PROJECT MANUAL

HAMPTON TOWNSHIP

BAY COUNTY, MI

BURNS ROAD WATERMAIN EXTENSION - 2021

September 2021
801130

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

SECTION 31 23 33

TRENCHING, EXCAVATING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for trenching, excavating and backfilling, special pipe foundations and special work below grade.

1.02 DEFINITIONS:

A. Maximum Density: Maximum dry weight in pounds per cubic foot of a specific material..

B. Optimum Moisture: Percentage of water at maximum density.

C. Rock Excavation: Includes all boulders or rock weighing 4,000 pounds (approximately one cubic yard) or more and all solid or ledge rock, slate, shale, sandstone and other hard materials that require continuous use of pneumatic tools, heavy rippers or continuous drilling and blasting for removal. Pavements are not included.

D. Suitable Excavated Material: Mineral (inorganic) soil free of cinders, refuse, sod, boulders, rocks, pavement, soft or plastic clays, vegetable or other organic material, and capable of being compacted as specified. Moisture content has bearing on the suitability of materials to be used.

E. Granular Material: Coarse grained materials having no cohesion, which derives its resistance to displacement from internal stability.

F. Cohesive Material: Fine grained material which derives its resistance to displacement by manual attraction between particles of the mass, involving forces of molecular origin (i.e. Clays are considered cohesive).

G. Grade Terminology: Article 3.07 SCHEDULES.

1.03 REFERENCES:

A. MDOT - Michigan Department of Transportation, *"2003 Standard Specifications for Construction".*

B. ASTM - American Society of Testing Materials, latest edition.

1.04 JOB CONDITIONS:

A. Obtain and comply with construction permits from agencies having jurisdiction over the work.

B. Scheduling: Clean up promptly following utility installation backfilling.

C. Dust Control: Broom or apply dust palliatives as needed.

D. Driveway Closing: Eight (8) hour maximum with prior notification to resident. Maintain emergency access to all properties during construction.

E. Signs, mailboxes and other movable surface features:
   1. Witness location prior to removal. Relocate to accessible location and maintain during construction.
   2. Upon completion of construction, replace to original position and condition.
   3. Replace regulatory traffic control signs immediately after utilities are placed and backfilled.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Trench Backfill:
   1. Granular Material shall be MDOT 902.08, Table 902-3, Class II limited to 1.0 inch maximum size.
   2. Concrete shall be Grade S3, 3,000 psi compressive strength, 4 inch maximum slump.
   3. Flowable Fill: Section 31 23 23.

B. Geotextile Fabric: Non-woven geotextile separator per MDOT 910.02.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Clearing and Grubbing:
   1. Save and protect all trees and vegetation not identified to be removed.
   2. Repair or replace trees, shrubs and other vegetation damaged by CONTRACTOR's operation at no additional charge.

B. Conflicting Underground Facilities:
   1. Before starting work, establish location and extent of existing underground facilities in work area.
   2. Establish potential conflict areas prior to construction.
   3. Excavate and expose existing underground facilities presenting potential conflict to determine their exact location and elevation.
   4. Advise ENGINEER of conflicts and obtain instructions on how to proceed.
   5. Make adjustments in proposed utility location at no additional cost to OWNER.
   6. Make arrangements with owner of existing underground facilities for relocation, if necessary.
   7. Schedule work accordingly.

3.02 EXCAVATION:

A. General:
   1. Dispose of surplus and unsuitable excavated material.
   2. Remove, salvage and stockpile topsoil on-site in area designated by ENGINEER.
   3. Unsuitable material encountered in subgrade or below payment line: Notify ENGINEER and obtain instruction on how to proceed.

B. Trenches:
   1. Depth: Provide a uniform and continuous bearing and support for proposed utility on solid and undisturbed or compact granular material.
   2. Minimum Width: Allow space for jointing and bedding.
   3. Maximum Width: The following limitations shall apply at utility crown:
      a. 6 inch through 10 inch diameter: 30 inches.
      b. 12 inch through 30 inch diameter: Outside diameter plus 24 inches.
      c. 30 inch and over diameter: Outside diameter plus 36 inches.
      d. Elliptical: Outside pipe width plus 36 inches.

C. Blasting:
   1. Not allowed unless otherwise indicated.
   2. If allowed, obtain and comply with required permits.
   3. If allowed, perform only during hours approved by OWNER.

D. Length of Open Trench shall be 200 feet maximum.

E. Damage to Existing Underground Utilities:
   1. Report all damage to ENGINEER and utility owner.
   2. Repair to utility owners standard.

3.03 BACKFILLING:

A. Pipe bedding area: Compact MDOT 6A stone.

B. Trench Backfill Area:
   1. Under permanent pavement, shoulder areas and areas within a one on one slope from the shoulder edge:
      a. Place MDOT Class II material compacted to ninety five percent (95%) of the maxiumum density using the Michigan core test.
   2. Under nonpermanent pavement: Same as permanent pavement.
   3. Under unimproved right-of-way areas: Compact suitable excavated material to eighty-five percent (85%) of maximum density.
   4. Under landscaped and unimproved areas: Compact suitable excavated material to eighty percent (80%) of maximum density.
   5. Under undercut existing structure: Place concrete.

C. Structures:
   1. Density requirements: Same as Trenches.
   2. Concrete structure: Place backfill only after seventy-five percent (75%) of concrete design strength has been reached.

3.04 TRENCH UNDERCUTTING AND BACKFILL:

A. Excavation: Perform to ENGINEER's instructions.
B. Backfill: Provide to payment line with granular material compacted in place.

3.05 COMPACTION, TESTING AND INSPECTION:

A. Surplus excavated and unsuitable excavated material shall become the property of the CONTRACTOR.

B. Dispose of surplus excavated or unsuitable excavated materials off-site.

C. Performance and test equipment will be provided by ENGINEER or OWNER approved independent laboratory.

D. Moisture - Density relationships:
   1. Cohesive (clays) soils: ASTM D 1557 (Modified Proctor).
   2. Granular (sands) soils: Michigan Cone Test.

E. Field Density: Either of following:
   1. ASTM D-2167 (Rubber Balloon).
   2. ASTM D-2922 (Nuclear).

F. Furnish equipment and personnel to provide access to test location and depth. Density tests will be performed at various levels, as determined by ENGINEER, during or after backfilling operation.

G. Correct any deficiencies resulting from insufficient or improper compaction. Retesting of density in areas of failed tests shall be performed by ENGINEER at the CONTRACTOR's expense.

3.06 SOIL EROSION AND SEDIMENTATION CONTROL: See SECTION 01 57 13 – TEMPORARY EROSION AND SEDIMENTATION CONTROL.

3.07 SCHEDULES: (See Details on Drawings).

END OF SECTION

SECTION 31 41 00

SHORING

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for all temporary support of trench excavations and excavation enclosures for work other than pump stations.

1.02 JOB CONDITIONS:

A. Interrupted Utility Service - Stand-by service: Provide to utility standards prior to shoring installation.

B. Installing and Removing by Jetting is prohibited.

C. Scheduling clean-up: Promptly following utility installation.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. General: Used or new, wood or steel.

B. Pipe Laying Box Dimensions: Provide adequate working room and control of trench width to meet utility bedding requirements.

C. Sheeting: Provide tore, straight, uniform sections with interlock that is continuous the full length of the sheet.

PART 3 - EXECUTION

3.01 PERFORMANCE:

A. Installation and Removal:
   1. General: Protect adjacent property, work and workmen.
   2. Pipe laying box:
      a. Permitted where safety of workmen is sole consideration.
      b. Prevent dislocation of utility and bedding when moving.
   3. Voids left by removal: Fill and compact in accordance with SECTION 31 23 33 - TRENCHING, EXCAVATING, BACKFILLING AND COMPACTING.
   4. Shore, sheet pile and brace excavations as required to maintain them secure, remove shoring as the backfilling progresses, but only when banks are safe against cave-ins or collapse. Where shoring or underpinning furnishes permanent or temporary support, extreme care shall be taken to insure that no settlement or collapse will occur. Conform to MIOSHA safety rules and regulations.

B. Temporary Shoring Left in Place: Cut off minimum 2 feet below established surface grade.

END OF SECTION

SECTION 32 92 00

SURFACE PROTECTION AND RESTORATION

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for protection and restoration of surface features such as site improvements, surface restoration and turf establishment, and all trees, shrubs, lawns and other landscape features.

B. Definition of Site Improvements: Fences, retaining walls and parking appurtenances, playing fields and equipment, sheds, mail boxes, underground lawn sprinkling systems and yard accessories.

1.02 REFERENCES:

A. MDOT - Michigan Department of Transportation, *"2020 Standard Specifications for Construction".*

1.03 SUBMITTALS:

A. Submit the following:

1. Manufacturer's certifications that materials provided meet specifications.

2. Seed mixture.

1.04 JOB REQUIREMENTS:

A. Surface Areas Disturbed by Construction Operation:
1. Restoration and Turf Establishment: Fine grade to 4 inches below finished grade. Place 4 inches of new topsoil and remove by raking all debris and stones greater than 1 inch diameter. Rake smooth to finished grade, seed, fertilize and mulch, or place mulch blanket pegged in place, where specified or directed by ENGINEER. Place sod in areas indicated on the Drawings.

B. Scheduling:
1. Restoration of lawns and other surface features: Promptly following curb and gutter, site or utility improvements, and paving.
2. Restoration of site improvements: Promptly following utility installation and paving.
3. Clean up: Promptly following restoration.

C. Seasonal Limitations: MDOT 816.03.C.4.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Trees, Shrubs and Plants: MDOT 917.01.

B. Topsoil:
   1. Topsoil may be salvaged and reinstalled from the project site or imported to the site:
      a. Salvaged topsoil:
         1) Must be segregated during construction and kept free of intermingling with other soils.
         2) The acceptance of salvaged topsoil is subject to its ability to establish turf. The salvaged topsoil must be acceptable to the Owner and property owner after turf is established. The existing topsoil may or may not be acceptable in its existing condition.
   2. Material:
      a. Salvaged and imported topsoil:
         1) Shall be screened and amended either on-site or off-site.
         2) Shall be loose, friable, and free of refuse and foreign material.
         3) 20% minimum organic material by test method ASTM D2974.
         4) pH of 6.8 to 7.5 by test method ASTM D4972.
         5) Gradation:
            a) 100% passing the ½" sieve.
            b) 98% minimum passing the ¼" sieve.
            c) 30% maximum passing the #200 sieve.

C. Chemical Fertilizer: MDOT 917.10.
   1. Phosphorus not allowed unless otherwise approved.

D. Grass Seed: MDOT 917.12.
   1. All species and their cultivars or varieties must be guaranteed hardy for Michigan.
   2. The species selected must be disease and insect resistant and of good color.
   3. Grass seed mix shall contain no more that 5% inert material by weight.
   4. The species of seed selected must be adapted for the site conditions and locations including but not limited to manicured yards.
   5. Grass Seed Mix shall be comprised of at least four of the below species and each species selected shall be 5% to 25% of the grass seed mixture by weight. At least two species selected shall be salt tolerant.
      a. Kentucky Bluegrass.
      b. Perennial Ryegrass.
      c. Hard Fescue.
      d. Creeping Red Fescue.
      e. Chewings Fescue.
      f. Turf-type Tall Fescue.
      g. Buffalo grass.
      h. Alkaligrass-Fults Puccinellia distans

E. Sod: MDOT 917.13.

F. Mulch Blanket: Excelsior or straw mulch blanket listed on the current Qualified Products List, MDOT Materials Sampling Guide. MDOT 917.

G. Site Improvements: Provide materials equal to or better than those that existed prior to start of construction whether shown or not shown on the drawings.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Inspection: Approval required.

3.02 TREES AND SHRUBS:

A. Protection: All items not indicated for removal.

B. Damaged branches: Trim and seal within fifteen (15) days.

C. Replacement: MDOT 815.01 through 815.04. Place mulching around tree with diameter one foot greater than ball diameter.

3.03 TOPSOIL:

A. Place 4 inches of new topsoil in preparation of seeding or sodding. Remove by raking all debris and stones larger than 1-inch diameter.

B. Construction methods: MDOT 816.03.A

3.04 SEEDING, FERTILIZING AND MULCHING:

A. Construction methods: MDOT 816.

3.05 MULCH BLANKET:

A. Construction Methods: MDOT 816.

3.06 SODDING:

A. Construction Methods: MDOT 816.

3.07 SITE IMPROVEMENTS:

A. Protection: All items not indicated for removal.

B. Replacement: Remove carefully, store and protect, and replace.

C. Restoration: Approval required.

3.08 SURFACE RESTORATION:

A. Seed: Backfill with site soil, place 4 inches of new topsoil, fine grade, remove by raking stones larger than 1 inch, clay lumps, wood, debris and other extraneous materials.

B. Sod: Grade backfill to smooth subgrade, place and fine grade 4 inches of new topsoil, place MDOT Class A sod, fertilizer, water and roll into new topsoil.

3.09 MAINTENANCE

B. Mowing:
   1. Contractor shall mow the grass prior to final acceptance.
   2. Turf shall be maintained at a visually appealing level and not more than 8 inches in height at any time prior to acceptance.

C. Weeding:

1. Weeds must be controlled to less than 10% of the turf establishment area during establishment and turf shall be weed free at time of acceptance.
2. The Contractor shall apply weed killer no sooner than recommended for newly established turf by weed control product manufacturer.

D. Watering:
1. Shall occur at minimum of once per week for 2 months after turf establishment has been placed.
2. Amount of water shall total a combined minimum of 1.5 inches of natural rainwater, irrigation water and contractor applied water per week.

E. Repair:
1. The Contractor is responsible, at no additional cost, for the repair of turf establishment work occasioned by storm events up to 3 inches of rain in a 24-hour period as documented by local meteorological data.
2. Repairs made to damaged turf establishment areas as a result of a documented storm by a local meteorological data resulting in rainfall amounts of more than 3 inches in a 24 hr period will be paid for as an increase to the turf restoration quantity.

F. Inspections:
1. The Contractor is responsible for all inspection of turf establishment work. Provide notification to Owner or Owner's representative of upcoming inspections or maintenance work.
2. Provide a Contractor’s Daily Report to report inspections made and to document turf establishment work performed on this project.
3. Complete and submit a Contractor’s Daily Report when any work performed is in progress.
4. Include all necessary materials documentation including tests slips, certifications, etc. with the associated Contractor’s Daily Report.

3.10 ACCEPTANCE

A. Final Acceptance:
1. Before final acceptance of the turf establishment work there must be no exposed bare soil and the turf must be fully germinated, erosion free, weed free, disease free, dark green in color and in a vigorous growing condition.
2. Once growth of weed-free grass has been achieved the Contractor’s responsibility in this matter shall have ended. However, it is to be clearly understood that any failure on the part of the property owner to properly care for the restored lawn area prior to achieving a good growth of weed-free grass shall in no way relieve the Contractor of his responsibility as set forth above.

3.11 SITE IMPROVEMENTS:

A. Site Improvements damaged by contractor shall be replaced by Contractor at Contractor’s cost.

B. Unique and one-of-a-kind items damaged during construction shall be repaired, replaced or otherwise resolved by the Contractor to its owner’s satisfaction.

END OF SECTION

SECTION 33 11 00

WATER MAINS

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes the work required for water mains, structures and appurtenant work installed by open-cut excavation methods.

1.02 REFERENCES:

A. AWWA - American Waterworks Association, latest edition.

B. ANSI - American National Standards Institute, latest edition.

C. ASTM - American Society of Testing Materials, latest edition.

1.03 SUBMITTALS:

A. Submit the following for review by ENGINEER:
   1. Product Data on Valves, Hydrants and service fittings.
   2. Details for each connection to existing water main.
   3. Proposed equipment (calibrated) and method for flushing, pressure testing, leakage testing and chlorination.

B. Report the following “as built” information to ENGINEER:
   1. Three (3) witness measurements to buried fittings, valves and curb boxes from permanent fixtures such as building corners, power poles and trees 8 inch diameter and larger.

C. Manufacturer’s certifications on pipe and fittings indicating conformance to specifications prior to installation.

1.04 JOB CONDITIONS:

A. Interrupting Water Service:
   1. Scheduling: Obtain OWNER's approval prior to interruption of service.
   2. Provide notice of twenty-four (24) hours to affected occupants and twenty-four (24) hours to Fire Department of time and duration.
   3. Provide stand-by service as required; outage not to exceed four (4) hours.
   4. Existing valve operation shall be by OWNER's employees only.
   5. Prevent contamination of existing water mains.

B. Install service lines after pressure and bacteriological testing is accepted.

C. Clean up promptly following pipe installation within maximum of 600 feet behind pipe laying operation. Clean up includes backfill and rough grading.

D. Salvage all existing valve boxes, curb boxes and hydrants removed and deliver to the OWNER’s yard. Hydrants shall be removed carefully without causing damage to the hydrant and fittings.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Hydrant Leads: Ductile iron pipe with mechanical joints.

B. All materials which may come in contact with water intended for use in the public water supply shall be certified to meet ANSI/NSF Standard 14, 61 and 372.

C. All chemicals which may come in contact with water intended for use in the public water supply shall be certified to meet ANSI/NSF Standard 60.

2.02 PIPE:

A. PVC: AWWA C900 and C905, or C909, Pressure Class 150 (DR 18). The pipe shall meet NSF Standard 14 for potable water and be stamped NSF-pw on the pipe wall.

B. Service Tubing:
   1. Copper: ASTM B88, Type K annealed and soft temper.
   2. Polyethylene (PE): CTS-OD PE 3408 per ASTM D2737, SDR 9, 200 psi.

2.03 JOINTS:

A. Ductile Iron Pipe and Fittings:
   1. Mechanical: AWWA C111 / ANSI A21.11.
   2. Push-on: AWWA C111 / ANSI A21.11.

B. PVC Plastic Pipe: Bell and spigot with elastomeric rubber ring gaskets ASTM D-3139.

C. Service Tubing and Fittings:
   1. Copper: Flared or compression.
   2. Polyethylene (PE): Mechanical or compression with stainless steel stiffener.

2.04 TRACER WIRE:

A. If PVC or HDPE pipe is used in this project, the CONTRACTOR shall install a 10 gauge solid copper locator wire with insulation suitable for direct burial with the water main. The locator wire shall be attached to the main at approximately 15 feet intervals with plastic cable ties. Splices shall be soldered copper-to-copper and shrink-wrapped to establish insulation across spliced length. A minimum of 6 feet of wire shall be left accessible inside structures and at fire hydrants. The CONTRACTOR shall be responsible for testing continuity of wire locator.

2.05 FITTINGS:

A. Ductile Iron: AWWA C110 / ANSI A21.10, or AWWA C153 / ANSI A21.53, Class 54, 250 psi working pressure through 12 inches and 150 psi above. Mechanical joint solid sleeves shall be Clow Corporation #F1012 or equal.

2.06 VALVES (OPEN RIGHT):

A. Gate: AWWA C515 Resilient seated, epoxy coated surfaces, rubber encapsulated gate, bronze non-rising stem with double o-ring seal. Provide full diameter unobstructed flow. End connections shall match pipe.

1. Manufacturer(s): US pipe Metroseal 250, American Darling**,** EJ, or approved equal.

B. Boxes: Three (3) section cast iron with lid marked WATER:
   1. Upper section: Screw on adjoining center section and full diameter throughout. Place geotextile fabric around threaded joint of risers, if used.
   2. Center section: Minimum 5 inch inside diameter.
   3. Base section: Fit over valve bonnet and shaped round for valves through 10 inch and oval for 12 inch and over. Place geotextile fabric around valve bonnet.

2.07 HYDRANTS (OPEN RIGHT):

A. AWWA C502, mechanical joint with a plugged drain outlet.

B. Residential: 5 inch size with 6 inch inlet connection, 2 - 2½ inch hose nozzles and 1 – 4½ inch pumper nozzle.

C. Provide National Standard Fire Hose Thread.

D. Manufacturer: East Jordon 5BR250.

E. Color: OWNER's standard. Painted at factory with primer and two (2) coats.

F. Barrel length shall be properly sized so the centerline of the pumper nozzle is 21" to 27" above grade at the specified depth of cover over the pipe.

G. Hydrant Extension: 36-inch maximum, limited to one per hydrant.
   a. Install between breakaway flange and top of hydrant lower section.

2.08 SERVICE FITTINGS:

A. Corporation Stops:
   1. Copper tubing: Mueller Co. H-15008, or Ford F-1000 or FB-1000.
   2. Plastic tubing: Mueller Co. H-15008, or Ford F-1000 or FB-1000.

B. Curb Stops: Mueller Co. H-15209, or Ford B44.

D. Curb Boxes: Mueller Co. (Arch type) H-10306 (with H-10310 base for 2" curb stop), Ford EA2-55-50 (Arch type).

2.10 MISCELLANEOUS:

A. Service Clamps: Brass or bronze with stainless steel parts, AWWA C800 threads.

B. Tie Rods and Clamps: Clow Corp. or Traverse City Iron Works.

C. Plastic Seamless Encasement Tubing:
   1. Material: ASTM D-4976 Polyethylene, cross-laminated, high density, 4 mils thick, conforming to ASTM A674 and AWWA C105.
   2. Closing Tape: Minimum 2 inch wide Poly Ken #900 or Scotchwrap #50.

D. Mechanical Joint Restraint: Megalug by EBAA Iron Sales, Inc., or approved equal.

E. Pipe Insulation: Closed cell extruded polystyrene 2 inch thick rigid board manufactured by Dow, Owens Corning or ENGINEER approved equal.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Alignment and Grade:
   1. Deviations: Notify ENGINEER and obtain instructions to proceed where there is a grade discrepancy or an obstruction not shown on plans.
      a. Verify location and depth of existing utilities in advance of construction and provide adjustments in alignment and grade of water main at no additional cost to OWNER.
   2. Depth of pipe: Minimum cover over pipe below finished grade by zones (unless otherwise indicated on plans):
      a. Lower part of lower peninsula of Michigan and south (South of the north boundary of tier of townships 20 north which is approximately highway US 10): 5 feet - 0 inches.
      b. Upper part of lower peninsula: 5 feet - 6 inches.
      c. Upper Peninsula: 6 feet - 0 inches.
   3. High points in pipeline: Locate at services and hydrants.

B. Bedding:
   1. Method: Article 3.05 SCHEDULES. Utilize Type II bedding for PVC pipe.
   2. Provide bedding area backfill in accordance with SECTION 31 23 00 –TRENCHING, EXCAVATING AND BACKFILLING.
   3. Provide continuous bearing supporting entire length of pipe barrel evenly.
   4. Bedding of carrier pipe in casing pipe shall be in accordance with SECTION 33 05 25 BORING AND JACKING.

C. Cleaning Pipe and Fittings:
   1. General: Provide interior free of foreign material and joint surfaces free of lumps and blisters.

3.02 INSTALLATION:

A. General: Meet requirements of AWWA C600 for ductile iron pipe, AWWA C605 for PVC pipe and these specifications.

B. Laying Pipe:
   1. Prevent entrance of foreign material and plug watertight when left unattended.
   2. Provide pipe length and bedding as a unit in a frost free, dry trench.
   3. Special supports and saddles: Article 3.05 SCHEDULES.
   4. Provide minimum vertical separation between water main and crossing sanitary sewer, storm sewer or force main of 18 inches, measured from edge of pipe to edge of pipe. Provide minimum horizontal separation between water main and parallel sanitary sewer, storm sewer or force main of 10 feet, measured from edge of pipe to edge of pipe.
   5. ENGINEER’s approval required for pipe lengths less than 6 feet.
   6. Joint deflection for ductile iron pipe shall not exceed the following values or as recommended by pipe manufacturer.

Maximum Joint Deflection

Nominal Pipe Size (inches)	Push-On Joint		Mechanical Joint	
	Deflection Angle (Deg-Min)	Maximum Offset (inches)*	Deflection Angle (Deg-Min)	Maximum Offset (inches)*
4	3° - 30’	14	6° - 15’	23
6	3° - 30’	14	5° - 20’	20
8	3° - 30’	14	4° - 00’	15
12	3° - 30’	14	4° - 00’	15
16	2° - 15’	8 ¼	2° - 40’	10
24	2° - 15’	8 ¼	1° - 45’	7

*Offsets are based upon 18-foot lengths of pipe

C. Cutting Pipe:
   1. PVC: Power saw or hand saw.

D. Jointing:
   1. Mechanical:
      a. Lubricate as recommended by manufacturer.
      b. Tighten bolts evenly to 75 to 90 foot-pounds.
   2. Push-on:
      a. Lubricate as recommended by manufacturer.
      b. Shape beveling as recommended by manufacturer.
   3. Plastic: Manufacturer's standard.

E. Setting Valves, Fittings and Fire Hydrants:
   1. General: Article 3.05 SCHEDULES.
   2. Valves: Set plumb.
   3. Valve boxes:
      a. Base section: Center and plumb over operating nut and 2 inches above bonnet joint.
      b. Upper section: Set cover ¼- inch below finished grade.
      c. Witnesses: Provide 3 measurements to permanent surface features.
   4. Hydrants:
      a. Connection: With ductile iron pipe and auxiliary valve.
      b. Positioning: Plumb with pumper nozzle facing curb and nozzle centerline 21-27 inches above finished grade.
      c. Provide necessary length of 6 inch pipe for hydrant leads.
      d. Provide access to all hydrants.
   5. Tie valves to tees and crosses and tie hydrants to valves.
   6. Provide joint restraint using Megalug retainer glands in accordance with the pipe restraint table in Paragraph 3.02 I.1.

F. Connections:
   1. Existing water mains:
      a. Provide temporary support during cut-in.
      b. Disinfect by swabbing pipe, valves and fittings with four percent (4%) chlorine solution.
      c. Pressure off: Install mechanical joint solid sleeve.
      d. Pressure on: Install tapping sleeve, valve and box.

e. Asbestos cement pipe: Meet requirements of ASTM E 2394 – 04.

2. Service lines:
   a. Align at right angles to street or easement line.
   b. Minimum depth shall be same as pipe.
   c. Install after acceptable pressure test and chlorination of water main.
   d. Curb boxes: Set plumb and provide 3 measurements to surface features.
      (1) Locate at easement line within easement or at right-of-way line within road right-of-way, unless otherwise directed.
      (2) Cover with 5' long section of 4" PVC pipe buried 2 feet.
      (3) Set cover ¼-inch below finished grade.
   f. Tapping shall be at 45º above center and shall provide horizontal loop at corporation stop.
      (1) Plastic Pipe: Tap pipe using a hole saw cutter (new cutter) and double strap saddle per manufacturer's recommendation. No direct tapping allowed.
   f. Maximum tap sizes shall be as follows:

Type of Pipe	Pipe Size									
	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	Maximum Tap Size with Double Strap Saddle									
All Pipe:	1"	1½"	2"	2"	2"	2"'	2"	2"	2"	2"

H. Dead-end water main stubs longer than 20 feet:
   1. Install standpipe with shutoff at dead ends to aid in chlorinating, testing and flushing. Remove standpipe upon approval of water main.

I. Pipe Joint Restraint:
   1. Provide mechanical joint restraint for the minimum lengths shown in the table below:

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

* The length of restrained pipe required shown in the table above is based on trench backfill being compacted to 95% of the maximum density according to the Modified Proctor Method. The above table does not consider polyethylene wrapped pipe. If the pipe is wrapped with polyethylene, a greater length of restrained pipe will be required. Unless otherwise specified, a multiplier of 1.5 shall be used to determine the required length when the pipe is wrapped with polyethylene.

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

a. Tees: Pipe restraint length shown in the table above shall be provided in the branch direction. Also, the minimum length of pipe restraint in the straight through (run) direction shall be 10 feet on both sides of the tee.
b. Bends: Pipe restraint length shown in the table above shall be provided on both sides of the bend.
c. Dead End: Pipe restraint length shown in the table above shall be provided back from the dead end plug.
d. See 3.06 SCHEDULES for a detail illustrating the joint restraint requirements.
e. All joints shall be restrained for pipe within casings.
f. All joints between bends on water main offsets shall be restrained.

J. Reaction Backing (allowed only where restrained joints cannot be used and when approved by ENGINEER):
1. Placement:
a. Place concrete manhole block next to pipe and concrete reaction backing behind. Mega lugs and fitting bolts shall not be covered with concrete.
2. Bearing area: Provide the following square feet of concrete against trench wall in sand:

Pipe Size	Tees Plugs	Hydrants 90º Els	Wyes 45º Els	22½º Els	11¼º Els
4"	2	1	1	1	1
6"	3	3	2	1	1
8"	4	6	3	2	1
10"	7	9	5	3	2
12"	9	11	6	3	2
14"	11	15	8	5	3
16"	13	20	10	6	3
18"	16	25	12	7	4
20"	20	28	14	8	4
24"	28	40	20	11	6

3. Other Soil Conditions:
(a) Cement sand or hardpan - Multiply above by 0.5
(b) Gravel - Multiply above by 0.7
(c) Hard dry clay - Multiply above by 0.7
(d) Soft clay - Multiply above by 2.0
(e) Muck - secure all fittings with Megalug retainer glands or tie rod clamps and concrete reaction backing the same as listed for sand conditions. Install as required by SECTION 31 23 33 – TRENCHING, EXCAVATING, BACKFILLING AND COMPACTING.

K. Repair sewer laterals disturbed during construction with PVC schedule 40 pipe and FERNCO fittings.

M. Pipe Insulation: Where noted on Drawings, place insulation board 4 feet wide over pipe at top of bedding.

3.03 FIELD QUALITY CONTROL:

A. Testing and Inspection:
   1. General:
      a. Observation: By ENGINEER.
      b. Completion: Before connecting to existing line.
      c. Notification: Pretest and arrange with ENGINEER for observation of test. Contractor to pay additional cost for ENGINEER to witness retests.
      d. Equipment and assistance: Provide.
      e. Required water: By OWNER where available from municipal system.
      f. Connection to existing water main: After passing pressure and leakage tests, and bacteriological testing.
      g. Meet requirements of AWWA C600 for ductile iron pipe, AWWA C605 for PVC pipe and these specifications.
   2. Pressure/Leakage Test:
      a. Conditions: Air or air-water methods of applying pressure prohibited.
      b. Sequence: Prior to Flushing and Chlorination.
      c. Procedure: Fill system slowly, expel air through corporation stop at high points and apply pressure.
      d. Pressure: Maintain 150 psi.
      e. Duration: Two (2) hours.
      f. Make-up water: From measurable source.
      g. Leakage: Quantity of water supplied to maintain test pressure.
      h. Allowable: Less than:

$$L = \frac{SD \times \text{square root of } P}{148{,}000}$$

         where,
         L = leakage (gallons per hour).
         S = length of pipe (feet).
         D = nominal pipe diameter (inches).
         P = average test pressure (pounds per square inch gauge).

      i. Correction: Repair defects and repeat test until acceptable.
      j. Maximum length of pipe to be tested shall be 2000 feet.

   3. Testing valves only: Maintain pressure on main and check all valves as follows:
      a. Vent extreme ends of main and briefly check each valve progressively back towards test point.
      b. Allowable pressure drop shall be less than 10 psi in five (5) minutes with test pump off.
      c. Correction: Repair defects and repeat test until acceptable.

3.04 FLUSHING:

A. Flushing: Shall be performed in accordance with ANSI/AWWA C600, C605 & C651.
   1. Sequence: Following pressure testing and prior to chlorination.
   2. Maximum intervals: 2,000 feet.
   3. Required water: By OWNER where and when available from municipal system. Maintain 40 psi residual pressure in existing water system.
   4. Minimum velocity: 3.0 feet per second at pipe wall. See table below for size and number of Taps required to achieve minimum velocity:

Required flow and openings to flush pipelines

Pipe Diameter *inches*	Flow Required to Produce 3.0 ft/s Velocity in Main *gpm*	Size of Tap 1"	Size of Tap 1½"	Size of Tap 2"	Number of 2 ½-in. Hydrant Outlet
		Number of Taps on Pipe			
4	120	1	-	-	1
6	260	-	1	-	1
8	470	-	2		1
10	730	-	3	2	1
12	1,060	-	-	3	1
16	1,880	-	-	5	1

B. The CONTRACTOR shall submit to the ENGINEER a procedure schedule outlining the method the CONTRACTOR proposes to use for flushing water mains. Mains shall be flushed at a maximum of one quarter mile intervals. Utility owner shall be given notice by CONTRACTOR prior to any flushing.

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

3.05 DISINFECTION:

A. Chlorination: Shall be performed in accordance with ANSI/AWWA C651-14, continuous feed method.
   1. Observation: By ENGINEER.
   2. Required water: By OWNER where available from municipal system.
   3. Chlorine gas: Not permitted on job-site.
   4. High Test Calcium Hypochlorite (HTH, "Perchloren," "Maxochlor," "Pittchlor"): Powder and water shall be mixed to form a 1 percent chlorine solution (10,000 ppm). Pump solution at a constant rate into the water main while bleeding off the water at the extreme end. AWWA B300.
   5. Liquid Chlorine: Liquid chlorine may be applied to the water main much the same way as the hypochlorite solution listed above. AWWA B301.
   6. Sequence: Following pressure tests and flushing and prior to connection to existing water main.
   7. Retention time: Chlorinated water of at least 25 mg/l initial shall remain in the pipe for at least 24 hours. At the end of the 24-hour period the chlorine residual shall be at least 10mg/l or re-chlorination must take place.
   8. Procedure: Operate all valves during disinfection.
   9. Bacteriological Testing:
      a. Two consecutive safe bacteriological samples shall be taken 24 hours apart before placing the water main into service. Samples shall be collected for every 1,200 feet of new main, plus samples from each branch and the end of the line. If excessive quantities of debris, or trench water, have entered the main, samples shall then be taken at approximately 200-foot intervals.
      b. Sampling: By OWNER.
      c. Laboratory: State of Michigan certified for Drinking Water.
   10. Correction: Re-chlorinate sections not meeting MDEQ bacteriological requirements.
      a. Retesting shall be paid by CONTRACTOR.

B. Disinfection report; record:
   1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
5. Date and time of flushing start and completion.
6. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report record:
1. Date issued, project name, and testing lab name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards.
8. Bacteriologist's signature and authority.

D. The chlorinating agent shall be applied in both method and concentrations per AWWA C651, latest version.

E. De-chlorination: After chlorination, the water shall be flushed from the line at its extremities until all of the heavily chlorinated, but before bacteriological sampling, the water main shall be flushed and then filled with potable water from a suitable source with a residual chlorine concentration in the water that is no higher than that generally prevailing in the distribution system and that is acceptable for domestic use. If flushed water is discharged directly to open drains, discharge water through de-chlorinated tablets in mesh bag or other acceptable means/methods to remove chlorine.

E. Collect water samples in sterile bottles containing sodium thiosulfate for bacteriological analysis from the end-most outlet of the pipe line at the end of every branch and every 1200 feet of new main. Two (2) samples must be taken 24 hours apart for each section of the line tested. If both samples show safe results, and meet the Safe Drinking Water Standards, the new pipe line may be placed in service through cooperation of the OWNER and CONTRACTOR. If, however, the results are unsafe, a repetition of the chlorine treatment is necessary. Samples should never be collected from hoses or fire hydrants. A suggested sampling tap is a corporation cock with copper goose neck assembly. The goose neck assembly may be removed after use, at the option of the OWNER, samples shall be taken during chlorination.

F. If cutting into or repairing water mains, follow procedures outlined in ANSI/AWWA C651-14.

3.06 SCHEDULES:

A. Standard Details:
1. Special supports for underground utilities / pipe saddles.
2. Methods of bedding pipe – pressure pipe.
3. Hydrant berm.
4. Water main offset / relocation detail.
5. Hydrant assembly.
6. Copper service lead connection / sample point.
7. Joint restraint requirements.

END OF SECTION