DIVISION 16 – ELECTRICAL

Prepared by Krishna Engineering Company

SECTION 16000

ELECTRICAL REQUIREMENTS

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1.2 Characteristics
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PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes characteristics, scope and requirements of electrical work.

B. Related work specified elsewhere: Division 1 - General Requirements.

1.2 CHARACTERISTICS

A. All electrical service is 60 Hz.

B. Existing power services to campground: 240 volts, 1 phase, 3 wire; grounded neutral.

C. New power supply to campground: 240 volts, 1 phase, 3 wire; grounded neutral.

1.3 WORK BY ALLIANT ENERGY

A. Disconnect and remove Alliant Energy electric service equipment that is not retained and used for new electric services to campground.

B. Power Transformer for Distribution Panel 1:

1. Furnish and install underground primary conductors from power transformer for distribution panel 1 to power transformer for distribution panel 2 and connect.

C. Power service to Distribution Panel 2:

1. Furnish and install underground primary conductors from power transformer for distribution panel 2 to power transformer for distribution panel 3.

2. Furnish and install secondary conductors from power transformer to metering transformer cabinet in underground conduits furnished and installed by Contractor.

3. Furnish and set box pad for power transformer.

4. Furnish and set power transformer on box pad; make physical connections on primary and secondary side.

5. Furnish and install metering instruments in metering transformer cabinet; furnish and install wiring between metering instruments and meter socket in metering conduit furnished and installed by Contractor; furnish and install meter in meter socket furnished and installed by Contractor; connect metering equipment.

6. Energize power transformer.

D. Power service to Distribution Panel 3:

1. Furnish and install underground primary conductors from power transformer for distribution panel 3 to power transformer for distribution panel 4.

2. Furnish and install secondary conductors from power transformer to metering transformer cabinet in underground conduits furnished and installed by Contractor.

3. Furnish and set box pad for power transformer.

4. Furnish and set power transformer on box pad; make physical connections on primary and secondary side.

5. Furnish and install metering instruments in metering transformer cabinet; furnish and install wiring between metering instruments and meter socket in metering conduit furnished and installed by Contractor; furnish and install meter in meter socket furnished and installed by Contractor; connect metering equipment.

6. Energize power transformer.

E. Power service to Distribution Panel 4:

1. Furnish and install underground primary conductors from power transformer for distribution panel 4 to power transformer for distribution panel 5.

2. Furnish and install secondary conductors from power transformer to metering transformer cabinet in underground conduits furnished and installed by Contractor.

3. Furnish and set box pad for power transformer.

4. Furnish and set power transformer on box pad; make physical connections on primary and secondary side.

5. Furnish and install metering instruments in metering transformer cabinet; furnish and install wiring between metering instruments and meter socket in metering conduit furnished and installed by Contractor; furnish and install meter in meter socket furnished and installed by Contractor; connect metering equipment.

6. Energize power transformer.

F. Power service to Distribution Panel 5:

1. Furnish and install primary conductors down existing power pole and underground to power transformer.

2. Furnish and install secondary conductors from power transformer to metering transformer cabinet in underground conduits furnished and installed by Contractor.

3. Furnish and set box pad for power transformer.

4. Furnish and set power transformer on box pad; make physical connections on primary and secondary side.

5. Furnish and install metering instruments in metering transformer cabinet; furnish and install wiring between metering instruments and meter socket in metering conduit furnished and installed by Contractor; furnish and install meter in meter socket furnished and installed by Contractor; connect metering equipment.

6. Energize power transformer.

1.4 SCOPE OF WORK

A. Meet requirements of current editions of Alliant Energy Electric Service Rules and Alliant Energy Electric Service Equipment for work associated with power services to distribution panels 2, 3, 4 and 5.

B. Work associated Distribution Panel 2 power service:

1. Furnish and install two 4" conduits with pull strings minimum 42" below grade from Alliant Energy power transformer secondary section to metering transformer cabinet; use Schedule 40 rigid nonmetallic conduit with 18" radius elbows and offsets below grade; use Schedule 80 rigid nonmetallic conduit above grade; provide expansion fitting in each conduit immediately below metering transformer cabinet.

2. Construct outdoor free standing meter structure complying with Alliant Energy requirements at location shown on Drawings.

3. Furnish and install metering transformer cabinet and meter socket complying with Alliant Energy requirements on meter structure at location shown on Drawings.

4. Furnish and install 1" metering conduit from metering transformer cabinet to meter socket.

C. Work associated Distribution Panel 3 power service:

1. Furnish and install two 4" conduits with pull strings minimum 42" below grade from Alliant Energy power transformer secondary section to metering transformer cabinet; use Schedule 40 rigid nonmetallic conduit with 18" radius elbows and offsets below grade; use Schedule 80 rigid nonmetallic conduit above grade; provide expansion fitting in each conduit immediately below metering transformer cabinet.

2. Construct outdoor free standing meter structure complying with Alliant Energy requirements at location shown on Drawings.

3. Furnish and install metering transformer cabinet and meter socket complying with Alliant Energy requirements on meter structure at location shown on Drawings.

4. Furnish and install 1" metering conduit from metering transformer cabinet to meter socket.

D. Work associated Distribution Panel 4 power service:

1. Furnish and install two 4" conduits with pull strings minimum 42" below grade from Alliant Energy power transformer secondary section to metering transformer cabinet; use Schedule 40 rigid nonmetallic conduit with 18" radius elbows and offsets below grade; use Schedule 80 rigid nonmetallic conduit above grade; provide expansion fitting in each conduit immediately below metering transformer cabinet.

2. Construct outdoor free standing meter structure complying with Alliant Energy requirements at location shown on Drawings.

3. Furnish and install metering transformer cabinet and meter socket complying with Alliant Energy requirements on meter structure at location shown on Drawings.

4. Furnish and install 1" metering conduit from metering transformer cabinet to meter socket.

E. Work associated Distribution Panel 5 power service:

1. Furnish and install two 4" conduits with pull strings minimum 42" below grade from Alliant Energy power transformer secondary section to metering transformer cabinet; use Schedule 40 rigid nonmetallic conduit with 18" radius elbows and offsets below grade; use Schedule 80 rigid nonmetallic conduit above grade; provide expansion fitting in each conduit immediately below metering transformer cabinet.

2. Construct outdoor free standing meter structure complying with Alliant Energy requirements at location shown on Drawings.

3. Furnish and install metering transformer cabinet and meter socket complying with Alliant Energy requirements on meter structure at location shown on Drawings.

4. Furnish and install 1" metering conduit from metering transformer cabinet to meter socket.

F. Call Dick Morreim, Alliant Energy Lead Construction Specialist, to schedule work by them; telephone number (712) 336-6008.

G. Owner will pay Alliant Energy charges for new campground electrical power services; pay all other charges of Alliant Energy.

H. Size free standing meter structures for installation of metering equipment and distribution panels; install distribution panels minimum 8" from metering equipment.

I. General:

1. Do work in professional manner without damaging any existing structures, equipment, piping and other items.

a. When any item is damaged during performance of work under this project, repair or replace that item to satisfaction of Owner.

b. Disconnect and remove all unused power distribution equipment, wires (exposed, concealed and buried), exposed conduit, underground conduit exposed during construction of this project, junction boxes, pull boxes and wiring devices no longer required; cap concealed conduits.

c. Allow Owner to salvage desired equipment/parts/components from removed items prior to removal from project site; unless noted otherwise, all removed items not salvaged by Owner are property of Contractor; promptly remove from project site; remove concrete pads; restore ground to match adjacent conditions.

J. Furnish, install and connect distribution panels and campsite outlet posts specified under Section 16400.

K. Make modifications to existing equipment as specified under Section 16400.

L. Furnish and install power and control wiring to interconnect all equipment and appurtenances requiring electrical power/controls and make required connections for complete working installation.

1.5 ELECTRICAL HAZARDS ANALYSIS

A. Perform electrical system study to identify shock hazards and arc flash hazards as per NFPA 70E - Standard for Electrical Safety in the Workplace; perform arc flash hazards analysis as per IEEE Standard 1584 - Guide for Performing Arc-Flash Calculations; use methods of latest edition of NFPA 70E or IEEE 1584.

1. Electrical system study includes short circuit and fault current analysis, protective device coordination study, shock hazards and arc flash analysis.

2. Perform system calculations in accordance with and as required by NFPA 70E from each Alliant Energy transformer connection to all locations where energized electrical conductors or circuit parts are exposed.

3. Collect and verify information required to produce accurate as constructed calculations.

4. Submit preliminary arc flash hazards analysis report to Owner for review and comment; report to include:

a. Single-line diagrams of system with relevant information used in calculations on 11" high x 8-1/2" wide or 11" high x 17" wide paper utilizing computer aided drafting.

b. Short circuit analysis for the applicable portions of the system.

c. Protective device coordination study with time-current curves for the applicable portions of the system.

d. Shock hazards and arc flash hazards analysis and calculations on a component basis.

e. Summarized results of calculations.

f. Recommendations for minimizing shock hazards and arc flash hazards.

B. Provide final arc flash hazards analysis report.

1. Five sets of paper copy of written report.

2. Five sets of compact discs containing:

a. Electronic copy of database.

b. Electronic copy of calculated data for creating labels; in Microsoft Excel format.

3. See Division 1 for additional requirements.

C. Furnish and install labels on electrical equipment included in electrical system study.

1. Labels: 4" x 4" Brady polyester tape with permanent pressure sensitive acrylic adhesive suitable for use with thermal transfer printers.

2. Include the following information on labels:

a. Warning of arc flash and shock hazard.

b. Flash Hazard Boundary distance from hazard.

c. Calculated associated incident energy value (cal/cm^2).

d. Hazard risk category or description of required personal protective equipment.

e. Shock hazard voltage when cover is open.

f. Limited Approach Boundary distance from hazard.

g. Restricted Approach Boundary distance from hazard.

h. Prohibited Approach Boundary distance from hazard.

i. Equipment name or identification.

D. Provide electrical arc flash hazard marking as per NEC 110.16 for electrical equipment not meeting requirements of NEC 110.16 through manufacturer's labeling or labeling furnished under electrical system study.

1.6 EQUIPMENT IDENTIFICATION

A. Attach corrosion resistant nameplate(s) on equipment where required elsewhere in specifications or where legally required.

B. Unless specified otherwise, fabricate nameplates from laminated black phenolic resin plates with a white core.

1. Engrave plate with minimum $^3/_{16}$" high, 20 cutter Helvetica lettering

2. Permanently attach nameplate to equipment.

3. Nameplates that are furnished by manufacturer as a standard catalog item are exceptions.

1.7 CODES AND STANDARDS

A. All work must comply with latest edition of NEC, state and local codes and ordinances.

1. Prior to beginning work, determine requirements of all codes and ordinances.

2. Upon completion of project, correct all work not meeting requirements of any codes or ordinances at no expense to Owner.

B. All electrical equipment, boxes, conduits, wiring and miscellaneous accessories must be suitable, UL listed, labeled and approved for use in locations intended.

1. Installation: in accordance with any instructions included in UL listing or labeling.

2. Wiring methods: comply with all code requirements for particular location and use.

End.

SECTION 16100

WIRING MATERIALS AND METHODS

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3.3 Installation of Wiring
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PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes wires, cables, conduits and associated equipment.

B. Related work specified elsewhere:

1. Division 1 - General Requirements.
2. Section 16000 - Electrical Requirements.
3. Section 16400 - Electrical Equipment.

1.2 SUBMITTALS

A. Provide properly identified catalog data on conduits, wiring and miscellaneous materials to prove complete compliance with drawings and specifications.

B. Provide complete installation instructions as specified under Division 1.

C. See Division 1 for additional requirements.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

A. Low carbon steel; zinc electroplated or hot dip coated inside and outside; threaded joints.

B. Conform to ANSI Specifications C80.1, UL Standard No. 6 and NEMA RN1-1980.

C. Furnish in full 10' lengths with standard pipe threads at each end; stamp or label each standard length of conduit with name or trademark of manufacturer and UL label.

D. Cast ferrous alloy, galvanized and threaded type fittings; elbow fittings for normal bends, condulet fittings for sharp bends.

2.2 RIGID NONMETALLIC CONDUIT (RNC)

A. Type: heavy wall, rigid pvc.

B. Description: NEMA TC-2 and UL Standard 651, Schedule 40 or Schedule 80 pvc.

C. Fittings and Conduit Bodies: NEMA TC-3 and UL Standard 651.

D. Solvent cement conforming to ASTM D2564.

2.3 BUILDING WIRING (600V) AND CABLES

A. Furnish all wiring necessary for complete working installation; minimum size: No. 12 AWG.

B. Wires:

1. Materials: use only soft drawn copper, ASTM B3 or B33.

2. Solid conductors for No. 12 AWG and smaller; Class B stranding meeting requirements of ASTM B8 for conductors No. 10 AWG and larger.

3. Temperature rating: minimum 75°C, wet location.

4. Insulation and jacket: USE, USE-2, XHHW or XHHW-2.

5. Provide permanently marked size, type of insulation, voltage and manufacturer's name on outer covering at regular intervals, not exceeding 4'.

2.4 MISCELLANEOUS MATERIALS

A. Caution tape: detectable underground utility hazard tape of laminated aluminum, 3" wide, red tape with black lettered legend CAUTION CAUTION CAUTION - ELECTRIC LINE BURIED BELOW; Panduit Part No. HTU3R-E, Thomas & Betts NAF-0600, or equal.

B. Duct seal: soft, non-hardening weatherproof compound containing no asbestos fibers, UV resistant, malleable, non-conductive, non-toxic, non-shrinking, permanently pliable, odorless, non-sticky formula, non-staining; non-corrosive adhesive properties suitable for use on wood, glass, plastic, aluminum and steel; temperature stable between -40°F to 180°F; paintable.

C. Wire-pulling lubricant: heavy paste viscosity, wax based formulation that adheres to cable over long runs, plating out to coat both cable and conduit wall; non-water soluble, non-toxic, nonflammable, noncombustible and non-corrosive; Ideal Industries, Inc. Yellow 77, or equal.

D. Grounding Materials:

1. Ground rods: ¾" x 10', one piece; copper bonded steel.

2. Thermic weld kits: Erico Products, Inc. Cadweld, or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. All locations are wet locations.

3.2 INSTALLATION OF CONDUITS

A. Minimum required sizes are noted on Drawings; provide additional conduits as required to interconnect all equipment and appurtenances requiring electrical power; size all conduits to meet requirements of NEC; minimum size: ¾".

B. Rigid metal conduit: use at all exposed locations, except where other types of conduits are specified or permitted by Engineer in field.

1. Install in accordance with NEC Art. 344.

2. Do field cutting, threading, coupling and joining in strict accordance with manufacturer's instructions; cut with hand or power hacksaws; ream cut ends to remove burrs or sharp edges.

3. Make all threaded joints wrenchtight and all compression joints mechanically secure and snug so as to make continuous current-carrying electrical contact.

4. Cap ends of all conduit during construction with watertight seals.

5. Seal conduit joints watertight on couplings and hub type fittings in manner approved by Engineer; apply zinc chromate paint where protective coating is damaged.

6. At all entrances to panels and other equipment enclosures:

a. Provide insulated bushings.

b. Provide double bonding locknuts for entrances without threaded hubs.

7. Clean inside of all conduit by mechanical means before wires or cables are installed.

8. Seal all conduits connected to all electrical equipment watertight with duct seal.

C. Rigid nonmetallic conduit: use for Alliant Energy conductors as specified under 1.4 of Section 16000.

1. Install in accordance with NEC Art. 352.

2. Meet all applicable installation requirements specified under 3.2 B.

3. Join conduits by using couplings and solvent cement furnished or recommended by manufacturer of conduit; finished joint must be secure and watertight.

4. Bends:

a. 2" and smaller conduit: may be made "hot" in field; leave inside dimension undistorted.

b. Larger than 2" conduit: factory bends only.

3.3 INSTALLATION OF WIRING

A. Install wiring in conduit where installed above grade, where specified, or shown or noted on Drawings.

B. Install Type XHHW (or XHHW-2) where noted on Drawings and where installed in conduit above grade; install Type USE (or USE-2) where direct buried, installed in buried conduit and in conduits emerging from under ground.

C. Markings and color code:

1. Use green for equipment grounds; in sizes No. 8 AWG and larger, where green is not readily available, black or white may be substituted if marked with green identifying tape on ends and at all accessible locations.

2. Use black and red for ungrounded conductors and white for neutral conductors of 240 volt, single phase system; use same color for same phase throughout system; permanently post means of identification on inside of door of each distribution panel.

3. In sizes No. 8 AWG and larger, where specified color is not readily available, black or white may be substituted if marked with specified color identifying tape on ends and at all accessible locations.

D. Wire pulling:

1. Pull wiring only in clean and dry conduits.

2. Use pulling grips.

3. Lubricate with suitable lubricant.

E. Bend in accordance with ICEA.

F. Splicing and terminations:

1. Install all runs of power wiring without splices wherever possible; obtain approval of Owner prior to any splicing.

2. Make splices, connections and terminations with appropriate kits containing necessary connectors and insulating materials for specific conductor size and type of insulation; adhere to manufacturer's recommended procedures; 3M, Raychem, General Electric, or equal.

G. Connections to apparatus lugs:

1. Solderless compression type lugs, NEMA standard for electric power connections; manufacturer and type approved by Owner.

2. Preparation: thoroughly clean lug and conductor, coat with suitable oxidation inhibiting compound.

3.4 GROUNDING

A. Comply with requirements of NEC Art. 250.

B. Locate ground rods as required to provide effective grounding system.

C. Thermic weld all underground connections, concealed connections and splices in grounding system.

3.5 TESTING

A. Test all installed cables and wiring for shorts or grounds.

1. Check conductor insulation resistance after installation in conduit; replace conductors with less than acceptable insulation resistance with new conductors and retest.

2. Record all test data and submit five copies to Owner.

End.

SECTION 16400

ELECTRICAL EQUIPMENT

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3.1 Installation

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes electrical equipment.

B. Related work specified elsewhere:

1. Division 1 - General Requirements.

2. Section 16000 - Electrical Requirements.

3. Section 16100 - Wiring Materials and Methods.

1.2 SUBMITTALS

A. Provide equipment dimensional drawings and properly identified catalog data and other necessary information and cross-references on distribution panels and campsite outlet post to prove complete compliance with Drawings and specifications.

B. Provide complete installation, operation and maintenance instructions as specified under Division 1.

C. See Division 1 for additional requirements.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELS

A. Distribution Panels 2, 3, 4 and 5: surface mounted, 240/120 volts, single phase, three wire distribution panel with 600 ampere copper mains, copper neutral and copper equipment ground bar, 600 ampere main circuit breaker, total branch circuit breaker mounting space for circuit breakers and minimum spaces specified below, NEMA 3R enclosure and gasketed door with three-point vault type locking mechanism with chrome-finish pad-locking handle, manufacturer's standard gray baked enamel finish; suitable for use as service equipment; General Electric Spectra Series or Square D I-Line.

1. Minimum integrated short circuit rating: 42,000 amperes rms symmetrical.

2. Provide following thermal-magnetic molded case circuit breakers in distribution panel 2:

   a. Two pole, 175 amperes for Circuits 3 and 5.

   b. Two pole, 150 amperes for Circuits 1 and 2.

   c. Two pole, 125 amperes for Circuits 4 and 6.

   d. Two pole spaces only for Circuits 7 and 8.

3. Provide following thermal-magnetic molded case circuit breakers in distribution panel 3:

   a. Two pole, 175 amperes for Circuit 3.

   b. Two pole, 150 amperes for Circuits 1 and 2.

   c. Two pole, 125 amperes for Circuits 4 and 5.

   d. Two pole, 100 amperes for Circuit 6.

   e. Two pole spaces only for Circuits 7 and 8.

4. Provide following thermal-magnetic molded case circuit breakers in distribution panel 4:

   a. Two pole, 175 amperes for Circuits 3 and 4.

   b. Two pole, 150 amperes for Circuits 1 and 2.

   c. Two pole spaces only for Circuits 5 and 6.

5. Provide following thermal-magnetic molded case circuit breakers in distribution panel 5:

   a. Two pole, 200 amperes for Circuit 2.

   b. Two pole, 150 amperes for Circuits 1, 4 and 6.

   c. Two pole, 125 amperes for Circuits 3 and 7.

   d. Two pole, 90 amperes for Circuit 5.

   e. Two pole spaces only for Circuit 8.

B. Provide corrosion-resistant permanent nameplate for each distribution panel and for each circuit breaker in each distribution panel; legend as selected by Owner.

2.2 CAMPSITE OUTLET POST

A. Pedestal style unmetered electrical supply rated 240/120 volts, single phase; main lugs suitable for loop feed; Midwest Electric Products, Inc. Model Number UO75GP6010, Milbank Manufacturing Co. Catalog Number U5200-XL-75, or approved equal.

   1. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical.

   2. Thermal-magnetic molded case circuit breakers: two pole 50 amperes, one pole 30 amperes and one pole 20 amperes.

   3. Receptacles: one each NEMA Configuration 14-50R, TT30R and GFCI 5-20R.

2.3 MODIFICATIONS TO EXISTING EQUIPMENT

A. Modifications to existing lighting panel in west restroom building:

1. Furnish 15A/2P thermal magnetic branch circuit breaker for Circuit 2,4 (pole mounted light fixture or spare); Siemens Industry, Inc. Catalog No. Q215.

2. Furnish 15A/1P thermal magnetic branch circuit breaker for Circuit 6 (spare or pole mounted light fixture); Siemens Industry, Inc. Catalog No. Q115.

3. Disconnect main bonding jumper.

4. Provide typewritten directory of actual load served by circuit breaker in pocket on inside of lighting panel door.

5. Provide nameplate to identify source of power supply to lighting panel.

B. Modifications to existing lighting panel in south shower building:

1. Disconnect main bonding jumper, if installed.

2. Disconnect equipment grounding conductors connected to neutral bus (if any are connected) and connect to ground bus.

3. Disconnect neutral conductors connected to ground bus (if any are connected) and connect to neutral bus.

4. Provide nameplate to identify source of power supply to lighting panel.

2.4 EXTRA MATERIALS

A. Deliver one spare campsite outlet post to Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install distribution panels 2, 3, 4 and 5 on field constructed free standing meter structures at locations shown on Drawings and connect.

B. Install campsite outlet posts at locations shown on Drawings and connect.

C. Make modifications to existing equipment as noted on Drawings or as specified and connect.

End.

TECHNICAL SPECIFICATIONS

DIVISIONS 2, 3 & 16

LICENSED PROFESSIONAL ENGINEER GEORGE ALAN PETERSON 15787 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. 2/1/12 George Alan Peterson P.E., Reg. No. 15787 (Date) My license renewal date is December 31, 2012 Pages or sheets covered by this seal: Specification Sections 2, 3 and 16 for the Emerson Bay Recreation Area, Campground Improvements Project, IDNR 11-01-30-03.

DIVISION 2 - SITEWORK

SECTION 02100

SITE PREPARATION

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PART 1 - GENERAL

1.1 JOB CONDITIONS

A. Notify corporations, companies, individuals or authorities owning utilities running to property or encountered during excavating operations.

B. Cap or remove services in accordance with instructions by owners of services.

C. Protect, support, and maintain utilities which are to remain.

D. Replace to original condition or better, landscape work such as trees, shrubs, and grass within and outside of construction and grading limits that are damaged.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Notify the Engineer prior to start of clearing and grubbing activities.

B. Clear and grub area within limits to be covered with new construction, buildings, walks, parking areas, drives, and where grade to be raised of shrubs, trees, stumps, vegetation, rubbish, and other perishable or objectionable matter. Grub stumps.

C. Remove trees and shrubs where specifically called for on the Drawings. Shrub, hedge rows, brush, and similar vegetation removal will not be measured for payment.

D. Remove cleared material from site.

3.2 STRIPPING TOPSOIL

A. Remove topsoil to entire depth in areas where grade is to be raised and in areas to be covered by structure, walk, or paving. Stockpile where designated by Engineer. Stockpile for proper drainage.

B. Strip stockpile areas of vegetation prior to stockpiling.

C. Stripped topsoil shall be free from clay, stones, excessive vegetation, and debris.

D. Use for finish grading.

3.3 TREE REMOVAL

A. Obtain authorization from IDNR prior to removing any trees, including those indicated on Drawings.

B. Removal includes grubbing and removing stump and roots to a depth of at least 12-inches and disposal of trees and debris.

C. Unit price for tree removal shall include placement of backfill in area where roots have been removed, and removal and disposal of all materials.

D. Tree removal shall be paid for at the Contract Unit Price for each "Tree Removal (including grubbing)." There will be no distinction between or measurement of trunk size or height.

3.4 DISPOSAL OF SPOIL MATERIAL

A. Contractor is responsible for disposal methods and compliance with all Federal, State, County and City laws, ordinances and regulations.

B. Contractor is responsible for obtaining all permits necessary for disposal.

C. Disposal of spoil material may be by one of the following methods:

1. Removal and disposal:
   a. Promptly remove cleared debris from site. Burning of debris on-site is not permitted.
   b. Disposal site will be arranged by Contractor subject to approval by Owner.

2. On-site volume reduction:
   a. Promptly dispose of removed debris by cutting, chipping and grinding trees or other vegetative matter.
   b. Log chipper must have capacity to chop logs removed and is subject to approval by Engineer. Chopper must be capable of chopping logs into chips no larger than 2-inches by 2-inches, ½-inch thick.
   c. Chips will be hauled off site for final disposal.

End.

SECTION 02140

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PART 1 - GENERAL

1.1 SUMMARY

A. Provide and maintain means for removal of water entering all structural and trenching excavations.

B. Dispose of water in a manner not causing damage, pollution, or unsafe conditions to adjacent land and water areas.

PART 3 – EXECUTION

3.1 PROTECTION

A. Surface runoff: Control grading around the excavation to prevent surface water from running into the excavations for the structure and trenches.

B. Protect adjacent and/or downstream property and structures from damage due to water removal and disposal.

3.2 PREPARATION

A. Provide for safe disposal of removed water.

3.3 DEWATERING

A. Install and maintain dewatering system.

B. Maintain water level within the excavation at or below the surface of the excavation, trench bottom, or base of the bedding course, until all Work to be performed therein is completed.

C. Carry out dewatering operation so the strength of the soil under or alongside of the excavation is not weakened or destroyed.

D. After completion of the structure or conduit installation, restore the normal water table in a manner not to disturb the foundation or the pipe or its foundation.

E. Provide de-silting devices or basins if necessary to protect adjacent property or structures or downstream property or structures.

F. Saturated foundations: Prior to placing any concrete for foundations, remove soils in footing excavation that have become saturated with surface water.

End.

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING

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B. Trench execution and backfill.

C. Backfill for manholes, appurtenances and structures.

D. Sheeting, shoring and bracing.

E. Cleanup.

1.2 RELATED SECTIONS AND REFERENCES

A. Related Sections:
1. Section 02140 Dewatering.

2. Section 02510 Concrete Sidewalks.
3. Section 02585 Lawns, Grass and Erosion Control.
4. Section 02721 Site Utilities System.

B. References:
1. Standard Specifications for Highway and Bridge Construction, Iowa Department of Transportation, latest edition.

1.3 GENERAL REQUIREMENTS

A. Schedule Work to keep streets, sidewalks, and utilities in usable condition. Avoid property owner inconvenience insofar as practicable.

B. Do not trespass on private property or outside the limits of construction. Maintain construction operations on existing right-of-way or easements provided by Owner.

C. Contractor shall provide name(s) and telephone number of person(s) who have access to equipment and are authorized to make emergency repairs to Contractor's Work, such as to correct trench cave-ins, moving excavated material, and correct other problems during weekends and off-work hours, so access can be maintained for fire fighting equipment, and to maintain barricades for public safety.

D. Disposal area(s):
1. Remove brush, rubbish, spoil, excess excavated material, and material not suitable for backfill to off-site location of Contractor's choice.
2. Remove waste material promptly as it is generated by construction operations. Do not permit to accumulate.

E. Costs for all Work in this Specification Section is considered incidental to pipe construction. Piping can be constructed by open-trench or horizontal boring methods. Review proposed methods with IDNR staff prior to beginning Work. Do not open-cut roadways without consultation with IDNR staff.

1.4 EXISTING UTILITIES

A. Obtain from utility companies locations of buried utilities in the project areas.

B. Repair existing fences, and culverts, and drain tiles disturbed by construction.

C. Contractor fully responsible for liaison with utility companies and for repairing, at no expense to Owner, utilities damaged by Contractor.

D. In event of break in existing watermain, gas main, sewer, or electric or communication cable, immediately notify responsible official of organization operating utility affected.

PART 2 - PRODUCTS

2.1 PIPE ENVELOPE

A. Applies to full trench width from bottom of trench to 1-foot above top of pipe for plastic pipe and other flexible pipe materials; to pipe centerline for ductile-iron pipe and other rigid pipe materials.

B. Depth of material for pipe bedding shall be as shown on the Drawings.

C. Bedding and initial backfill materials for ductile-iron and other rigid pipe material shall be ¾-inch crushed stone meeting IDOT gradation number 11. Bedding and initial backfill materials for plastic pipe and other flexible pipe materials shall be fine aggregate (sand) meeting IDOT gradation number 32.

2.2 REMAINING BACKFILL

A. Applies to backfill above 1-foot above top of pipe for plastic and other flexible pipe materials and above the centerline of the pipe for concrete and other rigid pipe materials.

B. As soon as the condition of the pipe will permit, the entire width of the trench shall be backfilled. Earthen materials or aggregate shall be placed longitudinally along the pipe. Elevation of the haunching material on each side of the pipe shall be the same. Special care shall be taken to completely fill the space under the pipe haunches. Materials shall be placed in maximum 6-inch layers, loose measurement and compacted by ramming or tampering.

C. Granular backfill material shall be ¾-inch crushed stone meeting IDOT gradation number 11.

D. Material for earthen backfill may be job-excavated material, free from debris, stones larger than 2-inches, organic matter, and frozen material.

E. Where subgrade conditions warrant extra precautions for the bedding of rigid pipe, Engineer may order the construction of a concrete cradle to support the rigid pipe. Cradle shall be constructed as directed by the Engineer. Extra payment for concrete cradle may be made in accordance with the Contract Documents if not shown on the Drawings.

F. Trenches shall be backfilled in accordance with the following methods, in accordance with the details on the Drawings:

1. METHOD I – This method applies to pipes under yards and unimproved areas. In this method, the trench shall be backfilled with excavated materials in a manner that will not dislodge or damage the pipe or cause bridging action in the trench. The material shall be deposited in uniform layers not exceeding 12-inches thick, loose measure. Each layer shall be compacted by ramming or tamping or, if directed by the Engineer shall be inundated or deposited with water. Pipes in these areas will generally not require water jetting unless the Engineer determines that early settlement is required. If jetting is used, it shall be considered incidental to piping installation and no additional compensation will be allowed. Top 4-inches shall be topsoil. Any rocks or clods greater than 2-inches in diameter shall be removed from the topsoil as it is spread. Top of the trench shall be left neatly rounded to allow for settlement.

2. METHOD II – This method applies to alleys or parking areas that do not have permanent surfaces or oil and chip surfaces. In this case, the trench from the top of the granular pipe bedding to 6-inches below the ground surface shall be backfilled with granular backfill materials. The granular material shall be deposited in uniform layers not exceeding 6-inches thick, loose measure, and each layer shall be compacted by ramming or tamping. 6-inches of surface course aggregate shall be applied so that the finished surface of the aggregate is at the proposed surface elevation or matches the existing surface elevation. Material for surface course aggregate shall be crushed limestone.

3. METHOD III – This method applies to all pipes buried beneath existing utilities or structures. In this case, the trench from the top of the granular pipe bedding to at least 6-inches above the existing utility or structure shall be backfilled with granular backfill. The granular material shall be deposited in uniform layers not exceeding 6-inches thick, loose measure, and each layer shall be compacted by ramming or tamping. Trench from 6-inches

above the existing utility or structure to the surface shall then be backfilled in accordance with another applicable method; I, II or IV.

4. METHOD IV – This method applies to any area where the existing or new surface is Portland cement concrete or bituminous concrete. In this case, the trench from the top of the granular pipe bedding to the bottom of the existing or new surface shall be backfilled with granular backfill. Granular material shall be deposited in uniform layers not exceeding 6-inches thick, loose measure, and each layer shall be compacted by ramming or tamping.

5. METHOD V – This method applies to pipes buried beneath areas with oil and chip surfaces. Trench from the top of the pipe bedding to 12-inches below the surface shall be backfilled with granular backfill. Next 8-inches of the trench shall be granular subbase material per Specification Section 02511, paragraph 2.1.B. Final 4-inches of the trench shall be a combination of HMA base course and HMA surface course (with a total thickness of 4-inches) with tack coat per Specification Section 02517.

6. METHOD VI – This method applies to pipes beneath cultivated fields. Backfill shall be placed as in METHOD I, except no excavated material shall be allowed within the upper zone originally occupied by topsoil. After the backfill reaches the approximately lower limit of the original topsoil zone, the stockpiled topsoil shall be spread in such a manner that natural settlement will not result in a depression along the pipeline. All rocks and boulders greater than 2-inches in diameter shall be removed from the topsoil as it is spread. Sufficient care shall be taken to prevent the inclusion of any material in the topsoil which would be considered unsuitable to agricultural purposes or deemed as a hazard to agricultural equipment. All manholes to be located within this area and indicated on the Drawings to be buried shall have the top of the frame and lid at least 18-inches below the finished ground elevation.

7. METHOD VII – This method applies to pipes buried within earthen berms. From the top of the pipe bedding to 12-inches below the proposed finish grade, trench shall be backfilled with select excavated material (compacted to 90 percent standard proctor) placed in 8-inch layers. Top 12-inches shall be filled with topsoil.

G. Water jetting backfill:

1. Where water jetting is called for, all trench backfill shall be compacted by jetting and water soaking in the manner described below. Trench compaction shall be started at the point of lowest elevation of the trench and work up along the trench. Jetting and water soaking shall not begin until the trench has been backfilled to within 6-inches of the finished surface.

2. Holes through which water is injected into the backfill shall be centered over the trench backfill and at longitudinal intervals of not more than 6-feet. Additional holes shall be provided if deemed necessary by the Engineer to secure adequate settlement. All holes shall be jetted and shall be carried to a point 1-foot above the top of the pipe. Drilling the holes by means of augers or other mechanical means will not be permitted. Care shall be taken in jetting so to prevent direct contact with, or disturbances of the pipe. No more than 100-linear feet of completed sewer lines shall remain un-jetted at any one time.

3. Water shall be injected at a pressure and rate just sufficient to sink the holes at a moderate rate. After a hole has been jetted to the required depth, the water shall continue to be injected until it begins to overflow the surface. Contractor shall, at his own expense, bore test holes at such locations as the Engineer may designate in order to determine the effectiveness of the water soaking. A soil auger shall be used for boring test holes. As soon as the jetting and water soaking has been completed, all holes shall be filled with soil and compacted. Surface depressions resulting from backfill subsidence caused by jetting and

water soaking shall be filled and re-compacted by tamping or rolling to the satisfaction of the Engineer.

4. Water shall be furnished at the Contractor's expense. Contractor shall conform to municipal ordinances, rules, or regulations concerning its use. Water jetting backfill shall be incidental to pipe line installations.

H. Where there is a deficiency of suitable backfill material due to a rejection of part or all of the excavated material as unsatisfactory for backfill purposes, Contractor shall furnish satisfactory backfill material wasted from trench excavation in other locations or from other sources furnished by the Contractor. Backfill furnished and disposal of unsatisfactory material under these circumstances shall be incidental to piping installation.

I. Backfilling shall proceed so that not more than 100-feet intervals between the end of the backfilled section and the end of the laid pipe. No backfill material shall be placed until the Engineer has examined the grade of the pipe.

J. Where the trenches have been sheeted or braced, care must be taken in removing the same to keep the filling well above the lower ends of the sheeting or bracing so as to prevent caving of the sides of the trench sown onto the pipe and displacing them or damaging structures along the sides of the trench.

K. Tamping shall be done with a hand held tamper or vibratory plate of 6-inches or less in width. No other type of compaction equipment will be allowed. Care shall be used to place and tamp this backfill as not to disturb the joints, alignment, or grade of the pipe. Filling shall be carried on simultaneously on both sides of the pipe.

L. Where the trench excavation is within the public right-of-way, or within 5-feet of a roadway, sidewalk, driveway, or wherever indicated on the Drawings, the trench backfill shall be tamped continuously to the surface with a mechanical tamper of a type approved by the Engineer. All material shall be compacted to 95 percent of the Standard Proctor Density as determined by ASTM D1557. No layer of material being compacted shall exceed 1-foot in depth. Engineer may perform density tests after tamping is complete on any layer.

M. Where un-compacted backfill is indicated on the Drawings, the backfill material from the top of the granular backfill to the surface may be simply pushed into the trench and run over with the backfilling equipment.

2.3 BACKFILL FOR MANHOLES, APPURTENANCES, AND STRUCTURES

A. Backfill material as required for adjacent trench.

2.4 SIDEWALK AND PAVEMENT MATERIALS

A. Concrete pavement, and all types of concrete base pavement, may be cut only where, in the manner and to the extent specified herein, or authorized by the Engineer. Cuts shall be no larger than necessary to provide adequate working space for proper installation of pipe and pipeline appurtenances. A concrete saw shall be used for the cutting of concrete pavements along each side of trenches and at structures. All cuts shall be a minimum of 2-inches deep or ¼ the depth of the pavement, which ever is greater.

B. Concrete pavements over trenches excavated for pipelines shall be removed to a width not less than 24-inches wider than the width of the trench at pavement subgrade. Trench width at pavement subgrade shall not exceed the minimum dimension that will allow good and safe construction except that no under cutting will be permitted. Shoulder not less than 12-inches in width, at any point, shall be left between the cut edge of the pavement and top edge of the trench. Pavement cuts shall be made

to and between straight lines that, unless otherwise required, shall be parallel to the centerline of the trench.

C. Where the line of the trench parallels the length of concrete walks and the trench location is all or partially under the walk, then the entire walk shall be removed and replaced. If necessary to remove concrete curbs, gutters, or walks, they shall be replaced to the existing joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify with testing laboratory fill materials to be reused is acceptable.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Maintain and protect existing utilities remaining, which pass through work area.

C. Protect plant life, lawns and other features remaining as a portion of final landscaping.

D. Protect benchmarks, existing structures, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

E. Cut out soft areas of subgrade not capable of insitu compaction.

3.3 TRENCH CONSTRUCTION

A. Widths: Trenches shall be excavated to limiting trench widths and pipe clearances to provide adequate working space and clearances for proper pipe installation, jointing, and embedment operation. Also, for the protection of the pipe from external loads, limits to the maximum width of the lower portion of the trench below an elevation 6-inches above the top of the installation pipe shall apply. Such limiting minimum and maximum trench widths together with the minimum permissible clearance between the installed pipe and either trench wall shall be as follows:

Minimum and Maximum Trench Widths*			
Pipe Size, Inches	Minimum Width, Inches	Minimum Sidewall Clearance, Inches	Maximum Width, Inches
Up to 6	20	5	30
8	20	5	30
10	23	5	30
12	26	6	30
15	29	6	33
18	32	6	44
24	44	7	56

*Measured 6-inches above top of pipe

B. Tunneling and boring: All excavation shall be done in open trenches except where tunneling or boring is shown on the Drawings or where written consent is given by the Engineer to tunnel or bore.

C. Open trench in advance of Work: Not more than 100-feet of trench shall be opened up in advance of the completed piping or conduit work.

D. Barricading work: Contractor shall provide and maintain the fences, walks, and bridges that are necessary for the public safety and convenience. Contractor shall place sufficient lights on or near the work and keep them burning from sunset to sunrise to ensure the safety of the public. Contractor shall keep watchmen on the work whenever the Engineer deems it necessary. Material delivered to the job shall be placed with minimal interference to traffic.

E. Bell holes shall be carefully excavated at proper intervals so that the bells support no part of the load. No more shall be excavated than necessary to ensure the making of good joints.

F. Sheeting and bracing: In limiting trench widths, proper trench wall protection shall be used in accordance with OSHA Standards. If proper trench wall protection is not used, OSHA specified wall slopes shall be required for each type of soil. If wall protection is used, the sides of the trench shall be properly secured and supported by bracing and sheet piling according to approved sheeting methods. Sheeting shall not extend below the top of the pipe. Bracing, sheeting, and shoring will not be considered an extra. Contractor shall sling, shore up, and secure in place all present sewers, water lines, conduits, and structures of a similar nature that are encountered in or near the trenches. Contractor at his expense shall restore any such structure or conduit damaged by the excavation to its original condition.

G. No explosives are to be used.

H. Whenever work is to proceed over private property or other than the traveled way of streets or alleys, the topsoil shall be removed to a depth as directed by the Engineer up to a maximum of 1-foot. Such topsoil shall be stockpiled separately until backfilling operations are completed and then spread in a uniform layer, a minimum of 6-inches thick, over the area disturbed by the work.

3.4 GENERAL

A. Trenches not requiring select backfill: Pile excavated material, suitable for backfill, in an orderly manner a sufficient distance back from edge of excavation to avoid slides or cave-ins (2-foot minimum clear distance).

B. Trenches requiring granular backfill: Place unsuitable excavated material directly on trucks and haul away. No spoil banks permitted.

C. If granular material suitable for trench backfill is encountered in trenches requiring trench backfill: Pile in an orderly manner a sufficient distance back from edge of excavation to avoid slides or cave-ins (2-foot minimum clear distance).

D. Excavate existing utilities sufficiently in advance of pipe laying to determine crossing arrangement. No payment will be allowed for down time due to utility relocation.

E. Excavation shall be open cut.

F. Use caution when placing and compacting backfill to avoid placing construction loads on pipe that may damage or displace newly laid pipe.

G. Support, brace or remove utility poles either adjacent to or in trench excavation.

H. Utility mains shown on Drawings, in conflict with new facilities: Perform relocation or make arrangements with utility to perform Work at no additional cost to Owner.

I. Utility mains not shown on Drawings, in conflict with trench excavation or new facilities:
   1. Notify Engineer and utility company immediately.

2. Authorized relocation performed by Contractor or performed by others at Contractor's expense paid for under provisions of Article 11 of General Conditions.

3.5 SHEETING, SHORING, AND BRACING

A. Construct sheeting, shoring, and bracing where shown on Drawings and where required to hold walls of excavation to protect existing utilities, trees, structures, and other similar features and to provide protection of employees.

B. Design of sheeting, shoring, and bracing shall be responsibility of Contractor and shall comply with OSHA requirements.

C. When movable trench shield is used below centerline of pipe, it shall never be lifted prior to any forward movement, to avoid the caving in of the bottom sides of the trench walls.

3.6 DEWATERING

A. Execute Work in dry conditions.

B. Provide equipment for handling water encountered.

C. Do not lay pipe or pour concrete on excessively we soil.

D. Prevent surface water from flowing into excavation; promptly remove any water accumulated.

E. Divert stream flow and/or sewage away from areas of construction.

F. Do not discharge water pumped from excavations to existing sanitary sewers.

G. Methods used shall not cause settlement or damage to adjacent property.

H. Also see Section 02140.

3.7 SIDEWALK AND PAVEMENT REMOVAL

A. Where large portions of existing streets are removed, measure and record exact dimensions and elevations before pavement removal. Streets and curbs shall be rebuilt to same widths and elevations as existed prior to construction.

B. Remove pavement, sidewalk, or curb and gutter to minimum of 1-foot from trench. No undercutting will be permitted.

C. Saw cut vertically; remove on straight lines approximately parallel or perpendicular to centerline of pavement.

D. Concrete and bituminous concrete and bituminous oil and chip pavement:
1. Cut with concrete saw; minimum vertical cut 1-1/2-inch deep, as needed to give clean break.
2. Break out remainder of slab.

E. Sidewalk: Saw cut and remove to nearest joint beyond minimum distance of 1-foot from edge of trench.

F. Dispose of waste material in disposal area.

3.8 REPAIR OF EXISTING DRAIN TILES AND STORM SEWERS

A. Drain tiles and storm sewers broken during the trench excavation shall be repaired so their carrying capacities shall not be impaired. Broken drain tiles shall be replaced with larger sized piping, either corrugated metal pipe, PVC plastic pipe SDR-26, or ductile-iron pipe, as noted on the Drawings. Length of the pipe shall be such that it bears a minimum of 2-feet on undisturbed soil on each side of the piping trench, with each drain tile to pipe junction encased in concrete. All repairs of drain tile encountered shall be observed by the Engineer or Owner prior to backfilling. Compacted granular backfill will be required as of any existing utility or structure. Pipe to field tile junction shall be wrapped with burlap or other material prior to concrete encasement to prevent concrete from entering the flow line of the pipe.

B. Drain tiles and storm sewers uncovered during the trench excavation which are laid parallel to the trench shall be protected and kept in service. Those tiles or storm sewers accidentally broken shall be repaired or replaced. If necessary they shall be re-routed around the improvements. Contractor shall receive additional compensation for replacing the broken tiles or storm sewers if, as determined by the Engineer, the Contractor took adequate precautions against their damage.

3.9 RESTORATION OF SURFACES

A. Restoration of surfaces shall include the removal of the existing surface, and disposal of surplus material, and the construction of new surfaces. Type of surface restored shall be equal to or better than the surface removed. Surfaces not removed during excavation but damaged by the Contractor's equipment or operation shall also be removed and replaced or repaired to original condition.

B. Wherever conduits are constructed under traveled roadways, driveways, sidewalks, curbs and gutters, or other traveled surfaces, a temporary surface shall be placed over the top of the trench as soon as possible after compaction has been satisfactorily completed. Temporary surface shall consist of 12-inches of coarse aggregate, materials as specified for trench backfill (crushed limestone or washed gravel). Top of the temporary surface shall be smooth and meet the grade of the adjacent undisturbed surface. Temporary surface shall be maintained at the Contractor's expense until final restoration of the surface is performed as specified. No permanent restoration of surfaces shall be initiated until authorized by the Engineer. Temporary surfacing shall be required over the entire width of the trench, but any width in excess of the specified trench width shown on the Drawings shall not be used in computing payment quantities.

C. Contractor shall restore all removed or damaged fences, poles, and other property and surface structures removed or disturbed during or as a result of construction operations to a condition which is equal to or better than the appearance, quality and condition that existed before the work began. Restoration shall be made as soon as possible after compaction of the backfill has been completed.

3.10 SIDEWALK AND PAVEMENT REPLACEMENT – Not Used

3.11 GRASSED SURFACE RESTORATION

A. Refer to Section 02585.

3.12 CLEANUP

A. Contractor shall clean up as the Work proceeds. Premises shall be kept free of accumulations of waste materials and earth, rubbish and other debris resulting from the work. If in the judgment of the Engineer, the Contractor fails to keep the site clean as described herein above, Engineer will recommend to the Owner withholding all progress payment until the site has been cleaned up to the Engineer's satisfaction.

B. All debris and waste materials and salvaged materials unless required by the Specifications to be reused or delivered to the Owner, shall become the property of the Contractor and shall be removed by the Contractor from the construction site.

C. Any dirt, mud, or other debris tracked onto the adjacent streets by any of the Contractor's or supplier's vehicles shall be immediately cleared from the surface. Where truck crossings occur over sidewalks, that shall be kept from all spilled earth and grading materials and shall at all times be maintained in a passable condition for foot traffic.

D. Generally, the transportation of materials to and from the job site shall be over regular streets. When the Contractor's operations or that of its shippers, haulers, or subcontractors are such that dirt, mud, or debris are spilled or otherwise deposited on streets, driveways, or sidewalks, the Contractor shall clean up any large chunks before the close of every day's operation or before it is broken up or becomes impacted on the surface. In case of dispute or Contractor's failure to perform the cleanup work, the Owner may clean the streets and walks, remove the rubbish, etc. and will charge the cost to the Contractor by withholding monies due to cover all charged work.

E. At completion of the Work, Contractor will remove all waste materials, rubbish and debris from and about the premises as well as all tools, scaffolding and surplus materials, and will leave the site clean and ready for occupancy by the Owner. Contractor will restore to their original condition those portions of the site disturbed or damaged by the Contractor's operations.

F. Open burning of debris will not be permitted unless specifically authorized in writing by the Owner, and then only following state, municipal or other local codes, ordinances, rules or regulations.

End.

SECTION 02224

EARTHWORK

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Earthwork (rough-grading and finish-grading) for construction of subgrade for paving, landscape grading and earthwork associated with construction of campground sites shown on the Drawings and indicated in these Specifications.

B. Consolidation and compaction.

C. Fill for over-excavation.

D. Unsuitable and excess cut earthen material are to be hauled, spread, or stockpiled per Owner's direction at either an on-site location or to a site within 3-miles of the campground.

E. All earthwork (rough-grading and finish-grading) shall be paid for at the Contract Lump Sum Price "Campground Rough Grading."

F. Subgrade preparation for paving shall be considered incidental to construction.

1.2 RELATED SECTIONS

A. Section 02221 Trenching, Backfilling and Compacting.

1.3 DEFINITIONS

A. Earth: All materials, not classified as rock, including clay, silt, sand, gravel, hardpan, disintegrated shale, debris, loose stones, boulders less than ¾-cubic yard in volume, trees, stumps, roots and rubbish.

B. Rock: Solid mineral material with a volume in excess of ¾-cubic yard or solid material that cannot be removed with heavy duty trench excavating equipment such as a CAT 350 Excavator equipped with a rock ripper bucket without drilling, jack-hammering or blasting.

C. Rubble: Buried concrete foundations, beams, walls and other material which require continuous use of pneumatic tools or blasting.

D. Borrow: Materials in excess of excavated materials, needed to construct access drive embankments, parking lots and grading around buildings.

E. Removal of rock, rubble and miscellaneous debris above ground is incidental to construction.

1.4 REFERENCES

A. ANSI/ASTM C316 - Method for sieve analysis of fine and coarse aggregate.

B. ANSI/ASTM D698 - Test method for Moisture Density Relationship of Soils and Soil-Aggregate Mixtures using 5.5 lb. Rammer and 12 inch drop.

C. ASTM D2434-68 - Test Method for Permeability.

D. Where reference is made to one of the above standards, the revision in effect at the time of the notice to proceed shall apply.

1.5 JOB CONDITIONS

A. Notify corporations, companies, individuals or authorities owning above or below ground conduit, wires, pipes or other utilities running to property or encountered during the work operations. Cap or remove and relocate services in accordance with instructions by owner of said services. Protect, support, and maintain utilities to remain in accordance with requirements of owners of said services.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill material for site grading shall be on-site excavated material including borrow material. All fill material to be free of rubble, organics and vegetation.

B. Topsoil, fertile, friable, containing liberal amounts of humus, suitable for growth of grass:
   1. Free from hard lumps, roots, gravel cinders and stones over 1- inch in any dimension, weed seed, and other undesirable material.
   2. Topsoil removed and stockpiled may be used provided it meets the above requirements.

C. Borrow: If additional fill is necessary, Contractor is responsible for obtaining suitable fill. Contractor shall make his own excavation calculations as no compensation will be made for quantity variations or borrow.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Maintain and protect existing utilities.

C. Protect plant life, ground cover and other features remaining as a portion of the final landscaping. Areas disturbed outside construction limits indicated on the Drawings will be shaped, graded and seeded at no additional cost to the Owner.

D. Remove and replace fences and other structures indicated on the Drawings.

E. Protect benchmarks, grade stakes and other control stakes. Cost of re-staking will be paid by the Contractor:
   1. Contractor shall pay Owner for costs associated with replacing benchmarks, grade stakes and control stakes destroyed by the Contractor.
   2. These costs will be deducted from payments made by the Owner to the Contractor.

F. Clear entire surface of all areas to be excavated:
   1. Generally, remove all stumps, down timber, logs, snags, brush, undergrowth hedges, heavy growth of grass or weeds, structures, debris and rubbish of any nature.
   2. Clear all areas on which embankments or fill is to be placed.
      a. Comply with item 3.1, A.
      b. Excavate a minimum of 6-inches to remove roots and organic material.
      c. Disk to a depth of 6-inches.

3.2 SITE EARTHWORK AND GRADING

A. Grading plan is shown on the Drawings. Fill areas may be constructed of material borrowed from excavations and local borrow areas. The haul distance to perform fill operations shall be incidental to the price of excavation and no separate or additional payment will be awarded.

B. Contractor shall adjust the in-place subgrade soil moisture content to within a range of +0 to +4 percent above the optimum moisture content and:
   1. Compact to minimum of 98 percent of the materials maximum dry density (ASTM D698) under structures.
   2. Compaction under roadway, parking areas, and campsite pads to a minimum of 95 percent.
   3. Compaction of lawn and grass areas (non-traveled) to a minimum of 90 percent.

C. Excavated material suitable for backfill may be stockpiled on-site at designated locations.

D. Prior to placing fill disc area minimum of 6-inches deep and compact with a minimum of 8 full coverage passes with compaction equipment approved by Engineer.
   1. Slopes steeper than 5:1 (horizontal to vertical): Bench prior to placing fill.
   2. Benches to be cut a maximum of 3 to 4-feet deep and have an approximate width of 10-feet.

E. Place earthen fill material in maximum 6-inch loose lifts, compact to specified maximum dry density as measured by Standard Proctor Test using sheeps-foot roller.

F. Should moisture conditions become such that in the opinion of the Engineer, adequate compaction cannot be obtained, he may require that the operations be halted until moisture conditions have improved. Frozen materials shall not be used in the construction of the embankments. Fill shall not be placed on a frozen surface. If the operation in the construction of any section of the embankment

has to be stopped during which rain is likely to occur, the surface shall be left in such a condition that it will provide drainage.

3.3 EXCAVATION

A. Remove unsuitable material from excavated areas and prepare such areas for filling and backfilling as specified hereinafter.

B. Excavated material suitable for backfill may be stockpiled on-site in location designated by Engineer, except place no fill where trenches or other services will be located.

C. Place excavated soil not suitable for backfilling or site grading and materials containing slag, cinders, foundry sand, debris, and rubble in designated spoil areas and grade to drain.

D. Prior to placing fill for site grading, disc area minimum of 6-inches deep and compact with a minimum of 8 full coverage passes with a sheeps-foot roller. Remove soft spots as directed by Engineer:
   1. Slopes steeper than 5:1 (horizontal to vertical): Bench prior to placing fill.

E. Should moisture conditions become such that in the opinion of the Engineer adequate compaction cannot be obtained, Engineer may require that the operations be halted until moisture conditions have improved. Frozen materials shall not be used in the construction of the embankments. The fill shall not be placed on a frozen surface. If the operation in the construction of any section of the embankment has to be stopped during which rain is likely to occur, the surface shall be left in such a condition that it will provide drainage.

3.4 SUBGRADE CONSTRUCTION FOR PAVING

A. Specification applies to construction of subgrades under road paving, parking lots, driveways and other paved areas including:
   1. Crushed stone surfacing.
   2. Portland Cement Concrete paving.
   3. HMA paving.

B. Shape and consolidate subgrade in preparation for placement of pavement or granular surfacing.

C. Provide uniform composition at least 12-inches below top of subgrade for full width of subgrade plus 2-feet on each side, scarify materials, mix and re-compact, or otherwise treat to produce a uniform condition. Sequence of compaction is as follows:
   1. Grade to subgrade elevation.
   2. Remove top 6-inches of subgrade material and stockpile.
   3. Scarify, disk and re-compact lower 6-inches of subgrade to 95 percent standard proctor density.
   4. Replace top 6-inches of subgrade and re-compact to 95 percent standard proctor density.

D. Remove stones over 2-inches in size from loosened portion of subgrade and dispose of as directed by Engineer.

E. Construct subgrade with uniform density for a width equal to that of proposed drive plus 2-feet on each side: Density not less than 95 percent of maximum density.

F. In areas where roller cannot compact, provide approved select material, 12-inches minimum thickness and compact to 95 percent maximum density with vibrating tamper.

G. Construct to elevation and cross-section such that, after rolling, surface will be at required subgrade elevation.

H. Fill depressions that develop during rolling with suitable material. Continue rolling until subgrade is uniformly firm, properly shaped and true to grade and cross-section.
   1. Maintain until pavement or granular surfacing is placed.
   2. Remove materials (other than sand) which will not compact readily under roller; replace with materials which will compact readily; again roll that portion of subgrade.

I. If ruts or other objectionable irregularities form in subgrade during construction, reshape and re-roll subgrade before placing pavement or granular surfacing. Fill ruts or other depressions with material similar to other subgrade material.

J. Draw template, resting on side forms, over subgrade before pavement material is deposited.
   1. Use steel shod template, known as planner or scratch template with metal pegs set to proper subgrade elevation and spaced at intervals of 6-inches throughout its length.
   2. In irregular sections where use of template is impractical, check subgrade by most accurate practical method with authorization of Engineer.

3.5 FINISH GRADING

A. Examination:
   1. Verify fill material to be reused is acceptable.
   2. Verify building and trench backfilling has been inspected.
   3. Verify subsoil base has been contoured and compacted.

B. Subsoil preparation:
   1. Eliminate uneven areas and low spots.
   2. Remove debris, roots, branches and stones in excess of 1-inch in size. Remove subsoil contaminated with petroleum products.
   3. Scarify subgrade to depth of 3-inches where topsoil is scheduled. Scarify in areas where equipment is used for hauling and spreading topsoil and has compacted subsoil.

C. Placing topsoil:
   1. Place topsoil in areas disturbed by construction to a nominal depth of 6-inches.
   2. Use topsoil in relatively dry state. Place during dry weather.
   3. Fine grade topsoil eliminating rough or low areas. Maintain profiles and contour of subgrade.
   4. Remove roots, weeds and foreign material while spreading.
   5. Manually spread topsoil close to trees, plants and building to prevent damage.
   6. Lightly compact placed topsoil.
   7. Remove surplus subsoil and topsoil from site.
   8. Leave stockpile area and site clean and raked, ready to be seeded.

D. Tolerances:
   1. Top of topsoil: Plus or minus 1-inch.

E. Protection:
   1. Protect landscaping and other features remaining as final work.
   2. Protect existing structures, fences, sidewalks, utilities, paving and curbs.

F. Schedule:
   1. Finish grading required on all surfaces not receiving paved surfaces.

End.

SECTION 02273

EROSION AND SEDIMENT CONTROL

INDEX

PART 1 - GENERAL

1.1 Section Includes.
1.2 Description of Work.
1.3 Scheduling.
1.4 Special Requirements.
1.5 Measurement for Payment.

PART 2 - PRODUCTS

2.1 Filter Material for Filter Socks.
2.2 Filter Socks.
2.3 Silt Fence.

PART 3 - EXECUTION

3.1 Filter Socks.
3.2 Silt Fences.
3.3 Maintenance.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sediment control measures.

1.2 DESCRIPTION OF WORK

A. Furnish all materials; install, construct, maintain, and remove specified erosion control devices; at locations shown on the Drawings, or where specified by the Engineer, in accordance with the Contract Documents.

B. Complete the required construction Work on this project, while minimizing soil erosion and controlling water pollution. Maintain these features as specified, from initial construction stages to final completion of the project.

1.3 SCHEDULING

A. Implement erosion and sediment control measures at the appropriate time(s).

B. Coordinate construction to minimize damage to erosion and sediment control devices.

1.4 SPECIAL REQUIREMENTS

A. Iowa DNR Permit:

1. When applicable, comply with the requirements of the Iowa Department of Natural Resources, NPDES (National Pollutant Discharge Elimination System) General Permit

No. 2 for Stormwater Discharge Associated with Industrial Activity for Construction Activities, and the Stormwater Pollution Prevention Plan.

2. For projects covered under the Iowa DNR General Permit No. 2, sign on as a co-permittee with the Owner and any other Contractors or subcontractors.

B. Protection of property: Prevent accumulation of earth, sediment, or debris from project site onto adjoining public or private property. Remove any accumulation of earth or debris immediately, and take remedial actions for prevention.

1.5 MEASUREMENT FOR PAYMENT

A. Filter socks:
1. Installation: Filter socks will be measured and paid for at the Contract Unit price per linear foot for "Filter Socks." Filter socks installed to replace existing socks which are no longer adequate, due to sediment accumulation, will be measured and paid for as new socks.
2. Removal: Filter sock removal shall be considered incidental to construction.

B. Silt fence:
1. Installation: Silt fence will be measured and paid for at the Contract Unit price per linear foot for "Silt Fence." Silt fence installed to replace existing fences that are no longer adequate due to sediment accumulation, will be measured and paid for as new silt fence.
2. Removal of sediment: When required, removal of sediment from existing silt fence installations will be performed by the Contractor and will be considered incidental to construction.
3. Removal of device: Removal of silt fence will be considered incidental to construction. Contractor shall restore the area to finished grade and remove and disposal of fence, posts, and accumulated sediment.

C. Inlet protection device:
1. Installation: Provide fabricated materials to protect all new pipe inlets.
2. Payment: Installation is considered incidental to construction.

PART 2 - PRODUCTS

2.1 FILTER MATERIAL FOR FILTER SOCKS

A. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.

B. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.

C. Use material meeting the following particle sizes:

Sieve Size	Percent Passing[1]
2-inch	100
1-inch	90-100
3/8-inch	0-30

[1]The target flow rate of in-place material is 10 gal/min/lf. Engineer may approve use of alternate materials meeting the target flow rate.

2.2 FILTER SOCKS

A. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8-inch openings, constructed of 5-mil thickness, photodegradable HDPE.

B. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8-inch openings, constructed of 500-denier polypropylene.

C. Use 1-inch by 2-inch (minimum) hardwood stakes or stakes of equivalent strength.

2.3 SILT FENCE

A. Fabric: Conform to Iowa DOT Article 4196.01.

B. Posts: 4-foot minimum steel (T-section) weighing at least 1.25-pounds per foot, exclusive of anchor plate. Painted posts are not required.

C. Fastener: Wire or plastic ties with a minimum tensile strength of 50-pounds.

PART 3 - EXECUTION

3.1 FILTER SOCKS

A. Installation:
1. Pneumatically fill mesh filter socks: 8-inch diameter.
2. Fill socks with filter material.
3. Place the filter sock along the contour as specified in the Contract Documents or as directed by the Engineer.
4. Place additional filter material or soil from the site, on the upstream side of the sock, in the seam between the tube and the ground.
5. Construct a "J-hook" at each end of a continuous run of filter sock, by turning the end of the sock uphill, as necessary to prevent runoff from flowing around the ends when water behind the sock ponds up to a level even with the top of the sock.
6. Drive stakes into the ground at a maximum spacing of 10-feet securing the sock and preventing movement.

B. Maintenance: Perform the following incidental work:
1. Repair or replace non-functioning filter socks that allow water to flow under the sock, are torn, or are otherwise damaged, due to inadequate installation.
2. Remove filter material from damaged socks that are located along streambanks, around intakes, in ditches, or in other locations where the material may be carried to surface waters.

C. Removal: When indicated in the Contract Documents, or as directed by the Engineer; remove the filter sock upon completion of the project, and after final stabilization is achieved:
1. Upon completion of the project, completely remove socks and filter material that are located along streambanks, around intakes, in ditches, or in other locations where the filter material may be carried to surface waters if the sock degrades and/or tears.
2. Slice the sock longitudinally. Remove and dispose of the filter sock material and stakes.
3. Spread the filter material and accumulated sediment to match finished grade and to ensure proper drainage.
4. If the site has been brought to finished grade and prepared for permanent seeding, spread and incorporate the filter material into the surface by tilling, or as required to break up any large particles and provide a finished surface suitable for permanent seeding.

D. Replacement:
1. When accumulated sediment reaches a level one-half the height of the sock, or when the

sock becomes clogged with sediment and no longer allows runoff to flow through, remove the sock as described above, and replace according to the installation instructions above.

2. At the Engineer's option, the existing filter sock and accumulated sediment may be left in place, and a new filter sock installed up-slope from the existing filter sock.

3.2 SILT FENCES

A. Installation:

1. Install material along the contour of the ground, as specified in the Contract Documents, or as directed by the Engineer.
2. Install silt fence with a mechanical soil slicing machine that creates a slit in the ground while simultaneously installing the fabric. Trenching method may be used when situations will not allow soil slicing, as determined by the Engineer.
3. Construct a "J-hook" at each end of a continuous run of silt fence, by turning the end of the silt fence uphill, as necessary to prevent runoff from flowing around ends when water behind the fence ponds to a level even with the top of the fence.
4. Insert 12-inches of fabric to a minimum depth of 6-inches (fabric may be folded below the ground line).
5. Compact installation by driving along each side of the silt fence, or by other means, as necessary to adequately anchor the material in the ground, to prevent pullout and water flow under the fence.
6. Drive steel posts into the ground alongside the silt fence, to a minimum depth of 20-inches, unless otherwise specified by the Engineer. Space posts as required to adequately support silt fence.

B. Maintenance: At the Contractor's expense, repair or replace non-functioning silt fence that allows water to flow under the fence, is torn, or is otherwise damaged, due to inadequate installation.

C. Removal:

1. Remove the silt fence upon final stabilization of the project area.
2. Remove and dispose of silt fence and posts.
3. Remove sediment or spread to match finished grade; ensure proper drainage.
4. Stabilize the area disturbed by removal operations.

D. Replacement:

1. When accumulated sediment reaches a level one-half the height of the fence, remove the silt fence as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing silt fence and accumulated sediment may be left in place, and a new silt fence installed up-slope from the existing silt fence.
3. When permitted by the Engineer, the existing silt fence may be left in place and the accumulated sediment removed. Carefully inspect the existing silt fence for structural integrity and signs of undermining. Make any necessary repairs.

3.3 MAINTENANCE

A. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled, and are ordered by the Engineer; perform such work at the Contractor's expense.

B. Prevent the accumulation of soil sediment or debris onto streets adjacent to project site. Remove any accumulation of earth or soil immediately, and take remedial actions for prevention.

C. In case of repeated failures on the part of the Contractor to control erosion, pollution, and/or siltation, Engineer reserves the right to employ outside assistance, or to use the Jurisdiction's own forces to provide the necessary corrective measures. Such incurred direct costs, plus project

engineering costs, will be at the Contractor's expense, and appropriate deductions will be made from the Contractor's monthly progress estimate and final payment.

End.

SECTION 02510

CONCRETE SIDEWALKS

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PART 1 - GENERAL

1.1 Work Includes.
1.2 Definition.
1.3 Quality Assurance.

PART 2 - PRODUCTS

2.1 Materials.

PART 3 - EXECUTION

3.1 Preparation.
3.2 Forming.
3.3 Reinforcing.
3.4 Installation.
3.5 Joints.
3.6 Protection and Curing.

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Concrete sidewalk (minimum 4-inch thickness) shall be paid for at the Contract Unit Price per square foot for "Concrete Sidewalks." Price shall include all costs for labor, materials and equipment for placement of new sidewalks, including excavation and subgrade preparations, formwork, and granular base.

1.2 DEFINITION

A. Term "IDOT Specifications" in this Section refers to Standard Specifications for Highway and Bridge Construction, most recent addition, Iowa Department of Transportation, including current revised and supplemental specifications.

1.3 QUALITY ASSURANCE

A. Certification shall be provided by producer that Portland cement concrete furnished is in accordance with design mix specifications.

B. Reference Standards: American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO M213-81 - Preformed Expansion Fillers for Concrete Paving and Structural Construction.
   2. AASHTO M153-70 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Considerations.
   3. AASHTO M148-82 - Liquid Membrane-Forming Compounds for Curing Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete: Comply with Section 02516.

B. Expansion joint filler: ¾-inch wide preformed expansion joint filler in accordance with Section 2511.05F of IDOT Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

A. In accordance with Section 2511.05.A of IDOT Specifications.

B. Place, compact, and level a layer of sand (subbase), minimum 1-inch thickness. Sand shall conform to IDOT gradation number 1.

C. Moisten subbase prior to placing concrete.

3.2 FORMING

A. Wood or metal, straight and sufficient length to resist springing, tipping or other displacement during process of depositing and consolidating concrete.

B. Full depth of sidewalk 4-inch (minimum) or as shown on Drawings.

C. Secure, stake, brace, and hold firmly to required line and grade, and sufficiently tight to prevent leakage of mortar.

D. Clean and oil forms before placing concrete.

3.3 REINFORCING

A. Reinforcing is not required unless directed by Engineer.

3.4 INSTALLATION

A. Forms shall be checked by Engineer before concrete is placed.

B. Place concrete in accordance with Section 2511.05.C of IDOT Specifications.

C. Consolidate and spade sufficiently to bring mortar to surface. Strike off and float with wooden float.

D. Steel trowel and brush surface before mortar is set.

E. Before giving concrete final finish, check surface with 10-foot straightedge. Correct variations in surface of more than 1-inch by adding or removing concrete while concrete is still plastic.

F. Round edges of sidewalks along forms and joints with edger of ¼-inch radius.

3.5 JOINTS

A. Contraction joints:

1. Slot or groove at least 1-1/2-inches deep and ¼-inch wide formed by inserting metal parting strip in concrete after it has been stuck off and consolidated and while concrete will retain its shape and finish joint edge.
2. When authorized by Engineer, contraction joint may be sawed. Saw joint at least 1-1/2-inches deep and 1/8-inch wide. Saw as soon as practicable after concrete has set sufficiently to preclude raveling during sawing and before any shrinkage cracking takes place in concrete.
3. Construct transverse joints at right angles to centerline of sidewalk and longitudinal joints parallel to sidewalk centerline.
4. Divide sidewalk into sections with contraction joints. Spacing shall be 4 feet as indicated on the Drawings or authorized by the Engineer.
5. On slabs constructed in partial widths, place transverse joints in line with like joints in previously constructed slabs.

B. Expansion joints:

1. Place ¾-inch expansion joint filler between sidewalk and building or other rigid structure.
2. Extend expansion joint filler full depth of sidewalk with top slightly below finished surface of sidewalk.
3. On long lengths of sidewalk, ¾-inch expansion joints shall be placed at minimum of 48-foot intervals.

C. Sidewalk joint sealer: Gray, one-component, non-priming, self-leveling, pour grade, polyurethane joint sealer; ASTM C920-79, Type S, Grade P, Class 25 or FS TT-5-00230C, Type 1, Class A; Sonolastic SL1, Vulkem 45; or equivalent. Use in sidewalk joints adjacent to buildings and curb and gutter.

3.6 PROTECTION AND CURING

A. Erect and maintain suitable barricades as may be necessary to exclude traffic from newly constructed sidewalk. Sidewalk damaged by traffic or otherwise damaged prior to acceptance shall be repaired or replaced at expense of Contractor.

B. After finishing, concrete shall be cured and protected by one of the methods described in Section 2301.19 of IDOT Specifications.

End.

SECTION 02511

CRUSHED STONE BASE AND SURFACE COURSES

INDEX

PART 1 - GENERAL

1.1 Description.
1.2 Related Sections.
1.3 Quality Assurance
1.4 Submittals.

PART 2 - PRODUCTS

2.1 Materials.

PART 3 - EXECUTION

3.1 Preparation.
3.2 Equipment.
3.3 Application.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section consists of furnishing, hauling, placing, compacting, and shaping to obtain desired cross-section and profile for crushed stone base course and / or surface course for campsite surfaces, as a base course for PCC shoulders, and as a base course for new PCC roadway paving.

B. **Campsite construction:** Crushed stone materials shall be paid for at the Contract Unit Price per square yard for "Campsite Granular Material (6-inch thickness)." For payment, there will be no distinction between base and surface courses.

C. **Roadway base course construction:** Crushed stone materials placed as a base for PCC shoulder and roadway paving (minimum 4-inch thickness) shall be considered incidental to PCC paving.

1.2 RELATED SECTIONS

A. Term "IDOT Specifications" refers to Standard Specifications for Highway and Bridge Construction, most recent edition, Iowa Department of Transportation, including current revised and supplemental specifications.

B. Section 02221 Trenching, Backfilling and Compacting.

C. Section 02224 Earthwork.

1.3 QUALITY ASSURANCE

A. Provide one 30-pound representative sample of aggregate from source. Sample shall be tested by independent testing laboratory for gradation, plasticity index and liquid limit, abrasion, freeze-thaw, and absorption. Cost of laboratory testing shall be paid for by Owner.

B. Minimum of 6 in-place density tests shall be made by independent testing firm at locations chosen by Engineer. Cost of testing shall be paid for by Owner.

1.4 SUBMITTALS

A. Submit certification that aggregate source is approved by IDOT for material specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate for crushed stone surface course shall meet requirements of Section 4120.04 of IDOT Specifications (Class A crushed stone). Gradation must comply with gradation number 11 of Section 4109.

B. Aggregate for gravel surfacing base course shall meet requirements of Section 4123 of IDOT Specifications (Modified Subbase Material). Gradation must comply with gradation number 14 of Section 4109.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade preparation shall be in accordance with Specification Section 02224 and IDOT Specification 2109.05.

3.2 EQUIPMENT

A. Weighing equipment and procedures: IDOT Specifications 2001.07.

B. Compaction equipment:
   1. Be of such design so operation shall not disturb subgrade or subbase.
   2. Types of equipment used shall be in accordance with IDOT Specification 2001.05, except that other types of equipment may be used provided it is demonstrated that they will consistently produce specified density and gradation.
   3. Compaction equipment known as sheep-foot rollers shall not be used to compact base or surface material.

C. Equipment for applying water: IDOT Specification 2001.09.

D. Prewetting equipment: IDOT Specification 2001.08.

E. Proportioning equipment: When base material is composed of more than one aggregate, proportioning equipment shall include system of calibrated gates.

F. Spreading equipment: Capable of uniformly spreading base material to required thickness.

G. Motor patrols: IDOT Specification 2001.15.

3.3 APPLICATION

A. Construct crushed stone base on prepared subgrade or subbase in accordance with following requirements.

1. Delivery of base material:
   a. Pre-wet aggregate before delivery of aggregate to subbase.
   b. Engineer may control rate of delivery of aggregate to reduce time aggregate will remain on subbase in uncompacted condition to practical minimum.

2. Moisture content:
   a. At time base material is delivered to subbase, water shall be uniformly distributed throughout material so that all particles are uniformly wetted.
   b. Amount of water shall be within 2 percentage points of amount determined as field optimum to produce maximum density, together with stability with field compaction procedure. Moisture content will usually be 85 to 90 percent of optimum determined according to 1.0.05 Laboratory Test Method 103.
   c. Maintain moisture content in aggregate until compaction of base has been completed.

3. Spreading aggregate:
   a. **Campsite construction:** Spread wetted base and surface material to width and depth so that base will conform to desired profile and cross-section. Compacted thickness shall be a minimum 3-inch for base material and a minimum 3-inch for surface material. The total combined thickness is 6-inches.
   b. **Base course for PCC paving:** Spread wetted base material to width and depth so that base will conform to desired profile and cross-section. Compacted thickness shall be a minimum of 4-inches for base material.
   c. Maximum compacted thickness of material which may be spread for compaction as single course will be limited to that which will be uniformly and satisfactorily compacted for full depth of such course by compaction equipment employed.
   d. Spread so that uniformity of base and surface material and its moisture content is maintained. When spreader does not spread to full design width in one operation, Engineer may require special handling of center joint to avoid segregation. Special handling may include motor patrol cut of joint after initial compaction, followed by spreading cut material in path of second spreading operation.
   e. Contractor shall be responsible for obtaining designated thickness and for application rates. Any course determined to be deficient in thickness may be corrected by increased thickness of subsequent lift of course; however, thickness of course of 1/2 or 3/8-inch mixture size shall not be increased by more that ¼- inch to correct deficiency.

4. Compaction:
   a. Promptly after material has been spread, thoroughly and uniformly compact to not less than 95 percent of maximum density described in Laboratory Test Method 103 (Standard Proctor Test).

End.

SECTION 02516

PORTLAND CEMENT CONCRETE PAVEMENT

INDEX

PART 1 - GENERAL

1.1 Description.
1.2 References.
1.3 Submittals.
1.4 Equipment Requirements.

PART 2 - PRODUCTS

2.1 Materials.
2.2 Storage and Protection of Materials.
2.3 Quality Control.
2.4 Mixing.

PART 3 - EXECUTION

3.1 Subgrade Preparation.
3.2 Pavement Construction.
3.3 Curing and Protection.
3.4 Restrictions.
3.5 Defects.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section describes the following:
1. Construction of Portland Cement Concrete pavement and shoulders on prepared subgrade or subbase as shown on Drawings and specified herein.
2. Portland cement pavement includes deformed tie bars and joints.
3. Thickness of Portland Cement Concrete pavement and shoulders shall be a minimum of 6-inches.
4. Payment for PCC pavement and shoulders shall be at the Contract Unit Price per square yard for "PCC Pavement" and shall include all labor, equipment and materials necessary to perform the work, including the sub-base preparation, base course aggregate and compaction.

B. Related work specified elsewhere:
1. Section 02221 Trenching, Backfilling and Compacting.
2. Section 02224 Earthwork.
3. Section 03300 Cast-in-Place Concrete.

1.2 REFERENCES

A. Iowa Department of Transportation (IDOT) Standard Specifications for Highway and Bridge Construction, most recent addition.

1.3 SUBMITTALS

A. Refer to Specification Section 03300 for concrete submittal requirements and tests.

1.4 EQUIPMENT REQUIREMENTS

A. Batch or ready-mix plant:
   1. Shall comply with Iowa DOT standard specifications 2001.06, 2001.20 and 2001.21.
   2. Automatic cut-off gates at cement batching scale required.
   3. Scales and measuring devices certified at Contractor's expense.

B. Concrete mixing equipment: Shall comply with Iowa DOT standard specification 2001.21.

C. Construction equipment: Shall comply with Iowa DOT standard specification 2301.07.

D. Alternate equipment and methods for finishing and consolidating pavement may be permitted by Engineer if satisfactory operation and construction on previous projects can be demonstrated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete shall be C4 mix, Type I (Portland cement), 4,000-psi at 28-days, 3,000-psi at 7-days.
   1. Class 3 durability coarse aggregate shall be used.
   2. Entrained air content: 6.5 percent (+/- 1.5 percent).

B. Admixtures:
   1. Air entraining: ASTM C260.
   2. Fly ash: Type C, ASTM C618 and C494.
   3. Retarding: Shall comply with IDOT standard specification 4103.01.
   4. Calcium chloride may be used only with authorization of Engineer.
   5. Other admixtures may be used subject to authorization of Engineer in accordance with ASTM C494 or applicable standards.

C. Fine aggregate: Shall comply with IDOT Standard Specifications 4110.01, 4110.02, 4110.03 and 4110.04.

D. Coarse aggregate: Shall comply with IDOT Standard Specifications 4115.01, 4115.02, 4115.03, 4115.04 and 4115.05, Durability Class 3.

E. Water: Clean and clear, free from salt, oil, acid, strong alkalis, vegetable matter, or other substances injurious to concrete; water may be heated for cold weather paving operations; anti-freezing agents not permitted.

F. Reinforcing steel: Shall comply with IDOT Standard Specification 4151.02.

G. Metal expansion tubes:
   1. Fabricated steel tubes; conform to requirements of IDOT.
   2. Provide tubes with internal diameter 1/16-inch larger than dowel bar; bar stop capable of withstanding 20-pounds push, minimum.

H. Metal keyways:
   1. Fabricated 24-gauge sheet steel.
   2. Conform to requirements of IDOT.

3. Provide lengths in multiples of tie bar spacing
4. Punch to receive tie bars.

I. Supports for reinforcing steel:
1. Support tie bars as required to place and maintain correct location during construction.
2. Welded wire fabric supports: Heavy gauge wire, welded or bent to form 4-legged chair; use only with authorization of Engineer.
3. Support dowel bars at expansion and contraction joints as shown on Standard Drawings.

J. Joint filler:
1. Preformed expansion joint filler.
2. Asphalt saturated fiber strips.
3. AASHTO M213.
4. Furnish in strips of Drawing dimensions.

K. Concrete pavement joint sealer:
1. Bituminous joint filler and sealer; hot poured joint filler: ASTM D3405; Comply with IDOT 2301.25.
2. Backer rope: Cellulose, cotton or plastic foam suitable for use with hot-poured sealer; size and compression such that it maintains position during filling operation.

L. Sidewalk joint sealer:
1. Joint sealer: Gray, one-component, non-priming, self-leveling, pour grade, polyurethane joint sealer; ASTM C920-79, Type S, Grade P, Class 25 or FS TT-5-00230C, Type 1, Class A; Sonolastic SL1, Vulkem 45; or equivalent.
2. Use in sidewalk joints adjacent to buildings and curb and gutter.

M. Liquid curing compound: IDOT 4105.05.

N. Plastic film: Shall comply with IDOT Standard Specification 4106.02.

O. Fly ash:
1. Meet requirements of IDOT Section 2301.04.E and Section 4108, Class C.
2. Use source currently approved by IDOT.
3. Not acceptable for use after October 15 or prior to March 15.
4. Maximum substitution rate shall is 15 percent.

P. Burlap: AASHTO M182, Class 3.

2.2 STORAGE AND PROTECTION OF MATERIALS

A. Fine aggregates: Shall comply with IDOT Standard Specification 4110.

B. Coarse aggregates: Shall comply with IDOT Standard Specification 4115.

C. Cement: Shall comply with IDOT Standard Specifications 4101 and 2301.13B.

2.3 QUALITY CONTROL

A. Tests on trial batches and concrete placed at project site:
1. Slump: Shall comply with IDOT Standard Specification 2301.04B.
2. Air Entrainment: Shall comply with IDOT Standard Specification 2301.04C.
3. Minimum compressive strength: ASTM C39; 3,000 psi when tested at 7-days and 4,000-psi when tested at 28-days.

4. Quantity of compression cylinders as specified in Section 03300 - Cast-in-Place Concrete; Cast, protect and cure cylinders in accordance with ASTM C31; All concrete testing performed by ACI certified field testing technician per ASTM C94, Section 14.
5. Unit weight of fresh concrete.

2.4 MIXING

A. Batch mix: Shall comply with IDOT Standard Specification 2301.13.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. Prepare subgrade or subbase as specified in Section 02224 Earthwork.

3.2 PAVEMENT CONSTRUCTION

A. Setting and removing forms: Shall comply with IDOT Standard Specification 2301.09.

B. Concrete and steel placement: Shall comply with IDOT Standard Specifications 2301.12 and 2301.14.

C. Finishing: Shall comply with IDOT Standard Specification 2301.16.

D. Construct joints as shown on Standard Drawings. Seal as specified:
1. Round edges of concrete adjacent to header boards and expansion joint material to 1/8-inch radius.
2. Shall comply with IDOT Standard Specification 2301.25.

E. Seal all joints before pavement is opened to Contractor's forces or general traffic. Seal only dry and clean joint surfaces. Slightly under-fill joints. Keep sealer off of adjacent pavement. Comply with IDOT Standard Specification 2301.25.

F. Heat joint sealer to required temperature in thermostatically controlled heating kettle approved by Engineer; do not overheat.

3.3 CURING AND PROTECTION

A. Apply liquid curing compound in fine spray to form continuous, uniform film on surface and vertical edges of pavement and curbs. Comply with IDOT Standard Specification 2301.19.

B. Concrete pavement less than 36-hours old shall be protected during cold weather. Comply with IDOT Standard Specification 2301.19.

C. Concrete damaged by excessive scaling, popouts, shrinkage cracks, rain or freezing shall be removed and replaced at Contractor's expense.

3.4 RESTRICTIONS

A. Weather:
1. Place no concrete when existing or forthcoming stormy or inclement weather prevents good workmanship, when subgrade is frozen or if air temperature is 38°F or below and falling; Use no aggregates containing frozen lumps.

2. With favorable weather conditions, start paving operations when temperature of concrete delivered to subgrade is 40°F or higher.
3. Continue paving operations as long as concrete temperature requirement is met and air temperature remains above 38°F.

B. Night operation: Comply with IDOT Standard Specification 2301.30

C. Use of pavement:
1. Time for pavement for use will be determined by results of tests on cylinders taken during concrete placement.
2. Pavement may be opened to Contractor's forces after 7-days for purpose of removing coverings and building shoulders if tests of cylinders from pavement section show compressive strength of 3,000-psi or higher.
3. Open pavement to general traffic when authorized by Engineer.
4. Shall comply with IDOT Standard Specification 2301.31 with exception of cylinders will be required in place of beams.
5. Concrete placed in cold weather may require additional curing time, as directed by Engineer; keep all vehicles off pavement until such curing time has been completed.

3.5 DEFECTS

A. Pavement containing fractures, spalls, random cracks, significant popouts or shrinkage cracks, or other unacceptable defects. Remove and replace at no cost to Owner. Rout and seal all random cracks which develop prior to project completion.

End.

SECTION 02517

HOT MIX ASPHALT PAVING

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3.2 Surface Conditions.
3.3 Asphalt Paving Plants and Equipment for Placing HMA.
3.4 Placement of HMA.
3.5 Density and Surface Requirements.
3.6 Weigh Tickets.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of existing HMA paving shall be paid for at the Contract Unit Price per square yard for "HMA Pavement Removal."

B. At the time of bidding, no HMA paving is planned. This Specification is included for reference should such paving be directed by the Owner.

1.2 RELATED WORK

A. Not Used.

1.3 REFERENCES

A. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregate.

B. The Asphalt Institute, Manual MS-13, Asphalt Surface Treatments and Asphalt Penetration Macadam.

C. Standard Specifications for Highway and Bridge Construction, Iowa Department of Transportation most recent addition, Section 2303, Asphalt Cement Concrete Mixtures, including current supplemental specifications.

1.4 SUBMITTALS

A. Aggregate gradation and durability reports in accordance with Section 4127.04, Type A aggregate of IDOT Standard Specifications for Highway and Bridge Construction.

B. Job mix formula.

PART 2 - PRODUCTS

2.1 TACK COAT

A. Emulsified asphalt material used for tack coat shall conform to ASTM D 977 and shall be SS-1 or SS-1H, or CSS-1 and CSS-1H, conforming to ASTM D 2397. The application temperature is as follows:
   1. SS-1 or CSS-1, 90-160 degrees F. (32-71 degrees C.).
   2. SS-1H or CSS-1H, 90-160 degrees F. (32-71 degrees C.).

2.2 HMA BASE COURSE

A. HMA base course shall consist of materials conforming to the requirements of Section 2303 of the Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, most recent edition, for HMA (1M ESAL) Base, ¾-inch..

2.3 HMA SURFACE COURSE

A. HMA surface course shall consist of materials conforming to the requirements of Section 2303 and 4127 of the Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, most recent edition, for HMA (1M ESAL) Surf, ½-inch, no fric.

PART 3 - EXECUTION

3.1 FIXTURES IN PAVEMENT SURFACE

A. All manholes, catch basins, valve holes, or other fixtures encountered within the area to be covered by HMA shall be adjusted to conform to the adjacent finished surface. This adjustment shall be made before the final lift is placed adjacent to the fixture but after all preceding lifts have been placed adjacent to the fixture.

3.2 SURFACE CONDITIONS

A. HMA shall not be placed on a wet or damp surface and shall not be placed when the temperature on a shaded portion of the road surface is less than shown in the following table:

All Lower Layers of Bituminous Mixtures	
Nominal Thickness (inches)	Road Surface Temperature, °F
2	35
All Wearing Course Layers of Type A and Type B ACC	
Nominal Thickness (inches)	Road Surface Temperature, °F
2	40

B. HMA shall not be placed after November 15, except with approval of the Construction Engineer. Wearing courses 1-inch or less in design thickness and courses with sprinkle treatment shall not be placed after October 1, except by authorization of Construction Engineer.

C. Tack coats shall be applied when the entire surface area on which the road is to be applied is clean and free of moisture, conforming to the requirements of IDOT Standard Specification 2303.03.A.2.

3.3 ASPHALT PAVING PLANTS AND EQUIPMENT FOR PLACING HMA

A. Plants and equipment shall meet IDOT Standard Specifications for 2303.

3.4 PLACEMENT OF HMA

A. Placement shall be in accordance with IDOT Standard Specification Sections 2303.

3.5 DENSITY AND SURFACE REQUIREMENTS

A. Compaction shall be Class 1A to 96 percent of laboratory density IDOT Standard Specification Section 2303.03.D. Smoothness standard shall be IDOT Standard Specification 2303.17, para. D.

3.6 WEIGH TICKETS

A. A weigh ticket of a type approved by the Engineer shall be furnished in duplicate for each load leaving the plant. Contractor shall deliver one copy to the inspector on the site when the load is dumped. Except for unavoidable delay or breakdown, the delivery of HMA concrete to any individual spreading unit shall be continuous and uniform at a rate sufficient to provide continuous operation of the spreading unit.

B. HMA shall not be used when its temperature is less than 245 degrees F for a nominal layer thickness of 1-1/2-inches or less, and 225 degrees F for a nominal layer thickness of more than 1-1/2-inches.

End.

SECTION 02585

SEEDING

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1.5 Scheduling and Conflicts.
1.6 Measurement and Payment.

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2.2 Seed Mixtures and Seeding Dates.
2.3 Fertilizer.
2.4 Sticking Agent.
2.5 Inoculant for Legumes.
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2.7 Mulch for Hydraulic Seeding.
2.8 Equipment.
2.9 Biocell Area.

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3.2 Conventional Seeding – Not Used.
3.3 Hydraulic Seeding.
3.4 Pneumatic Seeding – Not Used.
3.5 Biocell Area.
3.6 Watering.
3.7 Re-seeding.
3.8 Cleanup.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Certification of products.

B. Acceptance and warranty.

C. Seed types and mixes.

D. Equipment.

E. Application of seed.

1. 2 DESCRIPTION OF WORK

A. Specification includes materials, equipment, and labor requirements for the complete and satisfactory installation and maintenance for all seeding, including:
   1. Turf / lawn areas.
   2. Special ditch areas.
   3. Biocell area.

B. Requirements for the Work on this Project are familiarity with the site, scope of Work of the Project, and coordination of the seeding with related Work.

C. Seeding includes the operations of seedbed preparation, furnishing, applying, and covering the seed, and compaction of the seedbed.

1.3 SUBMITTALS

A. Submit certification of products to the Engineer prior to seed placement:

   1. Seed: Submit a mechanically printed seed tag from an Iowa Crop Improvement Association-approved seed conditioner or grower. Submit a laboratory analysis for all seeds, specifying the purity and germination. Provide 48-hours notice prior to mixing the seed and give the Engineer an opportunity to witness the seed mixing.

   2. Fertilizer: Submit certification of the fertilizer analysis with scale weight and statement of guaranteed analysis. Submit from a certified fertilizer dealer, a mechanically printed commercial fertilizer label or bill of lading. All fertilizer will meet the inspection and acceptance requirements of Iowa DOT Materials I.M. 469.03.

   3. Wood cellulose fiber mulch: Submit certification of the degradable wood cellulose fiber mulch ingredients with applicable use and rate, and the water retention capacity by manufacturer or supplier.

   4. Wood excelsior mulch: Bale wood excelsior and determine the mass (weight). Use the mass of the material, furnished by the manufacturer, to determine the rate of application.

   5. Straw mulch: Certify weight. Furnish a list of the number of bales and a corresponding ticket from an approved scale for the mulch material to be used on the project.

   6. Compost: Submit certification of composted organics analysis with U.S. Compost Council's Seal of Testing Assurance (STA), recommended rates of application, and manufacturer's estimated cubic yards per ton.

   7. Inoculant: Furnish information from inoculant packaging.

   8. Tackifier: Submit certification of the tackifier ingredients, recommended rates of application, and expiration date.

B. When requested, submit written instructions recommending procedures for maintenance of seeded areas.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in original, unopened, and undamaged containers. Do not mix or blend materials except in the presence of the Engineer.

B. Deliver, handle, and store all materials according to product recommendations, and protect from loss, damage, and deterioration.

C. Materials not meeting these requirements will be rejected.

1.5 SCHEDULING AND CONFLICTS

A. Coordinate the seeding schedule with all other Work on the Project. Notify the Engineer at least 3-calendar days prior to the start of seeding operations.

B. Perform seeding operations an after all land-disturbing activity are completed, and after the seedbed has been approved by the Engineer.

1.6 MEASUREMENT AND PAYMENT

A. Seeding, fertilizing, and mulching for hydraulic seeding: Payment for seeding will be full compensation for furnishing all materials, equipment, tools, and labor necessary to complete the Work. It includes removal of rock and other debris from the area, repairing rills and washes, preparing the seedbed, furnishing and placing seed, including any treatment required, furnishing and placing fertilizer and mulch, and furnishing water and other care during the care period.

B. Turf / lawn areas: Seeding for the completed turf area installation will not be measured. This seeding will be paid for at the Contract Lump Sum prices for "Seeding – Type 1."

C. Special ditch areas: Seeding for the specified ditch and slope areas will be measured in acres. This seeding will be paid for at the Contract Unit Price per acre for "Seeding – Type 2."

D. Biocell area: Construction of the biocell area will be paid for at the Contract Lump Sum price for "Biocell Area." Work included in this Contract Lump Sum price includes earthwork, drain piping, base aggregate, the sand / topsoil mixture, and seeding.

PART 2 - PRODUCTS

2.1 SEED

A. Provide fresh, clean, new crop, certified seed complying with tolerance for germination and purity and free of poa annua, bent grass, and noxious weed seed. Furnish all seeds, including grass, legume, forbs, and cereal crop seeds, from an established seed dealer or certified seed grower. All materials and suppliers are to follow Iowa Seed Law and Iowa Department of Agriculture and Land Stewardship regulations, and be labeled accordingly:
   1. Turfgrass will have a certified "blue tag."
   2. Native grass and forbs that are source-identified as G-0 Iowa certified yellow tag, when available.

B. Mix seed to the specified proportions by weight by methods approved by the Engineer.

C. Seed quality: Ensure the seed provided meets or exceeds the minimum requirements of purity and germination stated on an analysis document that specifies quality. Approval of all seed for use will be based on the accumulated total of Pure Live Seed (PLS) for each phase of work. PLS is obtained by multiplying purity times germination. PLS shall not be less than the accumulated total of the PLS specified. If the purity and/or germination of native grasses exceeds the minimum required, adjust the application rate based on PLS.

   If the seed does not comply with minimum requirements for purity and germination and such seed cannot be obtained, the Engineer may approve use of the seed on a basis of PLS or may authorize a suitable substitution for the seed specified.

D. Requirements on containers:

1. Seed: Provide seed with a tag on each container. Seed analysis on the label shall be mechanically printed.
2. Mulch: When packaged, provide mulch in new labeled containers.
3. Tackifier: Provide tackifier packaged in new labeled containers.
4. Inoculant: Use inoculant that has a manufacturer's container, indicating the specific legume seed to be inoculated and the expiration date. All inoculant must meet requirements of the Iowa Seed Law. Follow precautions specified on the product label.
5. Sticking agent: Use a commercial sticking agent recommended by the manufacturer of the inoculant. For quantities less than 50-pounds, the sticking agent need not be a commercial agent, but requires approval by the Engineer. Apply sticking agent separately prior to application of inoculant. Follow safety precautions specified on the product label.

Common Name	Scientific Name	Purity (%)	Germination (%)
DOMESTIC GRASSES:			
Bluegrass, Kentucky	Poa pratensis	98	85
Fescue, creeping, red, hard	Festuca rubra	98	85
Ryegrass, Perennial	Lolium perenne	95	90
NURSE CROP OR STABILIZING CROP:			
Oats	Avena sativa	97	90

Common Name	Scientific Name	Min. PLS (%)
IOWA NATIVE GRASSES:		
Little Bluestem	Andropogon scoparius	30
Sideoats Grama	Bouteloua curtipendula	30

2.2 SEED MIXTURES AND SEEDING DATES

A. Type 1: Used for campground turf site, fertilized, and typically mowed.

Seeding Dates: March 1 – May 31, August 10 – September 30	
Common Name	**Application Rate lb/acre**
Kentucky Bluegrass	65
Creeping Red Fescue	25
Fine-Leafed Perennial Ryegrass	20
Annual Ryegrass	40

B. Type 2 - Mixture for Slopes and Ditches and for Biocell area: Not typically mowed.

Seeding Dates: March 1 – June 30	
Common Name	**Application Rate lb/acre**
Little Bluestem	8
Sideoats Grama	7
Oats	16

2.3 FERTILIZER

A. Grade: Identify the grade of fertilizer according to the percent nitrogen (N), percent of available phosphoric acid (P_2O_5), and percent water soluble potassium (K_2O), in that order, and base

approval on that identification.

Contractor may substitute other fertilizer containing analysis percentages different from those specified, provided that the minimum amounts of actual nitrogen, phosphate, and potash per acre are supplied, and that in no case does the total amount per acre of the 3 fertilizer elements be exceeded by 30 percent of the following minimum amounts:

1. For conventional seeding, permanent: Not Used.
2. For conventional seeding, temporary: Not Used.
3. For hydraulic seeding: Apply fertilizer in combination with seeding by a hydraulic seeder and as specified in Iowa DOT Article 2601.04, H. Apply a 13-13-13 commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate of 450-pounds per acre.
4. For pneumatic seeding: Not Used.

B. Type: Use fertilizer that can be uniformly distributed by the application equipment. Furnish fertilizer either as separate ingredients or in chemically-combined form.

2.4 STICKING AGENT

A. Use a sticking agent that is a commercial material recommended by the manufacturer to improve adhesion of inoculant to the seed. For small quantities less than 50-pounds, the sticking agent need not be a commercial agent, but it must be approved by the Engineer and must be applied separately, prior to application of inoculant.

B. Follow safety precautions specified on the product label. A sticking agent is not required if a liquid formulation of inoculant is used.

2.5 INOCULANT FOR LEGUMES

A. An inoculant is a culture of bacteria specifically formulated for each legume seed (alfalfa, clovers, lespedesa, birdsfoot trefoil, hairy vetch, and crown vetch).

2.6 WATER

A. Use water that is free of any substance harmful to seed germination or plant growth.

2.7 MULCH FOR HYDRAULIC SEEDING

A. Wood cellulose:

1. Use material that is a natural or cooked cellulose fiber processed from whole wood chips, or a combination of up to 50 percent recycled paper (by volume).
2. Product contains a colloidal polysaccharide tackifier adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing.
3. Form a homogeneous slurry of material, tackifier, and water.
4. Use a slurry that can be applied with standard hydraulic mulching equipment.
5. Dye the slurry green to facilitate visual metering during application.
6. Do not use materials that have growth or germination-inhibiting factors or any toxic effect on plant or animal life when combined with seed or fertilizer.

B. Bonded fiber matrix (BFM):

1. Produced from long-strand wood fibers, held together by organic tackifiers and bonding agents that, when dry, become insoluble and non-dispersible.
2. Upon curing 24 to 48-hours, form a continuous, 100 percent coverage, flexible, absorbent, erosion-resistant blanket that encourages seed germination.
3. Manufactured to be applied hydraulically.
4. Physical properties:

a) Fibers: Virgin wood, greater than 88 percent of total volume.
b) Organic material: Greater than 96 percent of total volume.
c) Tackifier: 8 to 10 percent.
d) pH: 4.8 minimum.
e) Moisture content: 12 percent +/- 3 percent.
f) Water-holding capacity: 1.2-gal/lb.

C. Mechanically-bonded fiber matrix (MBFM):
a. Produced from long-strand wood fibers and crimped, interlocking synthetic fibers.
b. Within 2-hours of application, form a continuous, 100 percent coverage, flexible, absorbent, porous, erosion-resistant blanket that encourages seed germination.
c. Manufactured to be applied hydraulically.
d. Physical properties:
1) Wood fibers: 73 percent minimum.
2) Tackifier: 10 percent +/- 1 percent.
3) Crimped, interlocking synthetic fibers: 5 percent +/- 1 percent.
4) Moisture content: 12 percent +/- 3 percent.

2.8 EQUIPMENT

A. Aerial equipment: When aerial application of seed and fertilizer is specified, use aerial equipment capable of providing a uniform distribution of seed and fertilizer on the specified area.

B. Compost blower: A compost blower is pneumatic equipment to blow compost over the desired area. It may be equipped with a supplemental seed injection system.

C. Cultipacker: Use a pull-type cultipacker with individual rollers or wheels. Cultipackers with sprocket-type spacers between the wheels may be used. The cultipacker must produce a corrugated surface on the area being compacted. Operate the cultipacker separately from all other operations, and do not attach the cultipacker to the seeder or disk, unless combined cultipacker seeder is manufactured to operate as a unit. Make provisions for addition of weight.

D. Disk: When preparing a seedbed on ground having heavy vegetation, use a disk with cutaway blades. Make provisions for the addition of weight to obtain proper cutting depth.

E. Endgate cyclone seeders: Endgate cyclone seeders must be suitably mounted. Movement must be provided by mechanical means. The seed drops through an adjustable flow regulator onto a rotating, power driven, horizontal disk or fan.

F. Expanded mesh roller: Use equipment that is an open grid type or a cultipacker type, modified by covering with expanded metal mesh.

G. Field tiller: Use equipment designed for the preparation of the seedbed to the degree specified.

H. Gravity seeders: Gravity seeders must provide agitation of the seed, have an adjustable gate opening, and uniformly distribute seed on the prepared seedbed. Use a seed hopper equipped with baffle plates spaced not more than 2-feet apart. The baffle plates must extend from the agitator shaft to within approximately 2-inches of the top of the seed hopper. Wind guards are required to facilitate seeding when moderate wind conditions exist and when ordered by the Engineer. Place wind guards in front or in back (or both) of the seed outlet and extend them to near the ground line. This seeder may be used for application of fertilizer.

I. Hand cyclone seeders: Hand cyclone seeders are carried by the person dispensing seed. The seed drops through an adjustable flow regulator onto a rotating, hand driven, horizontal disk or fan.

J. Hydraulic seeder: Use hydraulic seeding equipment with a pump rated at not less than 100-gallons per minute. Inoculant, seed, and fertilizer may be applied in a single operation. The equipment must have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks must have a means of agitation. Calibrate tanks and provide them with a calibration stick or other approved device to indicate the volume used or remaining in the tank.

K. Interseeder / Slit seeder: An interseeder/slit seeder is an implement that cuts a slit into the soil and drops the seed into the slit.

L. Mowers: Use mowers that are rotary, flail, disk, or sickle type. Do not use mowers that bunch or windrow the mowed material.

M. Mulch stabilizer: Use a mulch stabilizer designed to anchor straw or hay mulch into soil by means of dull blades or disks. It should have flat blades or disks, may have cutaway edges, must have a nominal minimum diameter of 20-inches, and must be spaced at approximately 8-inch intervals. The mulch stabilizer must be pulled by mechanical means and weigh approximately-1,000 pounds. When directed by the Engineer, increase the weight by addition of ballast.

N. Native grass seed drill: Use a native grass seed drill designed to provide uniform distribution of native grass and wildflower seeds. Provide separate seed boxes to apply both small seeds as well as fluffy bearded seeds. If a no-till attachment is specified, use an attachment of the same manufacturer as the drill.

O. Pulverizer: A pulverizer is equipment designed to break up compacted soil to prepare a seedbed.

P. Rotary tiller: Use equipment with rotary-type blades designed for the preparation of seedbed to the degree specified.

Q. Slope harrow: Use a slope harrow, consisting of a rolling weight attached by heavy chain to a tractor. The chain must be of suitable length, with picks attached, and a means of rotating the picks as the rolling weight is pulled in a direction parallel to the movement of the tractor.

R. Spike tooth harrow: Use equipment designed to provide adjustment of the spike teeth to level the ground, or to be used as specified by the Engineer.

S. Straw mulching machine: Use a machine to uniformly apply mulch material over the desired area without excessive pulverization. Engineer may consider excessive pulverization as the general absence of straw longer than 6-inches after distribution.

2.9 BIOCELL AREA

A. Base aggregate: Base aggregate layer of the biocell shall be constructed using clean, porous aggregate meeting the IDOT standard gradation number 29. Install to thickness shown on the Drawings.

B. Underdrain piping: Underdrain piping shall be perforated PVC piping conforming to ASTM Standard D2729. Perforations shall be two rows of holes, ½-inch in diameter, on 5-inch centers, and 120-degree angle apart. Use solvent weld joints. Nominal size 3-inch piping shall have a 3.25-inch outside diameter and weigh 0.465-pounds per foot.

C. Topsoil / sand mixture: Mixture for biocell surface shall be 80 percent sand and 20 percent topsoil. The sand shall be clean, washed fine aggregate meeting the IDOT standard gradation 36. Topsoil shall be material from the site. It shall be free of stones, roots, and grass. The sand and topsoil shall be thoroughly mixed before placement within the biocell.

PART 3 - EXECUTION

3.1 AREA OF SEEDING

A. Seed all areas within the campground which do not have a paved surface or an aggregate surface, as shown on the Drawings. Do not disturb areas having a satisfactory growth of desirable grasses or legumes.

3.2 CONVENTIONAL SEEDING – Not Used.

3.3 HYDRAULIC SEEDING

A. Order of operations:
   1. Seedbed preparation
   2. Seed application, fertilizing, and mulching

B. Seedbed preparation:
   1. Area shall be free of stones and debris.
   2. Thoroughly till topsoil by disking or harrowing to level out undulations and irregularities and to destroy weed seedlings.
   3. Rake surface to produce fine soil texture before seeding.

C. Seed preparation: Inoculant, in the quantities specified above, may be applied directly into the supply tank with seed, water, and other material.

D. Seed application, fertilizing, and mulching:
   1. Place all material, seed, fertilizer, mulch, and tackifier (if applicable) in hydraulic mulching equipment specifically manufactured for hydraulic seeding. Do not apply fertilizer with native grass, wildflower, or wetland seeding.
   2. Ensure that the hydraulic equipment, pump, and application process do not damage or crack seeds.
   3. Mix materials with fresh potable water using a combination of both recirculation through the equipment's pump, and mechanical agitation to form a homogeneous slurry.
   4. If necessary, dampen dry, dusty soil, to prevent balling of the material during application.
   5. Apply the slurry evenly over all specified areas at component material rates specified:
      a. Wood cellulose mulch:
         1) Mulch: Minimum 2600-lb/acre dry weight.
         2) Tackifier: Minimum 50-lb/acre.

      b. Bonded fiber matrix: Minimum 3600-lb/acre dry weight.
      c. Mechanically-bonded fiber matrix: Minimum 3600-lb/acre dry weight.

   6. Retain and count empty bags of mulch to ensure final application rate.

3.4 PNEUMATIC SEEDING – Not Used.

3.5 BIOCELL AREA

A. Construct biocell area in accordance with the details shown on the Drawings and these Specifications. Use only clean topsoil (free from stones and grasses) in the mixture with sand. Thoroughly mix sand and topsoil prior to installation within the biocell.

B. Install drain piping in accordance with manufacturers instructions.

3.6 WATERING

A. Provide water, equipment, transportation, water tanker, hoses, sprinklers, and labor necessary for the application of water.

B. Use enough water to keep the soil and mulch moist to a depth of 1-inch and ensure growth of the seed. For turf-grass seeding areas, sufficiently water to keep the soil moist for a minimum of 21-days. If natural rainfall is adequate to keep the soil and mulch moist, artificial watering may not be needed.

3.7 RE-SEEDING

A. When all work related to seeding, fertilizing, and/or mulching has been completed on an area, and is washed out or damaged, re-seed, fertilize, and/or mulch the area at the contract lump sum prices when so ordered by the Engineer.

B. When work related to seeding, fertilizing, and/or mulching has not been completed in an area, and is washed out or damaged, re-seed, fertilize, and/or mulch the area as necessary, at the Contractor's expense.

3.8 CLEANUP

A. Remove all excess materials, debris, and equipment upon completion of work.

B. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.

C. Repair any damage resulting from seeding operations.

D. Remove hydraulic slurry and other excess debris related to seeding operations from buildings, landscaping, mulch, pavement, and any other areas not specified for application, at the end of each day.

End.

SECTION 02700

TRENCHLESS CONSTRUCTION (BORING, JACKING, AND TUNNELING)

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenchless installation of carrier pipe with casing pipe.

1.2 DESCRIPTION OF WORK

A. Excavate launching and receiving pits.

B. Install casing pipe by trenchless methods.

C. Install carrier pipe inside casing pipe.

D. Place backfill material in excavations.

1.3 SUBMITTALS

A. Proposed installation methods and equipment.

B. Gradation reports for bedding materials if required.

C. Shop Drawings of casing spacers and proposed spacing.

1.4 MEASUREMENT AND PAYMENT

A. All items of Work contained in this Section are incidental to the underground utility pipe being installed and will not be paid for separately.

PART 2 - PRODUCTS

2.1 CARRIER PIPE

A. Pipe: PVC pipe: Refer to Specification Section 02721, Paragraph 2.1.

2.2 CASING PIPE

A. Steel: Use only new, steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; or ASTM A 53, Grade B. Pipe may be welded or seamless. Wall thickness shall be at least 0.281-inches.

B. Joints: Comply with American Welding Society Code D1.1. Weld all joints with full penetrating weld. Welders must be qualified according to Iowa DOT Materials I.M. 560. Welds must comply with Iowa DOT Materials I.M. 558.

C. Pipe diameter: Minimum inside diameter shall allow installation of carrier pipe and casing spacers, with allowance for installation.

2.3 CASING SPACERS

A. Use manufactured casing spacers to position carrier pipe in casing:
   1. Spacers shall be Model SSI-12 manufactured by Advance Products and Systems; or equivalent.
   2. Install in “Clear Bell” arrangement.

B. Meet the following material requirements:
   1. Band: 14-gauge, T304 stainless steel. Width: 12-inches.
   2. Riser: 10-gauge, T304 stainless steel.
   3. Liner: EPDM.
   4. Bolts, nuts and washers: T304 stainless steel.
   5. Runners: 1-inch or 2-inch wide glass runners.
   6. Length: 11-inches.

2.4 BACKFILL FOR ABANDONED TUNNELS

A. Use Iowa DOT Class C concrete, approximately 4-inch slump.

B. Flowable mortar or CLSM may be used if authorized by the Engineer.

2.5 BACKFILL MATERIAL

A. Excavated materials: Use only suitable material for backfill material.

B. Special fill materials: For use if authorized by the Engineer.

2.6 CASING END SEAL

A. Use wrap around casing end seal on each end. Seal manufactured from 1/8-inch thick neoprene rubber. Use ½-inch T304 stainless steel bandings with non-magnetic worm gear mechanism.

B. Casing end seal shall be Model AW manufactured by Advance Products and Systems; or equivalent.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Remove topsoil to a minimum depth of 12-inches and stockpile.

B. Excavate the minimum size pits necessary to safely and properly perform the Work:
   1. Protect existing facilities, trees, and shrubs during excavation.
   2. Place excavated material away from trench.
   3. Grade and shape spoil piles to drain and protect adjacent areas from runoff. Do not allow spoil piles to obstruct drainage. Stabilize stockpiles with seeding and provide sediment control around stockpiles.

C. Remove rock, rubbish, debris, and other materials not suitable for use as backfill.

3.2 SHEETING, SHORING, AND BRACING

A. Comply with Spec Section 02221 Trenching, Backfilling, and Compacting, Para 3.5.

3.3 DEWATERING

A. Comply with Spec Section 02140.

3.4 TRENCHLESS INSTALLATION

A. Select a method of installation appropriate for the soil conditions anticipated which will:
   1. Allow the pipe to be installed to the desired line and grade within the specified tolerances.
   2. Prevent heaving or settlement of the ground surface or damage to nearby facilities.
   3. Prevent damage to the carrier pipe and any lining materials within the carrier pipe.

B. Installation method:
   1. Auger boring: Method utilizes a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove the spoil.
   2. Pipe jacking: Method in which pipe is pushed into the ground with hydraulic jacks while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine.

C. Line and grade:
   1. Install pipe at line and grade to allow the carrier pipe to be installed at its true starting elevation and grade within the specified maximum alignment deviation of the pipe centerline.
   2. When no deviation tolerances are specified in the Contract Documents, apply the following maximum deviations to the carrier pipe.
      a. Gravity pipe:
         1) Horizontally: ± 1.0-foot per 100-feet.
         2) Vertically: ± 0.2-feet up to 100-feet. An additional ± 0.1-foot per 100-feet thereafter. Back fall in pipe is not allowed.

b. Pressurized pipe:
   1) Horizontally: ± 2.0-feet
   2) Vertically: ± 1.0-foot. Maintain the minimum depth specified in the Contract Documents.

3. Deviation from line and grade:
   a. Provided adequate clearance remains for proper installation of the carrier pipe, Contractor will be allowed to correct deviations in grade of a casing pipe in order to achieve design grade of the carrier pipe by:
      1) Pouring an invert in the casing pipe.
      2) Shimming the carrier pipe with casing spacers to a uniform grade.

   b. Installations deviating from the specified tolerances which cannot be adjusted to conform to the specified tolerances may be rejected by the Engineer. If non-conforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no additional cost to the Owner.
   c. Abandon rejected installation and place special fill materials, at no additional cost to the Owner. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.

D. Casing pipe installation:
   1. Install pipe by approved methods.
   2. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage.
   3. Do not exceed the compressive or tensile strength capacity of the pipe during pushing or pulling operations.
   4. Fully support bore hole at all times to prevent collapse. Insert pipe as soil is removed, or support bore with drilling fluid.
   5. Fully weld all casing pipe joints. Use an interlocking connection system when approved by the Engineer.
   6. Fill space between the inside of the bore hole and the outside of the pipe with special fill material if the space is greater than 1-inch.

E. Carrier pipe installation through casing:

   1. Clean dirt and debris from the interior of the casing pipe after installation.
   2. Install casing spacers on carrier pipe sections as necessary to support the pipe barrel according to the pipe manufacturer's recommendations, based upon the type of pipe being installed:
      a. PVC pipe: Install a spacer within 1-foot of each side of the carrier pipe joint and one at the center of each section of pipe.
      b. DIP pipe: Install two spacers at even spacing for each section of pipe.
      c. Do not allow the pipe to be supported by joint bells.
      d. Lubricate casing spacers with drilling mud or flax soap. Do not use petroleum-based lubricants or oils.

   3. Ensure that thrust loads will not damage carrier pipe joints.
   4. Provide timbers for sufficient cushioning between the end of the pipe pushed and the jacking equipment to prevent damage to the pipe. Do not allow the steel jack face to thrust against the unprotected pipe end.
   5. Position jacks so the resulting force is applied evenly to the entire end of the pipe.
   6. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.
   7. Close the end of the casing pipe around the carrier pipe with a casing end seal.

3.5 PIT RESTORATION

A. Remove installation equipment and unused materials from the launching and receiving pits.

B. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to Spec Section 02221.

C. Place suitable backfill material in the pit. Replace topsoil from stockpile.

D. Restore the site to original condition or better.

End.

SECTION 02705

DIRECTIONAL BORING

INDEX

PART 1 - GENERAL

1.1 Section Includes.
1.2 Related Sections.
1.3 References.
1.4 Submittals.
1.5 Project Record Documents.

PART 2 - PRODUCTS

2.1 Equipment.
2.2 Guidance System.
2.3 Drilling Fluid (Mud) System.
2.4 Other Equipment.
2.5 Pipe Materials.
2.6 Connections between Dissimilar Pipes.

PART 3 - EXECUTION

3.1 Guidelines.
3.2 Directional Drilling Operations.
3.3 Testing Pipe.
3.4 Site Restoration.
3.5 Record Keeping.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Installation of piping and conduits with authorization from the IDNR staff.

1.2 RELATED SECTIONS

A. Section 02221 Trenching, Backfilling and Compacting.

1.3 REFERENCES

A. Polyvinyl chloride (PVC): ASTM D224; solvent weld joint.

B. Elastomeric polyvinyl chloride (PVC): ASTM D543, ASTM D412, ASTM D395, ASTM D476, ASTM D624, ASTM D1149, ASTM D518

C. Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe: ASTM F1962.

D. Standard Specification for Polyethylene Plastic Pipe and Fitting Material: ASTM D3350.

E. Where reference is made to one of the above standards, the revision in effect at the time of the Notice to Proceed shall apply.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01340.

B. Submit product data for pipe, pipe accessories.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record locations of pipe runs, grades, horizontal alignment, connections, and structures.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Directional drilling equipment shall consist of a:
1. Directional drilling rig of sufficient capacity to perform the bore and pull back the pipe.
2. Drilling fluid mixing, delivery, and recovery system of sufficient capacity to successfully complete the installation.
3. Drilling fluid recycling system to remove solids from the drilling fluid so the fluid can be reused (if required).
4. Magnetic guidance system or walk over system to accurately guide boring operations.
5. Vacuum truck of sufficient capacity to handle the drilling fluid volume.
6. Trained and competent personnel to operate the system.

B. Drilling rig:
1. Directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head.
2. Machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation.
3. Hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.
4. Hydraulic system shall be free of leaks.
5. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations.

C. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when the electrical current is detected.

D. Drill head: Drill head shall be steerable by changing it's rotation and shall provide necessary cutting surfaces and drilling fluid jets.

E. Mud motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.

F. Drill pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.2 GUIDANCE SYSTEM

A. Electronic walkover tracking system or a Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation.

B. Guidance shall be capable of tracking at all depths up to 50-feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction).

C. Guidance system shall be accurate and calibrated to manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to 50-feet and accurate to 2-feet horizontally on either side of the borehole.

D. Components: Contractor shall supply all components and materials to install, operate, and maintain the guidance system.

2.3 DRILLING FLUID (MUD) SYSTEM

A. Mixing system: Self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water and appropriate additives.

B. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder and to avoid clumping and ensure thorough mixing. Drilling fluid reservoir tank volume shall be a minimum of 1,000-gallons. Mixing system shall continually agitate the drilling fluid during drilling operations.

C. Drilling fluids: Drilling fluid shall be composed of clean water and bentonite clay. Water shall be from an authorized source with a pH of 8.5 to 10. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate. No additional material may be used in drilling fluid without prior approval from Engineer.

D. Delivery system: Mud pumping system shall have a minimum capacity of 35 to 500-gpm and the capability of delivering the drilling fluid at a constant minimum pressure of 1,200-psi. Delivery system shall have filters in-line to prevent solids from being pumped into drill pipe. Used drilling fluid and drilling fluid spilled during operations shall be contained and conveyed to the drilling fluid recycling system or shall be removed by vacuum trucks or other methods acceptable to the Engineer. Berm, minimum of 12-inches high, shall be maintained around drill rigs drilling fluid mixing system, entry and exit pits, and drilling fluid recycling system to prevent spills into the surrounding environments. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey drilling fluid containment areas to storage and recycling facilities for disposal.

2.4 OTHER EQUIPMENT

A. Pipe rollers: Pipe rollers shall be used for pipe assembly during final product pull back.

2.5 PIPE MATERIALS

A. Polyvinyl Chloride (PVC) Pipe, 4 through 12-inch diameter:
   1. Pipe material shall be of the restrained joint type Class 200 (DR14).
   2. Tested to meet or exceed performance requirements of AWWA Standard C900.
   3. Pipe O.D.'s shall be equivalent to iron pipe O.D.'s. Pipe shall include couplings, gaskets, splines and lubricant as manufactured by the pipe supplier.
   4. Pipe may be furnished in standard 20-foot lengths. Couplings shall be designed for use at the rated pressures of the pipe with which they are used.

5. All PVC pipe shall be color coded as follows:
   a. Potable water: Blue.
   b. Wastewater forcemain: Green.
   c. Water re-use: Purple.

6. Pipe shall be joined using separate PVC coupling with beveled edges, built-in sealing gaskets, and restraining grooves. Restraining splines shall be square and made from Nylon 101. Exposed splines shall be cut flush from the coupling wall to reduce soil drag. Couplings shall be beveled on leading edges to minimize soil friction.
7. Contractor shall adhere to the pipe manufacturer's most current calculations regarding tensile load limitations for trenchless application. This calculation shall be part of the required Shop Drawing submittal.

B. Polyvinyl Chloride (PVC) Pipe, 1-1/2 to 3-inch diameter:
1. PVC pipe of sizes 1-1/2 to 3-inch diameter shall be 250-psi pressure rated, SDR 17, manufactured with IPS O.D.
2. 20-foot lengths.
3. Meet or exceed ASTM Specifications D2241 and NSF 14 and 61.
4. Couplings and fittings shall be thrust-restrained for use at the rated pressures of the pipe with which they are used.
5. Maximum safe tensile loads allowable are 2,900-pounds and 5,000-pounds, respectively, for 2 and 3-inch diameter PVC pipe.
6. All couplings and fittings shall be manufactured for permanent use as for direct burial.
7. Color-coding shall be as follows:
   a. Potable water: Blue.
   b. Wastewater forcemain: Green.
   c. Water re-use: Purple.

C. High-Density Polyethylene (HDPE) Pipe:
1. Use:
   a. Pressure piping: Use if allowed by Owner.
   b. Pipe material shall be high density (PE 3408) pressure pipe intended for use as a potable water pipe, forcemain, or re-use main.

2. Pipe and fittings shall meet or exceed AWWA C906, DR9, or DR 11, in sizes 4 through 24-inch diameter and AWWA C901, DR 7.3 or DR9 in sizes 2 and 3-inch diameter.
3. Pipe O.D.'s shall be equivalent to DIP pipe O.D.'s.
4. All pipes shall be color coded by co-extruding longitudinal stripes into the pipe outside surface as follows:
   a. Potable water: Blue.
   b. Wastewater forcemain: Green.
   c. Water re-use: Purple.

5. Polyethylene fittings shall be made from material meeting the same pressure requirements or greater as the pipe. Fittings shall be molded by the pipe manufacturer meeting AWWA 906 requirements.
6. For pipe sizes 4-inch diameter and larger of IPS or DIPS, hydraulic fusion machines shall be used. For pipe sizes 4-inch diameter IPS and smaller, manually operated equipment may be used. Butt fusion process shall be also used for fittings, the location of which is shown on the drawings.
7. Hydraulic fusion machines shall be fully equipped with controls for setting pressures for facing, heating and fusing. Contractor shall provide an experienced and fully qualified machine operator who shall demonstrate his qualifications to the Engineer by conducting "dry-runs" of the fusion process using at least 2 different sizes of pipe and fittings.

D. Other piping materials can be used at the discretion of the Contractor with authorization from the Engineer.

2.6 CONNECTIONS BETWEEN DISSIMILAR PIPES

A. Provide manufactured adapter or coupling.

B. Provide special adapters for pressure piping, as required, with pressure rating not less than lowest rated pipe connected. Submit details to Engineer for review.

PART 3 - EXECUTION

3.1 GUIDELINES

A. Contractor shall follow general installation guidelines as outlined in ASTM F1962.

B. Protect pipe and joints from injury while handling and storing.

C. Use no deformed, defective, gouged or otherwise impaired pipe or joints.

D. Clean bell and spigot surfaces of dirt and foreign matter before jointing pipes.

E. Make joints in strict accordance with manufacturer's recommendations.

F. Rap and blow out piping before installation.

3.2 DIRECTIONAL DRILLING OPERATIONS

A. Contractor shall provide all material, equipment and facilities for directional drilling. Proper alignment and elevation of the bore hole shall be consistently maintained throughout the directional drill shall conform to the requirements of all applicable permits.

B. Piping shall be placed with a minimum of 36-inches of cover from existing grade to top of pipe. Maximum depth of cover shall be 60-inches unless specifically authorized by the Engineer. Bore profiles demonstrating compliance with the depth of cover requirements must be submitted for piping work claimed on each request for payment. Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on Drawings. If Contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.

C. Contractor shall place a silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection necessary by documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Pilot hole shall be drilled on the bore path with no deviations greater than 2 percent of depth over a length of 100-feet.

D. In the event pilot does deviate from the bore path more than 2-feet of depth in 100-feet, Contractor will notify Engineer. Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation. In the event a drilling fluid fracture, inadvertently returns or a returns loss occurs during pilot hole drilling operations, Contractor shall cease drilling, wait at least 30-minutes, inject a quantity of drilling fluid with a viscosity exceeding 120-seconds as measured by a march funnel and wait another 30-minutes. If mud fracture or returns loss

continues, Contractor will discuss additional options with the Engineer and work will then proceed accordingly.

E. Upon completion of the pilot hole phase of the operation, a complete set of "as-built" records shall be submitted in duplicate to the Engineer. These records shall include copies of the plan and profile Drawings, as well as directional survey reports as recorded during the drilling operation.

F. Upon completion and approval of the pilot hole location the hole enlarging phase shall begin. Final hole enlargement shall not exceed by 1.5 times the O.D. of the pipe joint.

G. Open bore hole may be stabilized by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. Drilling slurry must be in a homogenous / flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. Bentonite slurry is to be contained at the exit or entry side of the directional bore in pits or holding tanks. Slurry may be recycled at this time for re-use in the hole opening operation, or shall be hauled by the Contractor to an authorized dumpsite for authorized disposal. Following completion of the bore hole, the product pipe shall be pulled through the hole by means of a pulling eye attached to the lead joint of pipe. Attach a 10-gauge stranded insulated locate wire to the pulling eye and the crown of the pipe (PVC or HDPE) at each joint and at 10 foot intervals along the pipe with plastic zipper ties.

H. Contractor shall provide relief pits / bore holes as necessary along pipeline route to eliminate build-up of excessive hydrostatic pressure on pipeline resulting from drilling fluid's inability to escape bore hole.

I. Line and grade:
   1. Check drillhead depth, grade, and line at all hubs using methods as recommended by control equipment manufacturer and furnish copy of data to Engineer.
   2. Check invert elevation at all fittings, cleanouts, and service lines prior to installing pipeline by means of exposing, probing, or other method acceptable to Engineer. Maximum distance between invert elevation checks shall not exceed 300-feet on any pipeline.
   3. Variations from proposed invert elevation to be authorized by Engineer. If not acceptable to Engineer, retract to location authorized by Engineer and re-drill.

J. At completion of bore, attach reamer and pipeline to boring rod. Retract boring rod, pull pipeline into place. Nominal diameter of reamer shall be no more than 2-inches greater than nominal diameter of pipeline to be installed. Verify solvent weld joints are of sufficient strength to hold during pulling of pipeline.

3.3 TESTING PIPE

A. Cleaning and flushing are to be done by the Contractor in accordance with the requirements of the Contract and these Specifications.

B. Directional drilled pipe shall be tested by the Contractor after pullback. Average pressure shall be maintained at 150-psi for 2-hours with no leakage as may be indicated by a drop in pressure, or as may be allowed by the Engineer.

C. Test pump and water supply shall be arranged to allow accurate measurements of the water required to maintain the test pressure. Any material showing seepage or the slightest leakage shall be replaced as directed by the Engineer at no additional expense to the Owner.

D. Manufacturer's recommendations on pipe stretch allowances, bend radius, and tensile strength, allowable make-up water, and duration of test pressure shall be observed but may not be

authorized by the Engineer. Installed pipeline shall be tested end to end. All service lines on the new main shall also be tested along with the newly installed mains.

3.4 SITE RESTORATION

A. Following HDD operations, Contractor will de-mobilize equipment and restore the site to the original condition or better. All excavations will be backfilled and compacted according to the specifications or as directed by the Engineer.

B. Clean up and dispose of all mud and drilling mixture in boring pits.

C. Surface restoration shall be completed in accordance with the requirements of the Contract, to a condition as good as or better than existed prior to construction using like materials as the original.

3.5 RECORD KEEPING

A. Contractor shall maintain a daily project log of drilling operations and a guidance system log with a copy given to the Engineer at completion of the project.

B. Contractor shall furnish Record plan and profile Drawings based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. Record Drawings shall be submitted for piping work claimed on each pay request.

End.

SECTION 02711

GEOGRID STABILIZATION

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PART 1 - GENERAL

1.1 Section Includes.
1.2 Submittals.

PART 2 - PRODUCTS

2.1 Geogrid Material.

PART 3 - EXECUTION

3.1 Preparation.
3.2 Installation.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installation of geogrid sheets for aggregate stabilization, as shown on the Drawings or as detailed herein.

B. Payment for furnishing and installing geogrid sheets shall be made at the Contract Unit Price per square yard for "Campsite Geogrid Material."

1.2 SUBMITTALS

A. Submit Product Data including:
   1. Shop Drawings.
   2. Installation instructions.
   3. Sample of each product.

PART 2 - PRODUCTS

2.1 GEOGRID MATERIAL

A. Triax TX-160 manufactured by Tensar, International; or equivalent.

B. Properties:
   1. Manufactured from punch polypropylene sheet, oriented into three equilateral directions.
   2. Rib pitch, inches: 1.60.
   3. Mid-rib depth, inches: 0.60 diagonal and transverse.
   4. Mid-rib width, inches: 0.04 diagonal and 0.05 transverse.
   5. Aperture shape: Triangular.
   6. Radial stiffness at low strain, kN/m: 300.

C. Material:

1. Provide geogrid sheets in rolls measuring 13.1-feet in width and 246-feet in length.

PART 3 - EXECUTION

3.1 PREPARATION

A. Deliver and store on-site off the ground. Store vertically (rolls stood on end) or horizontally in stacks not exceeding 5 rolls high.

B. Clear, grub and excavate to design grade. Smooth grade and compact soils. Create surface that is uniformly smooth as possible, to the grades shown on the Drawings.

3.2 INSTALLATION

A. Place the rolls of geogrid in position. Cut the roll bands and manually unroll the material over the prepared surface.

B. Unroll geogrid in the direction of travel so the long axis of the roll is parallel with the traffic patterns. Overlap sides and ends 2-feet.

C. Overlap geogrids in the direction of fill placement, to avoid peeling of geogrid at overlaps. Connecting ties are not required. Cut and overlap geogrid to accommodated curves and directional changes.

D. Before unrolling, anchor the beginning of the roll in the centers and corners to the underlying surface. Align geogrid and pull taut to remove wrinkles and laydown slack. Shoveled piles of aggregate fill, pins or staples may be used to hold the geogrid in place prior to placement of the aggregate fill.

E. Standard, highway-legal rubber-tired trucks may drive over the geogrid at very slow speeds and dump aggregate fill as they advance. Avoid turns and sudden starts and stops. Do not drive tracked equipment directly on geogrid. When spreading material, raise blade gradually as each lift is pushed out over the geogrid. The desired effect is fill that cascades onto the geogrid rather than being pushed into it.

F. Use standard compaction equipment. Keep moisture content near optimum. Compact aggregate fill to specifications, after it has been graded smooth and before it is subject to accumulated traffic.

G. Provide a slight crown to the aggregate for initial rainfall runoff and to avoid fill saturation.

End.

SECTION 02721

SITE UTILITIES SYSTEMS

INDEX

PART 1 - GENERAL

1.1 Section Includes.
1.2 Referenced Standards.
1.3 Submittals.
1.4 Project Record Documents.

PART 2 - PRODUCTS

2.1 Pipe Materials – Pressure Applications.
2.2 Pipe Materials – Gravity Applications.
2.3 Valves.
2.4 Valve Boxes.
2.5 Gate Valves.
2.6 Corporation Stops.
2.7 Curb Stops.
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2.9 Flushing Hydrants.
2.10 Thrust Restraint.
2.11 Warning and Tracer Tape.
2.12 Connections between Dissimilar Pipes.
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PART 3 - EXECUTION

3.1 General Installation.
3.2 Pressure Pipe Main Installation.
3.3 Valve and Hydrant Installation.
3.4 Pressure Pipe Tests.
3.5 Disinfection.
3.6 Gravity Pipe Installation.
3.7 Gravity System Tests.
3.8 Manhole Installation and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. New watermain piping and valves to be installed within the campground.

B. New water services to selected campsites, area yard hydrants, flushing hydrants and drain manholes.

C. New sanitary sewer piping, manholes, cleanouts, to selected campsites, including connections for recreational vehicles.

D. All pipe, fittings, valves, and accessory materials necessary for piping not shown on Drawings. This piping includes:

1. Vents and drains.
2. Piping required for proper operations of piping system equipment, including drain valves for low points in piping. No additional compensation allowed for drain piping and small valves.
3. Connections to all monitoring and other instruments and control apparatus, including pressure gauges and other appurtenances required for satisfactory operation of piping system and proper functioning of instruments and controls.
4. Piping required for potable and non-potable water systems.
5. All flanges, unions, bolts, gasket material, reducing fittings, bushings and adapters.
6. Work items for payment shall be as listed in the Schedule of Prices.

E. Contractor shall be responsible for obtaining a non-fee connection permit from the Iowa Great Lakes Sanitary District's office. When work is completed, IDNR shall provide a certification to the Iowa Great Lakes Sanitary District the Project was completed in substantial accordance with the documents.

1.2 REFERENCED STANDARDS

A. American Society for Testing and Materials (ASTM).

B. American Water Works Association (AWWA).

1.3 SUBMITTALS

A. Submit Product Data under provisions of Section 01340.

B. Submit Product Data for pipe, pipe accessories, and tees or wyes. Certify material furnished conforms to applicable Standards of these Specifications:
1. Identify pipe service, design temperature, and material to be used for each service.
2. Proposed adapters between dissimilar piping materials.
3. Pipe material, pressure class and/or schedule number.
4. Valve types, sizes, weights, dimensions, materials, locations and pressure ratings.
5. Valve operator types, sizes, weights, dimensions and materials.

C. Submit Product Data for any precast concrete structures.

1.4 PROJECT RECORD DOCUMENTS

A. Accurately record locations of pipe runs, connections, manholes, valves, blow-offs and other appurtenances. IDNR will provide the Sanitary District with 2-copies of record drawings of the sewers, wyes, risers and laterals.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS – PRESSURE APPLICATIONS

A. Use specific pipe material and applicable pipe classes shown on the Drawings or as specified herein. If piping thickness specified is not available, use next heavier wall thickness.

B. Ductile-iron pipe (DI) (pressure or gravity applications):
1. Manufacture in accordance with all applicable requirements of AWWA C151 / ANSI A21.51 for 4-inch and larger diameter pipe, pressure class rated, Class 350 (minimum) and shall be in 18 or 20-foot lengths.

2. Thickness of Ductile Iron Pipe shall be determined by considering trench load and internal pressure separately in accordance with AWWA C150 / ANSI A21.50.
3. Ductile iron pipe shall be cement mortar lined with a seal coat in accordance with AWWA C104 / ANSI 21.4. Outside coat shall be a minimum of 1-mil bituminous paint according to AWWA C151 / ANSI A21.51 Section 51-8.1.
4. Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacturer to 500-psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.
5. All materials used in production of the pipe are to be tested in accordance with AWWA C151 for their adequacy within the design of the pipe, and certified test results are to be provided to Owner upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.
6. Pipe joints may be either mechanical joint or push-on pipe sizes 4 through 48-inches:
   a. Push-on joint shall conform to AWWA C151/ANSI A21.51 (such as "Fastite," "Tyton," or "Bell-Tite."). Dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. Gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized synthetic rubber, and comply with AWWA C111/ANSI A21.11.
   b. Mechanical joint shall be used at the specific locations indicated on the Drawings or as authorized by the Engineer. Mechanical joint shall consist of:
      1) A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting.
      2) A pipe or fitting spigot.
      3) Plain rubber (Styrene Butadiene [SBR]) per AWWA C110 / ANSI A21.11 sealing gasket.
      4) Separate ductile iron follower gland having cored or drilled bolt holes.
      5) Alloy steel Tee Head bolts and hexagon nuts. All threads are Coarse-Thread Series Class 2A, External and Class 2B, Internal, per ANSI B1.1. Nuts to be furnished in accordance with ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.

   c. Joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. Mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A 53 Standard Specification of Ductile Iron Castings.

7. Mechanical joint restraint:
   a. Restrained joints shall consist of the use of a mechanical joint restraint system, using Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc.: or equivalent. Bolt heads are to be “auto-torque” twist off.
   a. Restrained joint pipe shall be TR-Flex or Lok-Tyte as manufactured by United States Pipe and Foundry Company, Lok-Fast or Lok-Ring as manufactured by American Cast Iron Pipe Company, Snap-lok as manufactured by Griffin Pipe Products Company; or equivalent.

8. Fittings:
   a. Fittings shall be ductile iron, grade 70-50-05, and shall conform to AWWA C110 / ANSI A21.10 or AWWA C153 / ANSI 21.53 for compact fittings, pipe sizes 4 through 48-inches with the exception of manufacturer’s proprietary

design dimensions and thicknesses for iron, in accordance with AWWA C110/ANSI A21.10.

b. All ductile iron fittings shall have a minimum working pressure rating of 350-psi and shall be cement mortar lined and bituminous coated (minimum 1-millimeter), in accordance with AWWA C104/ANSI A 21.4.

c. Fittings shall be tested and the manufacturer shall provide certified test results when requested by Owner. Testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A21.11.

d. Acceptable manufacturers are: American Cast Iron Pipe Company, Griffin Pipe Company, Union/Tyler Pipe Company, or U. S. Pipe & Foundry Company; or equivalent.

e. Acceptable types of fittings are:

1) Full body mechanical joint fittings: Full-body ductile iron mechanical joint fittings shall be Class 250 minimum and shall conform to AWWA C110/ANSI A21.10. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

2) Mechanical joint compact fittings: Compact fittings shall be minimum class 350 and shall comply with AWWA C153 / ANSI A21.53, pipe sizes 4 through 48-inches. Glands, gaskets and bolts shall conform to AWWA C111 / ANSI A21.11.

3) Mechanical joint restraints: Joint restraints shall consist of the use of a Megalug joint restraint system using Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc.; or equivalent. Bolt heads are to be “auto-torque” twist off.

C. Polyvinylchloride (PVC) pressure pipe (AWWA): Not Used.

D. Polyvinylchloride (PVC) pressure pipe (SDR Series):

1. Use: Pressure applications: Finish watermain piping: 1 to 4-inch diameter.
2. SDR-PR pressure rated PVC pipe with single gasket joints.
3. Pressure rating or SDR rating shall be 21, unless indicated otherwise on the Drawings.
4. PVC pipe shall generally conform to ASTM Standard D-2241, "Poly (Vinyl-Chloride) PVC Pressure Related Pipe (SDR Series)".
5. Joints shall be push-on compression joints with rubber gaskets generally conforming to ASTM Standards D-3139, "Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals" and F-477, "Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe."
6. Joint shall have a built-in stop to maintain proper pipe end separation to allow for thermal expansion and contraction.
7. Joint shall permit a 3-degree deflection of the pipe and still provide a water tight seal.
8. Fittings shall be mechanical joint ductile-iron fittings with transition gaskets to fit the smaller outside diameter PVC pipe.

E. Polyvinylchloride (PVC) pressure pipe (Schedule 40, 80, 120):

1. Use: Pressure applications: Only as authorized by the Engineer.
2. Pipe shall generally conform to the requirements of the "Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) plastic pipe, schedules 40, 80, and 120," ASTM Standard D-1785, for pressure pipe use.
3. For pressure-flow pipe, joints for Schedule 40 PVC pipe shall be solvent-welded and joints for Schedule 80 PVC Pipe shall be threaded.
4. Threading shall be in general accordance with ASTM Standard D-2464.
5. Fittings for Schedule 40 PVC pipe shall generally conform to "Socket-type Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl-Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40," ASTM Standard D-2466.

6. Fittings for Schedule 80 PVC pipe shall conform to "Threaded Poly (Vinyl-Chloride) (PVC) and Chlorinated Poly (Vinyl-Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80," ASTM Standard D-2464.

F. Polyethylene pipe (PE):
1. Use: Pressure applications: Only as authorized by the Engineer
2. Conform to AWWA Standard C901 for pipe ½ through 3-inch diameter
3. PE Code 3406. Pressure-class 125. Wall thickness: DR-11 per ASTM D3035.
4. Burst pressure at 73.4°F: 504-psi.
5. Joints: Fused.
6. Fittings: Molded.
7. For PE pipe greater than 3-inch diameter, consult Engineer.

G. See Specification Section 02705 for pipe materials used in Directional Drilling operations.

2.2 PIPE MATERIALS – GRAVITY APPLICATIONS

A. Gravity sanitary sewer pipe shall be PVC, AWWA C900, Class 150 (DR18), manufactured in general accordance with ASTM 1784. Use integral bell and elastomeric gasketed push-on joints. Minimum laying length of 20-feet. Pipe OD shall match DIP OD.

B. Service wye fittings shall be of the same construction as the gravity sewer with 4-inch inlet connection. Service lines shall be 4-inch PVC, ASTM 2665 NSF DWV; Schedule 40; solvent weld joints with purple primer or oatly rain or shine glue. Minimum 20-foot laying lengths of pipe.

C. Reinforced concrete culvert pipe (RCCP):
1. ASTM C76: Class dependent upon backfill depth:
   a. Fill height 3 to 10-feet: Class III.
   b. Fill height 10 to 15-feet: Class IV.
   c. Fill height 15 to 25-feet: Class V.

2. Cement: ASTM C150 Type II.
3. Rubber gaskets: ASTM C443, Section 5.
4. Connections: Bell and spigot gasketed joint conforming to ASTM C443.
5. Both bell and spigot areas shall be reinforced.

2.3 VALVES

A. Use valve of single manufacturer for each classification in so far as possible.

B. Provide all special tools required for repacking and disassembly of materials.

C. Provide manufactured couplings or adapters if required to join pipe and valves.

D. Valve connections: Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.

2.4 VALVE BOXES

A. Provide valve box for each buried valve.

B. Valve box shall be complete, assembled unit consisting of adjustable box and extension stem with 2-inch square operating nut.

C. Box section: Hand-adjustable to required depth through coupling gland with O-ring seal.

D. Stem assembly: Telescoping design with torque capacity of 1,000-ft-lb.

E. Equip lower end of box with self-centering alignment ring to center box over valve nut.

F. Lid shall drop into valve box top, rotate 90º to retain, and lock in place with single bolt.

G. Arrange entire assembly to prevent dirt and grit from entering valve box assembly.

H. Lid shall be marked "Water" or "Sewer," as appropriate, and have directional arrow for open rotation.

I. Materials:
   1. Valve box, base, alignment ring, and top: High-density polyethylene.
   2. Extension steel: Galvanized steel tubing.
   3. Bolts and screens: Stainless steel.
   4. Lid: Cast iron.

J. Manufacturer: American Flow Control "Trench Adapter;" or equivalent.

2.5 GATE VALVES

A. Resilient wedge type (AWWA C509).

B. Mueller A-2360; or equivalent.

C. Sizes: 2 to 3-inch.

D. Provide valve box for each valve.

E. Ends: Radial compression ends to fit IPS PVC plastic piping.

2.6 CORPORATION STOPS

A. Mueller 300 Ball Corporation Valve, Model B-25029; or equivalent.

B. Inlet: AWWA IP thread. Outlet: Mueller 110 Compression Connection for IPS PE pipe; or equivalent.

C. Service saddle: Mueller S-13000 Series 2-piece hinged service saddles for IPS PVC pipe; or equivalent.

2.7 CURB STOPS

A. Mueller Mark II Oriseal curb valves H-15211; or equivalent.

B. Inlet and outlet: Mueller 110 Compression Connections for IPS PE pipe; quarter turn check; or equivalent.

C. Curb stop box:
   1. Provide curb box for each curb stop.
   2. Extension type with arch pattern base and foot piece.
   3. Mueller H-10306 series; or equivalent.
   4. Box height: variable from 54 to 66-inches.

2.8 YARD HYDRANTS

A. Woodford Iowa Model S3 Sanitary Yard Hydrant; or equivalent.

B. Piping connection size: 1-inch female NPT. Provide service connector between hydrant and PVC waterline.

2.9 FLUSHING HYDRANTS

A. Kupferle Model 77 blow-off hydrant; or equivalent.

B. Features:
1. Non-freezing, self-draining type.
2. Inlet: 2-inch.
3. Non-turning operating rod, opening to the left.
4. All working parts shall be bronze to bronze design and shall be serviceable from above grade.
5. Outlet: Bronze, 2-1/2-inch NST.

2.10 THRUST RESTRAINT

A. All caps, tees and bends in pressure water piping constructed from steel, ductile-iron or PVC having a deflection of 11-1/4° or greater shall be provided with thrust restraint. Restraint may be provided through the type of joint, restraint rods, or thrust blocks and shall be capable of sustaining the test and operating pressures of the piping system plus 50 percent.

B. Ductile-iron pipe joints in casing pipe and where noted on the Drawings shall be restrained using Field-Lok gaskets:
1. Stainless steel locking segments shall be molded into the Field-Lok gasket to grip the pipe and prevent joint separation.
2. Number of joints (away from a fitting) requiring restraining are listing in a table shown on the Drawings entitled “Casing Pipe & Thrust Restraint Details.”
3. Field-Lok gaskets shall be used in all pipe joints within casing piping.
4. Field-Lok gaskets shall provide suitable restraint for maximum working pressures of 250-psi.
5. Field-Lok gaskets shall be manufactured by U.S. Pipe and Foundry Company; or equivalent.

2.11 WARNING TAPE / TRACER WIRE

A. Mark location of all buried pipe lines AND conduit lines using yellow plastic-lined metallic tape. Install tracer wire for all buried plastic piping AND conduit lines.

B. Material: Polyethylene-lined metallic tape.

C. Message:
1. Continuous top line: "CAUTION".
2. Continuous bottom line: "(PIPE FUNCTION) PIPE BELOW", except for gas pipe use: "GAS PIPE BELOW".

D. Tape width: 3-inch.

E. Manufacturer: Seton Name Plate Corporation; or equivalent.

F. Install continuous tracer wire adjacent to plastic pipe in trench. Extend to ends of plastic pipes. Terminate at metal piping or metal hydrant:
   1. Wire: Solid, AWS #12, insulated, direct bury, Type UF.
   2. Underground splices: Use Scotchcast splicing kits, 3M Company; or equivalent.
   3. Terminate wires at ground surface at ends of PVC pipe, at connections to iron pipe and at hydrants with Scotchcast terminating kits, 3M Company; or equivalent.
   4. Test tracer wire for continuity after installation. Repair or replace as necessary.

G. Payment: Construction of Warning Tape / Tracer Wire is considered incidental to construction.

2.12 CONNECTIONS BETWEEN DIS-SIMILAR PIPES

A. Gravity piping: Provide manufactured adapter or coupling. If not available, provide concrete collar 6-inches thick and 12-inches each way from joint. Cover joint with burlap "diaper" band. Bind at edge with No. 9 tie wires.

B. Pressure piping: Provide special adapters with pressure rating not less than lowest rated pipe connected. Submit details to Engineer for review.

C. Provide dielectric isolators between pipes of different metallic make-up.

2.13 MANHOLES

A. Conform to details on Drawings. Use eccentric top except where noted or shown on Drawings.

B. Diameter and thickness of base may be increased by Engineer due to poor foundation conditions.

C. Standard manholes:
   1. Reinforced, precast concrete manhole sections: ASTM C478.
   2. Inside diameter 48-inch where manholes connect 27-inch pipe or smaller unless indicated otherwise.
   3. Minimum wall thickness 5-inches.
   4. Minimum reinforcing, 0.18 sq. in. per linear foot of wall cross-section.
   5. Eccentric cone for manholes 6-feet or deeper.
   6. Joints: Rubber ring gasket type, flexible joint, ASTM C443.
   7. Heavy bitumastic coating 12-inches wide at all joints on outside of barrel.

D. Special manholes and precast concrete structures:
   1. Reinforced, precast concrete sections: ASTM C478.
   2. Inside diameter as indicated on Drawings.
   3. Minimum wall thickness: Inside diameter in feet plus one inch, unless indicated differently on Drawings.
   4. Joints same as specified for standard manholes.

E. Shallow manholes:
   1. Construct as specified for standard manholes
   2. Use for manholes 6-feet or less in depth.
   3. Reinforced precast flat top concrete cover:
      a. Type 1: Design for normal field loading, use where not subject to traffic.
      b. Type 2: Design for AASHTO HS20 highway loadings; use for manholes subject to traffic.

F. Drop connections:
   1. Use for manholes where difference in elevation of connecting pipes is 2-feet or greater.
   2. Conform to details shown on Drawings.

G. Manhole bottoms:
1. Conform to details on Drawings.
2. 8-inch thick precast or poured without manhole section being embedded:
   a. Place primed manhole section in bed of mortar joint material.
   b. Pour non-shrink concrete fillet around outside of manhole section.

3. Poured with manhole section embedded 4-inches minimum.
4. Use flexible, water-tight connections between pipe and manhole opening. Lock pipe to manhole seal, lock joint flexible manhole sleeve. Precast monolithic base sections with resilient pipe connectors shall be used. Pipe to manhole connectors shall be A-Lok or equivalent.
5. Plug all stub outs with factory fabricated plugs.

H. Manhole accessories:
1. Concrete adjusting rings:
   a. Adjust to final grade using no less than 6-inches or more than 12-inches of concrete adjusting rings.
   b. Maximum total height of rings: 12-inches.
   c. Maximum ring thickness: 6-inches.
   d. Minimum ring thickness: 2-inches.
   e. Maximum number of rings: 2.
   f. Maximum number of 2-inch thick rings: 1.
   g. Grout joints between ring and frame, between rings, and between cone section or flat top and ring.

2. Manhole frames and lids shall be Neenah R16423 with 1642-0239 lid. Lids shall be Type C solid with concealed pickholes.

3. Steps: Not allowed.

4. Manhole chimney seal, external design, Cretex Specialty Products. Seal to extend from flange of manhole frame to 3-inches below adjusting ring minimum.

5. Chimney seal required on all manholes designated subject to flooding including ditches, waterways, manholes in paving, and other areas required by Owner:
   a. Sleeve and extension: Extruded high grade rubber conforming to ASTM C923.
   b. Compression bends: 16 gauge stainless steel conforming to ASTM A240, type 304.
   c. Screws, bolts or nuts: Stainless steel type 304 conforming to ASTM F593 and 594.

6. Manhole lid gasket: Cretex Specialty Products; or equivalent. Required on all manholes subject to flooding and as indicated on the Drawings. Install in accordance with manufacturers recommendations, glued in-place with Butyl Rubber Sealant.

I. Internal non-shrink grout: Sonogrout G.P., Sonopatch; or equivalent. Apply to all manhole section joints and around pipe line entering manhole on interior of manhole.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Protect pipe joints and valves from injury while handling and storing.

B. Do not use deformed, defective, gouged or otherwise impaired pipe joints or valves.

C. Clean bell and spigot surfaces of dirt and foreign matter before jointing pipe.

D. Make joints in strict accordance with manufacturers recommendations.

E. Rap and blow out piping and valves before and after installation.

F. Provide flexible joint at connection to all structures or provide pipe joint within 2-feet of outside face of structure for differential settlement. Provide details to Engineer for review.

G. Provide adjustable U-bolts for tied pipe where shown on Drawings. U-bolts as recommended by pipe manufacturer for pipe size shown on Drawings. Shop coat U-bolts.

H. Comply with trenching, backfilling and compacting: Specification Section 02221.

3.2 PRESSURE PIPE INSTALLATION

A. Comply with AWWA C-600.

B. Lay pipe in dry weather with minimum earth cover of 5-feet. Lay to depths or grades shown on Drawings.

C. Clean pipe interior of foreign material before lowering into trench. At times when pipe laying is not in progress, plug open ends with watertight plug or other means authorized by Engineer. This provision applies during the noon hour as well as overnight.

D. Before installation of metallic pipe, tap pipe lightly with light hammer to detect cracks. Defective, damaged, or unsound pipe will be rejected.

E. Place in trench in sound, undamaged condition. Do not injure pipe coating or lining. Do not use end hooks to install or move pipe. Use web slings.

F. Cut pipe in neat and workmanlike manner without damage to pipe:
   1. Mechanical pipe cutters subject to authorization of Engineer.
   2. Bevel cut ends of metallic push-on type pipe.
   3. Completely coat damaged ends of cut metallic pipe with sealer compatible with pipe liner. Spray-on type sealer to adhere to lining at any temperature. Pipe and fittings showing blisters or holes will be rejected by Engineer on-site.
   4. Use suitable fittings where grade or alignment requires offsets of more than 1-inch per foot.

G. Uncover existing mains a sufficient time ahead of pipe laying operations to determine fittings required to make connections. Make connections between existing and new mains with specials and fittings as required. Contractor responsible for cost of side cuts.

H. Comply with trenching, backfilling and compacting: Section 02221.

I. Install warning tape in trench directly over plastic pipe for full length of pipe and buried 1 to 2-feet. Wrap around valves.

J. Joining mechanical joint pipe:
   1. Thoroughly clean last 8-inches outside of the spigot and inside of bell to remove oil, grit, excess coating and other foreign matter.
   2. Soap end of pipe and slip gland on the spigot end of pipe with lip extension of gland towards socket or bell end.
   3. Paint rubber gasket with soap solution and place on the spigot with thick edge toward gland.

4. Push entire section of pipe forward to seal the spigot in bell. Press gasket in place.
5. Bolt and tighten with torque limiting wrench; torque as follows:

Size, inches	Torque, foot-pounds
5/8	40 – 60
¾	60 – 90
1	70 – 120
1-1/4	90 - 120

6. Tighten bolts alternately 180-degrees apart to produce equal pressure on all parts of gland.

K. Joining push-on joint pipe:
1. Thoroughly clean inside of bell and outside of spigot end to remove oil, grit, excess coating and other foreign material.
2. Insert gasket as recommended by pipe manufacturer.
3. Apply gasket lubricant as recommended by pipe manufacturer.
4. Place spigot end into socket with care to prevent joint from contacting ground.
5. Complete joint by forcing plain end to the bottom of socket.
6. Join with forked tool or jack-type tool. Do not force home with backhoe.

L. Horizontal separation of watermain from gravity sewer pipes:
1. 10-feet.
2. 3-feet if bottom of watermain is at least 18-inches above top of sewer and watermain is placed in a separate trench or in same trench on a separate bench.
3. When it is impossible to obtain the required horizontal clearance of 3-feet and a vertical clearance of 18-inches between sewers and watermains, construct the sewers using watermain materials meeting both a minimum pressure rating of 150-psi and the requirements of Sections 8.2 and 8.4 of the "Iowa Standards for Water Supply Distribution Systems." A linear separation of at least 2-feet shall be provided.

M. Vertical separation of sanitary sewers crossing any watermain:
1. Refer to detail on the Drawings.
2. Vertical separation of sanitary sewers crossing under any watermain should be at least 18-inches when measured from the top of the sewer to the bottom of the watermain.
3. If physical conditions prohibit the separation:
   a. Sewer may be placed not closer than 6-inches below a watermain.
   b. Sewer may be placed not closer than 18-inches above a watermain.
   c. Separation distance shall be the maximum feasible in all cases.
   d. Place length of new water pipe so both joints are as far as possible from sewer (10-feet horizontal).
   e. Install watermain or sewer main in casing pipe as shown on the Drawings.
   f. Backfill with low permeable soil within 10-feet of point of crossing.

N. Separation of watermain from sewer forcemain:
1. Minimum 10-feet horizontally unless forcemain is constructed of watermain quality materials having a minimum pressure rating of at least 150-psi and meeting requirements of Section 8.2 and 8.4 of the "Iowa Standards for Water Supply Distribution Systems."
2. Watermain is laid at least 4-feet from the sewer forcemain.
3. If these conditions cannot be met, notify Engineer. Engineer may authorize relocation of watermain.

O. Separation from manholes: 3-feet minimum horizontal separation.

P. Scheduling and construction of connections to existing mains shall be in conformance with Owner requirements.

1. Contact Owner for scheduling.
2. Provide minimum 48-hours notice to Owner. Owner will determine time and duration of shut-off.
3. Owner will operate all distribution system valves.

3.3 VALVE AND HYDRANT INSTALLATION

A. Valves:
1. Install with stems vertical and centered in manhole or box.
2. Check all valve bolts when installed; tighten as necessary after valves are in operation and under operating pressure.
3. Support valves in manholes or boxes as required.
4. Carefully tamp earth around each valve box or manhole to a distance of 4-feet on all sides of box or manhole or to undisturbed trench face if less than 4-feet.

B. Hydrants:
1. Set plumb; set at elevation so cover will not be less than for adjacent main. Set grade mark on hydrant barrel at finished grade level.
2. Set on concrete foundation.
3. Carefully tamp backfill around hydrant to a distance of 4-feet on all sides of hydrant or to undisturbed trench face, if less than 4-feet.
4. Tighten all stuffing boxes as hydrant is installed; operate hydrant in open and closed position to assure all parts are in working condition.
5. Block hydrant in place.

3.4 PRESSURE PIPE TESTS

A. Testing is considered incidental to pipe construction.

B. Water test all piping after installation in accordance to AWWA C600.

C. Hydrostatic test:
1. Flush out pipe before test to remove air. Insert taps to release trapped air.
2. Test at 150-psi for 2-hours. Allowable pressure drop during test period is 5-psi.

D. Leakage test:
1. Conduct leakage test concurrently with pressure test. Measure water loss by pumping from drum or by similar means.
2. Maximum allowable leakage (L) in gallons per hour:

$$L = \frac{SD\sqrt{P}}{133200}$$

L is the allowable leakage, in gallons per hour.
S is the length of pipe tested, in feet.
D is the nominal diameter of the pipe, in inches.
P is the average test pressure during the leakage test, in pounds per square inch gauge.

3. Provide all test pumps, test plugs, pipe, and gauges, and make all required piping connections.
4. Examine trench for leakage during test. Replace all defective pipe and fittings which do not pass leakage test at no cost to Owner, including cost of excavation and backfill. Repeat test until requirements have been met.

3.5 DISINFECTION

A. Disinfect by injecting a solution of calcium hypochlorite and water at slow rate to provide a minimum residual chlorine content of 50-ppm in watermain. Allow system to stand full of solution for 24-hours. Use chlorine tablets with authorization of Engineer. Disinfect in accordance to AWWA C601.

C. Minimum free chlorine residual at pipe extremities: 10-ppm at end of test period. If requirement is not met, repeat disinfection procedure.

D. Operate all valves and hydrants in new main to assure full disinfection; repeat test procedure if necessary.

E. Thoroughly flush main after test until extremities indicate same chlorine residual as supply water.

F. 5-days after completion of disinfection, Owner will collect a bacteriological sample from section of main disinfected. Sample must test "SAFE". If sample tests "UNSATISFACTORY" or "UNSAFE", repeat disinfection procedure until sample tests "SAFE". Contractor shall provide sample containers and pay costs for testing and transportation.

G. Costs for Disinfection are considered incidental to pipe construction.

3.6 GRAVITY PIPE INSTALLATION

A. Comply with Section 02221.

B. Provide smooth and uniform invert. Bear spigots against bell shoulders or tongues against grooves.

C. Line and grade:
1. Offset hubs: Refer to Specification Section 01050. Additional hubs to be set by Contractor.
2. Use laser for line and grade. Install inside pipe line. Do not install on top of pipe.
3. Check grade of pipe with gauge rod at each hub.
4. Keep pipe clean of all dirt and foreign material.
5. Use no defective pipe. Check each length for defects and hairline cracks at ends prior to lowering into trench.
6. Alignment will be checked by Engineer after installation and backfill.

D. When new sewer is to be connected to existing sewer not terminating in manhole, uncover end of existing sewer to allow adjustments in line and grade before any pipe is laid.

E. Begin laying pipe from lowest point in proposed sewer line.

F. Lay pipe with bell end of bell and spigot pipe or receiving groove end of tongue and groove pipe pointing upgrade.

G. Lay pipe uniformly to line and grade so finished sewer will present uniform bore.

H. Noticeable variations from true alignment and grade will be considered sufficient cause for rejection of work.

I. During intermissions in sewer construction, cover or bulkhead open face of last pipe laid to prevent sand, water, earth or other materials from entering pipe.

J. Laying of pipe in cold weather:
1. Engineer may order pipe laying discontinued whenever there is danger of quality of work being impaired because of cold weather.
2. Heat pipe and jointing materials to prevent freezing of joints.

3. Do not lay pipe on frozen ground.
4. Pipes with rubber gaskets or resilient-type joints: Warm gasket or joint material to facilitate making proper joint.
5. With solvent cemented joint: Remove all ice and snow from jointed area prior to application of solvent cement.

3.7 GRAVITY SYSTEM TESTS

A. All sewer system components listed in this Section will be tested in accordance with these Specifications including sewer mains, service lines, forcemains, manholes and structures. Contractor is responsible to schedule testing of the various components of the system.

B. No additional compensation will be awarded to the Contractor for Work involved in testing, repair of components not meeting acceptable test results, or retesting after repair of components.

C. Gravity piping:
1. Infiltration and exfiltration:
   a. Contractor shall test sewers using air per ASTM C924.
   b. Infiltration for new sewer construction shall not exceed 200-gallons per inch diameter per mile of pipe per day, with minimum of 2-feet hydrostatic groundwater level above top of pipe at highest point.
   c. Provide satisfactory evidence to Engineer prior to final acceptance.

2. Deflection test: Perform on all flexible and semi-rigid sewer pipes. Test 30-days following final backfill:
   a. Allowable deflection: Not greater than 5 percent.
   b. Test method: Mandrel having diameter equal to 95 percent of the inside diameter of pipe.
   c. Perform test without mechanical pulling devices.
   d. Does not apply to service lines.
   e. Failed mandrel tests shall be televised and submitted to Engineer for review. Engineer will evaluate the extent of deflection and determine the pipe section to be removed and replaced.

3. Lamping test: Perform lamp test between manholes. A full circle of light shall appear to viewer before pipe will be considered to have passed.

3.8 MANHOLE INSTALLATION AND TESTING

A. Excavation: In order to permit the joints to be mortared properly and also to permit proper compaction of the backfill material, the excavation shall be made to a diameter of at least 2-feet greater than the outside diameter of the structure.

B. Sub-base preparation: Adequate foundation for all manhole structures shall be obtained by removal and replacement of unsuitable material with well-graded granular material, by tightening with coarse ballast rock, or by such other means as provided for foundation preparation of the connected piping.

C. Base installation (precast-base):
1. Well-graded granular bedding course conforming to the requirements for aggregate for trench backfill, not less than 6-inches in thickness and extending to the limits of the excavation, shall be firmly tamped and made smooth and level to assure uniform contact and support of the precast element.

2. Precast base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and making sure all entering pipes can be inserted on proper grade.

D. Precast units with integral base:
1. Precast units may be constructed with a precast base section or a monolithic base structure as specified.
2. Precast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs.
3. Completed units shall be rigid, true to dimensions and shall be watertight.
4. All lift holes on precast elements shall be completely filled with mortar.
5. All joints between precast elements on manholes shall be made with an O-ring rubber or neoprene gasket.

E. Inlet and outlet pipes:
1. Piping connections to manholes shall be made with molded PVC or rubber gaskets.
2. Connection method shall guarantee a watertight seal.

F. Placing castings:
1. Castings placed on concrete or masonry surface shall be set in full mortar beds.
2. Mortar shall be mixed in proportion of one part cement to three parts sand, by volume, based on dry materials.

G. Castings shall be set accurately to the finished elevation so no subsequent adjustment will be necessary.

H. Manhole inverts:
1. Construct manhole flow channels of concrete, mortar or drain line pipe, which shall be of semicircular section conforming to the inside diameter changes in size or grade gradually, and changes in direction shall be by true curves.
2. Provide such channels for all connecting pipes to each manhole and benching as shown on the Drawings.

I. Jointing and plastering: Completely fill inside and outside of barrel's rubber gasket joints with mortar and leave smooth and free from surplus mortar on the inside of the manhole.

J. Frames and covers:
1. Unless otherwise shown on the Drawings, set frames and covers in full mortar bed.
2. In paved areas, top of the cover will be flush with the finished pavement.
3. In unpaved areas, top of the cover will be 2-inches higher than finished grade.

K. Backfill:
1. Space between the sides of the excavation and the outer surfaces of the manhole shall be backfilled with aggregate for trench backfill if the manhole is in a pavement or if the nearest point of the excavation for the manhole falls within 2-feet of a structure.
2. Use backfill and compaction procedures as specified for the adjoining pipe.

L. Cleaning: All newly constructed manholes shall be cleaned of any accumulation of silt, debris or foreign matter of any kind and shall be free of such accumulations at the time of final inspection.

M. Manhole test:
1. Test after backfilling.
2. Vacuum test shall include the top of the manhole cone section but shall exclude grade adjusting rings and frame.
3. Vacuum testing assembly and pumps shall be provided by Cherne Industries or equivalent.

4. Pneumatic plugs shall be inserted at least 8-inches into all pipe penetrations so that the inflated plug is located past the manhole / pipe gasket.
5. Insert bracing adequate to prevent either the plug or pipe from being drawn into the manhole during the test.
6. Vacuum gauge shall be liquid filled, have a 3.5-inch face, and read from 0 to 30-inches of mercury. Test equipment shall allow the installation to 2-gauges at the same time.
7. Draw a vacuum of at least 10.5-inches of mercury on the manhole, close and remove the vacuum line, and then adjust the vacuum so the gauge reads 10.0-inches of mercury. If the time for the vacuum gauge reading to drop from 10.0 to 9.0-inches of mercury is equal to or less than the value taken from the following table, the manhole is considered to have passed the test.

Manhole Depth, feet	**Time in seconds for 48-inch diameter manhole**
8	20
10	25
12	30
14	35

8. Manholes failing the vacuum test shall be uncovered and repairs on the exterior, retested prior to backfilling, and then re-tested after backfilling is completed.

End.

SECTION 03300

CAST-IN-PLACE CONCRETE

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Not Used.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete.

B. Control, expansion, and contraction joint devices associated with concrete work including joint sealants.

1.2 REFERENCES

A. ACI 301 - Structural Concrete for Buildings

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

D. ACI 305R - Hot Weather Concreting.

E. ACI 306R - Cold Weather Concreting.

F. ACI 308 - Standard Practice for Curing Concrete.

G. ACI 318 - Building Code Requirements for Reinforced Concrete.

H. ASTM C33 - Concrete Aggregates.

I. ASTM C94 - Ready-Mixed Concrete.

J. ASTM C150 - Portland Cement.

K. ASTM C260 - Air Entraining Admixtures for Concrete.

L. ASTM C494 - Chemicals Admixtures for Concrete.

M. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

N. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures.

O. Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction.

P. Where reference is made to one of the above standards, the revision in effect at the time of the Notice to Proceed shall apply.

1.3 SUBMITTALS

A. Submit concrete mix design.

B. Submit cylinder strength test results from proposed mix design prior to placing any concrete.

C. Quality control submittals in accordance with 2.6 of this Section.

D. Product Data for accessories, admixtures, etc.

1.4 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of embedded utilities and components which are concealed from view.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Acquire cement and aggregate from same source for all Work.

C. Conform to ACI 305R when concreting during hot weather.

D. Conform to ACI 306R when concreting during cold weather.

1.6 COORDINATION

A. Coordinate Work under provisions of Section 01010 General Provisions.

B. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland cement: ASTM C150, Type I - Normal.

B. Fine aggregate:
1. Meet requirements of ASTM C33-71a, except where more rigid requirements are included.
2. Gradation within requirements of ASTM C33, Sections 4, 5, 6 and 7. Sieve analysis of aggregate must accompany mix design when submitted to Engineer for review.
3. Natural sand:
   a. Clean, hard, strong, durable, uncoated grains.
   b. Coal and lignite: 0.25 percent maximum.
   c. Prove acceptability of aggregate by laboratory test conducted and certified by laboratory acceptable to Engineer on sample taken in accordance with ASTM C75.

C. Coarse aggregate:
1. Meet requirements of ASTM C33-71a, Sections 8, 9 and 10, except where more rigid requirements are included.
2. Clean, hard, strong, durable, uncoated grains.
3. Gradation within requirements of ASTM C33, Table II:
   a. #57, 1" to No. 4; for footings and plain concrete.
   b. #57, 1" to No. 4; for slabs on grade and reinforced walls.
   c. #57, 1" to No. 4; for slabs, beams, fillet and fill concrete.

4. Limitation of deleterious substances:
   a. Clay lumps and friable particles: Maximum 1.0 percent.
   b. Soft particles: Maximum 2.0 percent.
   c. Coal and Lignite: Maximum 0.25 percent.

5. Crushed limestone: Meet IDOT Specifications 4115.03 for quality and 4115.04 for durability; prove acceptability by submission of certified laboratory test report.
6. IDOT durability Class 3.

D. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Contractor to submit Shop Drawings covering details of any or all admixtures they may use during the project. Provide compression test data of similar concrete mixture with admixtures.

B. Admixtures shall conform the following standards:
1. Air-entraining agents: ASTM C260.
2. Water reducing agents: ASTM C494, Type A.
3. Retarding agents: ASTM C494, Type B.
4. Accelerating agents: ASTM C494, Type C.
5. Water reducing and retarding agents: ASTM C494, Type D.
6. Water reducing and accelerating agents: ASTM C494, Type E.
7. High range water reducing agents: ASTM C494, Type F.
8. High range water reducing and retarding agents: ASTM C494, Type G.
9. Fly ash and pozzolans: ASTM C618.

2.3 ACCESSORIES

A. Bonding agent: Two-component modified epoxy resin.

B. Vapor barrier: 6-mil thick clear polyethylene film, type recommended for below grade application.

C. Liquid membrane-forming curing compound:
1. Liquid type membrane-forming curing compound complying with ANSI/ASTM C309, Type I, Class A unless other type acceptable to Engineer.
2. Curing compound shall form a continuous unbroken membrane which shall adhere to moist concrete and which will not disintegrate, check or peel from the surface, or show signs of such deterioration within 30-days after application under actual working conditions.
3. Compound shall be sufficiently transparent and free from color so there will be no permanent change in the color of the concrete.
4. Compound shall contain, however, a temporary dye of sufficient color to make the membrane clearly visible for a period of at least 4-hours after application.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint filler type A: ASTM D1751 Asphalt impregnated fiberboard or felt, ½-inch, ¾-inch or 1-inch thick. Tongue and groove profile.

B. Joint sealant:
1. Interior: Kure-N-Seal, Sonneborn-Contech; or equivalent.
2. Exterior: Water soluble linseed oil base compound, Sonneborn Deepguard; or equivalent.

2.5 CONCRETE MIX

A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301 Method 1.

C. Provide concrete to the following criteria:
1. Compressive strength 7-days: 3,000 psi.
2. Compressive strength 28-days: 4,000 psi.
3. Water/Cement ratio: 0.48 maximum.
4. Minimum cement content: 6.5-sacks per cubic yard (611-pounds cement):
   a. Fly ash may be substituted for up to 15 percent of the total required cement content.
   b. Fly ash shall conform to IDOT Standard Specification Section 4108 Mineral Admixtures.
5. Air entrainment 6.5 percent $\pm$ 1.5 percent.
6. Consistency: Quantity of water required for the proper consistency of concrete shall be determined by the slump test in accordance with ANSI/ASTM C143.
7. Slump allowances shall be as follows:
   a. Vertical wall sections, columns: Maximum slump, 4-inches, plus or minus 1-inch tolerance.
   b. Footings, beams, slabs: Maximum slump, 3-inches, plus or minus 1-inch tolerance.

D. Use accelerating admixtures in cold weather only when authorization by Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride prohibited.

F. Use set retarding admixtures during hot weather only when authorization by Engineer.

G. For concrete in contact with sewage, effluent or exposed to chemical attack, comply with recommendations contained in Chapter 4 of Environmental Engineered Concrete Structures (Title 74-26 by ACI Committee 350-83) and with recommendations contained in ACI 301 and ACI 211.

2.6 QUALITY CONTROL

A. Slump tests:
   1. Make test in accordance with ASTM C143 on sample taken in accordance with ASTM C172.
   2. Tests required:
      a. First load each day.
      b. Every 50-cy or fraction thereof.
      c. Whenever other tests are being made.
      d. After any change in mix.
      e. When directed by Engineer.

B. Temperature test:
   1. Required whenever outside temperature is within 10°F of limiting temperature.
   2. Make tests at same time slump tests are taken.
   3. Use armored thermometer accurate to plus or minus 2°F.
   4. Place thermometer in freshly discharged concrete and leave it in place until reading becomes stable.

C. Air content tests:
   1. By pressure method ASTM C231 or volumetric method ASTM C173 on samples taken in accordance with ASTM C172.
   2. Test first load of air entrained concrete and spot check by additional test on each day when air entrained concrete is placed.

D. Unit weight of concrete.

E. Compression tests:
   1. Prepare cylinders in accordance with ASTM C31.
   2. Set of 3 cylinders required for every run of 50-cy or fraction thereof.
   3. Cure cylinders under laboratory conditions and test by procedure in ASTM C39.
   4. Prepare additional cylinders and cure under job conditions if air temperature is likely to fall below 40°F.
   5. Break cylinders at 7 and 28-days, or as directed by Engineer.
   6. If over 1 in 10 tests of laboratory specimens fall below specified design compressive strength, check design of mix and make necessary corrections before additional concrete is placed.
   7. When test specimens break below strength specified, Contractor may be required to test concrete affected by procedure in ASTM C42 core tests or load test portion of structure affected.
   8. Remove concrete not in accordance with specifications and replace without cost to Owner.

F. Record results of all tests immediately in Log of Tests which must be maintained at job site. Log must contain following information:
   1. Date and time tests are made.
   2. Test results, if immediately available.
   3. Exact location where tested concrete was placed in structure.
   4. Weather conditions, including air temperature at time tests were made.
   5. Plant and number of mixer truck which delivered concrete.
   6. Name of person who made test.
   7. Mix design number.

PART 3 – EXECUTION – Not Used – See Specification Section 02516.

End.