbed off for future connection. When cutting or machining of the pipe is necessary, use only the tools and methods recommended by the pipe manufacturer. All field joints shall:

- Provide equal or greater strength than the adjoining pipe
- Fit close and tight

00445.43(a)

- Provide a smooth and uniform interior surface
- Secure and hold adjoining sections to each other
- Fasten securely to adjoining structures and special sections

(b) Concrete Pipe - Lay elliptical reinforced pipe so that the top or bottom marks are not more than 5 degrees from vertical. Provide all rigid non-reinforced pipe entering or leaving manholes with flexible joints within 450 mm (18 inches) of the manhole structure and placed on firmly compacted bedding.

(c) PVC Pipe - Install PVC pipe and fittings in conformance with the manufacturer's recommendations.

Cut the pipe in a neat manner, at right angles to the axis of the pipe, and dress the cut end.

(d) Polyethylene Pipe - Install solid wall and corrugated HDPE polyethylene pipe and fittings in conformance with the manufacturer's recommendations.

Assemble and join solid wall HDPE pipe at the site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints are not permitted. All equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Use personnel certified as fusion technicians by the manufacturer of the pipe or fusing equipment to accomplish the fusing.

(e) Pipe Joints - Construct field joints, suitable for testing, for siphons, sanitary sewers, irrigation, and other installations as specified.

Construct watertight field joints for storm sewers and culverts with elastomeric joint material. Test joints according to 00445.70.

(f) Inspection - After the pipe is laid and joined, and before any backfilling over it, the installation will be inspected. Take up and relay or replace any pipe found to be out of alignment, unduly settled, or damaged.

00445.44 Strutting Metal Pipe - When the plans or Special Provisions call for metal pipe to be installed in a tied or strutted condition, place the ties or struts before backfilling, conforming to the details shown. Strutting with timber is not permitted in pipe furnished with paved invert or with centrifugally applied bituminous inner linings. Remove the ties and struts after the embankment over the pipe is completed and compacted.

00445.45 Backfilling:

(a) General - After the pipe is installed and inspected, backfill pipe zone and trench according to Section 00405 for pipes 1800 mm (72 inches) and less in diameter, and according to Section 00510 for pipes over 1800 mm (72 inches) in diameter.

(b) Exposed Pipe - When the top 25% of the pipe is exposed above the top of the trench, place and compact embankment materials in layers according to the requirements of the plans for the Pipe Zone.

Do not cross any pipe with tractors or other heavy equipment until it has been bedded and backfilled as specified, and is protected by at least a 1.2 m (4 foot) cover of compacted fill.

(c) Elliptical Pipe - Where elliptical shaped metal pipe is furnished, place backfill in a manner that will maintain a vertical elongation between 4% and 6% greater than the indicated normal diameter, and fill up to the minimum cover above the top of the pipe indicated on the fill height table included with the plans.

When elliptical shaped metal pipe 1200 mm (48 inches) and larger in size is furnished, install and maintain suitable tell-tales throughout the length of the pipe at intervals not exceeding 4.3 m (14 feet).

Hang the tell-tales from the crown of the pipe and use as a progressive check on the pipe deflection during backfilling and filling.

Remove tell-tales after the entire fill over the pipe has been completed.

00445.46 Concrete Blocks - When called for by the plans or directed, construct concrete blocks, with commercial grade concrete according to Section 00440.

00445.47 Contact Surfaces, Aluminum to Concrete - Where uncoated aluminum pipe or aluminum coated steel pipe will be touching portland cement concrete, give the contact surfaces of the pipe a coating of asphalt mastic applied at a rate which will give a minimum dry film thickness of 1.27 mm (50 mils).

Do not place concrete on contact surfaces until the mastic coating has dried to practical hardness. The coating is considered to have reached practical hardness when firm pressure between the thumb and fingers shows a slight tacky condition, but the film is not ruptured, and none of the coating adheres to the fingers.

00445.48 Tracer Wire - Install tracer wire in all trenches for sanitary and storm sewers. Place the tracer wire directly over the pipe centerline and on top of the pipe zone material. Splice a branch tracer wire at each manhole and extend a single wire up the outside of the manhole. Drill a 10 mm (3/8 inch) diameter hole through the manhole wall within 0.5 m (18 inches) of the finish grade of the manhole rim. Extend the wire through the hole with a 1 m (3 foot) minimum length of coiled wire inside the manhole. Seal the opening in the manhole wall with silicone sealant. Place a branch tracer wire over each pipe connected to the main sewer.

Make tracer wire splices using a high-pressure compression type solderless connector to securely join the wires both mechanically and electrically. Insulate splices to be moisture and waterproof. Splices wrapped with tape will not be accepted as waterproof. Have all splice kits approved prior to installation.

Test all tracer wire with locating equipment prior to acceptance.

Finishing, Clean Up and Testing

00445.70 General:

(a) Storm Sewer and Culvert Installations - Inspect storm sewer systems and culverts to assure that the lines are free of obstructions and leakage. Perform TV and deflection testing as required.

(b) Siphon, Irrigation and Sanitary Sewer Installations - After laying and joining pipe for siphons, irrigation and sanitary sewers, and backfilling trenches, test the installations for watertightness, including inlet and outlet connections, to the Engineer's satisfaction. Perform TV, deflection hydrostatic and low-pressure air testing as required.

00445.71 Requirements Prior to Tests:

(a) General - All sanitary gravity systems, siphon systems and irrigation systems and appurtenances shall successfully pass a hydrostatic or air test prior to acceptance and shall be free of visible infiltration of water. Test manholes as specified in Section 00470.

On pipe 750 mm (30 inches) in diameter and larger, individual joints may be tested by an approved joint testing device. All details of the testing procedure shall meet the approval of the Engineer.

00445.71(b)

(b) Plugging Tees, Wyes, Stubs and Service Connections (Sanitary Only) - Plug all wyes, tees, stubs and service connections with gasketed caps or plugs securely fastened or blocked to withstand test pressures.

(c) Testing Equipment - Furnish all necessary testing equipment and perform the tests in a manner that provides observable and accurate measurements of either air or water leakage under the specified conditions. Calibrate and certify gauges at the direction of the Engineer. Provide the certification with the gauge.

(d) Cleaning - Prior to the testing and inspection of the system, flush and clean all parts of the system and remove all debris.

00445.72 Pipe Testing:

(a) General - After completing installation of the system, including all service connections, backfilling and compaction, conduct a low-pressure air test or a hydrostatic test. Provide all equipment and personnel for the test. Conduct tests during normal working hours. The Engineer may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of the system and allow connections.

The method, equipment and personnel used in testing shall be subject to approval of the Engineer. The Engineer may, at any time, require a calibration check of the instrumentation used.

(1) Safety Precautions - Only qualified personnel will be permitted to conduct the test. All plugs used to close the system for the testing shall be capable of resisting the expected internal pressures. Securely brace plugs, if necessary.

(2) Ground Water - The presence of ground water will affect the results of the test. Determine the average height of groundwater over the lines immediately before starting the test, using an approved method.

(b) Hydrostatic Testing - Pipe and joints shall sustain losses not exceeding 0.006 L/hr per mm diameter per 30 m of pipe (0.04 gallons per hour per inch diameter per 100 feet of pipe) when field tested by exfiltration methods, except (1.1 L/hr (0.3 gallons per hour) may be used in arid climate zones if approved by the engineer.

The hydrostatic head for test purposes shall exceed the maximum estimated ground water level in the section being tested by at least 1.8 m (72 inches) of water column and in no case shall be less than 1.8 m (72 inches) of water column above the inside top of the highest section of pipe in the test section, including service connections. The engineer shall make the final decisions regarding test height for the water in the pipe section being tested. The length of pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed 8.5 m (28 feet) of water column.

The pipe test section may be filled 24 hours prior to time of exfiltration testing, if desired, to permit normal absorption into the pipe walls to take place.

All service connection footage shall be taken into account in computing allowable leakage.

(c) Air Testing - The pressure gauge used in air testing shall have minimum divisions of 0.5 kPa and an accuracy of 0.4 kPa (0.1 psi and an accuracy of 0.0625 psi). All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

(1) The Contractor may wet the lines prior to testing.

- (2) Determine the average height of the groundwater over the line. The test pressures required shall be increased 9.8 kPa for each 1 m (0.433 psi for each foot) of average water depth over the exterior crown of the pipe.
- (3) Add air slowly to the section of system being tested until the internal air pressure is raised to 27 kPa (4 psi) greater than the average back pressure due to groundwater.
- (4) After the test pressure is reached, allow at least two minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.
- (5) After the temperature stabilization period, disconnect the air supply.
- (6) Record the time in seconds that is required for the internal air pressure to drop from 24 kPa to 17 kPa (3.5 to 2.5 psi) greater than the average backpressure due to groundwater.

The tested section will be acceptable if the time recorded in (6) above is not less than the time in seconds (T) computed by the formula:

$$T = K/C$$

Where:

METRIC

- K = the sum of the computations (0.000 055 938 d²L) for each size of pipe and its length in the section
- C = the sum of the computations (0.000 050 143 dL) for each size of pipe and its length in the section, except that the minimum value for C shall be 1
- d = inside diameter of the pipe in mm
- L = length of pipe in m

ENGLISH

- K = the sum of the computations (0.011 d²L) for each size of pipe and its length in the section
- C = the sum of the computations (0.0003882 dL) for each size of pipe and its length in the section, except that the minimum value for C shall be 1
- d = inside diameter of the pipe in inches
- L = length of pipe in feet

(d) Individual Joint Testing:

(1) General - The Contractor may test each individual joint for leakage using a pneumatic joint testing apparatus. The method, equipment and personnel used in individual joint testing shall be as approved. The Engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge used shall have minimum divisions of 0.5 kPa and have an accuracy of 0.4 kPa (0.1 psi and have an accuracy of 0.0625 psi). All air used shall pass through a single control panel.

(2) Method - All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

- a. Determine the average height of the groundwater over the line. The test pressures required below shall be increased 9.8 kPa for each 1 m (0.433 psi for each foot) of average water depth over the exterior crown of the pipe.
- b. Add air slowly to the section being tested until the internal air pressure is raised to 27 kPa (4 psi) greater than the average backpressure due to ground water.

00445.72(d)

(3) Acceptance - The joint shall be considered acceptable if the pressure drops less than 7.0 kPa (1 psi) within five seconds.

00445.73 Deflection Testing for Flexible Pipe - Conduct deflection tests of sanitary and storm sewers constructed of flexible pipe. Conduct the testing by pulling an approved mandrel through the completed pipeline. Use a mandrel having at least 6 vanes and a diameter 95% of the pipe's initial inside diameter.

Conduct testing on a manhole-to-manhole basis after the line has been completely flushed out with water. Conduct the tests not less than 30 days after the trench backfill and compaction have been completed. The tests may be conducted concurrently with television inspection.

00445.74 Television Inspection of Sanitary and Storm Sewers - After laying and joining sanitary and storm sewer pipe installations from 150 mm (6 inches) to 1800 mm (72 inches) in diameter, including backfill and compaction of trenches, but before any finish surfacing or final paving, conduct a television inspection and make a written report of all sanitary sewer pipes and one-quarter of the storm sewer pipes. If deficiencies requiring correction are discovered, television inspection of additional runs of pipe may be required, as directed.

The television inspection shall be conducted by a technical service that is equipped to make audio-visual tape recordings.

The audio-visual tape recordings shall:

- Be in color VHS format
- Be clear and usable
- Include a visual footage meter recording on the tape
- Include a voice recording of suspected deficiencies
- Identify groundwater infiltration sources associated with construction or materials defects.

Submit the audio-visual tape and written report to the Engineer for review. Correct all deficiencies that are revealed in the tape and written report. Make an additional television inspection of repaired pipes at no additional cost to the Agency.

All tapes and written reports shall become the property of the Agency.

00445.75 Repairs - Locate and repair any sections failing to pass the required tests and inspections. Repeat the specified tests and inspections on those sections at no expense to the Agency.

Following a successful hydrostatic or air test, visible infiltration of ground water in any section will be considered evidence that the original test was in error or that failure of the section has occurred. Correct such failures and retest the repaired sections, at no expense to the Agency.

Measurement

00445.80 General - Trench excavation, bedding, pipe zone material, trench backfill, tracer wire and acceptance testing for pipes 1800 mm (72 inches) and less in diameter will be measured according to Section 00405.

Measurement for trench excavation, bedding, pipe zone material, trench backfill, tracer wire and acceptance testing for pipes greater than 1800 mm (72 inches) in diameter will be as specified in Section 00510.

00445.81 Pipes and Appurtenances - The quantities of pipe of the various kinds, types and sizes, complete and in place, except pipe installed under railroad, will be determined by the length and depth of installation as follows:

(a) Pipes - The length will be measured with no deduction for structures or fittings, along the pipe flow line from center to center of manholes, inlets, special sections or the end(s) of pipe, whichever is applicable.

The depth will be used to determine the maximum depth range and pay item for each pipe. The maximum depth range for each pipe will be one of the following:

Maximum Depth to Flow Line

1.5 m (5 feet)
3.0 m (10 feet)
6.0 m (20 feet)
over 6.0 m (20 feet)

The depth in excavation areas will be the maximum measured vertical distance between the pipe flow line and the surface of the original ground or subgrade, whichever is less, or the slopes of other areas outside the subgrade limits.

The depth in embankment areas will be the maximum measured vertical distance between the pipe flow line and the surface of the constructed embankment as determined in 00330.42(c-6).

(b) Tee and Wye Fittings - Tee and wye fittings will be measured on the unit basis per each by actual count of units in place. No deduction will be made from measurement of pipe for the length of the fitting. Pipe plugs, stoppers and other fittings required to accomplish the work will be incidental to this item.

(c) Slip Joints - Slip joints will be measured for payment on the unit basis, per each, by actual count of units in place.

(d) Sloped and Skewed Ends - Sloped ends, skewed ends, or sloped and skewed ends will be measured on the unit basis, per each, by actual count of units in place.

(e) Safety End Sections - Safety end sections will be measured for payment on the unit basis, per each, by actual count of units in place.

(f) Metal Pipe Anchors - There will be no separate measurement for metal pipe anchors.

(g) Concrete Pipe Anchors - Concrete pipe anchors will be measured on the unit basis, per each, by actual count of units in place.

(h) Concrete Closure Collars - Concrete closure collars will be measured on the unit basis, per each.

(i) Concrete in Blocks - The quantities of concrete used in blocks will be measured in place on the volume basis.

(j) Reinforcement - The quantities of reinforcement used in blocks will be measured on the mass (weight) basis or lump sum basis according to 00530.80 and either 00530.81 or 00530.82.

00445.84 Television Inspection - The quantities of television inspection will be measured by the meter (foot). Measure pipes with sloped ends to the top of the sloped end sections.

00445.85

00445.85 Acceptance Testing - No measurement will be made of required air, hydrostatic and deflection acceptance testing.

00445.86 Installation Under Pavement - Pipe installed under pavement will be measured according to 00445.81. Trench resurfacing will be measured according to Section 00495.

00445.88 Installation Under Railroad - There will be no measurement of materials (except for pipe) for the lump sum pay item "Pipe Under Railroad". Pipe installed under railroads will be measured according to 00445.81.

Payment

00445.90 General - The Contract unit price for each pay item reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if provided in the plans).

Payment for trench excavation, bedding, pipe zone material, trench backfill, tracer wire and acceptance testing for pipes 1800 mm (72 inches) and less in diameter will be as specified in Section 00405.

Payment for trench excavation, bedding, pipe zone material, trench backfill, tracer wire and acceptance testing for pipes greater than 1800 mm (72 inches) in diameter will be as specified in Section 00510.

00445.91 Pipes and Appurtenances - The accepted quantities will be paid for at the Contract price per unit of measurement for each of the pay items listed in the Schedule of Items. Payment will be payment in full for furnishing and placing all materials, equipment, labor and Incidentals necessary to complete the work as specified.

(a) Pipes - Payment for pipes 1800 mm (72 inches) and smaller in diameter will be made at the Contract unit price per meter (foot) for the following item:

_____ mm (inch) _____ Pipe, _____ Depth

The nominal pipe diameter will be inserted in the first blank. The type of pipe will be inserted in the second blank. The appropriate flow line depth range from the list in 00445.81 will be inserted in the third blank.

Payment for pipes larger than 1800 mm (72 inches) in diameter will be made at the Contract unit price per meter (foot) for the following item:

_____ mm (inch) _____ Pipe

The nominal pipe diameter will be inserted in the first blank. The type of pipe will be inserted in the second blank.

For arch type pipe, the nominal diameter of circular metal pipe from which the pipe arch is formed, or reformed, will be inserted in the first blank.

(b) Appurtenances - The following items, when in the Schedule of Items, will be paid for at the Contract price for the unit of measure specified:

Pay Item	Unit of Measurement
(a) Pipe Tees, _____ mm (inch).....	Each
(b) Pipe Wyes, _____ mm (inch).....	Each
(c) Slip Joints, _____ mm (inch).....	Each
(d) Sloped End Sections, _____ mm (inch).....	Each
(e) Safety End Sections, _____ mm (inch).....	Each
(f) Concrete Pipe Anchors	Each
(g) Concrete Closure Collars.....	Each
(h) Concrete in Blocks	m ³ (Cubic Yards)
(i) Reinforcement in Blocks	kg (Pounds)
(j) Reinforcement in Blocks	Lump Sum

Payment for items (a) through (g) will be by actual count for units installed, and will include payment for pipe plugs, stoppers and other fittings required to accomplish the work.

For items (a) through (e) the nominal size will be inserted in the blank.

Payment for item (c) includes payment in full for furnishing and installing the outer sleeve of the slip joint as specified. The cost of the inner sleeve will be included in payment for the item " _____ mm (inch) Culvert Pipe, _____ Depth".

Payment for the item (e) will be payment in full for all costs involved in furnishing and installing safety end sections, including safety bars when required.

There will be no separate payment for metal pipe anchors. Payment will be included in payment for the appropriate pipe pay item.

The accepted quantities of reinforcement will be paid for on the mass (weight) or lump sum basis according to 00530.90. If there is no item provided in the Schedule of Items for "Reinforcement in Blocks" the cost will be considered Incidental with payment for reinforcement included in the item "Concrete in Blocks".

00445.94 Television Inspection - Payment for television inspection will be made at the Contract unit price per meter (foot) for the item "TV Pipe Inspection". Payment will be payment in full for furnishing all equipment, labor and Incidentals necessary to complete the work as specified.

00445.95 Acceptance Testing - All work and material involved in testing, excluding TV testing, of siphons, sanitary sewers, storm sewers, culverts and irrigation systems as specified will be considered Incidental and included in payment made for the applicable pipe pay item.

00445.96 Installation Under Pavement - There will be no separate payment for the additional work involved in placing pipe under pavement. Payment for trench resurfacing will be according to Section 00495.

00445.98 Installation Under Railroads - Payment for the additional work involved in placing pipe under existing railroad tracks as specified within the limits indicated on the plans, will be made at the Contract lump sum amount for the pay item "Installing _____ mm (inch) Pipe Under Railroad". The nominal diameter of pipe will be inserted.

00445.98

Payment will be payment in full for furnishing all equipment, labor, and Incidentals necessary to complete the installation as specified. Payment for the pipe will be made according to 00445.91. Payment for resurfacing will be according to Section 00495.

00445.99 Incidental Basis - When neither the Special Provisions nor Schedule of Items indicates separate payment for work under this Section, perform the work as Incidental work for which no separate payment will be made.

Section 00450 - Structural Plate Pipe, Pipe Arch and Arch

Description

00450.00 Scope - This work consists of constructing structural plate pipe, pipe arches, plate arches, horizontal ellipses, vehicular underpasses and special shaped structures.

00450.01 Definitions:

(a) Structural Plate Pipe - Built-up pipe with a circular cross section of the type, thickness and diameter specified. It is fabricated with the vertical diameter about 5% greater than the nominal diameter shown on the plans.

(b) Structural Plate Pipe Arch - Built-up pipe with a cross section made up of a multi-centered shape of four circular arcs, tangent to each other at their junctions, symmetrical about the vertical axis, and of the type, thickness and span specified. The size is designated by span and rise, measured from the inside crests of corrugations.

(c) Structural Plate Arch - Built-up pipe with a cross section of variable radii to form an arch shape structure designed to be supported along its lower edges on separately constructed reinforced concrete foundations, and of the design, type, thickness and span as shown. This size is designated by span and rise measured from the inside crests of corrugations.

(d) Structural Plate Horizontal Ellipse - Built-up pipe in an elliptical shape with the horizontal diameter approximately 20% greater than the nominal diameter. The size is designated by span and rise, measured from the inside crests of corrugations.

(e) Structural Plate Vehicular Underpass - Built-up pipe in a high arch shape with large radius sides and invert, and small radius corners between sides and invert. The size is designated by span and rise, measured from the inside crests of corrugations.

Materials

00450.10 General - Use materials meeting the following requirements:

Aluminum alloy structural plates	02430.20
Bolts, nuts and washers	02430.90
Galvanized structural plates	02430.10
Commercial grade concrete	00440
Reinforcement	00530

Construction

00450.40 Trench Work - Excavate trench, prepare bedding, backfill and dispose of excavated material according to Section 00510 and the following:

(a) Trenches In Unstable Areas - Excavate unstable materials under the pipe or pipe arch and to a width of at least one-half the diameter or span width on each side of the structure, to depths below the established elevation for the bases or foundation of the structure, as directed. Unless otherwise directed, backfill with granular structure backfill. Bring the backfill material to the moisture content required for compaction and place in 150 mm (6 inch) layers. Compact each layer according to 00330.43. Bring the backfill material to the elevation established.

00450.40(b)

(b) Trenches in Unyielding Material - When rock, hardpan or other unyielding material is encountered, remove it below the designated grade, as ordered, to a depth under the pipe or pipe arch equal to at least 40 mm/m (1/2 inch per foot) of fill height over the top of the pipe, but not less than 200 mm (8 inches), nor more than three-fourths the vertical dimension of the structure. Unless otherwise directed, backfill with granular structure backfill.

00450.41 Installation in Paved Areas - If structures are installed within paved areas to be preserved, resurface according to Section 00495.

00450.42 Erection:

(a) General - Assemble corrugated metal plates at the site of installation to the lines and grades shown or directed. Connect the plates at longitudinal and circumferential seams with bolts. Stagger joints so that no more than three plates come together at any one point. Each plate shall be curved to one or more circular arcs as required, and according to 02430.10, to provide an assembled structure of specified dimensions and design.

Retain any camber specified for the invert when assembling and erecting the structures. Do not create an adverse grade in the structure.

(b) Plate Thickness - The thickness of the respective top, corner and bottom plates in any one structure shall be as shown.

(c) Bolts - Use at least 13 bolts per meter (4 bolts per foot) of longitudinal seam. Space bolts at circumferential seams not more than 300 mm (12 inches) apart. Use additional bolts for special conditions of installation if called for in the Special Provisions or by the plans. Unless otherwise permitted, place all bolts with nuts on the inside of the structure.

(d) Assembly - Assemble structural plate structures according to the manufacturer's assembly instructions and the following:

- Hold the unsupported edges of all plates in position by temporary props.
- Extend each row of side plates far enough to support the plate above until the first complete ring has been assembled.
- Progressively install enough bolts to hold the plates in position. Do not tighten bolts until tightening will not interfere with adjusting and matching of additional plates and sections.
- Do not damage the galvanizing or other protective coating when using drift pins or pry bars. Repair any damage at Contractor's expense.
- After all plates are in place, progressively and uniformly tighten the bolts from one end of the structure.
- Tighten bolts to at least 135 N-m (100 foot pounds) of torque for plates 5 mm (0.188 inch) thick or less, and 200 N-m (150 foot pounds) of torque for plates more than 5 mm (0.188 inch) thick.
- Recheck and retighten as necessary before backfilling.
- Do not torque bolts above 400 N-m (300 foot pounds) during tightening.

(e) Damaged Coating - Repair damaged galvanizing according to 02420.10(d).

00450.44 Arch Substructures and Headwalls - Rest each side of each arch in a groove formed in the concrete, or rest on a galvanized angle or channel securely anchored to or embedded in the substructure. If the span of the arch is greater than 4.6 m (15 feet) or the skew angle is more than 20 degrees, provide a metal bearing surface having a width at least equal to the depth of the corrugation.

Metal bearings may be either rolled, structural, or cold-formed galvanized angles or channels, and shall be at least 5 mm (3/16 inch) thick. Anchor the horizontal leg securely to the substructure on 600 mm (24 inches) centers or less. When the metal bearing is not embedded in a groove in the substructure, punch one vertical leg and bolt to the bottom row of plates.

00450.45 Strutting - If strutting is required, place and remove according to 00445.44.

00450.46 Backfilling - Backfill and compact the trench according to 00510.48(d) and the following:

(a) General - Perform backfilling so that a vertical elongation between 4% and 6% greater than the indicated normal diameter is maintained. Place backfill material evenly on both sides of the structure at least up to the three-quarter point of the structure. Fill above the top of the pipe with minimum cover as indicated on the fill height table included with the plans.

(b) Exposed Pipe - Place and compact embankment materials at exposed pipes according to Section 00445.

(c) Tell-Tales - Install and remove tell-tales according to Section 00445.

(d) Arches And Horizontal Ellipses - In addition to the other provisions of this subsection, exercise care as follows:

(1) Before Headwalls Are Placed - If backfilling pipes before headwalls are built, place the first backfill material midway between the ends, forming as narrow a ramp as possible until the top of the pipe is reached. Build the ramp evenly from both sides, and compact the backfill material as it is placed. After the ramps have been built to the top on each side of the pipe, deposit the remainder of the backfill evenly on both sides from the top of the pipe both ways from the center to the ends.

(2) After Headwalls Are Placed - If headwalls are built before the pipe is backfilled, place the first backfill material adjacent to one headwall until the top of the pipe is reached. Then deposit backfill material evenly on both sides from the top of the pipe toward the other headwall.

In multiple installations, follow the above procedures. Use care to place and bring the backfill up evenly on each side of each pipe to avoid unequal pressure.

Compact the backfill material thoroughly, but not excessively. Puddling the backfill is not permitted.

00450.47 Footings and Headwalls - Construct footings and headwalls for arches according to the design shown and the requirements of Sections 00440 and 00530.

00450.48 Contact Surfaces, Aluminum to Concrete - Where uncoated aluminum pipe will be in contact with portland cement concrete, give the contact surfaces of the aluminum pipe a coating of asphalt mastic according to 00445.47.

00450.49 Work Quality - The following defects constitute poor work and the presence of any in an individual culvert plate or in a shipment will be cause for rejection:

- Dents or bends in the metal itself

00450.49

- Illegible brand
- Loose or unevenly lined or spaced bolts
- Ragged edges
- Unrepaired, bruised, scaled or broken spelter coating
- Uneven laps
- Variation from the specified alignment
- Wrong plate location

Measurement

00450.80 Trench Work - For pipes having diameters of 1800 mm (72 inches) and less, there will be no separate measurement of trench excavation, bedding and backfill. The quantities of excavation for pipes over 1800 mm (72 inches) in diameter will be measured according to Section 00510.

00450.81 Installation Under Pavement - The quantities for pipe under pavement will be measured according to 00445.81.

00450.82 Structures - The quantities of structural plate pipes, pipe arches, arches, horizontal ellipses and vehicular underpasses will be measured for payment on the length basis, excluding overlaps and the lip of plates at structure ends. Pipe arches and arches will be measured along the bottom centerline of the structures. The length of structural plate pipes, horizontal ellipses and vehicular underpasses will be the average of the top and bottom centerline measurements.

00450.83 Reinforcement - The quantities of reinforcement used in footings and headwalls will be measured on the mass (weight) basis according to 00530.81.

00450.84 Concrete - The quantities of concrete used in footings and headwalls will be measured on the volume basis according to 00540.82.

Payment

00450.90 Trench Work - There will be no separate payment for trench excavation, bedding and backfill for pipes having diameters of 1800 mm (72 inches) or less. The accepted quantities of excavation for pipes over 1800 mm (72 inches) in diameter will be paid for according to Section 00510.

00450.91 Installation Under Pavement - There will be no separate payment for installing pipe under pavement. Payment for trench resurfacing will be according to 00495.90.

00450.92 Structures - The accepted quantities for structures will be paid for at the Contract unit price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) _____ mm (inch) Structural Plate Pipe.....	m (Foot)
(b) ____ x ____ Structural Plate Pipe Arch	m (Foot)
(c) ____ x ____ Structural Plate Arch	m (Foot)
(d) ____ x ____ Structural Plate Ellipse	m (Foot)
(e) ____ x ____ Structural Plate Vehicular Underpass.....	m (Foot)

In item (a) the size will be the nominal diameter of the pipe in mm (inches). In items (b), (c), (d) and (e), the size will be the span and rise, in mm (inches), of the structure.

Payment will be payment in full for furnishing and placing all materials, equipment, labor and Incidentals necessary to complete the work.

00450.93 Reinforcement - The accepted quantities of reinforcement in footings and headwalls will be paid for according to 00530.90.

00450.94 Concrete - The accepted quantities of concrete in footings and headwalls will be paid for according to 00540.92.

Section 00460 - Paved Culvert End Slopes

Description

00460.00 Scope - This work consists of constructing portland cement concrete paved culvert end slopes at locations indicated on the plans or where designated.

Materials

00460.10 General - Use materials \ meeting the following requirements:

Curing compound.....	02050
Commercial grade concrete.....	00440
Welded wire fabric	02510.40

Construction

00460.40 General - Construct paved culvert end slopes according to Section 00440 and the following:

- Shape the base on which the concrete is to be placed to the lines and grades established. Water and compact the areas before placing concrete.
- Finish the surface of the paved culvert end slopes to a smooth, uniform texture by troweling and floating and then brush the surface with a broom or burlap, as directed.

Measurement

00460.80 Area Basis - The quantities of each paved culvert end slope, as shown on the plans, will be measured on the area basis. No actual field measurement will be made, except to check the work, unless changes are ordered, and no allowance will be made for paved culvert end slopes which are constructed on a skew.

If changes are ordered and made in the work, those paved culvert end slopes that are changed will be measured in the field. Measurements will be based on the actual surface area of the paved culvert end slope (not including the culvert opening) plus the face area of the cut-off wall.

Payment

00460.90 Area Basis - The accepted quantities of paved culvert end slopes will be paid for at the Contract unit price per m² (square foot) for the item "Paved Culvert End Slopes". Payment will be payment in full for furnishing and placing all materials, equipment, labor and Incidentals necessary to complete the work.

Section 00470 - Manholes, Catch Basins and Inlets

Description

00470.00 Scope - This work consists of constructing manholes, catch basins, inlets, sumps, siphon boxes, slope protectors and other similar structures. Construct the structures of commercial grade concrete, corrugated metal, or other material, with necessary frames, covers, gratings, and other fittings and hardware.

References to manholes, sumps, inlets, siphon boxes and slope protectors refer to standard structures of specific design and use, and are identified on the plans. The term "concrete" refers to commercial grade concrete.

00470.01 Cast-in-Place and Precast Construction - Concrete manholes shall be cast-in-place or precast, as shown or specified. Concrete sumps shall be precast. Concrete inlets and siphon boxes may be either cast-in-place or precast.

Materials

00470.10 General - Use materials meeting the following requirements:

Concrete drain tile.....	02410.40
Corrugated metal pipe	02420.10, 02420.40
Joint material.....	02440.40, 02440.50, 02440.60
Commercial grade concrete	00440
Metal frames, grates, covers, and ladders	02450.30
Nonreinforced concrete pipe.....	02410.10
Polyvinyl chloride (PVC) pipe, Schedule 40.....	02410.70
Precast concrete manholes, catch basins and inlets	02450.10, 02450.20
Reinforcement.....	02510.10, 02510.40
High density polyethylene (HDPE) Pipe.....	02410.60

00470.11 Precast Concrete Manholes and Bases - Furnish cones with the same wall thickness and reinforcement as riser sections.

Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material to be supplied to the Project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 497/C 497M.

Precast manhole sections shall consist of circular sections in one of the following standard nominal inside diameters:

1050 mm (42")
 1200 mm (48")
 1350 mm (54")
 1500 mm (60")
 1800 mm (72")
 2100 mm (84")
 2400 mm (96")
 3000 mm (120")
 3300 mm (132")
 3600 mm (144")

00470.11

Heights of sections shall be multiples of 150 mm (6 inches), except heights of manhole sections 1800 mm (72 inches) through 2400 mm (96 inches) in diameter shall be as required to fit site conditions.

00470.12 Cap Screws - Cap screws and washers for watertight manhole covers shall be stainless steel with 414 MPa (60,000 psi) minimum tensile strength conforming to the requirements of ASTM A 453/A 453M.

00470.13 Inside Drop Manhole Connectors - Furnish stainless steel anchor bolts and anchor straps for inside drop pipe connections.

00470.14 Pipe and Fittings - Furnish pipe and fittings as specified and conforming to the applicable portions of Section 00445. Use tees, ells and other fittings for drop manholes made from the same material as the pipe connecting to the manhole.

00470.15 Pipe Stubouts for Future Sanitary Sewer Connections - Pipe stubouts shall be the same type and strength classification as approved for use in the lateral, main or trunk sewer construction. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Furnish watertight plugs with each stubout and adequately brace against hydrostatic or air test pressures.

00470.16 Sanitary Sewer Manhole Carry-Through - All sanitary sewer carry-through pipes and fittings through storm sewer manholes shall be ductile iron conforming to Section 02420.

00470.17 Sump Backfill - Use crushed or uncrushed rock, visually well graded in size from either 100 mm to 50 mm (4 inch to 2 inch) or 150 mm to 50 mm (6 inch to 2 inch).

00470.18 Base Drain Backfill - Use aggregate base or selected granular backfill material that is free from silts or other fines.

Construction

00470.40 General:

(a) Excavation, Backfill and Foundation Stabilization - Excavate and backfill according to Section 00405. When specified, or as directed, remove unstable material that will not support the manhole or other structure, excavate below grade and backfill with trench foundation stabilization material according to Section 00405.

(b) Pipe Connections - Place connecting pipe at the required alignment and grade. Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall. Ensure that pipe connections to the structure are completely watertight. Connect all pipe to manholes according to the manufacturer's recommendations.

Grout concrete pipe connections to manholes so they are watertight, using non-shrink grout conforming to 02440.50. When grouted into the manhole section, the pipe section shall not extend more than 0.6 m (2 feet) outside the manhole. If an approved flexible connection for concrete pipe is provided at the manhole, full or partial pipe sections may be stubbed into the manhole as required.

Connect flexible pipe to sanitary manholes using an approved adapter specifically manufactured for the intended service. Use only flexible pipe adapters from the QPL. Do not use field-fabricated waterstops or improvised adapters. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming to 02440.50.

00470.41 Precast Concrete Manholes - Precast manhole components may be used to construct standard, drop and carry-through manholes.

(a) Bases - If bases are cast in place, consolidate the concrete by mechanical vibration. Screed off the concrete so that the first manhole section to be placed has a level, uniform bearing for the full circumference.

If bases are precast, carefully place the base section on the prepared bedding so as to be fully and uniformly supported at true grade and alignment.

Construct the invert to match that of the sewer pipe. Where the size of the sewer pipe is changed at the manhole, construct the invert to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, break out the top to the springline of the pipe for the full width of the manhole, and completely cover the exposed edge of the pipe with mortar. During construction divert existing flows of water or sewage away from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

(b) Precast Manhole Sections - Thoroughly wet all lift holes, completely fill with nonshrink grout, and smooth and point both inside and out to ensure watertightness.

(1) Sanitary Manholes - Use preformed plastic or rubber gaskets on all joints between manhole sections.

(2) Storm Manholes - Non-shrink grout is allowed on joints, and on 600 mm (24 inch) extension rings above the cone. In roadways and other areas intended for traffic, a minimum of one 600 mm (24 inch) diameter precast riser is required between the cone and manhole cover frame.

When grout is used do the following:

- Clean and wet the surfaces to be joined with water.
- Apply non-shrink grout to the lower portion of the bell or groove of the section already laid and to the upper portion of the spigot or tongue of the section being laid.
- Clean the joint recesses, fill completely with non-shrink grout and wipe to a smooth finish both inside and out.
- Do not allow free water to come in contact with grout joints within 24 hours after the mortared joints are finished.
- Protect the completed joints against rapid drying.

(c) Grates, Frames, Covers and Fittings - Set metal frames for manholes and sumps on full non-shrink grout beds to prevent infiltration of surface water or groundwater between the frame and the concrete of the manhole section. If concrete is to be poured around the frames, coat the portion of the frame that will contact the concrete with hot asphalt before placing the concrete. Set frames, covers and grates true to the locations and grades established. Clean bearing surfaces and provide uniform contact. Secure all fastenings. Construct all mortared, sanitary sewer manhole necks and all riser ring joints made with non-shrink grout using an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

00470.42 Precast Concrete Catch Basins and Inlets - Install precast catch basins and inlets to the specified line and grade.

00470.43 Cast-in-Place Concrete Construction:

(a) General - Construct cast-in-place manholes, inlets, siphon boxes and concrete slope protectors according to Section 00440. Finish all inside surfaces smooth and free of depressions or protrusions. Form exterior surfaces with steel, plywood or other approved materials. Form other surfaces with matched boards, plywood, or other approved material. Do not cast directly against trench walls, rock, or earth.

(b) Cast-in-Place Catch Basins and Inlets - Construct forms for both the inside and outside walls of cast-in-place catch basins. Forms shall be tight and well braced, with chamfered corners. Remove all water and debris prior to placing concrete.

Consolidate the concrete immediately after placement with an approved vibrator. Limit vibration time to that necessary to produce satisfactory consolidation without causing segregation. Screed the top surface and trowel exposed surfaces to a smooth finish, free from marks or irregularities. Radius exposed edges with a steel edging tool. After forms are removed, patch any defects in the concrete with an approved mortar mix.

Immediately after removal of forms and final finishing, cure according to 00440.40(e).

00470.45 Steps and Ladders - Fasten steps and ladders to the manhole walls according to the manufacturer's recommendations and as shown.

00470.46 Corrugated Pipe Slope Protectors - Construct corrugated metal slope protectors according to the plans and the applicable requirements of Section 00445.

00470.48 Sump Backfill - Place and compact granular backfill material around concrete sumps in layers no more than 300 mm (12 inches) thick and according to 00330.43. Avoid damage or displacement of the structure.

00470.49 Concrete Inlet Base Drains - Provide concrete inlets with base drains leading from abutting aggregate base or selected granular backfill material.

Use nonreinforced concrete pipe, concrete drain tile, HDPE or polyvinyl chloride (PVC) plastic pipe for basin drains. Place and compact backfill without damaging pipe or inlet.

Maintenance, Clean up and Testing

00470.70 Cleaning - Upon completion, clean each structure of accumulated silt, debris or foreign matter of any kind and keep clean until final acceptance of the work.

00470.71 Sanitary Manhole Acceptance Testing - Field test all sanitary sewer manholes for acceptance by either hydrostatic or vacuum testing after completion of backfilling, compaction and surface restoration, including paving. If the manhole fails the test, make necessary repairs by an approved method, and retest the manhole. Repair and retest the manhole until a satisfactory test is obtained.

(a) Hydrostatic Testing - Perform hydrostatic testing according to ASTM C 497/C 497M. Plug all inlets and outlets and fill the manhole with water. Fill each manhole to the rim at the start of the test. Leakage in each manhole shall not exceed 1.1 L/hr/0.3 m (0.3 gallons per hour per foot) of head above the invert. Determine leakage by refilling to the rim using a calibrated container. Manholes may be filled 24 hours prior to the time of testing to permit normal absorption into the manhole walls.

(b) Vacuum Testing - Perform vacuum testing according to ASTM C 1244/C 1244M. Plug and brace all pipes entering the manhole. Place the test head in or on top of the manhole ring. Draw a vacuum of 254 mm (10 inches) of mercury on the manhole, close the valve on the vacuum line of the test head, and shut off the vacuum pump. Measure the time for the vacuum to drop to 228 mm (9 inches) of mercury. The manhole is acceptable if the time for the vacuum reading to drop from 254 mm (10 inches) of mercury to 228 mm (9 inches) of mercury meets or exceeds the values indicated in the table below:

Minimum Test Times For Various Manhole Diameters

Depth * (m)	METRIC								
	Diameter (mm)								
	750 or less	825	900	1050	1200	1350	1500	1650	1800
	Time ** (s)								
2.4 or less	11	12	14	17	20	23	26	29	33
3	14	15	18	21	25	29	33	36	41
3.7	17	18	21	25	30	35	39	43	49
4.2	20	21	25	30	35	41	46	51	57
4.9	22	24	29	34	40	46	52	58	67
5.5	25	27	32	38	45	52	59	65	73
6.1	28	30	35	42	50	53	65	72	81
6.7	31	33	39	46	55	64	72	79	89
7.3	33	36	42	51	59	64	78	87	97
7.9	35	39	46	55	64	75	85	94	105
8.5	39	42	49	59	69	81	91	101	113
9.1	42	45	53	63	74	87	98	108	121

* Depth is measured from the top of the manhole to the lowest invert.

** Test times for manhole depths between those shown in this table may be calculated by interpolation.

Depth * (feet)	ENGLISH								
	Diameter (inches)								
	30 or less	33	36	42	48	54	60	66	72
	Time ** (s)								
8 or less	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	35	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

* Depth is measured from the top of the manhole to the lowest invert.

** Test times for manhole depths between those shown in this table may be calculated by interpolation.

Measurement

00470.80 General - The quantities of manholes, sumps, inlets, catch basins, siphon boxes, slope protectors, and other structures will be measured on a unit basis, per each by actual count. Required earthwork not covered as trench or ditch excavation, pipe connections, sump, rock backfill, aggregate base backfill and drain tile is considered incidental to the pertinent structure and no separate measurement will be made.

No separate measurement will be made for acceptance testing of sanitary sewer manholes.

Payment

00470.90 General - The accepted quantities will be paid for at the Contract unit price for one or more of the following items:

Pay Item	Unit of Measurement
(a) Concrete Sanitary Sewer Manholes.....	Each
(b) Concrete Storm Sewer Manholes	Each
(c) Concrete Manholes, _____	Each
(d) Concrete Sumps	Each
(e) Concrete Inlets, Type _____	Each
(f) Concrete Siphon Boxes	Each
(g) Concrete Diversion Boxes.....	Each
(h) Concrete Irrigation Boxes.....	Each
(i) Concrete Junction Boxes	Each
(j) Concrete Monument Boxes.....	Each
(k) Manhole Slope Protectors.....	Each
(l) Catch Basins, _____	Each

In items (c), (e) and (l) the type of structure will be inserted in the blank, with a separate pay item provided for each type.

Payment will be payment in full for furnishing and placing all materials, equipment, labor and Incidentals necessary to complete the work as specified, including all earthwork not covered as trench or ditch excavation.

There will be no separate payment for performing required acceptance testing.

Section 00475 - Drain Wells

Description

00475.00 Scope - This work consists of drilling 200 mm (8 inch) diameter drain wells, including furnishing and installing steel well casings, at the locations and to the depths shown, for the purpose of intersecting large voids in underlying rock.

Materials

00475.10 Well Casing - Use NPS 8 (8 inch), Schedule 40 black steel well casing pipe conforming to ASTM A 53/A 53M.

Construction

00475.40 General - Drill the drain wells at the locations and to the depths directed, before constructing manholes and inlets.

Test each drain well by running water into it to determine if the well has sufficient capacity. The well shall have a capacity of at least 1500 L/min (400 gallons per minute) for eight continuous minutes.

Measurement

00475.80 Drain Wells - The quantities of drain wells will be measured on a unit basis, per each, by actual count.

00475.81 Extra for Drain Wells Deeper than 30 m (100 Feet) - The quantities of drain wells deeper than 30 m (100 feet) will be on a length basis for the amount greater than 30 m (100 feet).

00475.82 Steel Well Casing - The quantities of steel well casings will be measured on a length basis.

00475.83 Testing Wells - No separate measurement will be made for testing drain wells or for the water or other materials used.

Payment

00475.90 General - The accepted quantities will be paid for at the Contract unit price per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) 200 mm (8 Inch) Drain Wells	Each
(b) Extra for 200 mm (8 Inch) Drain Wells Deeper Than 30 m (100 Feet)m	(Foot)
(c) NPS 8 (8 Inch) Steel Well Casing.....m	(Foot)

Item (a) will be payment in full for all costs involved in drilling 200 mm (8 inch) drain wells up to 30 m (100 feet) in depth.

Item (b) will be payment in full for all extra costs involved in drilling in excess of 30 m (100 feet) in depth. The Contractor will not be entitled to extra or additional payment if it is not necessary to drill deeper than 30 m (100 feet).

Item (c) will be payment in full for all costs involved in furnishing and installing steel well casings.

00475.90

Payment will be payment in full for furnishing and installing drain wells and casings including all materials, equipment, labor and Incidentals required to complete the work as specified.

00475.91 Testing Wells - No separate or additional payment will be made for testing drain wells or for the water or other materials used.

Section 00480 - Drainage Curbs

Description

00480.00 Scope - This work consists of constructing mechanically extruded curbs using either commercial grade concrete (CGC) or asphalt concrete material.

Construct the curbs at the locations and to the lines, grades and dimensions shown on the plans or as directed.

Materials

00480.10 General - Use materials meeting the requirements of the following:

Emulsified Asphalt	02710
Epoxy Bonding Agent	02070.10
Preformed Expansion Joint Filler	02440.10

00480.11 Commercial Grade Concrete - Furnish commercial grade concrete (CGC) according to Section 00440. Provide combined coarse and fine aggregates conforming to the following gradation limits when tested according to AASHTO T 27, unless otherwise approved:

Sieve Size	Percent Passing, by mass (weight)
12.5 mm (1/2")	100
9.5 mm (3/8")	75 - 100
4.75 mm (No. 4)	50 - 75
1.18 mm (No. 16)	20 - 40
600 µm (No. 30)	12 - 23
300 µm (No. 50)	5 - 15
150 µm (No. 100)	0 - 5

00480.12 Asphalt Concrete - Use a dense graded asphalt concrete mixture conforming to Section 00745 (Level 2, 25 mm (1 inch) or 19 mm (3/4 inch) Dense). The mixture may be varied when conditions require, if approved by the Engineer.

Construction

00480.40 Preparation of Base - Clean pavements upon which drainage curbs are to be constructed so that they are free of dirt, dust, oil, grease or other extraneous matter.

00480.41 Bonding Material Application:

(a) CGC Curbs - Bond CGC curbs to underlying pavements with an epoxy bonding agent from the QPL or conforming to 00480.10. Apply according to the manufacturer's recommendations and at a rate that provides a thorough coating to the surface with all voids and depressions filled. Place the new curb on the epoxy bonding agent within 15 minutes after spreading, or before it loses its tackiness, whichever is sooner.

(b) Asphalt Concrete Curbs - Bond asphalt concrete curbs to underlying pavement with either:

- An epoxy bonding agent meeting the requirements of 00480.10 or from the QPL, applied in the manner specified in 00480.41(a), or

00480.41(b)

- An emulsified asphalt of the type designated by the Engineer and conforming to 00480.10. Apply emulsified asphalt at a rate of 0.2 to 0.5 L/m² (0.05 to 0.10 gallons per square yard) of curb. Place the new curb on the emulsified asphalt after the asphalt separates from the water (breaks), but before it loses its tackiness.

00480.42 Commercial Grade Concrete Curbs:

(a) Placing and Finishing - Feed concrete into the extruding machine at a uniform rate and operate the machine under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete. Perform finishing work as required to present a smooth, dense surface.

Remove and replace honeycombed sections. Repair of honeycombed and other defective sections by plastering will not be permitted.

(b) Transverse Expansion Joints - Space expansion joints as shown. The width of the joint and thickness of the filler shall not be less than 12 mm (1/2 inch). Construct each expansion joint at right angles to the curb alignment, normal to the surface of the curb and provide complete separation of new concrete.

Firmly support the adjacent portions of the curb with close fitting shields if expansion joints are sawed before the concrete has hardened.

Mortar the joint filler in place if sawing is performed after the concrete has hardened.

(c) Transverse Contraction Joints - Space contraction joints as shown. Form the joints by grooving, by inserting and removing plates or other devices, by inserting and leaving in place preformed expansion joint fillers or by other approved means.

Make joints no wider than 6 mm (1/4 inch), and deep enough so that at least one-third of the cross-sectional area of the curb is severed. Tool the edges of joints. Clean unfilled grooves and fill with joint filler flush with the surface of the concrete.

(d) Curing - Begin curing curbs immediately after completing machine or hand finishing of the fresh concrete, according to 00440.40(e).

00480.43 Asphalt Concrete Curbs - Construct asphalt concrete curbs by the mechanical extrusion method. Produce a well compacted mass of asphalt concrete with a uniform texture finish.

00480.44 Line and Grade - Place a 3.6 m (12 foot) straightedge on the top or face of curb. The curb surface shall not vary more than 6 mm (1/4 inch) from the edge of the straightedge, except at grade changes or curves.

Measurement

00480.80 Length Basis - The quantities of drainage curbs will be measured on the length basis, for each continuous run measured along the line and grade of the curb.

Payment

00480.90 Length Basis - The accepted quantities of drainage curbs will be paid for at the Contract unit price per meter (foot) for the item "Drainage Curbs". Payment will be payment in full for furnishing and placing all materials, equipment, tools, labor and incidentals necessary to complete the work as specified.

Section 00490 - Work on Existing Sewers and Structures

Description

00490.00 Scope - This work consists of joining new work to existing work, repairing or abandoning of sewer lines and structures, and adjusting existing manholes, sumps, inlets, boxes and other similar structures. Remove and dispose of pipe, manholes and catch basins that are scheduled for removal according to Section 00310.

00490.01 Descriptive Terms:

Adjust - To raise, lower or reconstruct structures to a new top elevation flush with the surrounding surface.

Box - Valve box, meter box, monument box or other similar structure with a removable cover.

Bypass Pumping - The process of pumping sanitary sewer or storm flows around a manhole or pipeline during the construction or rehabilitation of those facilities.

Inlet - Structure designed to receive surface water through a grate or orifice and to discharge water through pipes.

Manhole - Manhole, sump or similar structure designed to permit entry and working space, usually at intersections of sewer pipes.

Manhole Neck - The upper portion of a manhole, having vertical walls and a uniform diameter or dimension just sufficient to receive and support the metal frame.

Materials

00490.10 General - Materials used shall be either existing materials in a condition suitable for reuse and meeting current design, or new materials that meet the following:

Joint materials.....	02440.40, 02440.50, 02440.60
Metal frames, covers, grates and ladders	02450.30
Commercial grade concrete	00440
Precast concrete sections	02450.10, 02450.20
Reinforcement.....	02510.10

00490.11 High Early Strength Concrete - Use high early strength concrete conforming to the requirements of commercial grade concrete, except it shall contain a minimum of 420 kg/m³ (705 pounds per cubic yard) of Type III or Type IIIA cement or an approved Type C or Type E admixture with a minimum of 350 kg/m³ (592 pounds per cubic yard) of Type I or Type II cement.

Construction

00490.40 General - Excavate and backfill according to Section 00405. Remove and dispose of old concrete and other materials according to Section 00310.

Obtain approval before reusing salvaged metal frames, covers, grates and fittings on structures to be adjusted.

When concrete is poured around frames, paint the portion of the frame that will contact the concrete with hot asphalt before the concrete is poured.

Provide high early strength concrete when shown on the plans, or when traffic is required to traverse the structure due to staging requirements. The Engineer will determine the length of curing time.

New construction shall conform to Section 00470.

Repair, replace or restore to existing condition any sump backfill, inlet base drain, aggregate base or pavement disturbed or fouled by the adjustment work as directed.

Bypass pump sanitary sewer and stormwater flows around the pipe section or manhole being repaired or replaced by plugging an existing upstream manhole and pumping the flow around the work to a downstream manhole. Submit a bypass pumping plan to the Engineer at least 48 hours before beginning bypass pumping. Use a pump with adequate capacity to handle existing flows and additional flow due to rain. Pumps shall not exceed a noise level of 86 dB at a distance of 15.2 m (50 feet). Do not operate bypass pumps at night except in an emergency. Do not discharge raw sewage onto private property or city streets, or into storm drain systems.

00490.41 Manholes over Existing Sewers:

(a) General - Construct manholes in accordance with Section 00470. Test all sanitary sewer manholes in accordance with Section 00470.

Prevent material or debris from entering the line.

When required, provide all diversion facilities and perform all work necessary to maintain flow in existing lines. Obtain the Engineer's approval prior to diverting flows.

(b) Manholes over Existing Rigid Pipe Sewers - Construct manholes over existing rigid sewers after first cleaning and applying an approved commercial concrete bonding agent to all surfaces of the pipe that will be in contact with the manhole.

If the top of the existing rigid pipe is to be cut out, cut it to the spring line for the full width of the manhole. Smooth and point the exposed edge of pipe with mortar.

Make rigid sewer pipe connections using an acceptable pipe connection according to Section 00470.

(c) Manholes over Existing Flexible Pipe Sewers - Construct manholes over existing flexible sewers systems with approved water stops, watertight fittings or boots at connections with the existing flexible sewer.

If approved, manholes may be constructed over existing PVC sewers and sealed at the manhole wall using the following method:

- Apply a coating of PVC solvent to the pipe that will be in contact with the manhole.
- Apply a dense coating of clean mortar sand over the PVC solvent cement.
- After the cement has cured, apply a commercial concrete bonding agent to the sand prior to placement of concrete.

(d) Manhole Connections - Construct openings in the existing manhole base or barrel as required. Construct connections that are watertight and that will provide a smooth flow into and through the manhole. All sanitary sewer pipe connections, including those at invert level as well as penetrations for drop connectors, conduits and carry-throughs, shall conform to the requirements of Section 00470.

00490.42 Service Line Connections to Existing Sanitary Sewers - Make connections of service lines to existing sewers watertight. Make connections, where possible, to existing tees or wyes that have been previously installed and plugged. Remove the plug and make the connection according to Section 00445. Make transition couplings between dissimilar pipe materials using approved commercial adapters with stainless steel bands.

Where tees or wyes for connection are absent or unusable, connect service lines with approved commercial taps. Do not backfill any tap until it is inspected and approved by the Engineer.

Install taps without protrusion into, or damage to, the existing sewer. Support the sewer and replace bedding material, as necessary, to prevent settlement of the sewer grade.

00490.43 Abandoning Pipe in Place - Drain abandoned pipes and plug watertight. Plug abandoned pipes with gasketed mechanical plugs or grout seals, as directed. Where abandoned pipes connect to sewer manholes, install the plugs or seals from the inside of the manhole and reshape the channel to conform to the Standard Drawings.

Fill abandoned pipes greater than 300 mm (12 inches) diameter with sand, controlled low-strength material meeting the requirements of 00442, or other approved material.

00490.44 Filling Abandoned Pipes, Manholes and Catch Basins - Cap or plug all connecting pipes to manholes and catch basins that are scheduled to be abandoned. Remove the manhole cone or flat top and manhole sections, or the catch basin frame, to a minimum depth of 1.0 m (3 feet) below finish grade and fill the remaining manhole barrel or catch basin with granular material meeting the requirements of Section 02630. Compact the granular material to 90% of maximum density according to AASHTO T 99. When in landscaped or unimproved roadway sections, backfill with approved materials meeting the requirements of 00330.13. Place topsoil meeting the requirements of 00330.11 for the last 0.3 m (1 foot) of backfill.

00490.45 Salvaging Manhole Frames, Covers and Grates - Remove manhole frames, covers and grates scheduled for salvage and store in an approved location. Frames, grates and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the work if of suitable size and condition. Replace, at no additional cost to the Agency, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.

Clean salvaged components to be reused of foreign material by methods that will not harm the components.

00490.46 Adjusting Manholes:

(a) Metal Steps and Ladders - If existing manholes or similar structures have metal steps or metal ladders, provide new steps or new ladder extensions in the adjusted structure, in kind. Construct according to the Standard Drawings.

(b) Concrete and Masonry Manholes - Manholes may be raised or lowered as specified below or as shown.

(1) Minor adjustments of manholes are those that require adding or removing precast grade rings or metal rings as approved.

(2) Major adjustments of manholes are those that infringe into the cone or flat top section. Remove the cone or flat top, add or remove sections, and replace the cone or flat top. Use risers to attain desired grade.

Precast sections removed in the adjusting work may be reused in other adjusting work or in new construction provided they are in good condition and otherwise conform to the Specifications. Precast items that are not used in the work become the property of the Contractor.

(c) Raising Tops of Manholes - The top of the manhole may be raised by the use of riser rings or by reconstructing the neck. Fabricated metal rings and plates may be furnished and used in the adjustment work, provided that:

- The metal and its fabrication provide at least the strength and support required for covers or grates
- Uniform bearing of bearing surfaces is assured
- Positive safeguards are made against displacement when in service

Do not exceed 460 mm (18 inches) total distance from the top of the metal frame at its new adjusted grade to the top of the cone. Riser rings and repairs shall conform with the requirements of Section 00470. Extend manhole barrels of brick, block or concrete in kind.

(1) Concrete Manholes - Reconstruct the neck of the manhole as follows:

- Remove existing frames, covers and grates.
- Chip away the exposed top surface on which new mortar or concrete is to be placed, to a depth of 40 mm (1 1/2 inches) or until firm concrete is exposed.
- Clean the new surface by brushing, and moisten with water at the time of placing new concrete.
- Place new concrete to the required grade and cure at least three days when using commercial grade concrete, and as directed when using high early strength concrete.
- Seat the frame in fresh mortar and bring to the proper grade.

(2) Masonry Manholes - Reconstruct masonry manholes of bricks or concrete blocks as follows:

- Raise with new bricks, blocks, precast components, mortar or combinations thereof, or with concrete, as conditions warrant.
- Do not place mortar for building up existing masonry to a depth of more than 75 mm (3 inches).
- Do not place concrete to a depth of less than 75 mm (3 inches).
- To conform to these requirements, cut down as necessary the existing shells or walls of structures to be adjusted to provide space for the new construction.

(d) Lowering Tops of Manholes (Minor Adjustment) - When the adjustment does not require removal of the cone or flat top, proceed as follows:

- Expose the top of the structure to the required depth.
- Cut off or remove elements of the structure to an elevation below that established for the bottom of the metal frame or cover.

- Build up with mortar, concrete, brick or concrete blocks to the required elevation.
- Join new material to old as specified in above under (a) through (c).

(e) Metal Manholes - Adjust metal manholes to grade by resetting the entire structure on a firm foundation, by adding extensions of like design and material, or by severing the barrel in an acceptable manner. Salvaged structures not reused on the Project become the property of the Contractor.

00490.47 Adjusting Catch Basins and Inlets:

(a) Cast-in-Place Concrete Catch Basins and Inlets:

- After existing frames and grates or covers have been removed, chip away the exposed top surface to expose firm concrete. Provide at least 25 mm (1 inch) clearance below the frame to be placed.
- Clean the new surface by brushing and moistening with water at the time of placing new concrete.
- Provide the necessary forms to maintain existing structure dimensions in the new work.
- Place new concrete according to Section 00440 to the required grades. The frame may either be preset in the form or placed in the fresh concrete to the required grades.
- Finish the concrete top surfaces as required to match the grades required.
- Grout existing and new inside surfaces as required to attain a uniform surface transition.

(b) Precast Concrete Catch Basins and Inlets - The entire precast structure may be reset to a new grade when the nature of the structure and conditions permit.

Precast concrete sections may be added or removed as required to obtain proper grade.

Precast structures may be raised by using precast sections provided that:

- The material conforms to the general requirements of the existing structure
- Sections are set and joined to each other and to existing sections
- Uniform bearing of bearing surfaces is assured
- Positive safeguards are made against displacement when in service.

(c) Catch Basin Connections - Adjust as follows:

- Place connecting pipe at the required line and grade.
- Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.
- Connect to the structure with a watertight joint.

00490.48 Adjusting Boxes, Cleanout Lids and Similar Structures - Raise or lower boxes, lids and similar structures by one of the following methods:

- Resetting the entire structure on a firm foundation.
- Adding extensions of like material below the original structure if raising the structure to a point where it would not enclose or protect its contents.
- Placing precast box extensions, or cast-in-place concrete.
- Complete replacement of the structure with a new structure of adequate design approved by the Engineer.

00490.49 Finish Grade - Center a 3.6 m (12 foot) straightedge, as far as practical, over the center of the cover of manholes and boxes. The final grade of the pavement surface and adjusted manholes and boxes shall not vary more than 6 mm (1/4 inch) from the finish grade and cross section at any point along the straightedge.

Measurement

00490.80 Unit Basis - The quantities of adjusted and reconstructed manholes, sumps, inlets, boxes and other similar structures will be measured on the unit basis, per each by actual count.

Manholes over existing sewers, connections to existing structures, and filling abandoned structures will be measured on the unit basis, per each by actual count.

00490.81 Incidental Basis - There will be no separate measurement for abandoning pipes in place, removal and disposal of existing structures and pipe, or bypass pumping.

Payment

00490.90 Unit Basis - The accepted quantities will be paid for at the Contract unit price per each for the following items:

- (a) Minor Adjustment Of Manholes
- (b) Major Adjustment Of Manholes
- (c) Adjusting Sumps
- (d) Adjusting Inlets
- (e) Adjusting Boxes
- (f) Adjusting Catch Basins
- (g) Manholes Over Existing Sewers
- (h) Connection To Existing Structures
- (i) Filling Abandoned Structures

Item (a) applies to manholes adjusted by adding or removing precast or metal grade rings.

Item (b) applies to manholes adjusted by:

- Removing and reconstructing part or all of the cone or flat top
- Removing and replacing the entire cone or flat top
- Adding precast risers below the cone of precast manholes

Item (g) applies to manholes that are installed over existing sewers and includes all incidentals required to complete the work as specified.

Item (i) applies to filling abandoned pipes, manholes, sumps, inlets, boxes and other similar structures and includes all materials and labor required to complete the work as specified.

Payment will be payment in full for furnishing and placing all materials including all equipment, labor and incidentals necessary to complete the work as specified.

Earthwork, backfill, protective coatings, replacement of sump backfill, base drains, aggregate bases, pavements, connections, structure abandonment, structure filling and other miscellaneous work will be considered incidental to the work with no separate payment being made.

Section 00495 - Trench Resurfacing

Description

00495.00 Scope - This work consists of resurfacing pipe trenches, including replacement of pavement, curbs, sidewalks, rock surfacing, topsoil, landscaping and other features removed or damaged during pipe trenching operations.

Materials

00495.10 General - Provide trench resurfacing materials that match existing material removed from pipe trenches, or meeting the following:

Hot Mixed Asphalt Concrete (HMAC)	00745
Emulsified Asphalt Concrete (EAC)	00735
Asphalt prime coat	00705
Asphalt seal and cover coat	00710
Aggregate	00641
Concrete sidewalks, curbs and driveway	00759
Concrete paving	00756
Rock surfacing	00641
Topsoil, planting and seeding	01040

Tack Coat for sealing the edges of asphalt concrete paving shall be RC 70 or MC 70 conforming to AASHTO M81 or M82.

Sand used for edge sealing shall be clean sand with no visible sign of silts or organic materials.

Construction

00495.40 General - The following construction requirements are for resurfacing trenches in various locations. Refer to Section 00405 for trench surface removal requirements.

(a) Hot Mixed Asphalt Concrete (HMAC) Paving - Place HMAC paving according to Section 00745.

(b) Emulsified Asphalt Concrete (EAC) Paving - When temporary surfacing is required prior to placing permanent surfacing, place EAC paving a minimum of 25 mm (1 inch) thick. The temporary paving shall be smooth with surface variations not greater than 12 mm (1/2 inch) from the existing surfacing. Where the temporary patch adjoins existing surfaces the joint shall not be greater than 6 mm (1/4 inch) high. Maintain the temporary surfacing until the permanent surfacing is placed. HMAC paving may be used if approved.

(c) Asphalt Prime Coat - Apply asphalt prime coat according to Section 00705.

(d) Asphalt Seal and Cover Coat - Apply asphalt seal and cover coat according to Section 00710.

(e) Edge Sealing Tack Coat Application - Seal all adjoining asphalt concrete pavement surfaces with an edge sealing tack coat. Place sufficient tack coat to seal the adjoining surfaces. After the tack coat has been placed, place clean sand over the tack coat. Reapply additional tack coat and sand cover to any edges that are not completely sealed in the first application.

(f) Aggregate Base - Place aggregate base according to Section 00641.

(g) Concrete Sidewalk, Curb and Driveway - Construct concrete sidewalk, curbs and driveways according to Section 00759.

- (h) **Concrete Paving** - Construct concrete paving according to Section 00756.
- (i) **Rock Surfacing** - Construct rock surfacing according to Section 00641.
- (j) **Topsoil** - Place topsoil according to Sections 00405 and 01040.
- (k) **Landscaping** - Place landscaping according to the requirements of Section 01040.

Measurement

00495.80 Area Basis - Measurement for trench resurfacing will be on the area basis. The length will be measured horizontally along the centerline of the installed pipe from edge to edge of the surface replaced. The width will be measured from edge to edge of the top of the trench.

When the pipe is installed under pavement by tunneling, boring, or jacking methods, the work will be measured for payment according to Section 00406.

Payment

00495.90 Trench Resurfacing - Quantities of trench resurfacing accepted for payment will be paid at the Contract unit price per square meter (yard) for the item "Trench Resurfacing".

Payment will be payment in full for furnishing, placing and compacting all materials as specified or as directed and providing all equipment, labor, and Incidentals necessary to complete the work.

Any replacement of disturbed landscape items other than topsoil is considered incidental to the work and no separate or additional payment will be made.

When the pipe is installed under pavement by tunneling, jacking, or boring methods, the work will be paid for according to Section 00406.

Payment will be payment in full for furnishing, placing and compacting all materials as specified or as directed and providing all equipment, labor, and Incidentals necessary to complete the work.

Any replacement of disturbed landscape items is considered incidental to the work and no separate or additional payment will be made.

00495.92 Incidental Basis - When neither the Special Provisions nor the Schedule of Items indicates separate payment for trench resurfacing or other work under this Section, perform the work as Incidental work for which no separate payment will be made.

Blank Page