

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: The work covered by this section consist of site clearing, grading, general and building excavation, disposal of debris and spoils, dewatering preparation of subgrade, foundations, borrow, embankment, structural and general backfill, restoration, and cleanup necessary to construct the project, all as shown on the drawings and as specified herein.
- B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not limited to, the following:

Section 02930 - Lawns and Grasses  
Section 03100 - Concrete Formwork  
Section 03300 - Cast-In-Place Concrete

1.02 QUALITY ASSURANCE:

- A. Codes and Standards: Perform all excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Safety: All excavation work and methods of construction shall conform to the state of Iowa Bureau of Labor and all OSHA Standards.

1.03 JOB CONDITIONS:

- A. Site information shown on the Drawings regarding existing conditions is of a general nature. Visit the site and become familiar with existing conditions.
- B. Observe weather conditions. Attempt no work in frozen conditions without the approval of the DNR Construction Inspector.

1.04 PROTECTION OF PERSONS AND PROPERTY:

- A. Protect from damage existing buildings, walks, paving, fencing, sod, and other items noted to remain. Maintain benchmark, monuments, property stakes, and other reference points.
- B. Protect existing underground utilities to remain.
  - 1. Notify the DNR Construction Inspector of underground utilities or structures encountered but not indicated on drawings.
  - 2. Contractor responsibilities: correcting damage caused to existing construction, utilities, surfacing, and other items noted to remain at no additional expense to the Owner.
- C. Barricade open excavations occurring as part of this work and provide warning lights.

1.05 EXPLOSIVES:

- A. The use of explosives is not permitted.

PART 2 - PRODUCTS

2.01 GENERAL FILL AND EMBANKMENT MATERIAL:

- A. Materials to be incorporated in the top 12 inches of earth embankment or general fill shall be earthy materials, free from stones larger than 2 inches, broken concrete, roots, or other materials that would significantly affect scarifying, compacting and finishing the subgrade.
- B. It is anticipated that the majority of excavation material from the building excavation will be acceptable for this use.
- C. Obtain approval of fill material prior to any placement from the DNR Construction Inspector.

2.02 STRUCTURAL BACKFILL MATERIAL:

- A. Structural backfill material shall consist of a natural sand or a mixture of sand with gravel, crushed stone, or other broken fine material to fill all voids in coarser material.
  - 1. The maximum size of any gravel, stone, or broken or fragmented material shall be of such size that 100 percent passes a 6-inch sieve.
  - 2. The liquid limit of the material shall not be greater than 25 and the plasticity index shall not be more than 6.
  - 3. The portion of the material, which passes a No. 4 sieve, shall conform to the following requirements:

<u>Sieve Size</u>	<u>Percentage By Weight Passing</u>
No. 4	100
No. 40	Not more than 75
No. 100	Not more than 15
No. 200	Not more than 8

- B. The material shall be capable of being compacted to 95 percent maximum density without undue weaving and heaving as defined by ASTM D698, Method D.
- C. Obtain approval of fill material prior to any placement from the DNR Construction Inspector.

2.03 GRANULAR DRAINAGE FILL MATERIAL:

- A. Granular drainage fill for use under concrete slabs and walks where shown on the Drawings shall consist of granular free-draining material; consisting of clean bank run gravel or crushed stone of full range of sizes.

- B. Maximum size of aggregate shall be 3/4 inch. 15 to 50% of that portion of weight of fill shall be passing the No. 4 sieve.

2.04 TOPSOIL:

- A. Topsoil: Friable clay loam surface soil reasonably free of subsoil, clay lumps, stones and other objects over two inches in diameter, and without weeds, roots and other objectionable materials.

PART 3 - EXECUTION

3.01 SITE CLEARING:

- A. General: Remove all vegetation, improvements, or obstructions interfering with installation of new construction.
  - 1. Removal includes digging out of stumps, roots, boulders and any other necessary items, the removal of which is not covered in the work of another section.
- B. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except those indicated or directed to be left standing.
  - 1. Completely remove stumps, roots, boulders and other debris protruding through the ground.
  - 2. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.
  - 3. Depressions: Fill depressions caused by clearing and grubbing operations with satisfactory soil materials, unless further excavation work is required or indicated.

3.02 LAYING OUT WORK:

- A. Commission surveyor to locate new construction, set slope and grade stakes, and otherwise fully lay out work.
  - 1. Provide grade staking to maintain proper grades and control.
  - 2. Check existing grades at site against grades or contours indicated on Drawings, and report any differences to Architect before starting of grading.
  - 3. Stake out building and verify location before start of grading.
- B. Preserve stakes and markers.
  - 1. Replace at no cost to the Owner' stakes or markers carelessly or willfully damaged by operation.
  - 2. Assume responsibility for accuracy of lines, grades, and dimensions.

3.03 STRIPPING AND SALVAGING OF TOPSOIL:

- A. Preparation: Mow or otherwise remove weed grass and other vegetation on entire area expected to be disturbed by the work of this section.
- B. Sod: Shred sod by shallow plowing, blading or disking throughout the entire area.
- C. Excavation of Topsoil: Excavate topsoil throughout the entire prepared area to a depth of 12 inches and stockpile where designated by DNR Construction Inspector.

3.04 DEWATERING:

- A. Dewatering System: Provide, maintain and operate sufficient well points, headers, pumps, trenches, and sumps to keep all excavations for structures free from water at all times. Submit proposal to the DNR Construction Inspector for review prior to construction.
- B. Surface Runoff: Control grading around the excavation to prevent surface water from running into the excavations for the structure.
- C. Saturated Foundations: Prior to placing any concrete for foundations, remove soils in footing excavation that have become saturated with surface water.

3.05 EXCAVATION - GENERAL:

- A. General: General excavation consists of removal of materials of whatever nature, including boulders smaller than 1 cubic yard in volume, required for the construction of structures, roads, and walks.
  - 1. The method of excavating shall be at the Contractor's option, exercising great care to leave the final grade in an undisturbed condition.
  - 2. If final grade is disturbed, restore to requirements and satisfaction of the DNR Construction Inspector/Architect.
  - 3. Prior to placing any concrete for footings and foundation work, notify the DNR Construction Inspector to inspect the excavation and obtain approval to proceed with the placement.
- B. Frozen Ground: Provide frost protection for all structural excavation work and do not place concrete for foundation work on frozen ground.
- C. Protection of Existing Work: Protect existing work, including underground utilities and piping, from damage caused by excavation work.
  - 1. Repair any damage to existing work, utilities, or piping at Contractor's expense.
- D. Storage of Fill Materials: Store suitable excavated fill material away from excavations to avoid slides.
  - 1. Deposit excess earth on site, where directed by DNR Construction Inspector.

- E. Removal of Unsuitable Materials: The DNR Construction Inspector may find that changes to cross-sectional dimensions and depths shown on Drawings are necessary to secure foundations free from soft, weathered, shattered and loose materials or other objectionable materials.
  - 1. Remove unsuitable material encountered and replace with granular materials from established pits satisfactory to the DNR Construction Inspector.
  - 2. Compact granular materials to at least 95 percent of maximum density.
  - 3. When the excavation of unsuitable materials and replacement with granular fill material directed by the DNR Construction Inspector is found to be above normal expectations, it will be paid for at the unit prices listed in the Contractor's submitted cost breakdown.
    - a. What constitutes normal expectations will be determined by the Architect.
    - b. The Architect's decision will be final.
- F. Disposal of Excavated Materials: Materials free from sticks, roots, and other objectionable material may be used on site as directed by the DNR Construction Inspector.
  - 1. Remove excavated materials not suitable for fill as directed by the DNR Construction Inspector.

3.06 STRUCTURAL EXCAVATION:

- A. Excavate to elevations and dimensions indicated on the Drawings; allow additional space as required for construction operations and inspection.
- B. Remove all existing construction, encountered within the excavation, to a depth of 6 inches below the indicated elevation of footings and subgrades, to receive floor slabs, walks, and paving.
- C. If suitable bearing for foundations, is not encountered at depth indicated on the Drawings, immediately notify the DNR Construction Inspector.
  - 1. Do not proceed until instructions are given and necessary measurements made for the purpose of establishing additional volume of excavation.
- D. Excavate last 4 inches by hand, if machines are used for excavation.
- E. Fill with concrete, at Contractor's expense, unauthorized excavation carried below bottom of foundation levels shown.
- F. The DNR Construction Inspector will inspect and approve the bottoms of all excavation prior to concrete placement.

3.07 STRUCTURAL BACKFILL:

- A. Start backfill around foundations not less than 24 hours or more than seven (7) days after application of waterproofing.

1. Backfill walls and piers to about the same elevation on each side to equalize pressure.
- B. Compacted structural backfill to 95 percent of its maximum density.
  1. Compact to density and construction requirements as determined by ASTM D698, Method D or by AASHTO Method T-180 (Modified Proctor Density).
- C. Compact subgrade to receive structural backfill to 95 percent density.

3.08 DRAINAGE FILL UNDER INTERIOR SLABS:

- A. Unless otherwise indicated on the Drawings, place a 6-inch minimum layer of granular drainage fill.
- B. Compact this fill material to 95 percent of maximum density at optimum moisture content.

3.09 DRAINAGE FILL UNDER EXTERIOR SLABS:

- A. Provide 4-inch minimum layer of granular drainage fill sub-base for exterior concrete slabs.
- B. Compact with mechanical platform tamper or as approved by DNR Construction Inspector.

3.10 PLACING BACKFILL ADJACENT TO WALLS AND FOOTINGS:

- A. Deposit fill on each side of piers, walls and freestanding structures simultaneously to approximately the same elevation.
  1. Protect below grade waterproofing, dampproofing and insulation with a single thickness of 1/2" fiberboard, 1/8" asphalt impregnated board or other approved means.
  2. Place fill in workable condition, free of clods, frost, or debris, in 6" lifts and thoroughly compact each lift with mechanical tamper.
- B. Do not operate heavy equipment for spreading and compacting backfill closer to any wall than a distance equal to the height of the backfill above the top of the footings.
  1. Backfill adjacent to walls shall be compacted to the same density as the adjacent fill with a small vibratory or hand tamping compactor.

3.11 PREPARATION OF EARTH SUBGRADE FOR CONCRETE:

- A. When excavating for footings or bottom mat slabs to be cast on native soil, excavate to final grade in a manner as to not disturb the existing soil.
  1. If the soil is disturbed, compact it to the satisfaction of the DNR Construction Inspector.
  2. If the soil is not capable of compaction to the satisfaction of the DNR Construction Inspector, remove the disturbed material, and replace it with thoroughly compact structural backfill material.
- B. Do not place concrete on surfaces that are muddy, frozen or contain frost.

- C. If during the course of construction, bottom surfaces become saturated with water or muddy, remove the undesirable material and replace with compacted structural backfill as indicated above.

3.12 PLACING PIPE IN FILL:

- A. When it is necessary to place pipe culverts, drain piping, or other appurtenances in general or structural backfill, bring the fill up to at least one foot above the top of the pipe or appurtenances.
  - 1. Do not leave areas of backfill depressed to allow for trenches.
  - 2. After the compacted fill is complete, excavate for the pipe or appurtenances.
  - 3. Backfill materials and compaction shall conform to the fill in which it is placed.

3.13 TRIMMING AND CLEAN UP:

- A. Conduct final trimming and cleaning up shall as follows:
  - 1. Smooth out all irregularities, fill all washouts, make slopes uniform, slightly rounded at top and bottom, and compact the entire area of the fill to the required lines, grades and cross sections, within 1/10 foot above or below the established grade.
  - 2. Where additional material is required, provide similar fill as the one used, and obtain such material from source approved by the Architect/DNR Construction Inspector.
  - 3. When work is completed, remove and dispose of surplus material including stumps, trees and brush, and leave premises in a condition acceptable to the DNR Construction Inspector.

3.14 FINISH GRADING:

- A. After completion of rough grading, scarify areas to receive topsoil to finish grade shown.
- B. Deposit topsoil to a minimum depth of 6". In areas with existing topsoil, no additional topsoil is required.
- C. Grade topsoil to eliminate water pockets or irregularities.
- D. Eliminate soil lumps and round abrupt changes in slope.
- E. Spread excess earth on site as directed by DNR Construction Inspector.

3.15 SITE RESTORATION:

- A. All disturbed areas within the boundaries of this project not specifically receiving a finished surface are to be seeded in accordance with Section 02930.
- B. Prepare all surfaces to receive seeding per "Standard Specifications" 2001 I.D.O.T., Section 2601.04.

END OF SECTION 02200



1. Protect existing trees and other vegetation indicated or as directed by DNR Construction Inspector to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot traffic or vehicular traffic, or parking of vehicles within drip line.
  2. Provide temporary guards to protect trees and vegetation to be left standing.
  3. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to the DNR Construction Inspector.
- B. Existing Conditions:
1. Site information indicated on the Drawings regarding existing conditions, is of a general nature.
    - a. Visit the site and become familiar with existing conditions.
  2. Observe weather conditions.
    - a. Attempt no work in frozen conditions without the approval of the DNR Construction Inspector.

## PART 2 - PRODUCTS

### 2.01 MATERIALS:

- A. Fill and Backfill Materials:
1. Provide soil materials free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with not more than 15 percent of the rocks or lumps larger than 2-3/8" in their greatest dimension.
  2. Fill material is subject to the approval of the DNR Construction Inspector, and is that material removed from excavations or imported from off-site borrow areas, predominantly granular, nonexpansive soil free from roots and other deleterious matter.
  3. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill.
  4. Cohesionless Material Used for Backfill: Provide sand free from organic material and other foreign matter, and approved by the DNR Construction Inspector.
- B. Provide other materials, not specifically described but required for a complete and proper installation, selected by the Contractor subject to the approval of the Project Engineer.

## PART 3 - EXECUTION

### 3.01 PREPARATION:

A. Protection of Persons and Property:

1. Barricade open holes and depressions occurring as part of the work, and post warning lights on property adjacent to or with public access.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

B. Protection of Utilities:

1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to trenching.
  - a. If damaged, repair or replace at no additional cost to the Owner.
2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Project Engineer and secure instructions.
5. Do not proceed with permanent relocation of utilities until written instructions are received from the Project Engineer.

C. Dewatering:

1. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.
2. Keep trenches and site construction area free from water.

D. Dust Control: Use means necessary to prevent dust becoming a nuisance to the public, at neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

3.02 TRENCHING:

- A. Provide sheeting and shoring necessary for protection of the work and for the safety of personnel.
1. Prior to backfilling, remove all sheeting.

2. Do not permit sheeting to remain in the trenches except when, in the opinion of the DNR Construction Inspector, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impracticable.
    - a. In such cases, the Project Engineer, upon recommendation from the DNR Construction Inspector, may permit portions of sheeting to be cut off and remain in the trench.
- B. Open Cut:
1. Excavate for utilities by open cut.
  2. If conditions at the site prevent such open cut, and if approved by the Project Engineer, trenching may be used.
  3. Short sections of a trench may be tunneled if, in the opinion of the Project Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel.
  4. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects as directed by the DNR Construction Inspector.
  5. When the void is below the subgrade for the utility bedding, use suitable earth materials and compact to the relative density directed by the DNR Construction Inspector, but in no case less than 90 percent.
  6. When the void is in the side of the utility trench or open cut, use suitable earth or sand compacted or consolidated as approved by the DNR Construction Inspector, but in no case to a relative density less than 80 percent.
  7. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the Owner.
  8. Excavating for appurtenances:
    - a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
    - b. Overdepth excavation below such appurtenances, unless directed, will be considered unauthorized.
    - c. Fill unauthorized overdepth excavation with sand, gravel, or lean concrete as directed by the DNR Construction Inspector, and at no additional cost to the Owner.
- C. Trench to the minimum width allowed for proper installation of the utility, with sides as nearly vertical as possible.





C. Remainder of Trench:

1. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or 1/2 the layered thickness, whichever is smaller, in any dimension.
2. Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density directed by the DNR Construction Inspector.

D. Adjacent to Buildings: Mechanically compact backfill within ten feet of buildings.

E. Consolidation of backfill by jetting with water may be permitted, when specifically approved by the DNR Construction Inspector, in areas other than building and pavement areas.

3.05 PIPE JACKING:

- A. Unless so or otherwise required, the Contractor may, at his option, install steel pipe casings, tongue-and-groove reinforced concrete pipes, and steel pipes under existing roads or pavements by jacking into place using procedures approved by the governmental agencies having jurisdiction and approved by the DNR Construction Inspector.

3.06 TUNNELING OPERATIONS:

- A. Unless so or otherwise required, the Contractor is allowed the option to tunnel pipes into position using procedures approved by the Project Engineer/DNR Construction Inspector and the governmental agencies having jurisdiction.

3.07 FIELD QUALITY CONTROL:

A. Tests: Test for displacement of sewer and storm drains.

1. Check sewers and storm drains to determine whether displacement has occurred after the trench has been backfilled to above the pipe and has been compacted as specified.
2. Flash a light between manholes or, if the manholes have not yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror.
3. If the illuminated interior of the pipeline shows poor alignment, displaced pipes, or other defects, correct the defects to the specified conditions and at no additional cost to the Owner.

B. Inspection: The DNR Construction Inspector will inspect and approve open cuts and trenches before installation of utilities, and the following:

1. Assure that trenches are not backfilled until all tests have been completed.
2. Check backfilling for proper layer thickness and compaction.
3. Verify that test results conform to the specified requirements, and that sufficient tests are performed.





- A. Excavation, fill, pipe and fittings, and concrete materials shall be as specified in Related Work Sections.

## 2.03 PIPE MATERIALS

- A. Refer to Specifications Section 02730 – Sanitary Sewer Systems.
- B. Refer to Specifications Section 02660 – Water Distribution System.

## 2.04 APPURTENANCES

- A. Repair couplings (pressure applications):
  - 1. Mechanical fittings meeting requirements of pressure application; bolted couplings, Smith-Blair 441LR, or approved equal.
    - a. Sleeve: Ductile iron ASTM A536.
    - b. Gaskets: Grade 30 compounded rubber of new materials.
    - c. Follower flanges: Ductile iron ASTM A536.
    - d. Bolts and Nuts: 304 stainless steel.
    - e. Coating: Shop coat enamel.
  - 2. Sleeve fittings meeting pressure requirements of PVC pipe and designed to slide completely over pipe ends.
- B. Flexible Couplings (non-pressure applications):
  - 1. Flexible couplings designed to connect spigot ends of similar or dissimilar pipe and provide positive seal against infiltration and exfiltration; Fernco Flexible Coupling or equal.
    - a. Flexible elastomeric body conforming to applicable requirements of ASTM C443, C425, C564 and D1869; series 304 stainless steel bands and housings.
    - b. Furnish with shear rings designed to provide extra strength and rigidity to construction; series 304 stainless steel bolts, nuts and housing.
  - 2. Sleeve fitting meeting pressure requirements of PVC pipe and designed to slide completely over pipe ends.
- C. Service Saddles for directional drilled sewer:
  - 1. Saddle tee or wye in compliance with ASTM F1336 with gasketed branch and rubber seal to main.
  - 2. Mounting clamps series 304 stainless steel; adjustable compression type; 2 per saddle.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. The pipe shall be installed in the location to the line and grade designated on the Drawings by horizontal directional drilling.
- B. All materials delivered to the project for work on the project shall be neatly piled. Excavated material which is not removed from the immediate site of the work shall be kept trimmed up so as to cause as little inconvenience to the owners of neighboring property and to the public, as

possible.

- C. Excavated material, including but not limited to, pipe, pavement, concrete, and concrete rubble, and masonry units, which is unsuitable for backfill and all excavated material which has not been used for backfill shall, upon completion of the project, be removed from the site of the work by the Contractor at his own cost and expense.
- D. The drill staging area shall be kept neat and orderly and disturb as little area as possible. The pipe staging area shall be set up on the opposite side of the crossing, disturbing as little area as needed to accommodate workers, equipment, and to string, join and inspect the pipe.

### 3.02 PRESSURE PIPE

- A. Assemble and install pipe as specified herein, as shown on Standard Drawings and in accordance with the manufacturer's recommendations and guidelines.
- B. Protect pipe and joints during handling against impact, shocks, freefall and gouging.
- C. Make joints with equipment and methods recommended by pipe manufacturer.
  - 1 Clean joint contact surfaces immediately prior to jointing; use lubricants, primers, cement or adhesives as recommended by pipe manufacturer.
  - 2 Protect solvent weld joints from damage during cement cure; do not disturb pipe joint until fully cured; maintain joint at required temperature until fully cured.
- D. Examine pipe for defects and specification compliance prior to installation; damaged or unsound pipe or pipes with defective joints will be rejected.
- E. Remove debris from piping.
- F. Prior to beginning each directional bore:
  - 1 Inspect and calibrate steering control system and drill head field locator.
  - 2 Verify that there is adequate time, equipment, and materials necessary to complete the bore.
  - 3 Review field staking of path and construction plans; provide additional staking of directional bore path at no additional cost to the Owner.
  - 4 Verify location of all utilities; contact the Engineer before proceeding if directional bore path is in conflict with existing utilities or if specified separation distances will not be maintained.
  - 5 Determine drilling fluid mixture to be used based on subsurface soil conditions; additional soil testing will be performed at no additional cost to the Owner.
- G. Directional boring and installation of pipe:
  - 1. Select ground entry and exit locations and angles needed to accommodate the installation of the pipe at the horizontal alignment, vertical profile, and to depths shown on the plans; do not exceed the allowable pipe bending limits established by the manufacturer; excavate bore pit as needed.
  - 2. Locate and install pressure relief pits as needed to relieve excessive drilling fluid pressure.
  - 3. Complete boring of pilot hole to alignment and depth necessary to assure that final location of pipe is in general compliance with plans; utilizing the drill head field locator collect and record horizontal alignment and depth of bury at 100 foot intervals.

4. Backream the pilot hole to a diameter between 125% (minimum) and 150% (maximum) of the maximum outside diameter of the pipe material to be installed; 'slugging' of pilot hole is prohibited; exercise care not to 'hump' ground surface or surface of roads, drives, or sidewalks.
5. Before installing pipe, verify all measurements at site; make necessary field measurements to accurately determine piping make-up length.
6. Pull assembled pipe and tracer wire into borehole during last pass by reamer; continuously monitor pullback forces during pullback; limit pull forces so as to prevent damage to pipe; pushing of pipe into borehole to aid with insertion is prohibited; Provide adequate support of pipe during installation; do not allow twisting or binding of pipe in excess of manufacturer's recommendations
7. Connect directionally bored pipe with pipe or appurtenance installed by conventional trench excavation.
8. Clean up and dispose of cuttings and excess drilling fluids in a manner consistent with local, State and Federal requirements.
9. Back-fill excavated bore pit as appropriate. ,
10. Repair damage to ground surface or surface of roads, drives, or sidewalks along path of bore at no additional cost to Owner; remove mounded soils and or surfacing and repair as specified.
11. Length of bore will be equal to pipe length installed between points of connection to appurtenances or to piping installed by other methods, including not more than 20 feet of open trench excavation per bore,

### 3.03 GRAVITY PIPE

- A. Assemble and install pipe as specified herein, as shown on Standard Drawings and in accordance with the manufacturer's recommendations and guidelines.
- B. Protect pipe and joints during handling against impact, shocks, freefall and gouging.
- C. Make joints with equipment and methods recommended by pipe manufacturer.
  - 1 Clean joint contact surfaces immediately prior to jointing; use lubricants, primers, cement or adhesives as recommended by pipe manufacturer.
  - 2 Protect solvent weld joints from damage during cement cure; do not disturb pipe joint until fully cured; maintain joint at required temperature until fully cured.
- D. Examine pipe for defects and specification compliance prior to installation; damaged or unsound pipe or pipes with defective joints will be rejected.
- E. Remove debris from piping.
- F. Prior to beginning each directional bore:
  1. Inspect and calibrate steering control system and drill head field locator.
  2. Verify that that there is adequate time, equipment, and materials necessary to complete the bore.
  3. Review field staking of path and construction plans; provide additional staking of directional bore path at no additional cost to the Owner.
    - a. Update staking to reflect elevation of pilot hole that is needed to accomplish the

installation of piping at the flow line elevation shown on the plans.

4. Verify location of all utilities; contact the Engineer before proceeding if directional bore path is in conflict with existing utilities or if specified separation distances will not be maintained.
  5. Determine drilling fluid mixture to be used based on subsurface soil conditions; additional soil testing will be performed at no additional cost to the Owner.
- G. Directional boring and installation of pipe:
1. Select ground entry and exit locations and angles needed to accommodate the installation of the pipe at the horizontal alignment and vertical alignment shown on the plans; do not exceed the allowable pipe bending limits established by the manufacturer; excavate bore pit as needed.
  2. Locate and install pressure relief pits as needed to relieve excessive drilling fluid pressure.
  3. Complete boring of pilot hole to alignments and depth necessary to assure that final location of pipe is within allowable tolerance of compliance with plans; utilizing the drill head field locator and other methods, collect and record horizontal alignment and vertical alignment at 50 foot intervals.
  4. Allowable tolerance of horizontal and vertical alignment deviation from piping system design as shown on the plans:
    - a. Horizontal alignment of pilot hole shall be within +/-2 inches at 50 foot intervals.
    - b. Vertical alignment of pilot hole shall be within +/-0.1 feet at 50 foot intervals.
    - c. Retract and repeat directional drilling attempts, until horizontal and vertical alignments are within allowable tolerances, or install gravity sewer piping in accordance with Specification Section 02730.
  5. Back-ream the pilot hole to a diameter between 125% (minimum) and 150% (maximum) of the maximum outside diameter of the pipe material to be installed; 'slugging' of pilot hole is prohibited; exercise care not to 'hump' ground surface or surface of roads, drives, or sidewalks.
  6. Before installing pipe, verify all measurements at site; make necessary field measurements to accurately determine piping make-up length.
  7. Pull assembled pipe into borehole during last pass by reamer; continuously monitor pullback forces during pullback; limit pull forces so as to prevent damage to pipe; pushing of pipe into borehole to aid with insertion is prohibited; provide adequate support of pipe during installation; do not allow twisting or binding of pipe in excess of manufacturer's recommendations.
  8. Connect directionally bored pipe with pipe or appurtenance installed by conventional trench excavation.
  9. Provide sufficient length of pipe to extend past termination point to allow connection to other pipe sections.
  10. Allow minimum of 24 hours for stabilization after installing pipe before making connections to pipe.
  11. Mark location and depth of bore with spray paint on paved surfaces, and wooden stakes on non-paved surfaces at each end bores and at 25-foot intervals along bore.

12. Backfill excavated bore pit as appropriate.
13. Clean up and dispose of cuttings and excess drilling fluids in a manner consistent with local, State and Federal requirements.
14. Repair damage to ground surface or surface of roads, drives, or sidewalks along path of bore at no additional cost to Owner; remove mounded soils and or surfacing and repair as specified.
15. Length of bore will be equal to pipe length installed measured from point of connection to piping or manholes, for each size of pipe and type of pipe material along centerline of pipe with no deductions for manholes.

#### 3.04 SERVICE CONNECTIONS

- A. Conform to details shown on Drawings.
- B. Install saddle wyes; use standard saddle tee and riser in lieu of saddle wye where invert of sewer is 10' or more below ground surface; see Standard Drawing.
- C. Place stopper in end of service pipe:
  - 1 Provide weather tight joint on stopper to match that on pipe spigot; block plug to undisturbed earth with 2" x 4" strut.
  - 2 Mark location of sewer service connection with magnetic tape; connect to end of service.
- D. Install as recommended by manufacturer.
- E. Backfill excavated area after recording exact location of service connection.

#### 3.05 CONNECTIONS BETWEEN DISSIMILAR PIPE

- A. Provide and install suitable couplings for joining dissimilar materials.
- B. Install compacted granular bedding and backfill on stable trench for 12 inches either side of repair coupling.

#### 3.06 PROTECTION OF WATER SUPPLIES

- A. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenances thereto, which would permit the passage of any wastewater or polluted water into the potable water supply.
- B. Wells: Sewers constructed of standard sewer materials shall not be laid within 75 feet of a public well or 50 feet of a private well. Sewers constructed of water main materials may be laid within 75 feet of a public well and within 50 feet of a private well, but not closer than 25 feet to either.
  1. Where above separation is not met, notify Engineer immediately; Engineer will authorize relocation of sewer as required.
- C. Horizontal separation of gravity sewers from water mains:
  1. Gravity sewer should be separated from water mains by a horizontal distance of at least 10 feet unless:
    - a. The top of sewer main is at least 18 inches below the bottom of water main and,
    - b. The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from water main.
  2. Where required clearances between sewer and water main cannot be maintained: Use ductile iron pipe as specified for pressure pipe; pressure test and leakage test pipe as

specified herein.

- D. Separation of sewer and water main crossovers:
  - 1 Where new sewer crosses over water main or service where top .of sewer is within 18" of bottom of water main or service; provide 20' length of ductile iron pipe for sewer centered on the water main.
  - 2 Support water and sewer pipes and backfill with low permeability soil.
- E. Force mains shall be separated at least 4 feet horizontally from water main.
  - 1. Where specified horizontal distance cannot be maintained; notify Engineer immediately; Engineer will authorize relocation of force main or water main as required.
- F. Provide all necessary shut-down, repair and relocation of water mains, sanitary sewer or force main where conflicts occur; furnish labor, equipment, pipe and fittings; repair and relocation will be paid for as Extra Work; when broken due to carelessness of Contractor, repair is incidental to construction.

### 3.07 FIELD TESTS

- A. Perform testing in compliance with requirements of Specifications Sections 02730 – Sanitary Sewer Systems and 15042 – Cleaning and Pressure Testing of Pipelines.

**END OF SECTION 02230**

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: The work covered by this section consist of furnishing all materials, labor, and equipment necessary or required to do the grading, placing and compacting of fill materials and surfacing, paving for roadways, parking area as shown on the Drawings and as specified herein.
- B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 - Earthwork

- C. Measurements and Payments:
  - 1. Measure the quantity of material delivered in tons.
  - 2. Weight on accurate scales designed for weighing loaded trucks.
  - 3. Load vehicles to insure against loss of material between the scales and the point of delivery. No deductions will be made for the weight of moisture naturally occurring in the material. Material will not be deposited and spread until the scale weight ticket is delivered to the inspector and the weight of material verified.
  - 4. The Contract Documents provide for payment of a lump sum bid amount for the entire project, part of which is the work of this contract.
    - a. The quantity of material provided will be verified by scale tickets and compared to the estimated quantity provided as part of the Contractor's Price Breakdown.
    - b. In the event that the estimated quantity is larger than the quantity provided, the Contractor shall pay the Owner a deduct for the difference in cost for both quantity and labor.
    - c. Additional payments for increased quantities or labor will only be allowed if a change order is warranted due to a change in project scope or for unforeseen situations, as determined by the Architect, warranting additional material and labor to accomplish the original work of this section.
    - c. The Owner will make no additional payments for additional material or labor to correct deficiencies, shortages or mistakes by the Contractor.
- D. Basis of payment:
  - 1. Include in the contract lump sum amount, a lump sum amount for the cost of the work of this section based on unit price per ton for the surfacing material which shall be full

compensation for furnishing all material, tools, equipment and labor necessary to complete the work of this section in conformance with the Drawings and Specifications.

2. This shall be full payment for furnishing, delivering, depositing and spreading the surfacing material as directed and approved by the DNR Construction Inspector.
3. The DNR Construction Inspector will:
  - a. Verify that all quantities are in accordance with requirements.
  - b. Calculate the value of deducts owed the Owner at the unit price provided in the Contractor's Price Breakdown.

#### 1.02 REFERENCES:

- A. Standards of materials and construction shall conform to the Standard Specifications for Highway and Bridge Construction, Series of 1984 of the Iowa Department of Transportation.

#### 1.03 SUBMITTALS:

- A. Provide submittals as required in section 01300

#### 1.04 CONTROL OF MATERIALS:

- A. General: Use materials as specified in this section, tested and approved for use by the DNR Construction Inspector in accordance with the applicable portions of 2001 Series, I.D.O.T. Section 1106.
- B. Samples and Tests: Submit samples of materials to the DNR Construction Inspector in advance of the anticipated use to avoid construction delays. Submit samples and tests in accordance with 2001 Series, IDOT Section 1106.02.
- C. Field Testing: Testing of materials and workmanship will continue throughout the project as conducted by the DNR Construction Inspector. Cooperate in these tests in any way needed to obtain the required data and samples.
- D. Unacceptable Materials: Unacceptable materials will be rejected in accordance with 2001 Series, IDOT Section 1106.04.

#### 1.05 JOB CONDITIONS:

- A. Survey job conditions prior to commencing work. Bring any discrepancies between existing work and the Drawings and Specifications to the attention of the Architect/DNR Construction Inspector.
- B. Observe weather conditions. Attempt no work in frozen conditions without written approval from the DNR Construction Inspector.

## PART 2 - PRODUCTS

### 2.01 MATERIALS:

- A. Provide crushed stone consisting of a uniform mixture of coarse and fine particles produced by crushing ledge rock, predominantly limestone, dolomite, or quartzite.
  - 1. Special Gradation: As described in the Plans and as directed by the DNR Construction Inspector.

### PART 3 - EXECUTION

#### 3.01 GENERAL:

- A. Accomplish the work of this section in accordance with the applicable portions of the 2001 Series, IDOT Standard Specification for Highway and Bridge Construction.

#### 3.02 PREPARATION OF SUBGRADE:

- A. Conform to 2001 Series, IDOT Section 2111. If unsuitable subgrade materials are encountered, remove this material to a depth as indicated by the DNR Construction Inspector and replace with suitable ballast material.

#### 3.03 PLACING OF CRUSHED STONE COURSE:

- A. Construct base course using crushed rock top course material as defined by 2001 Series, IDOT Section 4121. Place the base course in accordance with applicable sections of the IDOT Standard Specifications for Granular Subbase, Standard Compaction as defined by the IDOT Standard Specifications.

#### 3.05 CLEAN UP:

- A. Upon completion of construction, remove all excess materials and construction debris, and restore any damage done to existing buildings or landscape.

END OF SECTION 02506

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Provisions for material, equipment and labor needed for the construction of a complete and proper water distribution system as shown on the drawings and as specified herein.
- B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02220 - Trenching, Backfilling and Compacting

1.02 REFERENCES:

- A. Furnish all equipment, apparatus and systems and installed in complete accordance with the latest edition or revision of the following applicable codes and standards.

ANSI - American National Standard Institute  
ASME - American Society of Mechanical Engineers  
ASTM - American Society of Testing Materials  
AWWA - American Water Works Association  
NBFU - National Bureau of Fire Underwriters  
NEC - National Electric Code  
NEMA - National Electric Manufacturers Association  
UL - Underwriters Laboratories, Inc.  
Iowa Code - Applicable State of Iowa Administrative Code  
UPC - Uniform Plumbing Code

- B. Where conflicts arise between the Contract Documents and code requirements, the latter shall prevail, unless the Contract Documents are more stringent.

1.03 SYSTEM DESCRIPTION:

- A. Assume connection point to building service lines as being approximately five feet outside buildings and structures to which service is required, as shown on the Drawings.

1.04 SUBMITTALS:

- A. Submit full information on all materials proposed for use on this part of the project 30 days prior to scheduled commencement of work. Include catalog data, dimension drawings, photographs and any such descriptive data as may be requested by the Project Engineer.

1.05 QUALITY ASSURANCE:

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the work and materials of all other trades.
- B. Provide only new material. Do not deliver any salvaged or used material with the intent to incorporate such items into the work of this section.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Project Engineer/DNR Construction Inspector and at no additional cost to the Owner.

1.07 PROJECT/SITE CONDITIONS:

- A. Survey conditions prior to commencing work. Bring any discrepancies of existing work with the Drawings and Specifications to the attention of the Project Engineer/DNR Construction Inspector.
  - 1. Verify sizes, dimensions, measurements, types and location of existing piping and appurtenances at points of connection.
  - 2. Conduct all field measurements necessary to determine pipe-laying lengths so that pipe can be laid in place without forcing or springing.
  - 3. Bring any discrepancies of existing work with the Drawings and Specifications to the attention of the Project Engineer/DNR Construction Inspector.
- B. Observe weather conditions. Attempt no work in frozen conditions without written approval from the DNR Construction Inspector.
- C. Make connections to existing mechanical facilities in accordance with the obvious intent of Drawings and Specifications. Claims for extra payments as a result of failure to examine existing conditions at the site will not be accepted.
- D. Keep duration of water service interruptions to existing facilities as short as possible.

1.08 MAINTENANCE

- A. Provide complete and detailed Operating Instructions, Service and repair sheets in a bound Maintenance Manual for pressure tanks, to cover initial start-up, operating procedures, maintenance and service procedures on all major components provided.
- B. Arrange for shipment of Maintenance Manual to coincide with shipment of tanks.

## PART 2 - PRODUCTS

### 2.01 MATERIAL:

- A. Pipe and fitting materials 3" size and larger: Use cast iron, ductile iron or plastic unless otherwise indicated or approved in advance by the Project Engineer.
- B. Pipe material less than 3" size: Use plastic or galvanized steel.

### 2.02 PIPE:

- A. Cast iron pipe (CIP): Provide ANSI A21.1 18/40,000 psi minimum thickness Class 22, with working pressure of not manufactured in accordance with ANSI A21.6 or ANSI A21.8, less than 150 psi, suitable for five foot cover with flat trench bottom and tamped backfill, unless otherwise shown or specified.
  - 1. Class thickness subject to trench loading.
  - 2. Pipe lining: Standard cement lining, coat inside and out with bituminous coating in compliance with ANSI A21.4.
- B. Ductile iron pipe (DIP): Provide ANSI A21.50 manufactured in accordance with ANSI A21.51 and AWWA C151 standards.
  - 1. Minimum standard ductile iron pipe shall be at least thickness Class 52 for 6" to 12" pipe and Class 51 for 16" and larger.
  - 2. Pipe lining: Standard cement lining, coat inside and out with bituminous coating in compliance with ANSI A21.4.
- C. Plastic pipes: Provide plastic pipes with a minimum Pressure Class of 160 psi and the outside dimensions of copper tubing.
  - 1. For water piping less than 2" in diameter, use either polybutylene tubing (PB) - AWWA designation C902, ASTM D-2666, or polyethylene (PE) - AWWA designation C901, ASTM D-2737.
    - a. Polyethylene (PE): ASTM D 1248, high density, Type III, Class C, Standard Code Designation PE 3306, or high density, Type III, Grade P34, Class C, Standard Code Designation PE 3406.

#### Size and Pressure Class:

- ½" - DR 9.0 PC 160 psi  
DR 7.3 PC 200 psi
- ¾" - DR 9.0 PC 160 psi  
DR 7.3 PC 200 psi
- 1" - DR 9.0 PC 160 psi  
DR 7.3 PC 200 psi

2. For water service 2" and over, use polyvinyl chloride pipe (PVC) - AWWA designation C900, SDR 21.
  - a. Polybutylene (PB): ASTM D 2581, Type II, Grade I, Class B, or Type II, Grade I, Class C.
 

Size and Pressure Class:

½" - DR 11 PC 200 psi  
 ¾" - DR 13.5 PC 160 psi  
     DR 11 PC 200 psi  
 1" - DR 13.5 PC 160 psi  
     DR 11 PC 200 psi
- C. Copper Service Pipe: Provide copper water tube, Type K, soft temper, for underground service, conforming to ASTM B88 and B251, marked with manufacturer's name, trademark and indication of pipe type.
  1. The outside diameter of the pipe and the minimum weight per foot shall be no less than that listed in ASTM B251, table 11.

2.03 JOINTS AND FITTINGS:

- A. Cast iron pipe joints and fittings: Use mechanical joints complying with ANSI A21.11, class 250 and fittings complying with ANSI A21.10.
  1. Water Main Pipe Fittings: Mechanical joints conforming to AWWA Standard C -101, C-104, C- 108, C -110, and C-111, class 22 thickness, coated inside and out with bituminous material in accordance with ANSI A21.4, in lengths of 16 feet or longer.
  2. Provide corrosion resistant steel ties with prime coat and with two coats of corrosion resistant paint and/or 3,000 lbs concrete trust blocks bearing on undisturbed dry soil, where joint separation can be expected at 150 psi pressure.
- B. Ductile iron pipe joints and fittings: Use mechanical joints complying with ANSI A21.11, class 250 and fittings complying with ANSI A21.10.
  1. Water Main Pipe Fittings: Mechanical joints conforming to AWWA Standard C -100, C-104, C -110, C -111, C- 150 and C- 151, class 52, coated inside and out with bituminous material in accordance with ANSI A21.4, conforming to the applicable cast iron pipe specifications.
- C. Polyvinyl chloride pipe joints and fittings: Use coupling and joining material meeting the requirements of AWWA standard C900 for PVC pipe 4" through 12" in diameter, 1120 Pressure Pipe Class 12454 -C, or 12454 -B Material, or ASTM D2241 Type I Grade PVC 1120, SDR 26 minimum.
  1. All fittings for PVC piping 4" diameter and larger shall have cast iron mechanical joint.

2. Class Requirements: Do not permit the total system pressure of the water to exceed the Pressure Class listed below:

DR or SDR	Class (psi)	Rating (psi)
SDR 26	95	160
DR 25	100	100
SDR 21	120	200
DR 18	150	150
SDR 17	165	250
DR 14	200	200
SDR 13.5	215	315

3. Determine the pressure in accordance with Appendix A of AWWA C900 if the anticipated instantaneous velocity change exceeds 2 fps.
4. Use rubber ring bell joints as integral and homogenous part of pipe for PVC pipe less than 4" in diameter.
5. Substitute a push- on or mechanical joint cast iron fitting for PVC pipe 2" through 3- 1/2" when a fitting with integral, homogenous rubber O- ring bell joint cannot be supplied.
6. Provide PVC pipe, coupling and jointing material outside of the range of 4" to 12" in accordance with ASTM Standard D2241 with a rated pressure class in accordance with Appendix A of AWWA C -900.

- C. Polyethylene (PE) or polybutylene (PB) pipe joints and fittings: Use joining material meeting the requirement of the standard referenced above for plastic pipe less than 2" in diameter.

#### 2.04 VALVES:

- A. Gate valves: Use gate valves manufactured, in accordance with AWWA C -500, with non rising stems, O ring stem seal, 2" operating nut, bronze mounted iron body, opening counter-clockwise, as specified for pipe.
1. Valves smaller than 12": Provide units designed for 200 psi working pressure.
  2. Valves 14" through 48": Provide units designed for 150 psi working pressure. Provide valves 2" and over in PVC water lines with duck- tipped transition gaskets.

#### 2.05 CURB STOP WITH DRAIN:

- A. Curb Stops with Drain: Mueller M -15210, Ford 222 -SW, A.Y. McDonald 4714, or approved equal.
- B. Curb Stops without Drain: Mueller M- 15200, or approved equal.

#### 2.06 CORPORATION STOPS:

- A. Copper service thread connection outlet: Mueller H- 1500, A.Y. McDonald 4701, Ford F600.
- B. For copper and plastic pipes: Mueller compression connection outlet, A.Y. McDonald 4714T, Ford F 1001, F 1002, or equal.

2.07 SERVICE SADDLES:

- A. Rockwell, Mueller Company, A.Y. McDonald or approved equal.

2.08 SERVICE BOXES:

- A. Mueller H- 10306, A.Y. McDonald 5601, Ford EAl-50-40-45R, or approved equal.

2.09 MARKING TAPE:

- A. A visually and electronically detectable tape Type D Terra tape, Griffolyn Co., Houston, TX, or Line Guard 11, Line Guard Incorporated, Weaton, Illinois or equal.

2.10 AIR RELEASE VALVES:

- A. Provide shop tested, air release valves with a working pressure of 150 psi, as shown. Clow F-3076, APCO No. 400 or approved equal.

2.11 HYDRANTS:

A. Flushing Hydrants:

1. Anti-freezing Kupferle Model No. 77 blow-off hydrant or approved equal, with 2" FIP side inlet. The hydrant outlet shall be sized and of a configuration to prevent the attachment of fire hoses.
2. Provide lower hydrant barrel length suitable for six feet of trench depth.
3. Furnish two (2) operating wrenches for each project.

B. Yard hydrants:

1. Woodford Iowa Model Y2 freezeless yard hydrant or approved equal. Set for fove feet burying depth.

2.12 FOUNTAINS:

- A. Factory-assembled handicapped accessible pedestal fountain with stainless steel receptor. Projector shall be vandal-resistant, two stream, mound building type. Separate self-closing pushbutton valve with automatic stream regulator. The manufacturer shall certify the unit to be lead-free as defined by the Safe Drinking Water Act. Fountain shall be Halsey Taylor Model 4590FR or an approved equal.

2.13 VALVE BOXES AND MANHOLES:

- A. Valve Boxes: 5 1/4" inside diameter, cast Iron, slide type, with cast iron drop cover for valves 12" and smaller.
- B. Valve Manholes: 48" precast concentric manholes for reinforce concrete pipe in accordance with ASTM C -478 for all valves larger than 12" diameter or as shown on the drawings.
  - 1. Frame and cover: 2'-6" diameter, Neenah R-1743 or equal.

2.14 PRESSURE TANKS:

- A. Pressure Tanks: Vertical, pre-pressurized, hydro-pneumatic, factory built, tank Model WX-401-C as manufactured by AMTROL, Inc., West Warwick, R.I. 02893 or approved equal. Pressure tanks shall have ASME Certification.
- B. The tank will provide a total volume of 17.5 gallons with a minimum acceptance factor of 0.65.
- C. Maximum working pressure of 150 psig and maximum operating temperature of 240°F.
- D. The tank shall have steel shell and heavy-duty butyl replaceable diaphragm.
- E. The tank shall be designed with operating pressure of 20/40 psig with arrangement for changeable operating pressures of 30/50 and 40/60 psig.
- F. Provide tank with pressure gauge having a range of 0-100 psi.

2.15 WATER METER:

- A. Water Meter: 2", with bronze case and measuring chambers, sealed register water meter, meeting AWWA C -700 Standards for cold type displacement. The
  - 1. Provide unit with hermetically sealed, tamperproof, magnetic drive register, recording in gallons, guaranteed for ten (10) years against malfunction or leakage.
  - 2. Stenner model WM2001G or approved equivalent.
  - 3. Provide copper unions on each side of register.

2.16 LIQUID CHEMICAL FEED PUMP & CONTROL:

- A. The metering pumps shall be positive displacement peristaltic pumps. Pump materials of construction shall be suitable for use with the liquids to be pumped. Pump manufacturer shall submit documentation indicating that all the materials selected are compatible with the liquid to be pumped. Materials of construction shall be provided for the pump head, valve body, valves valve seat, pump tubing, drive housing, and base.
- B. Power supply will be 120 volt, 60 Hz, single phase. Metering pumps shall have a plug-in type electrical connection.
- C. Metering pumps shall have a minimum suction lift of 25'.
- D. Pump shall be provided with the following:
  - a. Pump base as required for wall or shelf top mounting.
  - b. Injection check valve.
  - c. Weighted strainer
  - d. 20' roll or suction/dishcharge tubing 1/4" or 3/8" white.
  - e. 1 Spare pump tube.
  - f. Installation manual.
- E. Pump shall be capable of delivering from 0.2 to 3.0 gpd against a pressure of 100 psi.

- F. The pump shall be Stenner 45MPH2 or approved equal.
- G. The pump control module (PCM) will be of the same manufacturer as the pump itself. The PCM will be capable of receiving signal from the water meter to deliver flow proportional dosage for injection into the pipeline.

2.16 OTHER MATERIAL:

- A. Provide other material, not specifically described herein but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer/DNR Construction Inspector.

PART 3 EXECUTION:

3.01 EXAMINATION:

- A. Examine the area and conditions under which the work of this section will be performed.
- B. Bring any conditions that are incomplete or unsatisfactory to the attention of the DNR construction inspector.
  - 1. Correct conditions detrimental to timely and proper completion of the work.
  - 2. Do not proceed until unsatisfactory conditions have been corrected.
- C. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.02 PREPARATION:

- A. Conduct trenching and backfilling operations in accordance with Section 02220.
  - 1. Uncover existing mains in sufficient time ahead of pipe laying to determine the extent of fittings for connection.
  - 2. Provide any necessary special fittings to connect existing to new system.
- B. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:
  - 1. Carry pipe into position; do not drag.
  - 2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.
- C. Thoroughly clean interior of pipe and accessories before lowering pipe into trench.
  - 1. Keep clean during laying operations by plugging or other method approved by the DNR Construction Inspector.

- D. Before installation, inspect each piece of pipe and each fitting for defects:
  - 1. Replace material found to be defective before or after laying, with sound material meeting the specified requirements, and without additional cost to the Owner.
  - 2. Visually inspect for cracks or defects and reject any damaged or unsound pipe.
- E. Rubber gaskets: Store in a cool, dark place until just prior to time of installation.
- F. Locate water pipe at least ten feet away, horizontally, from sewer pipes.
  - 1. Where bottom of the water pipe will be at least 12" above top of the sewer pipe, locate water pipe at least six feet away, horizontally, from the sewer pipe.
- G. Where water lines cross under gravity-flow sewer lines, fully encase the sewer pipe in concrete for a distance of at least ten feet each side of the crossing, or provide pressure pipe with no joint located within 36" of the crossing.
  - 1. Cross water lines in cases above sewage force mains or inverted siphons at least 24" above the sewer line.
  - 2. Encase in concrete those joints in the sewer main closer, horizontally, than 36" to the crossing.
  - 3. Verify with and obtain approval for water/sewer conflict resolution from the DNR Construction Inspector.
- H. Do not place water lines in the same trench with sewer lines or electric wiring.

### 3.03 PIPE INSTALLATION:

- A. General:
  - 1. Install all pipe in strict accordance with drawings and/or specifications, AWWA Standard C -600, manufacturer's recommendations, and in the best commercial trade practice.
    - a. Supply and properly use any special tools required for laying, jointing, cutting, etc.
    - b. Clean all pipe before laying and keep it clean until accepted in the completed work.
    - c. Lay pipe conforming accurately to the lines and grades given.
    - d. Keep the trench free of water at all times during pipe laying operations.
    - e. Do not use hooks to install or move pipe.
  - 2. Lay bell and spigot pipe with the bells upgrade.

- a. Lay all types of piping, fitted together so that, when complete, the pipe will have a smooth and uniform invert.
  - b. Swab each length of pipe laid to remove all foreign material before the next length is laid.
  - c. Inspect each pipe for defects before it is lowered into the trench.
3. Install all piping for which no location dimensions are in a neat and workmanlike manner in accordance with the best trade practice.
    - a. Wherever possible, group runs and rises kept parallel.
    - b. Properly lay out all piping to clear obstructions such as equipment, larger-sized pipes, etc.
  4. Do not, under any conditions, let the pipe be laid against the walls of trench.
    - a. Allow a minimum distance of 12" from exterior of pipe to each trench wall.
    - b. Take additional precautions to prevent rocks or other large objects from lodging against the pipe during backfill.
  5. Install all equipment in strict accordance with the Drawings and the manufacturer's specifications.
  6. Inspect all pipe, fittings, couplings, apparatus and equipment for defects or obstructions.
    - a. Remove all defective material from the site.
  7. Use a water- tight plug to prevent ingress of water and other foreign material into open ends of water pipe.
    - a. Retain the plug in position during any period, such as overnight, longer than one- half hour when pipe laying is not in progress.
    - b. Retain the plug in position until the bottom of trench is pumped dry.
    - c. Plug or cap and block pipe ends and fittings left for future connection.
  8. Terminate service lines to facilities to be constructed by others, at the location indicated on the Drawings.
    - a. Cap the termination point if the service line between the facility and the termination point is not in place.

B. Pipe cutting:

1. Cut pipe neatly and without damage to the pipe.

3. Unless otherwise recommended by the pipe manufacturer and authorized by the Project Engineer, only cut pipe with authorized mechanical cutter.
  - a. Use wheel cutter when practicable.
  - b. Cut plastic pipe square and remove all burrs.

C. Pipe laying:

1. Lower pipe and accessories into trench using ropes, derrick, belt slings or other equipment approved by the Project Engineer.
2. Do not dump or drop any of the materials of this Section into the trench.
3. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
4. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings and joints.
5. Take up and relay pipe that has the grade or joint disturbed after laying.
6. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until joining is complete.
7. Securely close open ends of pipe, fittings and valves when work is not in progress.
8. Where any part of coating or lining is damaged, repair to the approval of the Project Engineer and at no additional cost to the Owner.

D. Plastic pipe laying:

1. Position pipe and fittings in trench in a manner that identifying markings will be readily visible for inspection.
2. Cutting and joining:
  - a. Protect against abrasion from holding devices.
  - b. Remove burrs and glosses from surfaces to be jointed. Use abrasive paper, file or steel wool.
  - c. Remove dirt, dust and moisture by wiping clean with chemical cleaner or dry cloth.
  - d. Using a pure bristle paint brush, apply an even coat of the specified solvent cement in the fitting socket and on the surface of the pipe to be joined.
  - e. Promptly insert pipe into bottom of the fitting socket; turn the pipe slightly to assure an even distribution of cement.

- f. Remove excess solvent cement from exterior of the joint.
    - g. Should cement begin to dry before the joint is made, reapply cement before assembling.
    - h. Allow at least one hour for the joint to gain strength before handling or installing the pipe.
  3. Do not thread plastic pipe; make connections only with the solvent cement or with special adapter fittings designed for this purpose.
  4. Align pipe system components without strain.
  5. Support piping at intervals of not more than four feet, at ends, branch fittings, and change of direction or elevation.
  6. Support plastic pipe in trenches with a 3" layer of sand.
  7. Allow no rocks, debris or potentially damaging substances within 6" of plastic pipe in trenches.
  8. Install PVC pipe in accordance with manufacture's recommendations
- E. Connections: Use specials and fittings to suit the actual conditions where connections are made between new work and existing mains.
  1. Use only those specials and fittings approved by the utility having jurisdiction.
- F. Sleeves:
  1. Where pipe passes through walls of valve pits or structures, provide cast iron wall sleeves.
  2. Fill annular space between walls and sleeves with rich cement mortar.
  3. Fill annular space between pipe and sleeves with mastic.
- G. River and lake crossing: Provide for river and lake crossings as shown on the drawings.
  1. Install pipe in trench with a minimum of 6'-0" of cover over the top of the pipe.
  2. Place excavated material over the pipe to a depth of 2'-0" over the pipe.
  3. Place stone riprap in the remaining 4'-0" of depth above the pipe.
    - a. Unless otherwise indicated on the Drawings or specified elsewhere provide riprap consisting of crushed limestone, dolomite, or quartzite with 90 to 100 percent passing a four-inch sieve and 0 to 10 percent passing a one- half inch sieve.
  4. Dispose of excess excavated material at a waste disposal site shown on the Drawings, or

if not shown, selected by the DNR Construction Inspector.

- H. Water Main Pipe on steep slopes:
  - 1. Unless otherwise indicated on the Drawings, install PVC pipe on steep slopes with anchors at each joint.
  - 2. Unless otherwise shown on the Drawings, provide a 2'-0" square by 1'-0" thick concrete anchor poured over the top of pipe.
  - 3. At "the Contractor's option, class 22 cast iron pipe with restraining fittings (Clow F-1058 or equal) may be use instead of PVC pipe with anchors, at no additional cost to the owner.
- I. PVC Water Main: Support continuously and uniformly over the entire length on firm and stable material.
  - 1. Install with one foot additional cover, as indicated on the Drawings.
  - 2. Do not use blocking for intermittent support across excavated sections or to change pipe grade.
- J. Detectable tape: Install detectable tape one (1) foot below the ground surface during backfilling or by plowing at a latter date.
  - 1. Install 2" wide detectable tape in trench over PVC main at a depth of 1'-0" to 2'-0" below ground surface.

### 3.04 JOINTING:

- A. Cast iron pipe, ductile iron pipe, mechanical joints, and push- on type joints: Install in accordance with AWWA C600, modified as necessary by the recommendation of the manufacturer to provide for special requirements of ductile iron pipe.
- B. Make connection between different types of pipe and accessories with transition fittings.
- C. Rubber gaskets: Handle, lubricate where necessary, and install in strict accordance with the recommendations of the manufacturer.

### 3.05 SETTING VALVES, VALVE BOXES AND HYDRANTS:

- A. General:
  - 1. Center valve boxes on the valves, setting plumb.
  - 2. Tamp earth fill around valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.
  - 3. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition.

B. Valves:

1. Install with stems vertical and centered in manhole or box.
2. Check and tighten valve bolts when up to operating pressure.
3. Support valves in manholes as necessary.
4. Inspect valves in open and closed position to verify proper operating condition.
5. Provide valve box or manhole for each valve.

C. Service boxes:

1. Where water lines are located below paved streets having curbs, install boxes directly back of the curbs.
2. Where no curbing exists, install boxes in accessible locations beyond limits of street surfacing, walks and driveways.

D. Hydrants:

1. Install Hydrants in accordance with the Drawings and manufacturer's recommended installation procedure.

3.06 PRESSURE TANKS:

- A. Install pressure tanks in accordance with manufacturer's recommended installation procedure.

3.07 THRUST BLOCKS:

A. General:

1. Provide thrust blocks, metal tie rods and clamps, lugs, on plugs, caps, tees and bends deflecting 22- 1/2 degrees or more either vertically or horizontally, and on water lines 6" in diameter or larger.
2. Provide concrete thrust blocking with a compressive strength of 2500 psi in 28 days.

B. Installation:

1. Locate thrust blocking between solid ground and the fitting to be anchored.
2. Unless otherwise shown or directed by the Project Engineer, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth.
3. Sides of thrust blocking not subject to thrust may be placed against forms.
4. Place thrust blocking so the fitting joints will be accessible for repair.
5. Protect steel rods and clamps by galvanizing or by coating with bituminous paint.

### 3.08 FIELD QUALITY CONTROL:

- A. Closing uninspected work: Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been completely inspected and tested, and has been approved by the DNR Construction Inspector.
- B. Hydrostatic tests:
  - 1. Where any section of a water line is provided with concrete thrust blocking for fittings, do not make hydrostatic tests until at least five days after installation of the concrete thrust blocking, unless otherwise directed by the Project Engineer.
  - 2. Flush out main before test to remove air, insert taps to release trapped air and plug after test.
  - 3. Test at 150 percent of maximum operating pressure for one (1) hour. Allowable pressure drop during test period shall be 10 percent of test pressure.
  - 4. Devise a method for disposal of waste water from hydrostatic tests, and for disinfection, as approved in advance by the DNR Construction Inspector.
- C. Pressure tests:
  - 1. After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, subject the newly laid piping and valved sections of water distribution and service piping to a hydrostatic pressure of 100 psi.
  - 2. Open and close each valve several times during the test.
  - 3. Carefully examine pipe, joints, fittings and valves.
  - 4. Replace or remake joints showing visible leakage.
    - a. Remote cracked pipe, defective pipe, and cracked or defective joints, fittings and valves.
    - b. Replace with sound material and repeat the test until results are satisfactory.
    - c. Make repair and replacement without additional cost to the Owner.
- D. Leakage test:
  - 1. Conduct leakage test after the pressure test has been completed satisfactorily.
  - 2. Duration of each leakage test: At least two hours.
  - 3. During the test, subject water lines to a pressure of 100 psi.
  - 4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test

pressure after the pipe has been filled with water and the air expelled.

- a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$\frac{ND \times \text{SQ. ROOT OF } P}{3,700} = L$$

- b. L = allowable leakage in gallons per hour;
  - c. N = number of joints in length of pipe under test;
  - d. D = nominal diameter of pipe in inches; and
  - e. P = average test pressure in lbs per sq. inch.
  - f. Should any test of pipe disclose leakage greater than that specified, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
5. Verify the allowable leakage per 1000 ft of pipe in gallon per hour for any specific test pressure above 100 with the DNR Construction Inspector.

E. Time for making test:

1. Except for joint material setting, or where concrete reaction backing necessitates a five-day delay, pipelines jointed with rubber gaskets, mechanical, or push-on joints or couplings may be subjected to hydrostatic pressure, inspected and tested for leakage at any time after partial completion of backfill.

3.09 DISINFECTION:

- A. Before acceptance of the potable water system, disinfect each unit of completed water supply, distribution, and service line in accordance with AWWA C601.
  1. Perform all such tests and disinfection in a manner approved by governmental agencies having jurisdiction.
  2. Furnish two copies of a Certificate of Disinfection to the Project Engineer.
- B. Arrange with Owner to notify customers in affected areas that service will be discontinued or water will be unpalatable during disinfection period.
- C. Disinfecting: Provide a minimum residual chlorine content of 50 ppm in water main; allow system to stand full of solution for 24 hours, by use of one of the following methods:
  1. Inject a solution of calcium hypochlorite and water at a slow rate into water main.
    - a. Use chlorine tablets securely fastened to pipe in accordance with manufacturer's recommendations followed by slowly filling water main in such a manner as to not dislodge the tablets from the wall of the pipe.

- D. Chlorination Requirement: Before being placed into service, chlorinate all new mains and repaired portions of or extensions to, existing mains so that a chlorine residual of not less than twenty- five (25) mg/1 remains in the water after standing twenty- four (24) hours in the pipe.
1. Chlorine dosage shall be at least 50 mg/1 initially.
- E. Method of Application: Apply chlorine by one of the following methods, subject to approval by the Engineer.
1. Liquid Chlorine: Use a solution- feed chlorinating device to apply a chlorine gas-water mixture, or feed the dry gas directly through proper devices to regulate the rate of flow and provide an effective diffusion of the gas into the water within the pipe being treated.
    - a. Chlorinating devices for feeding solutions .of the chlorine gas, or the gas itself, must be able to prevent the back- flow of water into the chlorine.
  2. Chlorine- Bearing Compounds in Water: Substitute a mixture of water and high- test calcium hypochlorite (65- 70% Cl) for the chlorine gas water mixture.
    - a. Mix the dry powder first as a paste and then add water to obtain a one (1) percent solution for a total quantity of seven and five tenths (7.5) gallons of water per pound of dry powder.
    - b. Inject this solution in one end of the section of main to be disinfected while filling the main with water as shown in the following table:

Chlorine Requirements to Produce 50MG/L Concentration in 100 Feet of Pipe - by Diameter

<u>Pipe Size Inches</u>	<u>100% Chlorine, Lb.</u>	<u>1% Chlorine Solution, Gals.</u>
4	0.027	0.33
6	0.061	0.13
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

3. Tablet Disinfection: Use this method for short extensions (up to 2,500 feet ) and smaller diameter mains (up to 12 inch).
  - a. Utilized only when scrupulous cleanliness has been used in construction since preliminary flushing must be eliminated.
  - b. Do not use this method if trench water or foreign material has entered the main or if the water is below 41°F.

- c. Place tablets in each section of pipe, hydrants, hydrant branches, and other appurtenances, attached at the top of the main by an adhesive, such as Permatex No.1 or equal as approved by the Engineer.
  - d. Crush and place tablets in joints between pipe sections, hydrants, hydrant branches, or appurtenances inside the annular space, or rubbed like chalk in butt ends to coat sections if the type of assembly does not permit crushing.
  - e. In filling a section of piping with water when using the tablet method, water velocity shall be less than one (1) foot per second.
- F. Flushing: Flush sections of pipe to be disinfected to remove any solids or contaminated material which may have become lodged in the pipe.
- 1. Provide a tap large enough to develop a velocity of at least two and five-tenths (2.5) feet per second, if no hydrant is installed at the end of the main.
    - a. Two and one-half (2.5) inch hydrant openings will, under normal pressures, provide this velocity in pipe sizes up to and including twelve (12) inch.
    - b. Provide taps 2" size and smaller required for chlorination or flushing purposes, or for temporary or permanent release of air, as a part of the construction of water mains.
    - c. Taps larger than 2" shall be paid for as a bid item or as an extra.
- G. Minimum free chlorine residual at pipe extremities: 10 ppm at end of test period; if requirement is not met, repeat disinfection procedure.
- H. Operate all valves and hydrants in new main to assure full disinfection and repeat test procedure if necessary.
- I. Thoroughly flush main after test until extremities indicate same chlorine residual as supply water.
- J. After completion of disinfection and flushing, collect bacteriological samples and submit for laboratory testing.
- 1. Sample must test "safe" before Owner will accept the work.

### 3.10 PROTECTION:

- A. Paint valves, pipe and vents in accordance with the provisions of Section 09900.

END OF SECTION 02660

**SECTION 02671  
WATER WELL PUMP AND PITLESS UNIT**

**PART 1 GENERAL**

1.01 DESCRIPTION

- A. This section covers materials, testing, and work required for placing into operation the necessary submersible pumps. Contractor shall supply all necessary materials, equipment, tools, labor, and superintendence necessary for completion of the work. The pumps will operate in conjunction with Variable Frequency Controllers (VFDs). Those pumps and motors utilizing VFDs shall be designed to operate from 60% to 100% speed for extended periods of time.

1.02 REFERENCES

- A. ANSI B1.20.1: NPT American Tap Pipe Thread
- B. ANSI B16.5: Pipe Flanges and Flanged Fittings.
- C. ASTM D-1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- D. ASTM D-2464: Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- E. ASTM D-2467: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- F. AWWA A100: Standard for Water Wells.
- G. Great Lakes – Upper Mississippi River Board of State Sanitary Engineers, Recommended Standards for Water Works.
- H. Location Specific References:
  - 1 Iowa Administrative Code 567 Chapter 43: Water Supplies – Design and Operation.
  - 2 Iowa Administrative Code 567 Chapter 82: Well Contractor Certification.
  - 3 Iowa Water Supply Facilities Design Standards, Chapter 3: Source Development.

1.03 SUBMITTALS

- A. Submit dimensional drawings, showing materials of construction by ASTM reference and grade.
- B. Submit manufacturer's certified pump performance curves for review by the Engineer. Pumps will not be shipped prior to approval of the pump curves by the Engineer. Show pump total head, torque, brake horsepower, pump efficiency, and required NPSH with pump and system operating point plotted.
- C. Submit data to indicate compliance with type of materials specified.

1.04 QUALITY CONTROL

- A. Owner and/or Owner's Representative will be on-site during the entire installation and testing of the first well pump. It is most likely that Owner and/or Owner's Representative will be on-site during installation and testing of remaining pumps.

1.05 MANUFACTURER'S SERVICES

- A. Equipment manufacturer's services at the jobsite shall not be required.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. All equipment for the pumps, including motors and installation appurtenances, shall be provided as a complete unit by the pump manufacturer, who shall assume full responsibility for the proper operation of the pumps and associated equipment. For pumps utilizing VFDs, coordinate with VFD manufacturer as necessary to assure proper pump, motor, and VFD operation.

2.02 MANUFACTURERS

- A. Pump selections were made based on Goulds Pumps. Other manufacturers may be acceptable provided the pump is to be supplied has an efficiency no lower than 5 percent from that specified for the primary design point. Flow at the secondary points shall be ±10% gpm, head shall be ±10 feet, and efficiency is no lower than 8 percent of those specified.
- B. Other pre-approved manufacturers include Paco, Grundfos, Fairbanks, and Peerless. Other manufacturers must be approved by the Engineer a minimum of ten (10) days prior to bid opening to be considered. Submit pump curves with primary and secondary points indicated and list any exceptions to the specification that may be taken during submittals.

2.03 NAMEPLATE

- A. Corrosion resistant nameplate by W.H. Brady, or approved equal, securely fastened to pump with the following data engraved or stamped in black letters (1/2" high) on a light contrasting background:

- 1 Name of pump manufacturer
- 2 Pump serial number
- 3 Year built
- 4 Number of stages
- 5 Design head and discharge
- 6 Pump speed (rpm)

2.04 WELL PUMPS

- A. The Contractor shall furnish and install one (1) submersible well pump complete with pipe, cable and cable fittings for well. The pump shall comply w1th ANSI B58.1- 1971 and as modified following.
- B. Pump Conditions

Nelson Unit

Flow, U.S. gpm.....	28
Total Dynamic Head, Feet of Water.....	365
Discharge Connection, Threaded.....	3"
Speed, rpm.....	3450
Motor Rating, H.P.....	5hp(3-phase, 230V)

Goulds submersible 25GS50432 with Goulds S-Drive or approved equal

Dyas Unit

Flow, U.S. gpm.....	13
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Total Dynamic Head, Feet of Water.....	375
Discharge Connection, Threaded.....	3"
Speed, rpm.....	3450
Motor Rating, H.P.....	2hp(3-phase, 230V)

Goulds submersible 13GS20432 with Goulds S-Drive or approved equal

The pump shall be vertical, multiple stage, water lubricated, well turbine pump directly connected to a totally enclosed submersible motor. The overall length (depth of setting) shall be measured from the face of the cast iron base plate to the face of pump inlet impeller and shall be listed in the foregoing table.

These specifications include furnishing and installing the pump with motor, column, couplings, anchor bolts, drawdown gage and line, and all miscellaneous and appurtenant parts required for operation of the unit. The column connections shall be coupled in such a manner that for maintenance or repair service, the units can be readily removed and reset and shall be interchangeable.

The units shall be of the vertical centrifugal turbine type, water lubricated, similar and equal to units manufactured by General, Goulds, Grundfos, or approved equal.

The well head shall be fitted with a pitless adaptor capable of supporting the submersible pump and column. The pitless unit shall be equipped with a check valve. The unit shall be similar and equal to units manufactured by Monitor, MAAS, or approved equal.

Pump bowls shall be of corrosion resistant material free from sand holes, blow bores or other detrimental defects, and shall be designed for maximum efficiency and long life. Pumps shall consist of conical strainer, suction nozzle, tail pipe, bowl assembly and adaptor for connecting directly to the discharge column pipe.

Impellers shall be thermoplastic, with non-overloading characteristics; all water passages shall have smooth surfaces; impellers shall be fastened to pump shaft by means of steel collets or stainless steel keys.

The column pipe shall be ASTM 1 A -53 prime steel pipe having threaded connections.

The pump shall be equipped with a polyethylene drawdown line, 1/4" diameter, attached securely every 20 feet, lower end at pump intake. Each motor shall be protected by installing the secondary lightning surge arrestor as close to well head as practicable. (see sketch attached)

The motor shall be vertical hollow shaft squirrel cage high thrust induction type, capable of continuous operation under water. The thrust bearing shall be of ample capacity to carry the weight of all rotating parts plus the hydraulic thrust.

The Contractor shall submit three (3) sets of characteristic curves and data describing the unit, for each type of pump, to the Engineer for written approval, before ordering pump equipment.

## 2.05 MISCELLANEOUS

Each well shall be provided with a casing vent to the atmosphere through a minimum one and one -half inch opening, covered with 24 mesh corrosion resistant screen. The vent shall terminate in a downturned position at least 24 inches above final ground elevation.

Electrical cable shall be firmly attached to the riser pipe at intervals of 20 feet or less.

The tip of pitless unit must terminate at least 18 inches above the final ground elevation.

The pitless unit must be threaded or welded to casing and must have access to disinfect the well. Further, there shall be a sealed entrance connection on the pitless unit for electrical cable.

The pitless unit shall be of material, weight and inside diameter equivalent to the casing, and is to be furnished as a "7' bury unit". The payment for this contract includes all necessary electrical work for this project, including control panel on service pole etc.

## 2.06 Grouting

Cement grout shall consist of a mixture of portland cement complying with ASTM C150-77 Standards, and water in a proportion of not more than six gallons of clean water per bag of cement (94 pounds).

Concrete grout shall consist of a mixture of portland cement complying with ASTM C150-77 standards, coarse aggregate not greater than one-half inch in size, and water in proportion of at least five bags of cement per cubic yard of concrete and not more than six gallons of clean water per bag of cement (94 pounds).

When annular opening is less than four inches, grout shall be of neat cement and placed by means of positive pressure from the bottom of annular opening upward in one continuous operation.

The use of bentonite, aquajel, or similar admixtures to increase fluidity, or reduce shrinkage of the concrete or cement grout shall comply with ASTM C494-77 standards and shall not exceed five percent of the grout mixture by weight.

The grout shall be allowed to properly cure before further work is begun on the well (a minimum 72 hours for Type I portland cement and a minimum 36 hours for Type III portland cement).

## 2.07 Testing and Records

### Microbiological Quality:

After disinfection and pumping of the chlorinated well water to waste, one or more water samples shall be collected and submitted to a certified bacteriology laboratory for bacteriological analysis in accordance with the analytical procedure defined in 400-22.4(1) "a" of the Iowa Administrative Code. Satisfactory results shall be obtained and reported to the Department of Natural Resources

## 2.08 Water Level Measurement

Equipment shall be provided for periodic measurement of static and pumping water levels in the well. The equipment shall be corrosion resistant and consist of a drawdown gauge calibrated in feet, air pump or other suitable device, watertight coupling for attaching the gauge to the casing, and corrosion resistant tubing firmly attached by durable brackets to the pump column or riser pipe at intervals of at least 20 feet.

## 2.09 ELECTRICAL

The Contractor shall furnish and install three wire copper underground service from existing power supply to well site as directed by the Engineer. This shall also include all hookups and 40 ampere circuit breaker for each well to be installed on control panels.

## 2.10 COORDINATION OF WORK AND START UP

The well Contractor shall initiate and complete his work in the shortest practicable time so as to not delay work of the other Contractors. Contractor shall coordinate his work and work schedule with the other Contractors. The well Contractor or his representative will be present for the initial start up of the well pumps after the permanent electrical power and control systems have been installed.

## 2.11 WATER SYSTEM CONNECTIONS

Contractor to tie in to the proposed water treatment system inside the new building. Existing pump and equipment are to remain the property of the DNR.

## 2.12 MEASUREMENT AND PAYMENT

Payment for work performed by the Contractor under this Division of the specifications will be made at the approved contract unit price for each of the items listed in the Proposal. This price and payment shall constitute full compensation to the Contractor for all costs in connection with furnishing all labor, tools, equipment and materials necessary to complete the items in accordance with the drawings and specifications. All incidental work which may or may not have been shown on the drawings or specified, but which is essential to the completion of the project in a workmanlike manner, including clean up and disposal of surplus and waste materials, shall be accomplished by the Contractor without cost to the Owner.

The quantities listed in the Proposal are not guaranteed quantities and are listed only for convenience in comparing bids. Payment will be made for the quantities actually constructed or installed, be they more or less than the listed quantities.

The price bid in the Bid Schedule of Mobilization will be paid the Contractor as full compensation for bringing his equipment to the job and setting up and removing same from the job site after completion of the well. No separate payment will be made for intermediate knock-downs and set-ups required during the construction period of the well; the cost thereof shall be included in the lump sum for mobilization.

## 2.13 DISINFECTION

### A. Time of Disinfection

After the well is completely constructed, it shall be thoroughly cleaned of all foreign substances, including tools, timbers, rope, debris of any kind, cement, oil, grease, joint dope and scum. The casing pipe shall be thoroughly swabbed, using alkalies if necessary, to remove oil, grease, or joint dope. The well shall then be disinfected with a chlorine solution.

### B. Chlorine Solution

The chlorine solution used for disinfecting the well shall be of such volume and strength and shall be so applied that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and applied in accordance with the directions of, and to the satisfaction of, the Engineer, and shall remain in the well at least 24 hours prior to removal by pumping. Following this, the Engineer shall obtain samples for analysis. If satisfactory results are not obtained, the Contractor shall re- disinfect the wells at his own expense until satisfactory results are obtained.

## **PART 3 - EXECUTION**

### 3.01 INSTALLATION

- A. Disinfect pump assembly immediately prior to setting the pump. Spray pump assembly with 200 mg/l chlorine solution.
- B. Bump pump motors to ensure that rotation of motor and pump is correct.
- C. Install column pipe to adapter, then install adapter to the pump discharge.
- D. The column pipe shall be supported every 10 feet by flange or by column pipe centralizer.
- E. If using plastic or flexible pipe for column pipe, compensate for stretching when establishing

pump depth and attaching downhole conduit or cables to the column pipe. Contractor shall check with the column pipe manufacturer to determine pipe stretch compensation for accurate pump depth setting. Leave 3 to 4 inches of slack between downhole conduit or cable straps to allow for stretching.

- F. Upon startup, measure head, flow and amperage to ensure that the pump is operating along the pump curve and the motor is not being overloaded.

### 3.02 PAINT

- A. Paint exposed portions of pitless and with two coats Tnemec Senes 66 or equal, top coat Tnemec Senes 73 or equal. Surface preparation SSPC SP6.

END OF SECTION 02671

PART 1 - GENERAL

1.01 SUMMARY:

- A. Provide sanitary sewerage system as shown on the Drawings, specified herein, and as needed for a complete and proper installation, including, but not necessarily limited to the following:
  - 1. Furnish and install all pipe, fittings, structures, intakes and accessories required for sewer construction as shown on Drawings and/or specified herein.
- B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02220 - Trenching, Backfilling and Compacting

1.02 REFERENCES:

- A. Safety: All methods of construction shall conform to the requirements of the State of Iowa Bureau of Labor and all OSHA standards.
- B. Codes and Standards: Comply with provisions of the following codes, specifications and standard except where more stringent requirements are shown or specified.

AASHTO - American Association of State Highway and Transportation Officials

ANSI - American National Standard Institute

ASME - American Society of Mechanical Engineers

ASTM - American Society of Testing Materials

AWWA - American Water Works Association

NBFU - National Bureau of Fire Underwriters

NEC - National Electrical Code

NEMA - National Electric Manufacturers Association

UL - Underwriters Laboratories, Inc.

Iowa Code - Applicable State of Iowa Administrative Code

UPC - Uniform Plumbing Code

- C. In addition to the above standards, conduct all the work of this Section in accordance with the latest edition of the Authorized Technical Specifications for Water and Sewer Projects of the Iowa Department of Natural Resources.
- D. Where conflicts arise between the Plans and Code Requirements, the latter shall prevail, unless plans are more stringent.
  - 1. Bring all conflicts to the attention of the Engineer and the DNR Construction Inspector.

1.03 SUBMITTALS:

- A. Provide submittals in accordance with Section 01300.
- B. Product Data: Prior to procurement, submit for Engineer's review, full information on all materials proposed for use in the work of this section, and do not install any material until approved by the Engineer.
  - 1. Materials list of items proposed to be provided under this section.
  - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
- C. Shop Drawings: Review shop drawings requirements with DNR Construction Inspector before ordering shop drawings.
  - 1. Submit shop drawings for fabrication and erection.
  - 2. Include plans, elevation, details of sections and connections.
  - 3. Show anchorage and accessory items. Provide templates for anchor and bolt installation.
- D. Quality Control Submittals:
  - 1. Provide manufacturer certificates, laboratory or factory test reports.
  - 2. Material certificates, signed by Contractor and manufacturer shall certify that each material item complies with or exceeds specified requirements.
  - 3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.04 QUALITY ASSURANCE:

- A. Qualification of Workers: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the requirements and the methods needed for proper performance of the work of this section.
- B. Provide one skilled individual to be present at all times during execution of this portion of the work and who shall personally direct all work performed under this section.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.06 PROJECT/SITE CONDITIONS:

A. Environmental Requirement:

1. Observe weather conditions.
2. Attempt no work shall in frozen conditions without written approval from the DNR Construction Inspector.

B. Existing Conditions:

1. Survey job conditions prior to commencing work.
2. Bring any discrepancies of existing work with the Drawings and Specifications to the attention of the Engineer/DNR Construction Inspector.
3. Make connections to existing facilities in accordance with the obvious intent of Drawings and Specifications.
4. Claims for extra payments as a result of failure to examine existing conditions at the site will not be allowed.

C. Field Measurements: Where possible, take field measurements prior to preparation of shop drawings and fabrication. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

1.07 SEQUENCING AND SCHEDULING:

A. Properly coordinate the work of this section with all other trades.

PART 2 - PRODUCTS

2.01 MATERIAL:

- A. Provide material required for a complete installation of the systems described on the Drawings as specified below.
- B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

2.02 MANUFACTURED UNITS:

A. Pipe and Fittings:

1. Ductile Iron Pipe (DIP) and Fittings: Manufactured in accordance with ANSI A21.51, minimum thickness Class 150 subject to trench loading.
  - a. Mechanical or push-on joint in accordance with ANSI A21.11.
  - b. Asphaltic coating exterior in accordance with AWWA C151.

- c. Standard cement lining with asphaltic seal coat for pipe and fittings in accordance with AWWA C105.
  2. Polyvinyl Chloride Pipe (PVC) and Fittings:
    - a. Pipe and fittings for gravity sewer pipe: Fittings shall be rated at same pressure as pipe. ASTM D-3034, Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
    - b. Joints for gravity sewer pipe: ASTM D-2855, ASTM D-3212.
    - c. Pipe Stiffness: ASTM D-2412.
    - d. Installation: Pipe and Fittings should be installed in accordance with ASTM D-2321.
    - e. PVC pipe materials shall have a SDR of 35 and a maximum deflection of 5 percent.
  8. Marking Tape: Provide and install electronically and visually detectable tape with markings "CAUTION - SEWER LINE BELOW," D Terra tape by Griffolyn Company, Inc., Houston, Texas or Type 11, detectable, by Lineguard Inc., Wheaton, Illinois.
- B. Manholes:
  1. Precast:
    - a. Provide reinforced precast concrete manhole sections complying with ASTM C478, except use portland cement as specified below.
    - b. Provide joints of mortar, with approved mastic or rubber gasket conforming to ASTM C443, or an approved combination of those types.
    - c. Provide precast units of concrete rings and eccentric cone section, with ladder rungs cast into the units.
  2. Portland Cement:
    - a. For concrete in manholes, comply with ASTM C150, type II.
    - b. For concrete in cradle and encasement: Type optional with the Contractor.
  3. Concrete: Provide 3,000 psi concrete in accordance with pertinent provisions of Section 03300 of these Specifications.
  4. Mortar: Comply with ASTM C270, type M.
- C. Manhole Steps, Covers, and Frames:
  1. Manhole Steps: R1980E by Neenah or equal. 1'-0 inch to 1'-4 inch maximum spacing.
  2. Manhole Cover: Neenah Type "B", or equal.

3. Frames: Minimum clear opening 24", minimum weight for frame and lid 390 lbs. R1642 by Neenah or equal.
- D. Use flexible watertight connection device between manhole wall and sewer pipe.
1. Conform to requirement of ASTM C923.
  2. Previous test results conducted by independent testing laboratories within 5 years of bid date may be used.
- E. Wall sleeves:
1. Use where shown for pipes passing through walls.
  2. Materials: Cast iron with intermediate flange on piping 3" or larger; galvanized steel pipe with anchor ring or lugs on piping smaller than 3".
  3. Sleeve length: Flush with surface.
  4. Clearance: As recommended by seal manufacturer.
  5. Seal: Mechanical, link-type, modular, field assembled, insulating, positive-sealing; "link-Seal" by Thunderline Corp., or equal.
- F. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION:

- A. Examine the area and conditions under which work of this Section will be performed.
1. Correct conditions detrimental to timely and proper completion of the work.
  2. Do not proceed until unsatisfactory conditions are corrected.
- B. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

#### 3.02 PREPARATION:

- A. Trench backfill and compact for the work of this Section in strict accordance with pertinent provisions of Section 02225 of these specifications.

#### 3.03 INSTALLATION:

- A. Protect pipe during handling against shock and free fall. Remove extraneous material from the pipe interior.

- B. Lay pipe by proceeding upgrade with the spigot end of bell and spigot pointing pipe pointing in the direction of the flow.
- C. Lay each pipe accurately to the indicated line and grade. Aligning so the sewer has a uniform invert.
- D. Continually clear interior of the pipe free from foreign material.
- E. Before making pipe joints, clean and dry all surfaces of the pipe to be joined.
- F. Use lubricants, primers, and adhesives recommended for the purpose by the pipe manufacturer.
- G. Place, fit, join, and adjust the joints to obtain the degree of water tightness required.
- H. Use no defective pipe; check each length for defect and hairline cracks at ends prior to lowering into trench.
- I. Lay all sewer pipe, under all conditions, in a dry trench, on an even, firm bed throughout the full length of the barrel so that no uneven strain is placed on any pipe. Maintain trench dry at all times.
- J. Provide bell holes at each pipe joint to allow barrel of pipe to support trench load.
- K. Insure proper lateral and vertical alignment of pipe and eliminate ground water infiltration.
- L. Install a visually and electronically detectable tape not more than one foot below ground surface, in the trench during backfilling, or by plowing in after backfilling.

3.04 CONFLICT WITH OTHER EXISTING UNDERGROUND UTILITIES:

- A. Provide temporary support for existing, water, gas, power and telephone utility services crossing the trench until backfilling has been completed.
- B. Construct permanent support for existing sewer or service crossing the trench as shown on the Drawings.
- C. Relocate water and sewer service in conflict with new pipe as indicated on the Drawings.
- D. When a conflict with an existing utility exists which has not been indicated on the drawings, consult with the DNR Construction Inspector prior to undertaking any corrective action.

3.05 SANITARY SEWER CONFLICT WITH WATER MAINS:

- A. Where new sewer paralleling water mains have not been clearly located by dimension on the Drawings, install the new sewer service no closer than ten feet from water supply main or service lines.
  - 1. Where the bottom of the water pipe will be at least 18" above the top of the sewer line, the horizontal spacing may be a minimum of six feet.
  - 2. If an 18" vertical clearance between water and sewer pipe is not obtainable, construct new sewer of cast iron or ductile iron pipe until separation or clearance condition is met.
- B. Where new sewer cross water mains, install new sewer at least 18" below the water main.
  - 1. If a minimum clearance of 18" cannot be obtained, construct new sewer of 20' length of cast or ductile iron pipe centered on the water main.
  - 2. If new sewer must pass over the water main, provide vertical separation of at least 18" between the bottom of the sewer and the top of the water main in addition to the requirement of the above paragraph.

3.06 SERVICE CONNECTIONS:

- A. Provide service connections where indicated on the drawings or as required for a complete and proper installation.
- B. Use wye or tee branch where invert of sewer is less than ten feet below ground surface.
  - 1. Rotate branch 30° minimum from vertical.
- C. Use tee branch and riser pipe where invert of sewer is 12' or more below ground surface.
  - 1. Extend riser up to 10' below ground surface.
- D. When conditions are such that connection pipe cannot be supported adequately on undisturbed soil or compacted fill, engage the pipe in concrete backfill, or support on a concrete cradle.
  - 1. Provide concrete required because of conditions resulting from faulty construction methods or negligence, at no additive cost to the Owner.

3.07 MANHOLES:

- A. General:
  - 1. Shape the invert channels to be smooth and semicircular, conforming to the inside of the adjacent sewer section.
  - 2. Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will allow.
  - 3. Make changes in size and grade of channels smoothly and evenly.

4. Form the invert channels directly in the concrete of the manhole base, with mortar, or by laying full section sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened.
5. Smooth the floor of the manhole outside the channels, and slope toward the channels at not less than 1" per foot nor more than 2" per foot.
6. Prevent free drop inside the manholes exceeding 18" measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels.
7. Construct drop manholes whenever the free drop otherwise would be greater than 18"

B. Manhole Rungs:

1. Provide each manhole with individual wall-mounted rungs fabricated of aluminum, plastic-covered steel, or galvanized steel.
2. Comply with the requirements of governmental agencies having jurisdiction.

C. Jointing and Plastering:

1. Completely fill mortar joints, and leave smooth and free from surplus mortar on the inside of the manhole.

D. Frames and Covers: Unless otherwise shown on the Drawings, set frames and covers.

1. In paved areas: The top of the cover will be flush with the finished pavement.
2. In unpaved areas: The top of the cover will be 2" higher than finished grade.

3.08 MANHOLE OVER EXISTING PIPE:

- A. Construct new manhole as specified, breaking upper half of existing pipe after base of manhole is completed so as not to obstruct flow of the existing pipe.

3.09 BUILDING CONNECTIONS:

- A. Terminate building connections where shown on the Drawings.
- B. Provide temporary closures at terminals where the building pipe is not installed.
  1. Place marker post at grade end of plugged line.
  2. Where building piping has been installed, connect to the building piping system.

3.10 TESTING AND INSPECTING:

- A. Do not allow or cause any of the work of this Section to be covered up or enclosed until after it has been inspected and tested, and has been approved by the DNR Construction Inspector.
- B. Prior to testing for leakage, backfill the trench to at least the lower half of the pipe.

1. If required to prevent pipe movement during testing, place sufficient additional backfill, leaving the joints uncovered.
- C. Water Exfiltration Tests: Provide all material, equipment, and labor required to test each section of sewer line between successive manholes by closing the lower end of the sewer to be tested, and the inlet sewer of the upper manhole. Use stoppers.
1. Fill the manhole and pipe with water to a point four feet above the invert of the sewer at the center of the upper manhole, or if ground water is present, four feet above the average adjacent ground water level.
  2. The maximum allowable exfiltration shall be 200 gallons per mile per inch diameter of sewer per 24-hour day at anytime. Leakage in excess of the specified level shall be brought down to specified level by repair of the system at no additional cost to the Owner.
- D. If, in the opinion of the DNR Construction Inspector, excessive ground water is encountered in the construction of a section of the sewer, do not use the exfiltration test.
- E. Water Infiltration Test: Provide all material, equipment, and labor required to test each section of sewer line.
1. Close the end of the sewer at the upper structure sufficiently to prevent the entrance of water.
  2. Discontinue pumping of ground water for at least three days before testing for infiltration.
  3. Infiltration into each individual reach of sewer between adjoining manholes shall not exceed 200 gallons per mile per inch diameter of sewer for 24-hour day at anytime.
  4. Visible leakage at joints or leakage in excess of that specified, shall be repaired at Contractor's expense.
- F. Provide and use measuring devices approved by the DNR Construction Inspector for all testing required by the work of this Section.
- G. Make test in the presence of the DNR Construction Inspector, giving the inspector at least three days advance notice of being ready for test observation.

END OF SECTION 02730

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Seedbed preparation and application of seed mixtures and fertilizer to all areas designated on the Drawings or all areas within the boundaries of this project having been disturbed by works of this project and not receiving finished surfacing, as determined by the DNR Construction Inspector and as specified herein.
- B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 - Earthwork

1.02 REFERENCES:

- A. Standards of materials and construction shall conform with the Standard Specifications for Highway and Bridge Construction, 1997 Series of the Iowa Department of Transportation.

1.03 QUALITY ASSURANCE:

- A. Codes and Standards: Perform all work of this section in accordance with the requirements of the "Standard Specifications" 1997 I.D.O.T. Section 2601.

1.04 PROJECT/SITE CONDITIONS:

- A. Environmental Requirement:
  - 1. Weather conditions shall be observed. Seeding shall be performed only during normal application periods, optimum temperature, moisture and climatic condition to promote germination and plan growth. Normal application periods are between March 1 and May 31 and between August 10 and September 30.
- B. Existing Conditions: Survey job conditions prior to commencing work. Bring any discrepancies between existing work and the Drawings and Specifications to the attention of the Project Engineer/DNR Construction Inspector.

1.05 SEQUENCING AND SCHEDULING:

- A. Properly coordinate the work of this section with all other trades.
- B. Do not start the work of this section until the work of all other trades has been completed unless otherwise approved by the DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. All topsoil used for seedbed shall be in accordance with Section 02200.
- B. All seeds shall be "redtag" quality or better supplied from the latest available crop, free of noxious weed seed and supplied in the following varieties and percentages of weight.
- C. Provide mixture of types and quantities as specified herein for seeding of areas designated by the Project Engineer, the DNR Construction Inspector as indicated on the Drawings, and as specified herein.

- 1. Class "A" Mixture: For areas to remain in semi-natural state where mowing is required only as a temporary control measure.

Fescue, Kentucky 31	25 lbs. per acre
Switchgrass (Blackwell)	8 lbs. per acre
Alfalfa (Northern Grown)	5 lbs. per acre
Birdfoot Trefoil (Empire)	4 lbs. per acre
Alsike Clover	4 lbs. per acre

- 2. Class "B" Mixture: For same situation as where Class "A" mixture is used but where a lighter mix is preferable.

Fescue, Kentucky 31	20 lbs. per acre
Switchgrass (Blackwell)	3 lbs. per acre
Alfalfa (Northern Grown)	4 lbs. per acre
Birdfoot Trefoil (Empire)	4 lbs. per acre
Alsike Clover	4 lbs. per acre

- 3. Class "C" Mixture: For area designated as fine seeded, lawns or other mowed grass areas.

Bluegrass, Kentucky	70%
Ryegrass, Perennial, Fineleaf	10%
Fescue Creeping Red	20%

- 4. Class "D" Mixture: For all areas, unless otherwise specified, where a prairie grass in natural state is required.

Big Bluestem	30 lbs. per acre
Switchgrass (Blackwell)	5 lbs. per acre
Sideoats Grama	5 lbs. per acre
Little Bluestem	5 lbs. per acre

- D. Seed is to be delivered on site in separate packaging for each individual type of seed within each mixture and mixed in the presence of the DNR Construction Inspector if required.

Commercial mixture in the quantities as specified will be acceptable at the discretion of the DNR Construction Inspector, if these quantities are verifiable.

- E. Seed mixture for this project to be selected by the DNR Construction Inspector.

2.02 FUNGICIDE:

- A. All seeds for permanent seeding shall be treated with a nonmercurial fungicide (75% concentration or equivalent) at the rate of 5-1/2 ounces per 100 pounds of seed.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 SEEDBED PREPARATION:

- A. The area to be seeded shall be raked or graded to fill washes or gullies. Pick up and dispose of all debris, including stones, boulders, logs, stumps, or other foreign material that will interfere with the seeding operation.

3.03 FERTILIZER APPLICATION:

- A. Spread fertilizer over the area at the rate of 750 pounds per acre of 15-15-15 (or equivalent).
- B. Unless otherwise indicated, spread all fertilizer with a mechanical spreader which will secure a uniform rate of application.
- C. Spread fertilizer after the preliminary preparation of seedbed and prior to the sowing of any seeds.
- D. Disk the fertilizer and roll the area prior to seeding.
- E. On area inaccessible to field machinery, spread fertilizer after preparation of the seedbed and thoroughly rake into the soil.
- F. Application of fertilizer in combination with seeding by hydraulic seeder as specified in I.D.O.T. Section 2601.04H will be acceptable at the discretion of the DNR Construction Inspector.

3.04 SEED APPLICATION:

- A. Preparation: Mix all seeds specified for this project thoroughly at the project site prior to placing in spreading equipment.

- B. On all areas accessible to field machinery, all grass seeds may be sown with a gravity, cyclone or hydraulic seeder as specified herein. On areas inaccessible to field machinery, the use of hand-cyclone seeder will be permitted.
- C. Apply seed mixture at a rate of four pounds per 1,000 square feet, unless otherwise indicated, during fair, calm weather. One half of the seed mixture shall be sown in one direction and the remainder at right angles to the first sowing.

3.05 SEED APPLICATION IN MAINTAINED LAWNS:

- A. For maintained lawns to be seeded as part of this project, apply fertilizer prior to preparation of the seedbed.
- B. A rotary tiller will be required for preparation of the seedbed. The seedbed after tilling will be raked firm, smooth and free of clods, rocks and other debris.
- C. Roll the seedbed shall both before and after the application of seeds. Apply seeds over damp soil by broadcast seeding.
- D. Roll, seed, and fertilize by hand or with hand operated equipment in areas inaccessible to field equipment.

3.06 SPRING OVERSEEDING:

- A. Seedbed preparation will not be required provided the overseeding is applied when the ground is free from frost action after March 1 and before April 1 or as directed by the DNR Construction Inspector.

3.07 MOWING:

- A. When requested by the DNR Construction Inspector, mowing may be required prior to permanent seeding or anytime during the growing season.

3.08 MULCHING:

- A. All seeded areas are to be mulched unless otherwise designated in the contract documents.
- B. All areas requiring mulch are to be mulched as soon as seed is sown and final rolling is completed.
- C. Mulch is to be evenly and uniformly distributed and anchored into the soil. The application rate for reasonably dry material shall be approximately 1-1/2 tons of dry cereal straw, 2 tons of wood excelsior, or 2 tons of prairie hay per acre, or other approved material, depending on the type of material furnished.
  - 1. All accessible mulched areas are to have mulch consolidated into the soil with a mulch stabilizer, and slope areas are to be tucked on the contour.

2. Crawler type or dual wheel tractors are to be used for the mulching operation. Equipment is to be operated in a manner to minimize displacement of the soil and disturbances of the design cross section.

END OF SECTION 02930

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: All labor, materials, and equipment required to construct, shore, and remove all forms to accommodate all concrete specified in Section 03300, Cast-In-Place Concrete, as shown on the Drawings, and as specified in other sections of these specifications.
- B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03200 - Concrete Reinforcement  
Section 03300 - Cast-In-Place Concrete

1.02 REFERENCES:

- A. Safety: All formwork and methods of construction shall conform to the requirements of the state of Iowa Bureau of Labor and all OSHA Standards.
- B. A.C.I. 347.

1.03 SUBMITTALS:

- A. Provide concrete mix formula to Construction Inspector.
- B. Manufacturer's Data: Within 30 calendar days after award of the contract, submit manufacturer's data and installation instruction for proprietary materials including form coatings, ties and accessories, and manufacturer's form system if used.
- C. Shop Drawings: When requested by the DNR Construction Inspector or the Project Engineer for the purpose of explaining details or structural integrity, the Contractor shall submit those drawings requested prior to construction of the project.

1.04 QUALITY ASSURANCE:

- A. Formwork: Design of formwork is the responsibility of the Contractor.
- B. Standards: Comply with all applicable provisions of ACI 347.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Form Materials:

1. Construct formwork for exposed concrete surfaces with smooth-faced undamaged plywood, undented metal, or other panel-type materials acceptable to the DNR Construction Inspector, to provide continuous, straight, plumb, smooth cast surface, furnish in largest practical sizes to minimize number of joints.
  2. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without reflection or bowing.
- B. Form Ties:
1. Provide factory-fabricated, adjustable length removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
  2. Provide ties so that portion remaining within concrete after removal of exterior parts is at least 1-1/2" from the outer concrete surface. Form ties shall not leave a hole larger than 1" diameter in the concrete surface.
- C. Form Coating: Provide commercial formulated form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

## 2.02 DESIGN OF FORMWORK:

- A. General:
1. Design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure.
  2. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.
  3. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
  4. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
  5. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
  6. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

7. Support form facing materials by structural members spaced sufficiently close to prevent objectionable deflection.
  8. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.
  9. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.
  10. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
- B. Earth Forms: Side forms of footings may be omitted and concrete placed directly against excavation only when requested by the Contractor and accepted by the DNR Construction Inspector. When omission of forms is accepted, provide additional concrete 1" on each side of the minimum design profiles and dimensions shown.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION:

- A. Examine the substrate and conditions under which work of this section is to be performed, and correct unsatisfactory conditions which would prevent proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02 ERECTION:

A. General:

1. Construct forms complying with ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level, and plumb work in finish structures.
2. Provide for openings, offsets, sinkages, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required. Use selected materials to obtain required finishes.
3. Forms for openings and construction which accommodates installation by other trades whose materials and products must be fabricated before the opportunity exists to verify the measurements of adjacent construction which effects such installations, shall be accurately sized and located as dimensioned on the Drawings. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as approved by the Project Engineer, without additional expense to the Owner.

B. Fabrication:

1. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast

concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

2. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to temporary openings on forms in as inconspicuous locations as possible, consistent with design requirements. Form intersecting planes to provide true, clean-cut corners.

C. Falsework:

1. Erect falsework and support, brace and maintain it to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place construction. Construct falsework so that adjustments can be made for take-up and settlement.
2. Provide wedges, jacks, or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.

D. Forms for Exposed Concrete:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
3. Use extra studs, walers, and bracing to prevent objectionable bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material which will produce bow.
4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

E. Corner Treatment: Unless shown otherwise, form chamfers with 3/4" x 3/4" strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

F. Control Joints: Locate as directed by DNR Construction Inspector or as indicated on the Drawings.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Verify size and location of openings, recesses and chases with the trade requiring such items. Accurately place and securely support items to be built into forms.

- H. **Cleaning and Tightening:** Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.03 INSTALLATION:

A. **Embedded Items:**

1. **General:** Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.
2. **Edge Forms and Screeds:** Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

- B. **Shores and Supports:** Comply with ACI 347 for shoring construction, and as herein specified. Submit a shore removal and reshoring schedule and drawings for the DNR Construction Inspector review before proceeding with this work. Do not proceed until schedule and drawings have been reviewed.

3.04 APPLICATION:

- A. **Form Coating:** Coat form contact surfaces with form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come in contact with surfaces which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

3.05 FIELD QUALITY CONTROL:

- A. **Inspection:** Concrete shall not be placed in forms until inspected by DNR Construction Inspector and permission is given to start placing concrete.

3.06 CLEANING:

- A. **General:** Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 10 degrees C (50 degrees F) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.
- B. **Formwork:** Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed in less than 14 days, and not until concrete has attained design minimum 28-day compressive strength. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of the concrete location or members, as specified in other sections.

- C. Form-Facing Material: Form-facing material may be removed four days after placement, only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.
- D. Reuse of Forms: Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable. Apply new form-coating compound material to concrete contact surfaces as specified for new formwork. When forms are reused for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

END OF SECTION 03100

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: All reinforcing steel, steel mesh, and accessories and the installation of these items for all concrete reinforcement for this project.
- B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03100 - Concrete Formwork  
Section 03300 - Cast-In-Place Concrete

1.02 REFERENCES:

- A. Comply with all applicable provisions of the following standards:
  - 1. CRSI "Manual of Standard Practice"
  - 2. ACI 315 "Details and Detailing of Concrete Reinforcement"
  - 3. ACI 318 "Building Code Requirements for Reinforced Concrete"

1.03 SUBMITTALS:

- A. Shop Drawings: Submit complete shop drawings of all materials proposed to be furnished and installed under this section in accordance with ACI "Manual of Standard Practice for Detailing Concrete Structure," ACI 315. Show:
  - 1. Bar schedule, stirrup spacing, diagrams of bent bars, and arrangements and assemblies.
  - 2. Review shop drawings requirements with DNR Construction Inspector before ordering shop drawings.
- B. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Delivery: Deliver reinforcement to the job site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

- B. Storage: Store reinforcement at the job site in a manner to prevent damage and accumulation of dirt and excessive rust.

## PART 2 - PRODUCTS

### 2.01 MATERIALS:

- A. Steel and Wire Reinforcement: Reinforcing steel shall consist of deformed bars of the size called for on the Drawings. Steel shall conform to ASTM A615 Grade 40. Deformation shall conform to ASTM A305. Mill certificates showing conformity with these requirements shall be furnished to the Project Engineer for each melt. Wire reinforcement shall conform to ASTM A82. Welded wire fabric shall conform to ASTM A185.
- B. Tie Wire: No. 16 double annealed iron wire.
- C. Accessories: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:
  - 1. Use wire bar-type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick and other such unacceptable materials.
  - 2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
  - 3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dip galvanized or plastic protected legs.

## PART 3 - EXECUTION

### 3.01 EXAMINATION:

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed, and correct conditions which would prevent proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION:

- A. General:
  - 1. Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified.
  - 2. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
  - 3. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

4. Place reinforcement to obtain the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
5. Bars are to be tied at all intersections except where spacing is less than one foot in each direction, in which case alternate intersections are to be tied.
6. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh.
7. Provide sufficient numbers of supports and of strengths to carry reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
8. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wrapping tie wire around bars.
9. Galvanized or epoxy coated reinforcement: Weight of reinforcement will be calculated from the theoretical weight of the nominal sizes and actual lengths of the various sizes of reinforcement shown on the plans. No adjustment in weight will be made for galvanizing or epoxy coating.

END OF SECTION 03200

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Provisions for all labor and materials required to construct all walls, footings, piers and slabs, and all other work or items classified as cast-in-place concrete.
1. All concrete foundations and slabs as shown on the project plan, floor plans and building sections, as well as all other concrete not specified elsewhere, are classified as cast-in-place concrete.
- B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03100 - Concrete Formwork  
Section 03200 - Concrete Reinforcement

1.02 REFERENCES:

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown or specified.
1. Uniform Building Code, U.B.C., 1985 edition.
2. American Concrete Institute (ACI).
- a. Manual of Concrete Practice.
- b. ACI 301 - Specifications for Structural Concrete for Buildings.
- c. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- d. ACI 305 - Hot Weather Concreting.
- e. ACI 306 - Cold Weather Concreting.
- f. ACI 308 - Standard Practice for Curing Concrete.
- g. ACI 318 - Building Code Requirements for Reinforced Concrete.
3. American Society for Testing of Materials (ASTM).
- a. ASTM C33 - Standard specification for concrete aggregates.

- b. ASTM C31 - Making and curing compressive and flexural strength test specimens in the field.
  - c. ASTM C94 - Standard specification for ready-mixed concrete.
  - d. ASTM C138 - Test for unit weight, yield and air content of concrete.
  - e. ASTM C143 - Test for slump test of Portland cement concrete.
  - f. ASTM C150 - Standard specification for Portland cement.
  - g. ASTM C260 - Standard specification for air-entraining admixture for concrete.
  - h. ASTM C309 - Standard specification for liquid membrane-forming compounds for curing concrete.
  - i. ASTM C494 - Standard specification for chemical admixtures for concrete.
  - j. ASTM D994 - Standard specification for preformed expansion joint filler for concrete.
  - k. ASTM D1850 - Standard specification for concrete joint sealer, cold application type.
- 4. Concrete Reinforcing Steel Institute (CRSI).
    - a. Manual of Standard Practice.
  - 5. State of Iowa Building Code, latest edition.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, accessories, admixtures, patching compounds, water stops, joint systems, curing compounds, dry-shake finish materials, and others as required by Project Engineer.
- B. Samples: Submit samples of materials specified as requested by Project Engineer including names, sources and descriptions.
- C. Quality Control Submittals:
  - 1. Design Data: Submit data on proposed design mixes when trial batch method is used.
  - 2. Test Reports: Employ, when necessary, at Contractor's expense, a testing laboratory acceptable to the Project Engineer to perform material evaluation tests and submit reports.
  - 3. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Project Engineer. Material certificates shall be signed by

Manufacturer and Contractor certifying that each material item complies with or exceeds specified requirements.

1.04 QUALITY ASSURANCE:

A. Qualifications:

1. During the progress of installation of the work of this section, provide at least one worker who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this section.
2. Use adequate numbers of skilled workers to ensure installation in strict accordance with the approved design.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A Protection: Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Project Engineer and at no additional cost to the Owner.

1.06 PROJECT/SITE CONDITIONS:

- A. Environmental Requirements: Weather conditions shall be observed. No work shall be attempted in frozen conditions without written approval from the DNR Construction Inspector.
- B. Existing Conditions: Review job conditions prior to commencing work. Bring any discrepancies between existing work and the Drawings and Specifications to the attention of the Project Engineer/DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, products from the following manufacturers can be incorporated into the work of this section.
1. Euclid Chemical Co., 19218 Redwood Road, Cleveland, Ohio 44110.
  2. Master Builders Co., Ltd., 79 Kincort Street, Toronto, Ontario M6M3E4.
  3. Sika Chemical Corporation, P. O. Box 297, Lyndhurst, New Jersey 07071.
  4. Chem-Master Corporation, 477 Industrial Parkway, Chagrin Falls, Ohio 44022.
  5. W. R. Grace and Co., 62 Wittemore Avenue, Cambridge, Massachusetts 02140.

6. W. R. Meadows, Inc., P. O. Box 543, Elgin, Illinois 60120.
7. Protex Industries, Inc., 1331 West Evans Avenue, Denver, Colorado 80223.
8. Sonneborn Building Products, 7711 Computer Avenue, Minneapolis, Minnesota 55435.
9. Antihydro Co., 265 Badger Avenue, Newark, New Jersey 07108.
10. L & M Construction Chemicals, Inc., 8316 Blondo Street, Omaha, Nebraska 68134.
11. Glifford-Hill and Co., Inc., Woodland Green, Charlotte, North Carolina 28210.
12. The Celotex Corporation, 1500 North Dale Mabry Highway, Tampa, Florida 33607.
13. J & P Petroleum Products, Tex-Mastic Construction Materials, 2715 South Westmoreland, P. O. Box 4206, Dallas, Texas 75208.

2.02 MATERIALS:

- A. Portland Cement: ANSI/ASTM C 150, Type I or Type III, high early-strength cements, unless otherwise acceptable to Project Engineer.
- B. Normal Weight Aggregates: ANSI/ASTM C 33, and as herein specified.
  1. Coarse aggregate for concrete shall consist of gravel or crushed stone particles, from a source approved by Iowa D.O.T., or combinations of these materials. The aggregate shall meet these requirements:
    - a. Abrasion loss: The percent of wear, determined in accordance with AASHTO T 96, Grading A or B, shall not exceed 35 for gravel and 50 for other crushed stone.
    - b. Durability: Coarse aggregate durability shall be a minimum of Class 1. Aggregate of Class 2 or Class 3 durability may be furnished by the Contractor, with the Project Engineer's approval, and at no extra cost to the Owner.
    - c. Gradation: Coarse aggregate shall meet requirements of D.O.T. Section 4109, Gradation No. 3, 4, or 5.
    - d. Maximum size of coarse aggregate: Not more than three-fourths minimum clear spacing between reinforcing bars and not more than one-fifth of smallest dimension of slab or member for which concrete is being used. Coarse aggregate for non-reinforced slabs maximum size one-third of slab thickness.
  2. Fine aggregate for concrete shall consist of clean, hard, durable mineral aggregate particles free from injurious amounts of silt, shale, coal, organic matter, or other

deleterious material, and shall be from a source approved by Iowa D.O.T. The aggregate shall meet these requirements:

a. Gradation: Fine aggregate shall meet the requirements of D.O.T. Section 4109 for Gradation No. 1.

C. Water: Water for concrete shall be clean, potable and free from injurious amounts of foreign matter.

D. Water-Reducing Admixtures: ANSI/ASTM, C 494, Type A and contain not more than one percent (1%) chloride ions.

"Eucon WR-74;" Euclid Chemical Co.  
"Pozzolith 322N;" Master Builders.  
"Plastocrete 160;" Sika Chemical Corp.  
"Chemtard;" Chem-Masters Corp. or approved equal

E. Air-Entraining Admixture: ANSI/ASTM C 260, added to mixer in lieu of air-entrained cement.

"Darex (AEA);" W. R. Grace Co.  
"Ad-Aire;" Carter-Waters Corp.  
"Protex AES;" Protex Industries, Inc.  
"Seal-Tight;" W. R. Meadows, Inc. or approved equal

F. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ANSI/ASTM C 309, Type I, Class A unless other type acceptable to Project Engineer.

"Masterseal;" Master Builders.  
"A-H 3 Way;" Sealer' Anti-Hydro Waterproofing Co.  
"Ecocure;" Euclid Chemical Co.  
"Clear Seal;" W. R. Grace.  
"Kure-N-Seal;" Sonneborn-Contech.  
"Polyclear;" Upco Chemical/USM Corp.  
"L & M Cure;" L & M Construction Materials.  
"LR-151;" Protex Industries.  
"Hardtop;" Gifford - Hill. or approved equal

1. 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, nor show signs of such deterioration within 30 days after application under actual working conditions. The compound shall be sufficiently transparent and free from color so there will be no permanent change in the color of the concrete. The compound shall contain, however, a temporary dye of sufficient color to make the membrane clearly visible for a period of at least four hours after application.

2.03 EQUIPMENT:

- A. Batching, Mixing, and Delivery Equipment: Use transit-mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to site in accordance with ANSI/ASTM 94.
- B. When air temperature is between 85°F. (30°C) and 90°F. (32°C), reduce mixing and delivery time from 1 1/2 hours to 75 minutes; and when air temperature is above 90°F. (32°C), reduce mixing and delivery time to 60 minutes.

2.04 ACCESSORIES:

- A. Preformed Joint Filler: ASTM D 994 and as herein specified.
  - 1. Preformed non-extruding resilient material, one-half (1/2) inch wide and of the depth required to bring surface to within one-half (1/2) inch of finished surface.
  - 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:  
  
"Flexcell;" Celotex Corporation.  
"Sealtight;" W. R. Meadows, Inc.  
"Tex Mastic;" J & P Petroleum Products. or approved equal
- B. Joint Sealer: ASTM D 1850 Concrete Joint Sealer, cold-application type.
- C. Vapor Barrier: Under slabs on ground, 4 mil polyethylene film, when required by the Drawings.
- D. Storage: Store all cement materials in weather-tight enclosure, clear of ground, and protected from weather with suitable covering.
- E. Embedded Items: Verify and coordinate embedded items furnished by other trades.
- F. Keyways and/or Expansion Tubes: IDOT Section 4191, Series of 1992, or as required by the Drawings.
- G. Admixtures: Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated as determined by ANSI/ASTM C 138. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:
  - 1. Concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:

<u>Maximum Size Aggregate</u>	<u>Amount of Air (%)</u>
1 1/2" or 2"	5% + 1%
3/4" or 1"	6% + 1%
3/8" or 1/2"	7 1/2% + 1%

2.05 MIXES:

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Project Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Project Engineer.
- B. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
  - 1. 4,000 p.s.i. 28-day compressive strength; 624 lbs. cement per cubic yard minimum; W/C ratio, 0.488 maximum.
- C. Consistency: The quantity of water required for the proper consistency of concrete shall be determined by the slump test in accordance with ANSI/ASTM C 143. Slump allowances shall be as follows:
  - 1. Vertical Wall Sections, Columns -- Maximum slump, 4 inches, plus or minus one inch tolerance.
  - 2. Footings, Beams, Slabs -- Maximum slump, 3 inches, plus or minus one inch tolerance.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- B. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

3.02 PREPARATION:

- A. Drain and pump all water from excavations, forms, and any locations where concrete is to be placed. Bottom of excavations shall be undisturbed earth free of frost or debris, level and compacted. Do not place any concrete until the DNR Construction Inspector has inspected and approved forms and soil conditions, and until reinforcing, sleeves, and embedded items have been placed. Clean all dirt and debris from transporting equipment. Clean reinforcement of all foreign matter. Clean forms and oil or wet (except in freezing conditions) surfaces. Compact, level, and dampen base fill material under slabs on grade. Prior to placing concrete, install polyethylene vapor barrier under interior slabs. Do not puncture or otherwise damage vapor barrier or membrane waterproofing.

- B. Transport concrete to prevent separation of materials in accordance with ACI practices. Do not add water to concrete during transporting. Handle from mixer to point of placement with carts, buggies, or conveyors. Do not dump concrete from mixer or from transporting equipment with a free fall of more than three feet. Deposit concrete as nearly to its final position as possible. Clean transporting equipment at frequent intervals during placement. Do not use partially hardened or contaminated concrete.

3.03 PLACEMENT OF CONCRETE:

- A. Place concrete in accordance with ACI 304 "Recommended practice for measuring, mixing, transporting and placing concrete" and as herein specified.
- B. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- C. Place concrete continuously so that fresh concrete is not placed against hardened concrete to form seams or planes of weakness. Work concrete into corners and around reinforcement. Machine vibrate sufficiently to insure thorough compaction and complete embedment of reinforcing. Stop placement at point of no shear, or where directed, and erect tight, plumb dams through forms. Place concrete between construction joints in one continuous operation. Locate construction joints in slabs under partitions. Brush on neat cement when pouring against hardened concrete.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
  - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
  - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least six (6) inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
  - 1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Bring slab surfaces to correct level with straight edge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

3. Maintain reinforcing in proper position during concrete placement operations.
- F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306, "Cold Weather Concreting," and as herein specified.
1. When air temperature has fallen to or is expected to fall below 40øF. (4øC), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 40øF. (4øC), and not more than 80øF. (27øC) at point of placement, and maintain minimum temperature over the entire work for no less than 72 hours.
    - a. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
    - b. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305, "Hot Weather Concreting," and as herein specified:
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90øF. (32øC). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated in total amount of mixing water.
  2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
  3. Wet forms thoroughly before placing concrete.
  4. Use water-reducing retarding admixture (Type A) when required by high temperatures, low humidity, or other adverse placing conditions.
- H. Construction Joints: Contractor to submit placement and type of construction joints to Project Engineer for review prior to placement of any concrete on the project.
- I. Expansion Joints: Install expansion joint filler where interior slabs abut exterior walls, interior bearing walls and columns, at perimeter of concrete equipment pads, and other necessary locations as determined by the inspector. Omit expansion joint filler and install 15 lb. felt, centered below doors, to break bond at exterior doors with concrete platforms, unless otherwise shown on the Drawings.
- J. Control Joints: Cut control joints in all exposed concrete slabs on grade, as directed by the Inspector. Locate in a uniform pattern throughout parking areas. Verify location and cut to depth of one-sixth (1/6) of slab thickness with minimum of three-fourths (3/4) inch depth.

Cut with carborundum saw, approximately six (6) to twenty-four (24) hours after placing concrete and when a minimum amount of raveling occurs in concrete.

1. On exterior walks, score with one-fourth inch by one inch (1/4" x 1") deep control joints. Use straight edge guide when scoring joints. Where required depth of control joint cannot be made by scoring, cut joints with carborundum saw.

3.04 CONCRETE FINISHING:

A. Finish on Formed Surfaces: All finished or formed surfaces shall conform accurately to the shape, alignment, grades and sections as shown on the Drawings. Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness, and shall present a finished, continuous, hard surface. All sharp angles, where required, shall be rounded or beveled.

1. Rough Form Finish:

- a. Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in the finish work or by any other construction.
- b. Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched, and all fins and other projections exceeding one-fourth inch (1/4") in height rubbed down or chipped off.

2. Smooth Form Finish:

- a. Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view, or that are to be covered with a coating material other than cement plaster applied directly to the concrete.
- b. Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams.
- c. Repair and patch defective areas with all fins and other projections completely removed and smoothed.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a smooth troweled finish.

C. Slab and Floor Finish: For all floor and flat roof surfaces and all exterior concrete floor, sidewalk and flat slab surfaces, the Contractor shall be particularly careful to provide an adequate slope to the drains or to suitable points of disposal. The direction of slope and the amount of crowning generally are shown on the Drawings; otherwise, they shall be as prescribed by the Project Engineer or the DNR Construction Inspector. Dry topping will not be allowed on any of the finishes.

1. Scratch Finish:

- a. Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious-finish flooring material.
  - b. After placing slabs, plane the surface to a tolerance not exceeding one-fourth inch (1/4") in twenty-four inches (24") when tested with a straight edge.
  - c. Slope surfaces uniformly to drains where required.
  - d. After leveling, roughen the surface before the final set by using stiff broom brush or rake.
2. Float Finish:
- a. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes hereinafter specified, and to slab surfaces which are to be covered with insulation, and as otherwise shown on the Drawings or in the schedules.
  - b. After placing concrete slabs, do not work the surface further until ready for floating.
  - c. Begin floating when the surface water has disappeared and when the concrete has stiffened sufficiently to permit operation of a power-driven float, hand float, or both.
  - d. Consolidate the surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units.
  - e. Check and level the surface plane to a tolerance not exceeding one-fourth inch (1/4") in ten feet (10'-0") when tested with a ten-foot (10'-0") straight edge placed on the surface at not less than two different angles.
  - f. Cut down high spots and fill low spots.
  - g. Uniformly slope surfaces to drains where required.
  - h. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.
3. Trowel Finish:
- a. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and to slab surfaces that are to be covered with resilient flooring, carpeting, paint, or other thin-film finish coating system.
  - b. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.

- c. Consolidate the concrete surface by the final hand troweling operation, free from trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding one-eighth inch (1/8") in ten feet (10'-0") when tested with a ten-foot (10'-0") straight edge.
  - d. Grind smooth those surface defects which would telegraph through applied floor covering system.
4. Coordinate the required finish with the Project Engineer or DNR Construction Inspector prior to the application.

3.05 CONCRETE CURING:

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- 1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than seven (7) days.
  - 2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven (7) days in accordance with ACI 308, "Standard Practice for Curing Concrete." Avoid rapid drying at end of final curing period.
- B. Curing Method: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof as herein specified.
- 1. Provide moisture curing by the following methods:
    - a. Keep concrete surface continuously wet by covering with water.
    - b. Continuous water-fog spray.
    - c. Covering concrete surface with specified absorbent cover, thoroughly saturating cover with water and keeping continuously wet. Place absorbent cover to provide coverage of concrete surfaces and edges, with four-inch (4") lap over adjacent absorbent cover.
  - 2. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least three inches (3") and sealed by waterproof tape or adhesive. Immediately repair any holes and tears during curing period using cover material and waterproof tape.
  - 3. Provide curing compounds for slabs as follows: Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within two (2) hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall

within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the coating manufacturer.

### 3.06 MISCELLANEOUS CONCRETE ITEMS:

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the Drawings or required for the machine and equipment actually furnished. Set anchor bolts for machines and equipment to template, at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment. Provide isolation joints surrounding bases where indicated or required.

### 3.07 FIELD QUALITY CONTROL:

- A. Test of Materials and Installed Work: Materials and installed work may require testing and retesting, as directed by Project Engineer, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.
  1. Slump Tests: Take one slump test for each 10 cubic yards, or as directed by Project Engineer, of concrete placed at one operation in accordance with ASTM C 143. Keep job record of test results and location.
  2. Control Tests: During placement of concrete, take three standard 6" test cylinders in accordance with ACI 318-63 and ASTM C 31 for each type of concrete used. Test one at seven (7) days and one at twenty-eight (28) days. Take one set for every 20 cubic yards and any fraction with a minimum of one set of three cylinders for each day's pour. Tag cylinders to show date and location of test cylinder. Have compressive strength tests made by independent laboratory and results sent directly to Project Engineer. Hold remaining cylinders in case of breakage. Should retention at job site delay testing beyond seven (7) days, fourteen (14) day test is acceptable. Keep test cylinders shaded and damp until sent to laboratory.

### 3.08 REMEDIAL WORK:

- A. General: Reinforce or replace deficient work as directed by the Project Engineer or DNR Construction Inspector and at no additional cost to the Owner.
- B. Patching: Repair defective areas and fill form-tie holes and similar defects in accordance with ACI 301. Where, in the opinion of the DNR Construction Inspector, surface defects such as

honeycomb occur, repair the defective areas as directed by the Project Engineer or DNR Construction Inspector.

3.09 PROTECTION OF CONCRETE CONSTRUCTION:

- A. All surfaces shall be protected against injury. During the first 72 hours after placing the concrete, any wheeling, working or walking on the concrete shall not be permitted. All slabs subject to wear shall be covered with a layer of sand or other suitable material as soon as the concrete has set. Sisalcraft paper or other similar tough waterproof paper may also be used, provided all joints between adjacent strips of paper are carefully sealed. This does not alter the requirements for proper curing.
- B. Do not place concrete slabs or top surfaces of walls during rain unless acceptable protective shelter is provided; and during such weather, all concrete placed within the preceding 12 hours shall be protected with waterproof canvas or other suitable coverings. These shall be provided and kept ready at hand.
- C. All concrete construction shall be protected from excessive loading. Installation of mechanical and electrical equipment shall be accomplished by employing shores, bearing plates, frames, cranes and temporary beams.

END OF SECTION 03300

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Furnishing all labor, materials, and equipment for a complete and satisfactory installation of systems shown on the Drawings and as specified herein, including, but not limited to the following:
  - a. Floor Drains
  - e. Pipe, Fittings, Valves, and Gates
  - f. Hangers, Sleeves, and Inserts
  - g. Insulation and Pipe Covering
  - h. Water Service and Meter Installation
  - m. Cutting and Patching
  - n. Flashing and Sealing
  - o. Excavation and Backfilling
  - p. All items shown or scheduled on the Drawings related to plumbing work.
2. The omission of direct reference to an essential part, the necessity of use of which is reasonably implied shall not release the Contractor from providing the same.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 Earthwork  
Section 26600 Water Distribution System  
Section 03300 Cast-In-Place Concrete  
Section 04200 Unit Masonry

1.02 REFERENCES:

A. All equipment, apparatus and systems shall be furnished and installed in complete accordance with the latest edition or revision of the following applicable codes and standards.

1. ASME American Society of Mechanical Engineers
2. ASTM American Society of Testing Materials
3. AWWA American Water Works Association
4. NBFU National Bureau of Fire Underwriters
5. NEC National Electrical Code
6. NEMA National Electric Manufacturers Assoc.
7. UL Underwriters Laboratories, Inc.
8. NPC National Plumbing Code
9. CIPRA Cast Iron Pipe Research Association
10. Iowa Code Applicable State of Iowa Administrative Code

- B. Where conflicts arise between the plans and code requirements, the latter shall prevail, unless the plans are more stringent.

1.03 SUBMITTALS:

- A. Provide submittals in accordance with Division 1.
- B. Submit full information on all materials proposed for use on the project 30 days prior to scheduled commencement of work.
  - 1. Include catalog data, dimension drawings, photographs and such descriptive data as may be requested by the Architect, all in accordance with the requirements of Supplementary General Covenants and Provision.
  - 2. Do not purchase nor install material until they have been approved for use by the Architect.
- C. Before final acceptance of the project, furnish to the Architect four copies each of operating manuals, maintenance manuals, and parts lists for each specific model of equipment furnished.

1.04 QUALITY ASSURANCE:

- A. Workmanship: Work shall be performed by trained, skilled, experienced plumbers under the full-time supervision of a competent supervisor.
- B. Materials: New and of grade and quality specified or scheduled.
- C. Testing: Test building sewer system and building water system in accordance with Section 318 of the Uniform Plumbing Code (UPC).
  - 1. Schedule with and conduct testing of systems in the presence of the DNR Construction Inspector.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.06 PROJECT/SITE CONDITIONS:

- A. Survey of conditions prior to commencing work.
  - 1. Report any discrepancies between existing work and the Contract Documents to the attention of the Architect/DNR Construction Inspector.
- B. Observe weather conditions. Attempt no work in frozen conditions without written approval from the DNR Construction Inspector.

- C. Make connections to existing mechanical facilities in accordance with the obvious intent of the Contract Documents.
  - 1. Claims for extra payments as a result of failure to examine existing conditions at the site will not be accepted.

1.07 SEQUENCING AND SCHEDULING:

- A. Contact other trade contractors and advise them of plumbing work that requires built-in anchors, mounting assemblies, or other attachments.
- B. Furnish anchors, mounting assemblies, or other attachments to other trade contractors for setting.
- C. Locate and size openings for other trade contractors.
- D. Prior to commencement of any work, and before any equipment is purchased, check Contract Documents for every trade and job condition; check all interior and exterior sewers for interferences; verify that new sewers can be drained by gravity into present sewer connections or future sewer connections without trapping.
- E. Report any discrepancies between work, Contract Documents, or job conditions immediately to the Engineer in writing. Position all fixtures, equipment, devices, piping, outlets, etc., to avoid interferences with and to assure proper coordination with the work of all other trades, cases, partitions, walls, cabinets, counters, wall, floor and ceiling patterns, architectural features, etc.
- F. Coordinate recessed devices, fixtures, etc., with wall, floor, and ceiling patterns.

1.08 WARRANTY:

- A. Provide equipment as specified under this section, covered by the manufacturer's standard warranty or guarantee on new equipment.
  - 1. Guarantee equipment for a minimum of one year from the date of final acceptance of the project.
- B. Guarantee the entire installation, including every part and every specialized system, from the standpoint of workmanship and material, for one year after formal acceptance by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Water Piping in Building:
  - 1. Cold water, hot water, and tempered water circulating lines 1-1/2" and smaller shall be hard drawn copper Type-L.
  - 2. Below grade and below slab water lines shall be Type-K copper.

3. Polybutylene tubing and fitting (PB) SDR11 in accordance with the latest edition of ASTM D3309.
  4. Chlorinated Polyvinyl Chloride (CPVC): Tubing SDR11 in accordance with the latest edition of ASTM D 2846 or IPS pipe schedule 40 or 80 in accordance with ASTM F441.
  5. Chlorinated Polyvinyl Chloride (CPVC) Fittings: For SDR 11 in accordance with ASTM D 2846, for IPS pipe schedule 40 in accordance with ASTM F438 and for IPS pipe schedule 80 with ASTM F439.
  6. Solvent Cement: For chlorinated polyvinyl chloride (CPVC) tubing and pipes in accordance with ASTM F 493.
- B. Water Piping Outside Building:
1. Cast Iron Pipe: Comply with ANSI A21.6 or ANSI A21.8, with working pressure of not less than 150 PSI unless otherwise shown or specified.
  2. Ductile Iron Pipe: Comply with ANSI A21.51 and AWWA C151 standards. Minimum standard ductile iron pipe shall be at least thickness class 50.
  3. Plastic Pipes:
    - a. For water piping less than 2" in diameter, use either polybutylene tubing (PB)-AWWA Designation C902, ASTM D-2666, or polyethylene (PE)-AWWA Designation C901, ASTM D-2737, with a pressure class of 160 PSI and outside dimensions of copper tubing.
    - b. For water service 2" and over, use polyvinyl chloride pipe (PVC)-AWWA Designation C900, SDR 21.
  4. Cast Iron or Ductile Iron Pipe Joints and Fittings: Use mechanical joints and fittings complying with ANSI A21.11 as modified by ANSI A21.51 for ductile iron pipe, with push-on joints complying with ANSI A21.11 for cast iron and ANSI A21.51 for ductile iron.
  5. Polyvinyl Chloride Pipe Joints and Fittings:
    - a. Use coupling and joining material meeting the requirements of AWWA standard C900 for PVC pipe 4" through 12" in diameter, all fittings for PVC piping 4" diameter and larger shall be cast iron mechanical joint.
    - b. Use rubber ring bell joints as integral and homogenous part of pipe for PVC pipe less than 4" in diameter.
    - c. Substitute a push-on or mechanical joint cast iron fitting for PVC pipe 2" through 3-1/2" when a fitting with integral, homogenous rubber O-ring bell joint cannot be supplied.

6. Polyethylene (PE) or Polybutylene (PB) Pipe Joints and Fittings: Use joining material meeting the requirement of the standard referenced above for plastic pipe less than 2" in diameter.

C. Pipe Wrapping: Scotchrap 0.020" thick tape.

## 2.02 COMPONENTS:

A. Corporation Stops:

1. Copper Service Thread Connection Outlet: Mueller H-1500, A. Y. McDonald 4701, Ford F 600.
2. For Copper and Plastic Pipes: Mueller compression connection outlet, A. Y. McDonald 4714T, Ford F 1001, F 1002, or approved equal.

B. Service Saddles: Rockwell, Mueller Company, A. Y. McDonald or approved equal.

C. Service Boxes: Mueller H-10306, A. Y. McDonald 5601 Ford EA1-50-40-4SR, or approved equal.

D. Curb Stop with Drain:

1. For Copper Pipes Both End: Mueller M-15210, Ford Z22-SW, A. Y. McDonald 4714, or approved equal.
2. For Copper and Plastic Pipes: Mueller 110 compression connection, A. Y. McDonald 4714-T, Ford or approved equal.

E. Valves:

1. Gate valves 3" and smaller, 125 SWP, Nibco, Inc., Series 113 or approved equal.
2. Globe valves 3" and smaller, 125 SWP, Nibco, Inc., Series 211 or approved equal.
3. Check valve 3" and smaller, 125 SWP, Nibco, Inc., Series 413 or approved equal.
4. Gas cock 2" and smaller, 125 PSI, Crane, Series 1228 or approved equal.
5. P&T relief valve, Watts Regulator ANSI 221.22 or approved equal.

F. Water Meter:

1. Displacement type, magnetic drive cold water meter. Water meter shall meet AWWA standards (C700-77), Main case bronze, Rockwell 2" or approved equal.
2. Copper Meter Yoke: Mueller Company or equal.

G. Floor Cleanout: Jay R. Smith Co. No. 4020 or equal.

H. Grade Cleanout: Jay R. Smith Co. No. 4591, or equal.

- I. Wall Cleanout: Jay R. Smith Co. No. 4515 or equal.
- J. Floor Drains: Jay R. Smith Company 2040 Series with round grate nickel-bronze or equal.

2.03 ACCESSORIES:

- A. Isolation: Isolating Dielectric Unions: EPCO, or approved equal.
- B. Pipe Insulation:
  - 1. Cold water piping concealed in wall or ceiling 1" thick snap on type with integral all service cover as manufactured by Certainteed Corp., Gustin-Bacon, Johns-Manville Sales Corp., or approved equal.
  - 2. Hot water and tempered water lines 1" thick snap on type with integral all service cover by Certainteed Corp., Gustin-Bacon, Johns-Manville Sales Corp., or approved equal.
- C. Marking Tape: A visually and electronically detectable tape: Type D Terra tape, Griffolyn Co., Houston, Texas, or Line Guard Type 11 detectable, Line Guard Incorporated, Wheaton, Illinois or approved equal.
- D. Flow Controls: Unless otherwise specified, flow controls shall limit water to 3 GPM for showers, 0.5 GPM for lavatories in public restrooms, and 2 GPM for lavatories in all other buildings as manufactured by Symmons Industries, Chicago Faucet Company or Speakman Company.
- E. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

2.04 WATER TREATMENT SYSTEM:

- A. Provide liquid chlorine feed system including 50-gal. solution tank with metering pump, and four 120-gal. contact tanks. Culligan Systems or equal.
- B. Provide multi-media iron filter system. Culligan Systems Hi-Flo 42F Depth Filtration System with Duplex HDF-24T Fiberglass Tanks or equal.
- C. Provide water softening system. Culligan Systems Hi-Flo 3e Automatic Softener System with Triplex HCE-210-2 Fiberglass Tanks, Meter and Brine Tank or equal.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine the substrate surfaces, conditions, and embedded attachments that plumbing work will be applied or attached to.
- B. Any conditions that are incomplete or unsatisfactory shall be brought to the attention of the Engineer or DNR Construction Inspector.

- C. Do not proceed with the work until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION:

- A. Verify layout, check clearances, sleeves, openings, proposed supports and substrates for installation of plumbing work.
- B. Furnish anchors and support equipment that is to be cast-in-place or set-in-place, to other trades for installation. Coordinate location and installation requirements with other trades.
- C. All pipe scheduled for underground installation shall be placed as early as possible.
- D. Trenching:
  - 1. Excavate trenches straight and true with uniform grade at bottom, free of rock projections and with a pipe cushion consisting of natural undisturbed soil or compacted sand.
  - 2. Provide trench width minimum 16" for main drainage and soil pipe, and cover below finish grade as indicated in Section 02220 or as directed by agencies having jurisdiction.
  - 3. Where conditions require variance from these minimums, obtain Engineer prior approval before proceeding with work.
    - a. Any variances approved by the Engineer shall be at no additional cost to the Owner.
- E. Backfilling:
  - 1. Backfill as soon as pipeline has been completed, inspected, and approved by Engineer/DNR Construction Inspector.
  - 2. Use backfill materials free of rocks, large clods, roots, debris and any foreign matter, and compact in 6" layers to 95 percent compaction.

### 3.03 INSTALLATION:

- A. General:
  - 1. Install all pipe in accordance with manufacturer's recommendations, the Contract Documents and in the best commercial trade practices.
    - a. Supply and properly use any special tools required for laying, jointing, cutting, etc..
    - b. Clean pipe thoroughly before laying and keep clean until accepted in the completed work and lay conforming accurately to the lines and grades given.
    - c. The trench free of water at all times during pipe laying operations.

2. Lay bell and spigot pipe with the bells upgrade. Lay and fit all types of piping together so that, when complete, the pipe will have a smooth and uniform invert.
  - a. Thoroughly swab each length of pipe laid to remove all foreign material before the next length is laid.
  - b. Inspect each pipe for defects before it is lowered into the trench.
3. Install all piping for which no location dimensions are shown in accordance with the best trade practice.
  - a. Wherever possible, group runs and rises and keep parallel.
  - b. Properly lay out all piping to clear obstructions such as equipment, larger sized pipes, etc.
4. Do not lay pipe against wall of trench.
  - a. Allow a minimum distance for exterior of pipe to trench wall of 12 inches.
  - b. Take additional precautions to prevent rocks or other large objects from lodging against the pipe during backfill.
5. Installed all equipment in strict accordance with manufacturer's specifications and as shown on the Drawings.
6. Install all horizontal waste and soil piping within the building with uniform pitch of 1/4" per foot.
7. Pitch all vents for adequate drainage.
8. Inspect all pipe, fittings, couplings, apparatus, and equipment for defects or obstructions.
9. Remove all defective material from the site.

B. Water System:

1. Install water piping system as indicated on the Drawings.
  - a. Exact layout of system shall be determined at the job site for accurate alignment and so as not to conflict with other work.
  - b. Size pipe as indicated on Drawings.
2. Pitch all water piping lines to accessible drainage points such as plugged tees or other approved means provided to drain down the system.
3. Install ground joint or flange union at all connection to meters, tanks, and other equipment and as required for proper assembly of system.

4. Wrap pipes built into concrete or masonry walls with tar paper or burlap to prevent bonding.
5. Do not locate pipes in outside walls or other location where freezing is likely to occur.
  - a. Attach or isolate pipes attached or in contact with structural members, so as not to cause transmission of noise into the structure.
  - b. Block end of all runs securely to prevent movement due to water hammer.

E. Joints and Connections:

1. Plastic Pipe:
  - a. Provide a smooth interior free of all projections, burrs, or sharp edges.
  - b. Install fittings with sealing materials recommended by pipe manufacturer without projection of sealing material into interior of pipe.
2. Copper Pipe: Cut pipe squarely and to accurate length for full penetration into fitting sockets.
  - a. Deburr pipe ends.
  - b. Soldering surface should be thoroughly cleaned, fluxed, and assembled immediately before oxidation of the polished surface can occur.
  - c. Use an approved noncorrosive flux and 50/50 solder.
  - d. Use significant heat to assure complete penetration of the solder and wipe excess flux after joint is made.
  - e. Use dielectric unions as connections between copper pipe and iron pipe on equipment with iron fittings.
3. Cast Iron Mechanical Joints:
  - a. Install cast iron piping and joints using recommended procedures outlined in "Handbook of Cast Iron Pipe" as published by Cast Iron Pipe Research Association.
4. Threaded Joints: Neatly cut threads with sharp tools, and joint in accordance with the best trade practices.
  - a. Remove scale from pipe before jointing.
  - b. Ream after cutting.
  - c. Apply an approved pipe compound to all make threads and screw in place.
  - d. Do not back off the pipe or reclean all and apply new compound.

- e. Apply compound neatly and wipe compound and dirt thoroughly off the outside of every joint.
- f. Install unions in all threaded joint piping to facilitate the removal of sections for maintenance and repair in accordance with the best trade practice.
- g. Connect pipes of dissimilar metals with insulating unions (Dielectric), including cast iron valve connections to adapters for copper pipe.
- h. Include such unions in the bid price whether unions are shown on the Drawings or not.

F. Plumbing Vents:

- 1. Provide plumbing vents as indicated on the Drawings and as required by Code.
- 2. Use applicable drainage pattern fittings. Provide cast iron increasers as extension of vents through the roof, beginning at least 12" under the roof and extending to height at least greater than the highest possible water level on the roof, but in no case less than 8".
- 3. Size increasers as follows:

<u>Vent Size</u>	<u>Increase To</u>
1" and 1"	2" minimum
2" and 2"	4" minimum
3"	5"
4"	6"

- 4. Install vents in practical alignment, adequately supported and with a constant pitch drainage back to the sewer system from finished spaces unless indicated otherwise on Drawings or as directed by Engineer or DNR Construction Inspector.

G. Floor Drains: Install floor drains of sizes and at locations indicated on Drawings.

- 1. Obtain exact finish floor levels (allow for slope to drains) from Contractor and set top rims accurately to proper levels.
- 2. Use Iowa Code floor drains with trap and cleanout where indicated.

H. Hangers, Support, and Anchors:

- 1. Install hangers, supports, and anchors for all piping, equipment, and materials.
  - a. Attach hangers, supports, and anchors to walls, ceilings, and floor with galvanized bolts.
- 2. Protect pipe insulation at point of contact with saddles.
- 3. Spacing shall not exceed the following spacing:

<u>Type of Pipe</u>	<u>Spacing</u>
a. Cast Iron	5'-0" o.c.
b. Copper or Steel, 1-1/2" or smaller	6'-0" o.c.
c. Copper or Steel, 2" or larger	10'-0" o.c.
4. Anchor all equipment securely to building construction.	

3.04 APPLICATION:

A. Application of Insulation and Pipe Covering:

1. Insulate all domestic cold water lines, except under floor.
2. Insulate all cold water lines, except exposed chrome plated supplies, bottoms of roof drains and horizontal runs of downspouts with 1" fiberglass having a dual temperature jacket with a self-sealing lap.
3. Insulate all fittings with mitered segments of pipe insulation, oversized pipe insulation or molded fittings.
4. Coat each fitting with two 1/2" coats of approved vapor barrier mastic reinforced with glass fabric extending 2" onto adjacent pipe insulation and then apply preformed vinyl jacket.

3.05 FIELD QUALITY CONTROL:

- A. Furnish all labor, material, and equipment necessary to perform pressure tests on all building piping systems.
- B. Contact DNR Construction Inspector five days prior to conducting any tests.
- C. Test water and sewer systems in accordance with Section 318 of the Uniform Plumbing Code (UPC).

3.06 CLEANING:

- A. Completely purge domestic water system.
  1. After purging, chlorinate enter water system in accordance with the latest methods of the American Water Works Association, for flushing and disinfecting water mains, and in accordance with the Iowa Department of Health requirements.
- B. Chlorinate system only when bonding is unoccupied.
- C. Thoroughly flush entire water system after sterilization process is complete.
- D. Arrange with appropriate authorities for tests on water system.

- E. Certificate of completion of chlorination and tests results to the Engineer/DNR Construction Inspector.

END OF SECTION 15400

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Provide complete and functioning electrical service and systems as shown on the Drawings, as specified herein, and as required for a complete and proper installation including, but not limited to:
  - a. Electrical service, complete, of size, voltage and type indicated or required to point of connection with utility company's equipment. Provide copper conductors only.
  - b. Main distribution panels, metering facilities, main switch, and distribution panels or boards as needed.
  - c. Complete feeder system, in conduit, to distribution panels and branch panels.
  - d. Complete branch circuit wiring for lighting, motors, receptacles, junction boxes, area lighting, and similar uses.
  - e. Lighting fixtures and lamps, wall switches, fans, receptacles, controls, and similar items.
  - f. Hangers, anchors, sleeves, chases, supports for fixtures, and other electrical materials and equipment in association therewith.
  - g. Complete exterior light equipment and wiring system including setting of poles.
  - h. Trenching and backfilling for underground electrical installation.
  - i. Wiring system, in conduit, for equipment and controls provided under other sections of these Specifications including, but not necessarily limited to, Plumbing and Heating, Ventilating and Air Conditioning Sections.
  - j. Motor starters and controls for motors provided under the Contract, but for which motor starters and controls are not otherwise provided.
2. The omission of direct reference to an essential part, the necessity or use of which is reasonably implied shall not release the Contractor from providing the same.
3. Inspect the site(s) and/or existing building(s) as necessary to become familiar with all existing conditions affecting the performance of the work under this Contract.
  - a. Extras will not be allowed for failure to do so.

- B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 Earthwork

1.02 REFERENCES:

- A. Codes, Ordinances, and Standards: Comply with all applicable codes and regulations of the following:
1. National Electric Code, latest edition;
  2. Iowa State Building Code;
  3. Local Utility Company Regulations;
  4. Underwriter's Laboratories.

1.03 SYSTEM DESCRIPTION:

- A. Power and lighting system: One 120/240 volt, 60 cycle, single phase 3-wire system service energizes the entire system.
- B. Verify the exact location of primary service, secondary service, and transformers at the job site.
- C. Underground Service Entrance: Provide continuous direct burial copper cable, USE neoprene jacket insulated and moisture resistant.
1. Minimum burial depth 24 inches.
  2. Furnish and install number and size of conductors shown or as required by N.E.C.
  3. All conductors shall be copper.

1.04 SUBMITTALS:

- A. Provide submittals in accordance with Division 1.
- B. Submit shop drawings, diagrams, and product information, material lists and manufacturer's specifications to Architect.
- C. Product Data, Submit:
1. Materials list of items proposed to be provided under this section;
  2. Manufacturers' specifications and other data needed to prove compliance with the specified requirements;
  3. Manufacturers' recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
- D. Samples:

1. When so requested by the Architect, promptly provide samples of items scheduled to be exposed in the final structure.
  2. When specifically requested by the Contractor and authorized by the Architect, approved samples will be returned to the Contractor for installation on the work.
- E. Manual: Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the DNR Construction Inspector two copies of an operation and maintenance manual. Include within each manual:
1. Copy of the approved Record Documents for this portion of the work;
  2. Copies of all circuit directories;
  3. Copies of all warranties and guarantees.

1.05 QUALITY ASSURANCE:

- A. Qualification of Installers: For the actual fabrication, installation, and testing of the work in this section, use only thoroughly trained, licensed, experienced workers completely familiar with the items required and with the manufacturer recommended methods of installation.
1. No allowance will be made for lack of skill on part of workers in acceptance or rejection of installed work.
- B. Provide only new materials of grade and quality specified. Unless otherwise approved or specified, provide materials, equipment, devices, pipe fittings, etc., of U.S. manufacture.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect/DNR Construction Inspector and at no additional cost to the Owner.

1.07 SEQUENCING AND SCHEDULING:

- A. Coordination of Work: Plan work so that it proceeds with a minimum of interference with other trades.
1. Coordinate openings, special frames and sleeves required for electrical work with the building construction and the mechanical installation.
- B. Cooperation with Other Trades: Perform the work of this section in conformity with the construction called for by other trades and afford other trades reasonable opportunity for the execution of their work.
1. Coordinate the work of this section with the work of other trades at such time and in such a manner as not to delay or interfere with other work.

2. Examine the Drawings and Specifications for the general and mechanical work and the work of other similar trades.

1.08 WARRANTY:

- A. Guarantee the entire installation, including every part and every specialized system, from the standpoint of workmanship and material for one year after formal acceptance by the Architect.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, manufacturer offering electrical material and components which may be incorporated in the work include, but are not limited to, the following:
  1. Square D
  2. General Electric
  3. ITE
  4. Westinghouse
  5. Hubbell
  6. Bryant
  7. Arrow-Hart

2.02 MATERIALS:

- A. Provide only materials that are new, of the type and quality specified.
  1. Where Underwriter's Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.
- B. Provide only copper conductors as part of permanent installation within this project, from connection with the power company's equipment to connection to fixtures, receptacles or other devices or appliance as specified herein.
  1. No other will be approved for use anywhere within this project at any location.
  2. Remove and replace any wire or cable used on this project which does not meet this requirement, at no cost to the Owner.
- C. Temporary Power:
  1. In addition to providing temporary power, provide and pay the costs for installing permanent electrical meter or meters as required;
  2. When permanent metering is in place and connected, the Owner will pay the costs for electrical power charged against the meter or meters.

2.03 COMPONENTS:

A. Distribution Panels:

1. Circuit breaker type with single main disconnect, solid neutral with voltage and main bus rating equal to or exceeding rating on panel schedule.
2. Provide code gauge steel galvanized boxes with surface cover.
3. Provide code gauge steel trim with gray enamel finish, and Door, complete with directory of circuits and key locked.
4. Provide plug-in or bolt-in circuit breakers, of rating indicated, poles indicated, and be manual quick-break and automatic quick-break, and automatic quick-break and thermal magnetic trip.
  - a. Multiple pole breakers shall have a common trip.
  - b. Provide breakers with ground fault protection for outlets as required by Code, except for outlets requiring ground fault interruption, as indicated on the Drawings, for which separate and individual ground fault protection and reset features shall be provided as part of the outlet.
5. Provide panels for 120/240 volt service of amperage indicated as manufactured by, but not limited to, one of the following:
  - a. Square D
  - b. General Electric
  - c. ITE
  - d. Westinghouse
6. U.L. approved and N.E.C. rated.
7. Identify all panelboards, cabinets, safety switches, and other apparatus used for operation and control of circuits, appliances and equipment.

B. Wiring Devices:

1. Receptacles: Specification grade, duplex, 3-pole grounding type, 15 amp, 125 V AC as manufactured by, but not limited to, one of the following:
  - a. Hubbell
  - b. Bryant
  - c. Leviton
2. Switches: Specification grade, quiet type, 20 amp, 120-277 V AC as manufactured by, but not limited to, one of the following:
  - a. Hubbell
  - b. Bryant
  - c. Arrow-Hart
3. Provide devices U.L. approved and N.E.C. rated.

4. Provide brown wiring devices and chrome plated smooth metal, switch and receptacle cover plates.
- C. Fittings, Boxes, Etc.:
1. Provide code gauge galvanized steel outlet boxes, junction boxes, and switch boxes .
  2. Provide square, rectangular, or octagonal boxes of a suitable and ample size.
- D. Raceways and Fittings:
1. Provide rigid galvanized steel conduit, or electrical metallic tubing (EMT) with compression or tap-on type fittings for Raceways and Fittings to be installed in walls, above ceilings, or exposed in mechanical areas.
  2. Provide rigid galvanized coated conduits with asphaltum paint for Raceways and Fittings to be installed in floor slab or underground.
  3. Provide conduit and fittings, 3/4" or larger, N.E.C. approved and rated.
  4. Do not use conduits smaller than 3/4".
- E. Conductors:
1. Wire and cable shall be 600 V insulated N.E.C. standard TW, THW, RHW, or XHHW.
  2. Provide only copper wiring.
  3. Branch circuit conductors, within 3 inches of a ballast in the ballast compartment, shall have 90° C. (194°F.) insulation or better.
- F. Lighting Fixtures: Provide both interior and exterior fixtures as shown on the Fixture Schedule in the Drawings.
1. General: Provide complete lighting fixtures with all required suspension accessories, canopies, casings, sockets, holders, reflectors, and other items, completely wired and assembled.
  2. Ballasts: For all fluorescent fixtures provide one of the high power-factor Class P type, and their design and construction conforming with CBM standard and identified as such with the CBM-ETL label, equipped with a dual protection system consisting of non-resetting protector in the power capacitor, and a U.L. approved protector adjacent to the coil.
  3. Provide indoor and outdoor lighting fixtures as shown on the schedules.
  4. Unless otherwise specified or shown on the Drawings, provide lighting poles of treated wood guaranteed to withstand 100 MPH winds while supporting indicated luminaires.

2.04 OTHER MATERIALS:

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION:

- A. Examine the areas and conditions under which the work of this section will be installed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION:

- A. Coordination: Coordinate installation of electrical items with the schedules for other work, to prevent unnecessary delays in the total work.
- B. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.
- C. Accuracy of Data: The data indicated on the Drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not guaranteed.
  - 1. Exact locations, distances, levels, and other conditions will be governed by the building.
  - 2. Use the Drawings and these Specifications for guidance, and secure the Architect's approval of all changes in locations.
- D. Measurements: No extra compensation will be made because of differences between locations shown on the Drawings and measurements at the building.
  - 1. Verify all measurements at the site.
- E. Circuiting: The branch circuits have been designed for maximum economy consistent with wire sizes for voltage drop and other considerations in accordance with the N.E.C or better.
- F. Trenching and backfilling: Perform all such trenching and backfilling required as part of the work of this contract in strict accordance with the provisions of Section 02200 and 02222 of these Specifications.

#### 3.03 INSTALLATION:

- A. Conceal all conduit in walls or ceiling space unless otherwise specifically approved by the Architect or indicated on the Drawings. Where conduit is allowed to be exposed, install the conduit parallel with or at right angles to structural members, walls, and lines of the building.
- B. Where conduit is installed in concrete slabs, on the ground, underground, or exposed to the weather, make all joints liquid-tight and gas-tight.

1. Bury all underground conduit to a depth of 2'0" below finished grade unless otherwise shown on the Drawings.
- C. Keep all conduit at least 6" away from the covering on hot water pipes.
- D. Except for cables or wires otherwise called for, install all conductors in conduit, metal gutter raceway, or pullboxes.
- E. Do not use conduit smaller than 3/4" for a branch circuit on this project.
1. Unless otherwise specified, provide code-size conduit for number and size of wire required by Code.
- F. Where conduit is installed concealed in walls or above the ceiling, or exposed in work areas, provide rigid galvanized conduit or electrical metallic tubing with compression-type fittings.
1. Paint or wrap elbows.
  2. Seal joints to prevent entrance of water.
  3. Provide ground wire of proper size.
  4. Use nylon (rather than steel) fish tape.
- G. Use flexible conduit only for short motor connections, or where subject to vibration.
- H. Provide necessary sleeves and chases where conduits pass through floors and walls, and provide other necessary openings and spaces, arranging for in proper time to prevent unnecessary cutting in connection with the work.
1. Perform cutting and patching in accordance with the provisions for the original work.
- I. Where conduit is exposed, run parallel to or at right angle with lines of the building.
1. Make bends with standard conduit elbows or conduit bent to not less than the same radius.
  2. Make bends free from dents and flattening.
- J. Securely and rigidly support conduits throughout the work.
- K. Where conduits pierce the roof, provide 24 gauge galvanized iron roof jacks and flashing collar brazed onto the conduits and covering the top of the roof jacks.
- L. Installation of Lighting Fixtures:
1. Install lighting fixtures in accordance with Fixture Schedule on Drawings complete and operational.
  2. Wire all fixtures with fixture wiring of at least 150 degrees C rating.

- a. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit wiring supplying the rows.
3. Install all fluorescent fixtures straight and true with reference to adjacent walls.
4. Install all lighting fixtures, including those mounted on continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe installation.
  - a. Screwed fastenings and toggles through ceiling or wall material are not acceptable.
5. Provide lamps for fixtures as shown on Fixture Schedule.

M. Installation of Conductors:

1. All conductors used for branch circuits shall be minimum number 12 protected by 20 ampere circuit breakers.
  - a. Install larger wires where necessary to limit voltage drop or as required by Code.
2. Install Conductors continually from outlet to outlet and make no splices except within outlet or junction boxes.
  - a. Junction boxes may be used where required.
3. No more than three circuits will be permitted in one raceway.
  - a. A common neutral may be used as permitted by the National Electric Code.
4. Terminals and Splices: Terminate stranded conductors with approved copper connecting lugs, accommodating the full diameter of the bare conductor.
  - a. Run the entire lengths of mains and feeders in continuous sections without joints or splices.
5. Splices will be permitted only at outlet or junction boxes.
  - a. Thoroughly clean splices, mechanically and electrically secure without solder, then soldered.
  - b. After soldering, wrap rubber and friction tape. Vinyl plastic tape will be acceptable subject to the approval of local inspection authorities.
  - c. Scotch lock type S, M, L, and D connectors will be approved as equal to soldering.
6. Place no conductor in or below concrete floor.

N. Installation of Panels:

1. Installation: Unless otherwise indicated on the Drawings, install all panels with the top of the trim 6'-0" above the furnished floor.
    - a. Surface mount panels located where they are not visible to the public.
  2. Directories: Mount a typewritten directory behind glass or plastic on the inside of each panel door.
    - a. On the directory, show the circuit number and complete description of all outlets on each circuit.
  3. Anchor panels securely to substrate with mechanical fasteners at locations indicated on Drawing.
- O. Certain materials and equipment will be furnished by others and installed or connected under this Contract. Verify installation details.
1. Foundations for apparatus and equipment will be furnished by other unless otherwise noted, detailed, or designated by General Contractor.
- P. Mounting Heights: To center of box above finished floor for the below-named items, unless otherwise shown or indicated.
1. Other mounting heights are indicated on the Drawings by detail or by a plus dimension shown adjacent to the symbol.
    - a. Flush toggle switches: 48".
    - b. Convenience outlets and similar: 12" - finished areas (unless noted otherwise).
    - c. Convenience outlets and power outlets: 48".
    - d. Safety switches: 54" to operator.
    - e. Motor controllers: 54" or top even with safety switch.
    - f. Panelboards: 72" to top.

### 3.04 FIELD QUALITY CONTROL:

- A. Testing: At the conclusion of the work, test each and every circuit to establish the proper operation of electric equipment and freedom from improper ground as well as to ascertain the insulation values which shall not be lower than those required by the National Electrical Code.
- B. Carry out final test in the presence of the Architect/DNR Construction Inspector.

### 3.05 CLEANING:

- A. Thoroughly clean exposed conduits, panel boards, fixtures, switches, hangers, and other exposed equipment.
- B. Clean and wash fixture glass and shield.

END OF SECTION 16000