SECTION 02 CERTIFICATIONS PAGE UI-018-LYONS-FERRING UPPER IOWA RIVER WATERSHED MANAGEMENT AUTHORITY WATERSHED IMPROVEMENTS (13-NDRI-009) ALLAMAKEE COUNTY, IOWA

STATE OF IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.	
Signature Printed or typed name: Anthony J. Harbaug License Number: 26394 My license renewal date is: 12-31-2021 Pages, Sheets, or Divisions covered by this Project Manual	Date Jh, P.E. Seal:

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IA-1 SITE PREPARATION

1. SCOPE

Site preparation work shall consist of clearing, grubbing, stripping, refuse removal, bank sloping and structure removal on the site as necessary to rid the site of all undesirable materials on or near the surface and prepare the site for the structure. All woody growth within the construction area shall be cleared and all stumps and roots one inch in diameter or larger shall be grubbed from the site. In addition, all areas within 25 feet of the footprint of the structure shall be cleared and grubbed except as directed by NRCS. The work shall also consist of the removal and disposal of structures (including fences) that must be removed to perform other items of work.

For wetland restoration, enhancement, or creation projects, the wetland area shall be disturbed as little as possible and existing naturally vegetated spillway areas shall not be disturbed.

2. FOUNDATION PREPARATION

The construction areas shall be stripped a minimum of 6 inches to remove all unsuitable materials such as organic matter, grasses, weeds, sod, debris, and stones larger than 6 inches in diameter.

In an earth embankment foundation area, all channel banks and sharp breaks shall be sloped to no steeper than 1.5 horizontal to 1 vertical.

The foundation area shall be thoroughly scarified before placement of fill material. The surface shall have moisture added or shall be compacted if necessary so that the first layer of fill material can be compacted and bonded to the foundation.

3. STRIPPED MATERIAL DISPOSAL

Suitable soil material shall be stockpiled for use as topsoil. The other stripped materials shall be buried, removed from the site, or disposed of as directed by the owner or NRCS. Whenever possible, material shall not be disposed of in the pool area created by the structure.

Stockpiled materials around a construction site should be placed so as not to hinder subsequent construction operations.

4. DISPOSAL OF REFUSE MATERIALS

Waste materials from clearing and structure removal shall be burned or buried at locations approved by the owner. Buried materials shall be covered with a minimum of 2 feet of earthfill. Whenever possible, material shall not be disposed of in any pool area created by the structure.

All refuse shall be disposed of in a manner which complies with all local and state regulations.

5. SALVAGE

Items to be salvaged shall be as shown on the drawings. Structures and fencing materials that are designated to be salvaged shall be carefully removed and neatly placed in the specified storage areas.

IA-3 STRUCTURE REMOVAL

1. SCOPE

The work shall consist of the removal, salvage and/or disposal of structures (including fences) from the designated areas and as indicated on the drawings.

2. MARKING

Each structure or item to be removed will be marked by means of stakes, flags, painted markers or other suitable methods.

3. REMOVAL

All structures designated for removal shall be removed to the specified extent and depth.

4. SALVAGE

Structures that are designated to be salvaged shall be carefully removed and neatly placed in the specified storage areas. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly match marked with paint prior to disassembly. All pins, nuts, bolts, washers, plates and other loose parts shall be marked or tagged to indicate their proper location in the structure and shall be fastened to the appropriate structural member or packed in suitable containers. Materials from fences designated to be salvaged shall be placed outside the work area on the property from which they are removed. Wire shall be rolled into uniform rolls of convenient size. Posts and rails shall be neatly piled.

5. DISPOSAL OF REFUSE MATERIALS

Refuse materials resulting from structure removal shall be burned or buried at locations shown on the drawings. Buried materials shall be covered with a minimum of 2 feet of earthfill. Whenever possible, material shall not be disposed of in the pool area created by the structure.

All refuse shall be disposed of in a manner which complies with all local and state regulations.

IA-5 POLLUTION CONTROL

1. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air during construction operations.

2. MATERIALS

All materials furnished shall meet the requirements shown on the drawings or in the specifications.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The measures and works shall include, but are not limited to, the following:

Staging of Earthwork Activities: The excavation and moving of soil materials shall be scheduled so that areas unprotected from erosion will be minimized. These areas will be unprotected for the shortest time feasible.

Seeding: Structures and disturbed areas shall be seeded as soon as possible after construction is completed.

Temporary seedings may be used as an alternative to other stabilization measures as approved by NRCS.

Mulching: Construction areas that have been disturbed but have no construction activity scheduled for 21 days or more shall have erosion protection measures applied by the 14th day. This erosion protection may be mulching or other approved temporary measures. Construction areas shall not be left open during a winter shutdown period and shall be protected by mulching.

All seeding and mulching shall be completed in accordance with the seeding plan and Iowa Construction Specification IA-6, Seeding and Mulching for Protective Cover.

The following works may be temporary. If they are installed as a temporary measure, they shall be removed and the area restored to its original state when they are no longer needed or when permanent measures are installed.

Diversions: Diversions may be required to divert clean runoff water away from work areas and to collect runoff from work areas for treatment and safe disposition.

Stream Crossings: Culverts or bridges may be required where construction equipment must cross streams.

Sediment Basins: Sediment basins may be required to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.

Sediment Filters: Straw bale filters, geotextile sediment fences, or other equivalent methods may be used to trap sediment from areas of limited runoff. Sediment filters shall be properly anchored to prevent erosion under them.

Waterways: Waterways may be required for the safe removal of runoff from fields, diversions, and other structures or measures.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of chemical pollutants, such as drained lubricating or transmission oils, greases, soaps, concrete mixer wash water, asphalt, etc., produced as a by-product of the construction work. At the completion of the construction work, sumps shall be removed and the area restored without causing pollution.

Sanitary facilities such as chemical toilets or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. At the completion of construction work, facilities shall be disposed of without causing pollution.

5. AIR POLLUTION

The burning of brush or trash or disposal of other materials shall adhere to local and state regulations.

Fire prevention measures shall be taken to prevent the start or the spreading of wild fires, which result from project work. Fire breaks or guards shall be constructed at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to fully suppress dust. All dust control methods shall insure safe operations at all times. If chemical dust suppressants are used, the material shall be a commercially available product specifically designed for dust suppression and the application shall follow manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures shall be provided to the Engineer five working days before use.

6. MAINTENANCE, REMOVAL, AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as near original conditions as practical.

IA-6 SEEDING AND MULCHING FOR PROTECTIVE COVER

1. SCOPE

The work shall consist of seeding, mulching, and fertilizing all disturbed areas and other areas as indicated on the drawings or otherwise designated.

2. SEEDBED PREPARATION AND APPLICATION

The entire area to be seeded shall be reasonably smooth and all washes and gullies shall be filled to conform to the desired cross-section before actual seedbed preparation is begun. At this stage of the operation, the required fertilizer and lime shall be applied uniformly and incorporated into the top 3 inches of the soil with suitable tillage equipment. The seedbed preparation operation shall be suspended when the soil is too wet or too dry. The seedbed shall be loosened to a depth of at least three inches.

On side slopes steeper than 2-1/2 horizontal to1 vertical, the 3 inch minimum depth of seedbed preparation is not required, but the soil shall be worked enough to insure sufficient loose soil to provide adequate seed cover.

Unless otherwise specified, the seeding operation shall be performed immediately after preparation of the seedbed. The seed shall be drilled or broadcast by equipment that will insure uniform distribution of the seed.

3. MATERIALS

The seeding, fertilizing, and mulching requirements are as specified on Form IA-CPA-4.

Straw from cereal grains or hay will be used as mulching material. It shall be relatively free of weeds.

4. MULCH APPLICATION

The required mulching shall be performed as soon as possible after seeding unless otherwise specified. The mulch shall be applied uniformly over the area. The type and rate shall be as specified. When mulching is required, all areas seeded during any one day shall be mulched within 24 hours. The mulch may be spread by any means that results in a uniform cover.

The mulch shall be anchored. Anchoring of the mulch may be performed by a mulch anchoring tool or regular farm disk weighted and set nearly straight, by installation of mulch netting, or by other methods approved by NRCS.

IA-8 MOBILIZATION AND DEMOBILIZATION

1. SCOPE

This work shall consist of the mobilization and demobilization of the Contractor's forces and equipment necessary for performing the work required under the contract.

The work shall not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract.

Mobilization will not be considered as work in fulfilling the contract requirement for commencement of work.

2. EQUIPMENT AND MATERIALS

Mobilization shall include all activities and costs for transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities for the Contractor's operations at the site; premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable; and other items specified in Section 4.

Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not included in the contract form the site; including the disassembly, removal and site cleanup of offices, buildings, and other facilities assembled for this contract.

The work includes mobilization and demobilization activities required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted or added items of work for which the contractor is entitled to an adjustment in contract price, compensation of such costs will be included in the price adjustment for the item or items of work changed or added.

3. SPECIAL SPECIFICATIONS

A. Measurement and Payment

- a. Payment will be made as the work proceeds, after presentation of invoices by the contractor showing specific mobilization and demobilization costs and evidence of the charges of suppliers, subcontractors, and others. If the total of such payments is less than the lump sum contract price, the unpaid balance will be included in the final contract payment. Payment of the lump sum contract price for mobilization and demobilization will constitute full compensation for the completion of the work.
- b. Payment will not be made under this item for the purchase costs of materials having a residual value, the cost of materials to be incorporated in the project, or the purchase costs of operating supplies.
- B. Items of Work and Construction Details
 - a. Items of work to be performed in conformance with this specification and the construction details therefor are:

i. Bid Item 4, Mobilization & Demobilization

1. This item shall consist of mobilizing and demobilizing personnel and equipment in preparation to perform the work within the scope of this contract.

- 2. Any work that is necessary to provide access to the site including, but not limited to, grading, temporary culverts, and clearing will be included in this item. When construction is completed access areas will be restored, as close as practical, to its original condition.
- 3. Any fence removed for access and /or to provide work area shall be replaced with same or like materials as approved by the engineer.
- 4. The Contractor shall exercise caution to minimize the amount of damage caused by the grading and clearing operations.
- 5. Portable toilets shall be provided at the construction site and used for the sanitary facilities.
- 6. This item shall not include transportation of personnel, equipment and operating supplies within the work limits areas of this contract.
- 7. Payment will constitute full compensation for related subsidiary items.

IA-9 SUBSURFACE DRAIN INVESTIGATION, REMOVAL, AND REPAIR

1. SCOPE

The work shall consist of investigation, location, repair, and/or removal of subsurface drains (tile) near new or existing animal waste storage facilities or in wetland restoration, enhancement, or creation project areas, or other situations where subsurface drains may be present.

2. INVESTIGATION AND LOCATION

An inspection trench at least 10 inches wide shall be dug at the location shown on the drawings or as directed by the engineer or his representative. The trench shall be at least 6 feet deep measured from the original ground line, unless otherwise shown on the plans. The Engineer or his representative shall examine the trench and excavated material to identify tile lines.

Size, material, operating condition and direction of flow of each conduit shall be documented. Location and flow line elevation of each conduit shall be surveyed with horizontal and vertical control based on benchmarks shown on the plans.

The inspection trench shall be documented by surveying the natural ground and trench bottom location and elevations at the beginning, end, and every 50 feet for trenches longer than 50 feet.

Backfilling shall not be started without approval of the Engineer. See Section 5 for backfill specifications.

Trench shields, shoring and bracing, or other methods necessary to safeguard the workers and work, and to prevent damage to the existing improvements shall be furnished, placed, and subsequently removed by the contractor.

3. TILE REPAIR

Unless designated for removal, replace damaged conduit with new conduit having equal or greater capacity using material specified in Section 6 or 7. When replacing short sections of clay or concrete tile with single-wall corrugated polyethylene pipe, use the next larger nominal size.

Make connections with manufactured fittings and tight joints. Where joints have gaps that would allow soil to enter, cover the joint with a permanent type material such as coal tar pitch treated roofing paper, fiber glass sheet or mat, or plastic sheet.

If the investigation trench has been excavated below the existing drain grade, backfill the trench with gravel or well-pulverized soil in layers not over four (4) inches thick and tamp by hand or manually directed power tamper to provide a firm foundation for the conduit at the existing grade. Do not backfill with any soil containing broken tile fragments.

Using selected soil free of hard clods, rocks, or frozen soil, hand tamp the backfill material around the haunch of the pipe in layers not over four (4) inches thick to provide support. Hold the conduit in place mechanically while placing excavated material around and over the conduit to ensure proper alignment and grade is maintained. Complete the backfill operation according to Section 5.

4. TILE REMOVAL

Remove conduits as shown on the plans or directed by the Engineer or his representative, including envelope filter material or other flow enhancing material when present.

Cap or plug the open ends of the disconnected conduit to prevent soil entry when the conduit will continue to function downstream, or otherwise shown on the plans. For a minimum distance of two feet around each sealed conduit end, backfill in layers not over four (4) inches thick and tamp by hand or manually directed power tamper to a density equal to or greater than the surrounding undisturbed soil. Do not backfill with any soil containing broken tile fragments, large stones, frozen material, or large dry clods.

Where tile are located beneath an existing animal waste facility, remove the tile or fill the entire length of tile with concrete or Portland cement grout as shown on the plans. When tile removal is specified, the owner shall contact the Iowa Department of Natural Resources (IDNR) for permission to remove the drainage tile under the structure. The structure shall be emptied of waste or lowered to a point below the tile prior to its removal. The structure must be retested for percolation and the results submitted to IDNR and approval received prior to reusing the structure.

If shown on the plans or directed by the engineer, reroute upstream drain lines so the capacity of the upstream drainage system is maintained. Install conduit in accordance with Iowa Construction Specification IA-46, Tile Drains for Land Drainage.

5. BACKFILL

Compact soil around disturbed tile as specified in Section 3 (Tile Repair) and Section 4 (Tile Removal). Keep the backfill within 5 feet of the conduit free from large stones, frozen material, and large dry clods. Unless otherwise shown on the plans, backfill the remainder of the trench as follows:

For trenches located under or near structures, backfill in 12 inch layers and compact each layer to a density equal to or greater than the surrounding undisturbed soil.

For other locations, backfill the remainder of each trench with the excavated soil material which shall extend above the ground surface and be well rounded over the trench.

6. MATERIALS

Unless otherwise shown on the plans, conduit and fittings used for repair shall conform to the specifications listed in Table 1. Perforated pipe shall have a water inlet area of at least 1 square inch per foot, provided by perforations spaced uniformly along the long axis of the pipe. The perforations shall be circular or slots. Circular perforations shall not exceed 3/16 inch in diameter. Slots shall not be more than 1/8 inch wide.

Table 1. Acceptable pipe for subsurface drain repair

Kind of Pipe [#]	Specification
Corrugated Polyethylene (PE) Pipe and Fittings, 3 to 6 inch	ASTM F 405
Corrugated Polyethylene (PE) Pipe and Fittings, 3 to 24 inch	ASTM F 667
Corrugated Profile Wall (Dual Wall) Polyethylene (PE) pipe, 2 to 60 inch	ASTM F 2648 ^{\$}
Corrugated Profile Wall (Dual Wall) Polyethylene (PE) pipe, 12 to 60 inch	ASTM F 2306 ^{\$}
Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120	ASTM D 1785
PVC Pressure-Rated Pipe (SDR Series)	ASTM D 2241
Clay drain tile	ASTM C 4
Concrete drain tile	ASTM C 412

[#] Pipe sizes are nominal and the ranges are inclusive
^{\$} Pipe conforming to AASHTO M 252 (3 to 10 inch), or AASHTO M 294 (12 to 60 inch) is acceptable

7. SPECIAL SPECIFICATIONS

None

IA-11 REMOVAL OF WATER

1. SCOPE

The work shall consist of the removal of surface water and ground water as needed to perform the required construction in accordance with the plans and specifications.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, diversions, flumes, sumps, and other temporary protective works needed to divert surface water away from the construction site while construction is in progress.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches, borrow areas and other parts of the construction site shall be dewatered as needed for proper execution of the construction work. The Contractor shall furnish, install, operate and maintain all works and equipment needed to perform the dewatering.

4. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized.

5. REMOVAL OF TEMPORARY WORKS

After temporary works have served their purposes and before the Contractor leaves the site, they shall be removed.

IA-21 EXCAVATION

1. SCOPE

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials. The cutoff trench and any other required excavations shall be dug to the lines and grades shown on the drawings or as staked in the field. Structure or trench excavations will conform to all safety requirements of OSHA.

2. USE OF EXCAVATED MATERIALS

Suitable materials from the specified excavations shall be used in the construction of required permanent earth fill. The suitability of materials for specific purposes shall be determined by the NRCS Inspector.

3. DISPOSAL OF WASTE MATERIAL

All surplus or waste material shall be disposed of in areas shown on the drawings or as approved by the NRCS Inspector. The waste material shall be smoothed and sloped to provide drainage.

4. STRUCTURE AND TRENCH EXCAVATION

Structure or trench excavations will conform to all safety requirements of OSHA.

5. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fills, additional materials shall be obtained from the designated borrow areas as shown on the drawings or as approved by NRCS and the landowner. On wetland projects, borrow shall not be taken from the wetland area within 10 feet of the embankment or as shown on the drawings.

Borrow areas shall be excavated and grading completed in a manner to eliminate steep or unstable side slopes or hazardous or unsightly conditions.

6. OVER-EXCAVATION

Excavation beyond the specified lines and grades shall be corrected by filling the resulting voids with compacted earthfill, except that if the earth is to become the subgrade for riprap, sand or gravel bedding or drainfill, the voids shall be filled with material conforming to the specifications for the riprap, bedding or drainfill, as appropriate.

IA-23 EARTHFILL

1. SCOPE

The work shall consist of the construction of earth fills required by the drawings and specifications. The completed work shall conform to the lines, grades, and elevations shown on the drawings or as staked in the field.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. Fill materials shall contain no sod, brush, roots or other bio-degradable materials. Rocks larger than 6 inches in diameter shall be removed prior to compaction of the fill.

3. FOUNDATION PREPARATION

Foundations for earthfill shall be stripped a minimum of 6 inches to remove vegetation and other unsuitable materials. Foundation surfaces shall be scarified to a minimum depth of 2 inches prior to placing fill material.

Foundation and abutment surfaces shall not be sloped steeper than 1.5 horizontal to 1 vertical unless otherwise shown on the drawings.

4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by NRCS. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Adjacent to structures or pipes, fill shall be placed in a manner which will prevent damage. The height of the fill adjacent to structures or pipes shall be increased at approximately the same rate on all sides.

The materials used throughout the earth fill shall be essentially uniform. Selective placement shall be as shown on the drawings or approved by NRCS.

If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified to a minimum depth of 2 inches before the next layer is placed.

The top surfaces of embankments shall be maintained approximately level during construction, except that a cross-slope of approximately 2% shall be maintained to ensure effective drainage.

When moving fill material from the borrow area(s) to the embankment by use of bulldozers only, the following steps shall be followed:

- Immediately after the borrow material is pushed to the embankment, it shall be spread in horizontal lifts placed parallel to the centerline of the embankment.
- Compactive effort will then be applied by operating equipment parallel to the centerline of the fill or embankment.
- Lift thicknesses shall be in strict compliance with Clause 6, below.

Sectional fills are not allowed unless they are shown on the construction drawings.

5. CONTROL OF MOISTURE CONTENT

The moisture content of the fill material shall be adequate for obtaining the required compaction. Material that is too wet shall be dried to meet this requirement, and material that is too dry shall have water added and mixed until the requirement is met.

The moisture content of the fill material shall be such that a ball formed with the hands does not crack or separate when struck sharply with a pencil and will easily ribbon out between the thumb and finger.

Earth foundations under and adjacent to concrete structures shall be prevented from drying and cracking before concrete and backfill are placed.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as possible.

6. COMPACTION

Earth fill shall be compacted by one of the following methods as specified on the plans or in Section 8, Special Specifications. If no method is specified, compaction will be in accordance with Method 1.

- Method 1 Earthfill shall be placed so that the wheels or tracks of the loaded hauling equipment, traveling in a direction parallel to the centerline of fill, pass over the entire surface of each layer being placed. Low ground pressure vehicles shall not be used for this purpose.
- Method 2 Two (2) complete passes of a tamping-type roller will be made over each layer. The roller shall be capable of exerting a minimum force of two hundred (200) pounds per square inch.
- Method 3 Minimum density shall be 90% of the maximum density as determined by ASTM D 698 and as shown on the plans.

The maximum thickness of a lift of fill before compaction shall be 9 inches, unless otherwise indicated on the drawings.

Fill adjacent to structures, pipe conduits, and appurtenances shall be placed in layers not more than 4 inches thick and compacted to a density equivalent to that of the surrounding fill. Methods used to obtain compaction for fine or coarse grained materials are as follows:

- For fine grained materials, hand tamping or manually directed power tampers may be used. Hand compaction only shall be used to compact the earthfill under the bottom half of circular pipes. Manually directed power tampers shall not be used in tight spaces where applying full compactive effort will result in direct contact of the tamper plate with the pipe. Care should be taken so that compaction around the spillway pipe does not cause uplift of the pipe resulting in a void beneath the pipe.
- For coarse grained materials (sands and gravels), vibratory plate compactors shall be used for obtaining compaction. However, hand tamping shall be used to compact the material under the bottom half of circular pipes.

In all cases, follow manufacturer instructions for the specific compaction equipment being used. Heavy equipment shall not be operated within 2 feet of any structure or pipe.

Compacting of fill adjacent to concrete structures shall not be started until the concrete is 7 days old.

7. ISLANDS, MOUNDS, AND LOAFING AREAS ON WETLAND RESTORATION, ENHANCEMENT, OR CREATION PROJECTS

Islands shall be randomly located within the wetland area at locations shown on the drawings or as staked in the field. The orientation of island shorelines shall be random with attention given to prevailing winds to limit wave damage. In general, the side of the island with the longest dimension shall be parallel to the prevailing wind direction. Side slopes of islands shall be as shown on the drawings, but in no case shall be steeper than 6 horizontal to 1 vertical. Island shapes shall be irregular.

Loafing areas shall be constructed in the areas shown on the drawings or as staked in the field and shall be graded to drain runoff water. The elevation of at least one loafing area should be above the maximum water level whenever possible.

Excavated material not suitable for embankments, wetland dikes, or islands can be used to create mounds or blended into surrounding topography to create a natural appearance. Spoil material shall not be spread on existing wetland areas.

Organic soils shall not be used to construct islands, loafing areas, dikes, or embankments.

IA-26 TOPSOILING

1. SCOPE

The work shall consist of salvaging topsoil from borrow areas or required excavations and spreading it on the exposed disturbed areas.

2. QUALITY OF TOPSOIL

Topsoil shall consist of friable surface soil reasonably free of grass, roots, weeds, sticks, stones, or other foreign materials.

3. EXCAVATION

After the site has been cleared and grubbed, the topsoil shall be removed from borrow areas and required excavation areas to the depth as shown on the drawings. Topsoil shall be stockpiled at locations approved by NRCS.

4. SPREADING

Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Surfaces designated to be covered shall be lightly scarified just prior to the spreading operation. Where compacted fills are designated to be covered by topsoil, the topsoil shall be placed concurrently with the fill and shall be bonded to the compacted fill with the equipment.

Topsoil shall be placed to the minimum depth shown on the drawings. After the spreading operation is completed, the surface shall be finished to a reasonably smooth surface.

IA-45 PLASTIC (PVC, PE) PIPE

1. SCOPE

The work shall consist of furnishing and installing plastic pipe and the necessary fittings specified herein or as shown on the drawings. This specification does not cover subsurface drainage systems.

2. MATERIALS

<u>Corrugated Polyethylene (PE) Tubing</u>. Corrugated PE tubing and fittings shall conform to the requirements of the applicable specification listed below:

Kind of Pipe	Specification
Corrugated Polyethylene(PE) Tubing and Fittings, Nominal Sizes 3 to 6 inch, inclusive	ASTM F 405
Large Diameter Corrugated Polyethylene Tubing and Fittings, Nominal Sizes 8 to 24 inch, inclusive	ASTM F 667
Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe	ASTMF 894

<u>Poly(Vinyl Chloride) (PVC) Plastic Pipe</u>. PVC pipe and fittings shall conform to the requirements of the applicable specification listed below:

Kind of Pipe	Specification
PVC Plastic Pipe, Schedules 40, 80 and 120	. ASTM D 1785
PVC Pressure-Rated Pipe (SDR Series)	. ASTM D 2241
PVC Pressure Pipe, 4 in. through 12 in., for Water Distribution	AWWA C900
PVC Water Transmission Pipe, Nominal Diameters 14 in through 36 in	AWWA C905

<u>PVC and PE Plastic Pipe</u>. Plastic pipes meant for non-potable, livestock water supply shall conform to the requirements of the applicable specification listed below:

Kind of Pipe	Specification
Polyethylene (PE) Plastic Pipe, (SIDR-PR) Based on	
Controlled Inside Diameter	. ASTM D 2239
PVC Pressure-Rated Pipe (SDR Series)	. ASTM D 2241

3. FITTINGS AND JOINTS

Pipe joints shall conform to the details shown on the drawings. Pipe shall be installed and joined in accordance with the manufacturer's recommendations.

Joints may be bell and spigot type with elastomeric gaskets, coupling type with elastomeric gasket on each end, or solvent cemented. Gaskets shall conform to ASTM D 1869. Solvent cemented joints shall not be used for pond spillway pipes. Solvent cemented joints for PVC pipe and fittings shall be in accordance with ASTM D 2855. When a lubricant is required to facilitate joint assembly, it shall be a type having no detrimental effect on the gasket or pipe material.

Mechanical joints (split couplings and snap couplings) may be used when joining PE pipe and fittings when the pipe is used for non-pressure flow and a free draining sand or gravel bedding material is provided. Elastomeric-sealed mechanical joints shall be used when joining PE pipe and

fittings under pressure flow or where seepage cannot be tolerated. Where non-pressure pipe is specified, the fittings shall be of the same or similar materials as the pipe and shall provide the same durability and strength as the pipe.

A special case of livestock water supply involves pipes through a dam or embankment. Only PE pipe meeting the above specification may be used. PE pipe, of $1\frac{1}{4}$, $1\frac{1}{2}$, or 2-inch diameter shall be installed so that there are no joints within the embankment area.

Where pressure pipe is specified, fittings shall have a design capacity equal to or exceeding that specified for the pipe to which it is attached. Fittings shall be cast iron, steel, one piece injection molded plastic fitting or fabricated from plastic pipe and one piece injection molded plastic fittings. Pressure pipe fittings shall conform to the requirements of the applicable specification listed below.

Kind of Fitting	Specification
Threaded PVC Plastic Pipe Fittings, Schedule 80	. ASTM D 2464
PVC Plastic Pipe Fittings, Schedule 40	. ASTM D 2466
PVC Plastic Pipe Fittings, Schedule 80	. ASTM D 2467
Butt Heat Fusion (PE) Plastic Fittings for PE Plastic Pipe and Tubing	. ASTM D 3261
Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals	. ASTM D 3139
PVC Pressure Pipe, 4 in. through 12 in., for Water Distribution	AWWA C900
PVC Water Transmission Pipe, Nominal Diameters 14 in through 36 in	. AWWA C905

4. HANDLING AND STORAGE

Pipe shall be delivered to the job site and handled by means which provide adequate support to the pipe and does not subject it to undue stresses or damage. When handling and placing plastic pipe, care shall be taken to prevent impact blows, abrasion damage, and gouging or cutting (by metal surfaces or rocks). All special handling requirements of the manufacturer shall be strictly observed. Special care shall be taken to avoid impact when the pipe must be handled at temperatures of 40 degrees F (4.4 degrees C) or less.

Pipe shall be stored on a relatively flat surface so that the barrels are evenly supported. Unless the pipe is specifically coated to withstand exposure to ultraviolet radiation, it shall be covered with an opaque material when stored outdoors for a period of 15 days or longer.

5. TRENCHING

Plastic pipe conduits shall be installed in trenches or plowed in according to the following methods:

- A. **Trencher Constructed** When conditions permit, trenching for pipelines, which are buried from 5 to 6 feet deep, are usually done with a narrow 4 to 6 inch wide chain trencher. Where there is little gravel and the ground is not too wet, these trenchers bring up well pulverized soil that makes good backfill material. Where rocks are not present, any of this material may be backfilled directly around the pipe. There is no practical way to compact the fill in these narrow trenches. The owner must be made aware that this material normally consolidates to its maximum extent in two to five years, but depressions or low spots can be hazards to livestock, humans and equipment.
- B. **Backhoe Constructed Trench** Backhoe trenches are usually a minimum of 12 inches wide. The material frequently comes out of the trench as clods, large chunks, and rocks. Immediately backfill over the pipe with 4 to 6 inches of soil that is free of these clods, large chunks, and rocks. If adequate excavated material is not available, then material such as sand or fine gravel should be imported and placed around the pipe to a depth of 4 to 6 inches over the top of the pipe. Fill the trench with the remaining excavated material.

C. **Plowing** – Plowing, or ripping, is a trenchless method for installing plastic pipe. It is a multi-stage process consisting of positioning a vibrating or static (non-vibrating) plow equipped with a trailing product guide which feeds pipe to the depth setting of the plow as it moves forward. The pipe is inserted into the ground continuously along a predetermined path and depth. The vertical depth of installation is controlled by hydraulic adjustment of the plow shear head and the surface contours. The depth of insertion must be continually adjusted to compensate for changes in terrain.

6. LAYING AND BEDDING THE PIPE

Plastic pipe conduits and fittings shall be installed as shown on the drawings and specified herein. The pipe shall be laid so that there is no reversal of grade between joints, unless otherwise shown on the drawings. The pipe shall be placed with the bell end upstream, unless otherwise specified. The pipe shall be carefully placed on the bedding or into the pipe trench.

Care shall be taken to prevent distortion and damage during unusually hot (over 90 degrees F) or cold weather (under 40 degrees F). After the pipe has been assembled in the trench, it shall be allowed to reach ground temperature before backfilling to prevent pull out of joints due to thermal contraction.

The pipe ends and the couplings shall be free of foreign material when assembled. During the placement of the pipe, each open end of the pipeline shall be closed off by a suitable cover or plug at the end of work on the pipeline each day and until work resumes or installation is complete.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Perforations shall be clear of any obstructions when the pipe is laid.

Pipe shall be firmly and uniformly supported throughout the entire length. Bell-holes shall be made in the bedding under bells or couplings and other fittings to prevent the pipe from being supported by fittings.

- a. <u>Earth Bedding</u>. When bedding is specified, the pipe shall be firmly and uniformly bedded in a shaped bedding groove that closely conforms to the bottom of the pipe for a depth equal to a minimum of 1 inch or 5 percent of the diameter of the pipe, whichever is greater. The bedding material shall be free of rocks or stones greater than 0.5 inch diameter and earth clods greater than 2 inch diameter.
- b. <u>Sand or Gravel Bedding</u>. When sand or gravel bedding is specified, the pipe shall be firmly and uniformly placed on a sand or gravel bed. Sand or gravel fill shall be carefully placed and compacted as specified herein and as shown on the drawings.

A few installations of above ground pipelines have been noted. These installations are normally laid directly on the ground and very close to an existing fence line for protection. Only those pipelines designed to withstand exposure to ultraviolet radiation may be utilized for these installations. Adequate thrust control shall be incorporated in these installations.

7. BACKFILL

The pipe shall be held down during backfilling to the top of the pipe to prevent its being lifted from its original placement.

Within 2 feet of the pipe, backfill shall be carefully placed and compacted by means of hand tamping or manually directed power tampers or plate vibrators to form a continuous uniform support around the pipe. Maximum thickness of layers before compaction within 2 feet of the pipe shall be 4 inches and at more than 2 feet from the pipe a maximum thickness before compaction shall be 9 inches. Unless otherwise specified, the initial backfill shall be compacted to a density equivalent to that of the adjacent fill or foundation materials.

The water content of cohesive backfill material shall be such that, kneaded in the hand, the soil will form a ball which does not readily separate. For non-cohesive sand and gravel backfill material, water content is not a concern for thin lifts.

IA-51 CORRUGATED METAL PIPE CONDUITS

1. SCOPE

The work shall consist of furnishing and placing circular, arched or elliptical corrugated metal pipe and the necessary fittings.

2. MATERIALS

Metallic-coated steel corrugated pipe and fittings shall be zinc-coated or aluminized, Type 2, and shall conform to the requirements of ASTM A 760 and A 929 for the specified type and size of pipe. Aluminum corrugated pipe shall conform to the requirements of ASTM B 745 for the specified type and size of pipe. All pipe is subject to the following additional requirements:

- A. When polymer coating is specified, pipe, coupling bands and anti-seep collars shall be coated in accordance with ASTM A 762. All riveted joints shall be caulked as described in paragraph B.
- B. Pipe with annular corrugations shall be furnished with caulked seams. Riveted pipe joints shall be caulked with a bituminous mastic material during fabrication to provide a watertight joint. All circumferential and longitudinal seams shall be caulked before riveting. This shall be accomplished by applying a uniform bead of the mastic compound to the inner lap surface before riveting such that when the rivets are in place, all voids are filled and a coating of mastic is between the lap surfaces. The inner surface of coupling bands shall be asphalt coated in the field prior to installation. A neoprene gasket having a minimum thickness of 3/8 inch and a minimum width of 7 inches may be used in lieu of mastic coated coupling bands.
- C. Welded or lock seams in helical corrugated pipe are considered to be watertight.
- D. When close riveted pipe is specified: (1) the pipe shall be fabricated so that the rivet spacing in the circumferential seams shall not exceed 3 inches, except that 12 rivets will be sufficient to secure the circumferential seams in 12-inch pipe, and (2) in those portions of the longitudinal seams that will be covered by the coupling bands, the rivets shall have finished flat heads or the rivets and holes shall be omitted and the seams shall be connected by welding to provide a minimum of obstruction to the seating off the coupling bands.
- E. Double riveting or double spot welding of pipe less than 42 inches in diameter may be required. If specified, the riveting or welding shall be done in the manner specified for pipe 42 inches or greater in diameter.

3. COUPLING BANDS

Coupling bands shall meet the requirements of the table below or have detailed drawings submitted for approval by the State Conservation Engineer. Coupling bands shall be of the same minimum thickness (gage) as the pipe being connected.

Description of Coupling Band	Maximum Fill Height, Ft.	Maximum Pipe Diam., In.
24-inch wide coupling band with four 1/2-inch Diam. galvanized rods with tank lugs for annular or helical corrugated metal pipe. Bands shall have a minimum lap of 3 inches.	All	All
Hugger band from Armco Steel Corp. for helical corrugated metal pipe with reformed ends; and for annular corrugated pipe. Bands include O-ring gaskets and two 1/2-inch Diam. galvanized rods and lugs. $\frac{1}{2}$	35	48
Hugger band without rods and lugs but including O-ring gaskets. $\frac{1}{2}$	20	24
Angles riveted or welded to a coupling band and drawn tight with bolts. Bands shall be a minimum of 7 corrugations wide and have a minimum lap of 2 inches.	35	15
Flanged couplings for helical corrugated pipe welded to the ends of the pipe and field assembled by a minimum of 3/8-inch Diam. bolts. A joint sealer shall be placed between the flanges to ensure water tightness.	25	12

1/ Use is limited to sites where soft foundation and conduit elongation is not anticipated.

4. FABRICATION

Fabrication of all appurtenances shall be done as shown on the drawings. All appurtenances shall be made of metallic-coated steel when corrugated steel pipe is used and aluminum when used with aluminum pipe. Dissimilar metals shall not be installed in contact with each other.

5. REPAIR OF DAMAGED COATINGS

The Contractor shall place the pipe without damaging the pipe or coatings. The pipe shall be transported and handled in a manner to prevent damage to the pipe or coating.

Breaks, scuffs, or other damage to the various coatings shall be repaired as follows:

- A. Metallic Coating by thoroughly wire brushing the damaged area and cleaning with solvent, and then painting two coats of one of the following paints:
 - (1) Zinc Dust Zinc Oxide Primer conforming to ASTM D 79 and D 520.
 - (2) Single package, moisture cured urethane prime in silver metallic color.
 - (3) Zinc-rich cold galvanized compound, brush, or aerosol applications.

B. Polymer Coating - apply two coats of polymer material similar to and compatible with the durability, adhesion and appearance of the original polymer coating. The repair coating shall be a minimum thickness of 0.010 (10 mils) after drying and shall bond securely to the pipe.

6. LAYING AND BEDDING THE PIPE

The pipe shall be laid to the line and grade shown on the drawings and shall be firmly and uniformly bedded throughout its entire length. Details of the bedding are as shown on the drawings.

The pipe shall be laid with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides at approximately the vertical mid-height of the pipe. Field welding of corrugated galvanized steel pipe will not be permitted. The pipe sections shall be joined with coupling bands.

7. BACKFILLING

Special care shall be taken during backfill operations not to disturb the grade and alignment.

The pipe shall be tied down or loaded sufficiently during backfilling around the sides to prevent its being lifted from the bedding.

Backfill material shall have sufficient moisture so that optimum compaction can be obtained. Backfill around the pipe shall be placed in layers not more than 4 inches thick before compaction.

Each layer of backfill shall be compacted with power tampers, hand tampers, or plate vibrators to the same density requirements as specified for the adjacent embankment. Backfill over and around the pipe shall be brought up uniformly on all sides. The passage of earth moving equipment will not be allowed over the pipe until backfill has been placed above the top of the pipe surface to a depth of two (2) feet.

IA-61 LOOSE ROCK RIPRAP

1. SCOPE

The work shall consist of the construction of loose rock riprap revetments, structures and blankets, including filter layers or bedding where specified.

2. MATERIALS

Rock for loose rock riprap, filter layers or bedding shall come from sources approved by NRCS. The rock shall be excavated, selected and handled as necessary to meet the quality and grading requirements of this specification and the construction drawings.

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to sub rounded in shape. The least dimension of an individual rock fragment shall not be less than 1/3 the greatest dimension of the fragment unless otherwise specified on the construction drawings.

3. SUBGRADE PREPARATION

The subgrade surfaces on which the riprap or bedding is to be placed shall be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall be compacted to a density equal to the adjacent existing soil material.

Rock materials shall not be placed until the foundation preparation is completed and the subgrade surfaces have been inspected and approved by NRCS.

4. EQUIPMENT-PLACED ROCK RIPRAP

Rock shall be placed by equipment on the surfaces and to the depths specified. The riprap shall be constructed to the full thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The rock shall be delivered and placed in a manner that will insure that the riprap in place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact, one to another, with the smaller rocks and spalls filling the voids between the larger rocks. Placement of rock shall begin at the bottom of the slope or downstream end of the structure.

Riprap shall be placed in a manner to prevent damage to structures. Hand placing will be required to the extent necessary to prevent damage to adjacent structures.

5. HAND-PLACED RIPRAP

Rock shall be placed by hand on the surfaces and to the depths specified. It shall be securely bedded with the larger rocks firmly in contact, one to another. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on edge unless otherwise specified. Placement of rock shall begin at the bottom of the slope or downstream end of the structure.

6. FILTER LAYERS OR BEDDING

When the drawings specify filter layers or bedding beneath riprap, the filter or bedding material shall be spread uniformly on the prepared subgrade surfaces to the depth specified. Compaction of filter layers or bedding will not be required, but the surface of such layers shall be finished reasonably free of mounds, dips or windrows.

IA-81 METAL FABRICATION AND INSTALLATION

1. SCOPE

The work shall consist of furnishing, fabricating, and installing metalwork including metal parts of composite structures.

2. MATERIALS

Steel shall be of structural quality. Finished surfaces shall be smooth and true to assure proper fit.

Bolts, nuts, washers, rods, rivets, etc., shall be of a material equal to the steel being fastened.

3. PROTECTIVE COATINGS

Protective coatings will consist of either galvanizing or painting and shall be applied by the fabricator.

Galvanizing shall consist of a zinc coating by the hot dip process, except that bolts, nuts, and washers may have a electrodeposited zinc coating.

Paint System for this specification shall consist of the application of one coat of Epoxy Polyamide Primer (lead and chromate free) and one or more coats of Epoxy Polyamide (intermediate or finish), lead free. When finished, it will have a minimum dry film thickness of 8.0 mils.

4. FABRICATION

Materials shall be carefully fabricated as shown on the drawings. The fabrication shall be smooth and true to assure proper fit. Galvanized items shall not be cut, welded, or drilled after the zinc coating is applied.

5. ERECTION

The metal shall be erected true and plumb, closely conforming to the drawings.

IA-92. FENCES

1. SCOPE

The work shall consist of furnishing and installing fences, including gates and fittings.

2. STANDARD FENCE

Barbed wire fences shall have a minimum of 4 wires for farm borders. A minimum of three wires shall be used for interior fencing, cross fencing, or excluding livestock from special areas such as wildlife area, forested tracts or other special use areas. Wires shall be spaced approximately an equal distance apart. The top wire shall be at least 42 inches high and 2 inches below the top on wood posts and 1 inch below the top on steel posts. The bottom wire shall be 18 inches or less above the ground level. Wire shall be spaced no more than 12 inches apart.

Each barbed wire shall consist of 2 twisted strands of either $12\frac{1}{2}$ gauge wire or $15\frac{1}{2}$ gauge high tensile strength wire. The barbs shall be either 2-point barbs on approximately 4 inch centers or 4-point barbs on approximately 5 inch centers. Wire shall be stretched and attached after the posts are properly set and backfilled. Attach wire to the side of the post closest to the livestock, except on corners and curves where the wire should be placed on the outside of the corner or curve.

Top and bottom strands of woven wire shall be a minimum of 12 ½ gauge. Wire for intermediate strands shall be 14 1/3 gauge or heavier. Fences with woven wire 32 inches or less in height shall have at least 2 barbed wires above the woven wire spaced 8 to 12 inches apart. Fences constructed with woven wire higher than 32 inches shall have at least 1 barbed wire 8 to 12 inches above the woven wire. The base of the woven wire shall be placed near the ground surface. The top wire shall be at least 42 inches above the ground level and 2 inches below the top of wood posts and 1 inch below the top of steel posts. All wire shall be galvanized. Wire shall be stretched and attached after the posts are properly set and backfilled. Attach wire to the side of the post closest to the livestock, except on corners and curves where the wire should be placed on the outside of the corner or curve.

Staples shall be 9 gauge steel or heavier with a minimum length of 1 ½ inches for soft woods and a minimum length of 1 inch for close grained hardwoods. Drive staples diagonal to the grain of the wood and at a slight downward angle. Space should be left between the staple and the post to permit free movement of the wire. Wires may be attached to steel posts by use of manufacturer's clips or by 14 gauge galvanized wire twisted at least two turns.

All wooden posts (except red cedar, Osage orange, or black locust) shall be treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) by a method that ensures complete penetration of the sapwood. At least half of the diameter of red cedar shall be heartwood. Quality of treated wood shall provide sufficient strength and quality to last for the expected life of the fence.

All corner posts, gate posts, end posts, pull posts and brace posts normally shall be wood with sufficient length for the construction of at least a 42 inch high fence and permit setting the post at least 36 inches deep. Earth backfill shall be thoroughly tamped. On areas where soil depth is restricted to less than 36 inches, additional anchors or deadman applied against the direction of pull may be needed. Wood posts shall have a minimum top diameter of 5 inches. A 2-½ inch steel pipe with appropriate bracing or set in concrete of sufficient depth also may be used. Reinforced concrete or metal posts of equivalent strength may be substituted if they have suitable means of attaching wires and braces.

The maximum spacing of line posts shall be one rod (16.5 feet). Wood line posts shall have a 3 inch top (2 ½ inch for Osage orange). Wood line posts shall have a minimum length of 6 ½ feet and shall be set or driven to a minimum depth of 24 inches where conditions permit. When posts are set, earth backfill shall be thoroughly tamped. Steel line posts shall weigh not less than 1.33 pounds per foot and shall have a steel anchor plate securely fastened to the plate. The posts shall be "T", "U", or "Y" shaped and have corrugations, knobs, studs, or grooves suitable for fastening fencing to the posts. Steel posts shall be rolled from high carbon steel and shall have a protective coating; either galvanized by the hot dip process, painted with one or more coats of high grade weather resistant paint for steel, or enameled and baked. Steel line posts shall be used as line posts at least once every 6 rods (99 feet) to act as a ground for lightning protection.

End bracing will be installed at locations where the fence ends and on both sides of gate openings. Corner bracing should be installed where fence alignment changes 15 degrees or more. Bracing is required at all corner, gate, pull and end assemblies in a fence. The brace member shall be the equivalent of a wood post with at least a 3 ½ inch diameter at the top or standard weight 2 inch diameter galvanized steel pipe. The brace shall be at least 3 feet above the ground and at least 8 inches below the top of the post. The brace member shall be 6 to 8 feet in length. A brace wire consisting of 2 complete loops of 9 gauge smooth wire, 2 loops of barbed wire or a single loop of 12 ½ gauge high tensile strength wire shall be installed. "H" braces or angle braces as shown in figure 3 will be used in standard fences.

Pull post assemblies consisting of three posts with braces shall be installed in straight reaches of fence at intervals 660 feet (40 rods), at any point where the vertical angle described by two adjacent reaches of wire is upward and exceeds 10 percent and at the beginning and end of each curve.

For a narrow ditch or draw crossing with slopes steeper than 8 feet horizontal to 1 foot vertical, the fence shall be anchored with a concrete anchor weighing at least 150 pounds and buried with at least 18 inches of cover or a commercial screw-in type metal anchor 5 inches in diameter and not less than 48" long to position the fence to the contour of the ditch or draw.

Wire gates shall be made of the same materials as used for the fence. Panel or tube type gates shall be equivalent in quality to the fencing material and shall be fitted with at least two hinges and a latch or galvanized chain for fastening.

3. CHAIN LINK FENCE

Chain link fence, fabric, posts, top rails, braces, gates and accessories shall conform to the requirements of ASTM Specifications types, classes and materials listed below. The fence shall be constructed in a workmanlike manner.

Fabric shall be ASTM A392, 2-inch mesh, 9 gauge galvanized steel wire. Zinc coating shall be Class 2. Fabric shall be 60 inches in height. Fabric shall not be stretched until at least 4 days after the posts are set in concrete backfill or grouted in concrete walls. A stretcher bar of the same length as the fabric width shall secure each end of each run of fabric. The bar and fabric shall be stretched taut and secured to the end post by tension bands equally spaced not more than 15 inches apart. The fabric shall be attached to all braces; the top rail, all line posts and the tension wire by wire ties or clips at intervals not exceeding two feet.

Posts and fence framework shall conform to the requirements of ASTM F1043 Group 1A, for Heavy Industrial Fence. Coatings shall be type A galvanized coating both internal and external surfaces. Steel pipe for posts shall conform to the requirements of ASTM F1043 and F1083. The minimum diameter of end, corner, and pull posts shall be 2 3/8 inches. Line posts shall be at lest 1.9 inches in diameter. Gate posts shall have a minimum diameter of 2 7/8 inches. The maximum spacing of line posts shall be ten feet. Post holes shall be at least 6 inches in diameter and 18 inches deep for line posts and 24 inches for corner, end, pull and gate posts. All posts shall be set in concrete backfill. Concrete shall completely fill the annular space around the posts and shall be neatly finished to slope

up to the post approximately 1 ½ inches above the ground surface. Pull posts shall be located in long straight runs of fence at intervals of 500 feet or less. Posts set in concrete walls shall be grouted into preformed holes at lest 12 inches in depth. Where posts are installed in highly corrosive soils such as disturbed mine spoil, the posts shall be vinyl coated in addition to the above requirements and set in concrete poured inside a 6 inch clay tile or plastic tubing at least 24 inches long.

When used, **braces and top rails** shall be installed horizontally at the height shown on the drawings or recommended by the manufacturer. See previous paragraph for specifications. Braces and top rails shall be attached to the posts by suitable fittings, as recommended by the manufacturer. When the brace has been placed, a 6 gauge double truss galvanized steel wire with adjustable tightener and fittings shall be attached to the corner post just below the brace and to the brace post approximately 4 inches above ground level. A similar truss wire shall be attached to brace post just below the brace and to the corner post approximately 4 inches above ground level. A 7 gauge galvanized steel tension wire, tightened by mechanical means, shall be placed approximately 4 inches from the ground level. A similar tension wire shall be placed at the top of the fence if a top rail is not used.

Gates, gateposts and gate accessories shall conform to the requirements of ASTM F900. Coating shall be the same as the adjoining fence and framework.

4. HIGH TENSILE WIRE (HTW) FENCE

HTW fence shall have a minimum of eight smooth strands of galvanized 12 ½ gauge **wire** with not less than 0.8 ounce of zinc per square foot of wire surface and a tensile strength of 200,000 pounds per square inch. Each strand of wire shall be strung to a tension of not less than 250 pounds. The top wire shall be 48 to 54 inches above the ground surface. The bottom wire shall not be more than 6 inches above the ground surface. The wire shall be fastened on a direct line splice with enough nicopress sleeves that the accumulated strength of the sleeves exceeds the tensile strength of the wire. End wrap splices shall be fastened with two nicopress sleeves. Splices may also be made with other products used as directed by the manufacturer.

Posts shall be the same size and material as posts for standard fences. Line posts shall be spaced not more than 30 feet apart with spacer made of wood or fiberglass spaced at not more than 15 feet from either post. Corners, pull assemblies, ends and gates shall have a double assembly consisting of three driven posts with horizontal braces. Each assembly shall be further braced with a double wrap of high tensile wire (see attachment A).

5. PERMANENT HTW ELECTRIC FENCE

Permanent HTW electric fences are constructed with the intent of being in place for years. It is the equivalent of any non-electric permanent fence. Electric fences provide psychological deterrent rather than a physical barrier to livestock and wildlife. To be effective, a shock of at least 1,000 volts must be delivered to cattle, 2,000 volts to sheep and 2,500-3,000 volts to deer, dogs, and coyotes.

Wire shall be a single strand of 12 ½ gauge or larger with a minimum tensile strength of 110,000 pounds per square inch. The wire shall galvanized (Type III) or aluminum or copper clad. Barbed wire should not be used on electric fences because of safety hazard. Wire will be attached to the posts by a method that allows them to slip. Wires will be attached to stays in a manner that prevents stay slippage along the fence. The tension of each wire shall be sufficient to maintain the wires at the appropriate height. Suggested wire heights and spacing are shown by intended use in the following table:

Fence Description	Number of Wires	Wire Height (In.)
Internal/Cross Fence		
Cow /calf & stocker	1 wire	30 to 34
Hogs	1 wire	12
Cow /calf & stocker	2 wire	22;32
Sheep and cattle	3 wire	10; 20; 32
Sheep and cattle	4 wire	10; 20;32;46
Perimeter Fence		
Cattle, horses, sheep (Non-	5 wire	10; 20; 30; 40; 50
predator)		
Sheep, goats (Predator)	8 wire	4; 8; 12; 18; 24; 30; 40; 52

Electronic energizers of power fence controllers shall be installed according to manufacturer's recommendations. The energizers shall be high power, low impedance with 5,000 volt peak output and a pulse that is less than 300 mAmps in intensity, finished within 0.0003 of a second and at a rate of 35-65 pulses per minute. Energizers shall be provided with high impact, weather resistant cases. Circuitry shall be solid state. Service modules shall be snap-in for fast field repair. A safety fuse to prevent over pulsing shall be provided. The system shall be 110 volt, 220 volt or 12-volt battery powered. The battery-powered system shall be capable of working for at least 3 weeks without replacing the battery. If the length of the fence requires more than 4 joules (watts times seconds equals joules), a solar charger will be needed for 12 volt systems. The energizer shall be capable of producing one joule for each mile of planned fence when average energy loss is expected.

All electric fences must be properly grounded. The energizer ground wire should be connected to a galvanized pipe or rod ½ inch or larger in diameter. Bury 3 feet of ground rod for each joule of energy output. Ground rods should be buried where soil remains moist for best results. Ground rods should be driven into the ground at least 10 feet apart when multiple rods are necessary to provide the required length of ground rod. Normally individual ground rods will be driven no more than 6 to 8 feet into the ground. Connect a continuous ground wire from the energizer to each ground rod with aluminum or galvanized steel clamp. If energizer terminals are not stainless steel or copper, do not use copper ground rods with copper wire may be used if energizer terminals are stainless steel or copper. Use copper clamps with copper wire and copper rods.

The ground wire(s) of the fence may be connected to the same ground as the energizer or to a separate ground with the same size and depth requirements. More ground rods may be needed for the system to function properly. Do not use the grounding system for other existing applications, such as power poles, breaker boxes and milk barns,. At least 25 feet should separate the fence grounding system from any other grounding system.

Lightening can cause damage to the energizer. Most energizers are poorly protected from damage caused by lightning. External **lightning arrestors** and an induction loop (lightning choke) should be installed for added protection. Lightning arrestor grounding rods should be placed at least 65 feet from those of the energizer (See attachment B).

Install an additional set of ground rods and attach to a lightning arrestor. The lightning arrestor ground must be better than the energizer ground for it to function properly, because lightning will seek the path of least resistance to ground. Use at least 1 more ground rod on the arrestor than was used on the energizer. Attach the lightning arrestor to the wires of the fence. Install a lightning choke in the fence line immediately between the lightning arrestor and the energizer.

For protection of energizers, it is recommended that for 120 or 240-volt energizers that a voltage **spike protector** be used. Also, a ground rod should be installed at electric company's transformer pole (primary ground) and another ground rod installed at the electrical circuit breaker box (secondary ground), if they do not exist. Additionally, a surge protector should be installed between the energizer and power supply.

Insulation used for positive charged wire(s) must be high-density polyethylene with ultra-violet stabilizer or high-density polypropylene with ultra-violet stabilizer.

Braces and end assemblies are required at all corners, gates and angles in the fence line (See attachment A for criteria on corners, angles, and brace assemblies.)

For 1 and 2 wire fences, corner, gate, end and brace assemblies use one of the following:

- Steel "T" post that are a minimum of 1.25 pounds per foot of length, with appropriate knee, deadman, angle or H-brace.
- Wood posts with a minimum top diameter of 3.5 inches set two feet in the ground with appropriate knee, deadman, angle, or H-brace.
- Wood, steel pipe or fiberglass post with a minimum top diameter of 5 inches, set to a depth equal to, or greater than, the height of the post above the ground without bracing.
- Steel pipe or fiberglass posts with a minimum diameter of 2 inches, set 2 feet in the ground with appropriate knee, angle, or H-brace, deadman or anchor plate.
- Steel pipe or fiberglass posts with a minimum diameter of 2 inches and set in concrete to a depth of 2 feet.
- Steel pipe or fiberglass posts with a minimum diameter of 1 inch with appropriate angle bracing and sufficient ground anchoring to maintain wire tension while remaining erect and firmly anchored.

For 3 or more wire power fences; corner, gate, end and brace assemblies will be either a floating angle brace or H-brace assembly. Posts will be 4-inch nominal wood, 2-inch nominal steel pipe (capped), 2-inch fiberglass or steel "T" posts with appropriate appurtenances for corner and end bracing. Posts must be set a minimum of 2 feet in the ground.

All wood posts shall be at least 2 inches higher than the top wire of the fence. Posts of any other material shall be at least 1 inch higher than the top wire of the fence.

Line post and stays will be either:

- Australian ironwood (eucalyptus) at least 2 inches in diameter; fiberglass, rigid plastic and PVC solid round sucker rod of at least 5/8 inch diameter, or fiberglass "T" post and stays of at least 1 inch in cross-section. Attach wire to the post with loose wire clips or run the wire through holes in the post. Attach the wire to stays with tight clips.
- Wood posts at least 3 inches in diameter of black locust, red cedar, Osage orange, redwood, pressure treated pine or any other wood of equal life and strength may be used. At least one half of the diameter of the red cedar and redwood post shall be heartwood. Pressure treated posts shall be treated with pentachlorophenol, creosote, or chromated copper arsenate (CCA) by a method which ensures the complete penetration of the sapwood. Insulators shall attach wire.
- Steel "U" or "T" posts that are a minimum of 1.25 pounds per foot of length. Wire shall be attached with insulators.

Posts for one or two wire fences shall be long enough to be set at least 18 inches in the ground, except that in soils which are sandy loam or coarser in texture, the posts shall be set at least 24 inches into the ground. Posts for 3 or more wire fences shall be set at least 24 inches into the ground. Posts in dips shall be constructed so that they do not pull out of the soil. Posts 2 inch or smaller shall be anchored. Wood posts shall be set to a depth sufficient to resist pull out.

Wood posts shall be at least 2 inches higher than the top wire on the fence. All other posts shall be at least 1 inch higher than the top wire of the fence.

Spacing of the line posts and stays depends on the terrain and the number of wires. Maximum spacing is as follows

- One or two wire fences may have line posts spaced up to 100 feet apart with no stays. Line posts may be spaced 150 feet apart with stays every 50 feet between the posts
- For three and four wire fences, the line posts may be spaced every 50 feet with no stays or every 150 feet with stays at spacing of not more than every 50 feet.
- Fences with more than 4 wires shall have posts and stays spaced every 30 feet, with posts not further apart than every 90 feet.
- In undulating terrain, space posts and stays as needed to maintain the fence height.

Insulators for conductive material posts, end, corner and angle braces shall be high-density polyethylene with ultra-violet stabilizer, high density polypropylene with ultra-violet stabilizer, or porcelain. All insulators shall be capable of withstanding 10,000 volts or more of current leakage. Red insulators attract hummingbirds and should not be used.

Electrified **gates** may be constructed of a single straight wire, galvanized cable, or polytape with a insulated spring loaded handle or an expandable, coiled, high tensile, 12 ½ gauge wire attached to an insulated handle. The number of wires shall be determined by the objective of the fence. The gate shall be constructed so that it is non-electrified when the gate is open. Overhead or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence.

Use insulated galvanized wire for crossing gates and areas where an electrical shock to livestock and humans is undesirable. All underground wires must be insulated for a minimum of 15,000 volts. Insulated underground wire should be specifically designed for high voltage electric fence. The insulation shall be high-density polyethylene with ultra-violet stabilizer or high-density polypropylene with ultra-violet stabilizer. Placing buried wire inside plastic pipe helps to decrease the likelihood of short-circuiting. Overhead transmission lines shall be at a height where the lines do not impeded movement of livestock or equipment.

An electrified **floodgate** may be used in lieu of a non-electrified gate if desired. The electrified floodgate should be constructed by stretching an electrified wire across the drainage above the high water level. Attach droppers of 12 ½ gauge high tensile fence wire, galvanized cable or galvanized chains to the electrified wire at a spacing of 6 inches for sheep and 12 inches for cattle. The droppers shall be extended to approximately 6 inches above normal water level. Connect gate to electric fence with a double insulated cable through a cutoff switch and flood control gate controller. If flooding is expected to last for an extended period of time, switch the floodgate off. (See attachment C).

Other materials of equivalent strength, durability and design may be used.

6. TEMPORARY ELECTRIC FENCE

Temporary electric fencing is constructed with the intent of being left in place for only a short period of time. The fence is not intended as a substitute or equivalent of permanent fence. The temporary fence requires materials, design and construction that will accomplish the intended purpose and last for the planned time period with no more maintenance than is desired.

Many companies market portable fence systems that use materials such as polyethylene wire and tape with steel or aluminum wire woven into them, aluminum wire, plastic and fiberglass posts, reels to roll up wire, and battery operated energizers that are high voltage and low impedance (see previous section on energizers). A minimum of six strands of steel or aluminum wire should be woven into the polywire or polytape. Temporary fences may be attached to permanent fences to subdivide pasture. Follow manufacturer's directions for construction, use and operation of temporary electric fences

Attachment A



Note: Distance from point A to B shall be a minimum twice the height between the top wire and the ground surface.

Single Post End Brace (Floating Angle Brace) Assembly

Figure 1
Attachment A





Knee or Deadman Braces may be used on fences with 2 wires or where pull distances is < 660 feet.

Electric Fencing Bracing Alternatives

Attachment A



Standard Suspension Fence, Corner and Pull Assembly



Materials: Post must be new eastern red juniper, blueberry juniper, bois-d'arc, treated pine, treated hardwood, or steel pipe (cemented). Used steel pipe is acceptable and must be painted.

Splices: Use "western-union splices, figure "8" knots or crimping sleeves for malleable wire. Use crimping sleeves or figure "8" knot for high tensile strength wire.

2 Post Brace With Deadman

(c)

Standard Suspension Fence, Corner and Pull Assembly

Attachment A



Single Post Corner or Angle Brace Assembly

(d)

Standard Suspension Fence, Corner and Pull Assembly



Materials: Post must be new eastern red juniper, blueberry juniper, bois—d'arc, treated pine, treated hardwood, or steel pipe. Used steel pipe is acceptable and must be painted. Splices: Use "western—union splices, figure "8" knots or crimping sleeves for malleable wire.

Use crimping sleeves or figure "8" knot for high tensile strength wire.

Deadmaned 3-Post Corner



Welded Steel 3–Post Diagonal End Brace Assembly

Attachment A



Note: Materials shown above may be substituted using 2 1/2" nominal steel pipe, capped, set in concrete (12 in. diameter hole). Pipe must be painted.

> Wooden 3 Post Double "H" Brace End Assembly Without Deadman



Without Deadman





Deadman is optional except where surface of soll is more than 20 inches in depth of loamy fine sand or coarser. End Brace Assembly Deer Managemet Fence

Attachment A



General Installation Specification For Deer Management Fence



Attachment B



Energizer earth/ground system

Lighting diverter earth/ground system

An induction loop may be as an alternative to a choke.

An induction loop is made by coiling 8 to 10 loops of heavily insulated 12 gage wire in $10-12^{\circ}$ diameter circles and taping the loops together.

Electric Fence

Attachment C



Electric Flood Gate

NATURAL RESOURCES CONSERVATION SERVICE CONSTRUCTION SPECIFICATION

IA-95 GEOTEXTILE

1. SCOPE

This work shall consist of furnishing all materials, equipment, and labor necessary for the installation of geotextile.

2. MATERIAL QUALITY

Geotextile shall be manufactured from synthetic long chain or continuous polymeric filaments or yarns, having a composition of at least 95 percent, by weight, of polypropylene, polyester or polyvinylidene-chloride. The geotextile shall be formed into a stable network of filaments or yarns that retain their relative position to each other, are inert to commonly encountered chemicals and are resistant to ultraviolet light, heat, hydrocarbons, mildew, rodents and insects. Unless otherwise specified, the class and type of geotextile shall be as shown on the drawings and shall meet the requirements for materials that follow:

- a. <u>Woven Geotextile</u> shall conform to the physical properties listed in <u>Table 1</u>. The woven geotextile shall be manufactured from monofilament yarns that are woven into a uniform pattern with distinct and measurable openings. The geotextile shall be manufactured so that the yarns will retain their relative position with regard to each other. The yarns shall contain stabilizers and/or inhibitors to enhance their resistance to ultraviolet light or heat exposure. The edges of the material shall be selvaged or otherwise finished to prevent the outer yarn from unraveling.
- b. <u>Nonwoven Geotextile</u> shall conform to the physical properties listed in <u>Table 2</u>. Nonwoven geotextile shall be manufactured from randomly oriented fibers that have been mechanically bonded together by the needle-punched process. In addition, one side may be slightly heat bonded. Thermally bonded, nonwoven geotextile, in addition to mechanically bonded, nonwoven geotextile, may be used for Road Stabilization. The filaments shall contain stabilizers and/or inhibitors to enhance their resistance to ultraviolet light or heat exposure.
- c. The geotextile shall be shipped in rolls wrapped with a protective covering to keep out mud, dirt, dust, debris and direct sunlight. Each roll of geotextile shall be clearly marked to identify the brand, type and production run.

3. STORAGE

Prior to use, the geotextile shall be stored in a clean dry place, out of direct sunlight, not subject to extremes of either hot or cold, and with the manufacturer's protective cover in place. Receiving, storage, and handling at the job site shall be in accordance with the requirements in ASTM D 4873.

4. SURFACE PREPARATION

The surface on which the geotextile is to be placed shall be graded to the neat lines and grades as shown on the drawings. The surface shall be reasonably smooth and free of loose rock and clods, holes, depressions, projections, muddy conditions and standing or flowing water (unless otherwise shown on the drawings).

5. PLACEMENT

Prior to placement of the geotextile, the soil surface will be inspected for quality assurance of design and construction. The geotextile shall be placed on the approved prepared surface at the locations and in accordance with the details shown on the drawings. The geotextile shall be unrolled along the placement area and loosely laid (not stretched) in such a manner that it will conform to the surface irregularities when material is placed on or against it. The geotextile may be folded and overlapped to permit proper placement in the designated area.

The geotextile shall be joined by overlapping a minimum of 18 inches (unless otherwise specified), and secured against the underlying foundation material. Securing pins, approved and provided by the geotextile manufacturer, shall be placed along the edge of the panel or roll material to adequately hold it in place during installation. Pins shall be steel or fiberglass formed as a "U", "L", or "T" shape or contain "ears" to prevent total penetration. Steel washers shall be provided on all but the "U" shaped pins. The upstream or up-slope geotextile shall overlap the abutting down-slope geotextile. At vertical laps, securing pins shall be inserted through both layers along a line through approximately the midpoint of the overlap. At horizontal laps and across slope laps, securing pins shall be inserted through the bottom layer only. Securing pins shall be placed along a line approximately 2 inches in from edge of the of the placed geotextile at intervals not to exceed 12 feet unless otherwise specified. Additional pins shall be installed as necessary and where appropriate, to prevent any undue slippage or movement of the geotextile. The use of securing pins will be held to the minimum necessary. Pins are to be left in place unless otherwise specified.

Should the geotextile be torn or punctured, or the overlaps disturbed, as evidenced by visible geotextile damage, subgrade pumping, intrusion, or grade distortion, the backfill around the damaged or displaced area shall be removed and restored to the original approved condition. The repair shall consist of a patch of the same type of geotextile being used, overlaying the existing geotextile. The patch shall extend a minimum of 2 feet from the edge of any damaged area.

The geotextile shall not be placed until it can be anchored and protected with the specified covering within 48 hours or protected from exposure to ultraviolet light. Geotextile shall be placed in accordance with the following applicable specification according to the use indicated in drawings:

Slope protection – Class I or II as indicated in Tables 1 and 2.

The geotextile shall not be placed until it can be anchored and protected with the specified covering within 48 hours or protected from exposure to ultraviolet light. Rock shall not be pushed or rolled over the geotextile.

Class I, unprotected – limit height for dropping stone onto bare geotextile to 3 feet.

Class II, protected – require the use of 6 inches a clean pit-run gravel over the geotextile to cushion the stone and limit the height of drop to 3 feet.

On slopes with strong seepage flow, the geotextile must be in intimate contact with the soil to prevent erosion of the soil surface. Use 6 inches of a clean pit-run gravel over the geotextile to hold it in place and minimize voids under the riprap. Embedment of the geotextile in a trench to form a cutoff at regular intervals down the slope will prevent erosion under the fabric. Place cutoffs more closely together in highly erodible soils and wider apart in more stable soils.

Subsurface drains – Class III as indicated in Tables 1 and 2.

The geotextile shall not be placed until drainfill or other material can be used to provide cover within the same working day. Drainfill material shall be placed in a manner that prevents damage to the geotextile. In no case shall material be dropped on uncovered geotextile from a height of more than 5 feet.

Iowa

Road stabilization – Class IV as indicated in Tables 1 and 2.

The geotextile shall be unrolled in a direction parallel to the roadway centerline in a loose manner permitting conformation to the surface irregularities when the roadway fill material is placed on its surface. In no case shall material be dropped on uncovered geotextile from a height of more than 5 feet. Unless otherwise specified, the minimum overlap of geotextile panels joined without sewing shall be 24 inches. The geotextile may be temporarily secured with pins recommended or provided by the manufacturer, but they shall be removed before the permanent covering material is placed.

6. SPECIAL SPECIFICATIONS

Property	Test Method	Class I	Class II	(Class III	Class IV
Grab tensile strength (pounds)	ASTM D4632	247 minimum	180 minimum		180 minimum	315 minimum
Elongation at failure (%)	ASTM D4632	< 50	< 50		< 50	< 50
Trapezoidal tear strength (pounds)	ASTM D4533	90 minimum	67 minimum	(67 minimum	112 minimum
Puncture strength (pounds)	ASTM D6241	495 minimum	371 minimum		371 minimum	618 minimum
Ultraviolet light (% retained strength)	ASTM D4355	50 minimum	50 minimum	:	50 minimum	70 minimum
Permittivity (sec ⁻¹)	ASTM D4491		а	as speci	ified	
Apparent opening size (AOS) ^{2/}	ASTM D4751		a	as speci	ified	
Percent open area (POA) (%)	USACE ^{3/} CWO-02215-86		а	as speci	ified	

TABLE 1. REQUIREMENTS FOR WOVEN GEOTEXTILES 1/

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Maximum average roll value.

3/ Note: CWO is a USACE reference.

TABLE 2. REQUIREMENTS FOR NONWOVEN GEOTEXTILES 1/

Property	Test Method	Class I ^{2/}	Class II ^{2/}	Class III ^{2/}	Class IV ^{2/}
Grab tensile strength (pounds)	ASTM D4632 grab test	202 minimum	157 minimum	112 minimum	202 minimum
Elongation at failure (%)	ASTM D4632	50 minimum	50 minimum	50 minimum	50 minimum
Trapezoidal tear strength (pounds)	ASTM D4533	79 minimum	56 minimum	40 minimum	79 minimum
Puncture strength (pounds)	ASTM D6241	433 minimum	309 minimum	223 minimum	433 minimum
Ultraviolet light (retained strength) (%)	ASTM D4355	50 minimum	50 minimum	50 minimum	50 minimum
Permittivity (sec ⁻¹)	ASTM D4491		0.70 minimum	or as specified	
Apparent opening size (AOS) (mm) ^{3/}	ASTM D4751		0.22 maximum	or as specified	

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Needle punched geotextiles may be used for all classes. Heat-bonded or resin-bonded geotextiles may be used for class IV only.

3/ Maximum average roll value.

NATURAL RESOURCES CONSERVATION SERVICE CONSTRUCTION SPECIFICATIONS

IA-620 UNDERGROUND OUTLET

1. SCOPE

This work shall consist of installation of underground outlets and any appurtenant water control structures in accordance with an approved plan and design.

2. MATERIALS

Materials for underground outlets shall meet the requirements as shown in the plans and specifications. They shall be field inspected for any deficiencies such as thin spots or cracking prior to installation.

Conduit

The following reference specifications pertain to products currently acceptable for use as underground outlets:

Plastic

Corrugated Polyethylene (PE) Pipe and Fittings (3-6 inch)	ASTM F	405
3 through 24 inch Corrugated Polyethylene (PE) Pipe and Fittings	ASTM F	667
Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth		
Interior and Fittings (4-36 inch)	ASTM F	949
Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	ASTM D	2729
Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	ASTM D	3034
Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)	ASTM D	2241
Polyethylene Plastics Pipe and Fittings Materials	ASTM D	335

Clay

Clay Drain Tile	. ASTM C 4
Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated	. ASTM C 700
Vitrified Clay Pipe, test methods	. ASTM C 301

Concrete

ASTM C 412
ASTM C 118
ASTM C 497
ASTM C 14
ASTM C 76
ASTM C 444
ASTM C 150

Other

Styrene-Rubber (SR) Plastic Drain Pipe and Fittings	ASTM D	2852
Corrugated Aluminum Pipe for Sewers and Drains	ASTM B	745
Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains	ASTM A	760

Inlet

The inlet shall be fabricated and installed as shown on the plans. Inlets must be of durable material, structurally sound, and resistant to damage by rodents or other animals. Inlets shall be of rigid material, which does not require supplemental support to remain in a vertical position. Materials, which meet these requirements, include the following:

- 1. Corrugated metal pipe, galvanized or aluminum, 16 gauge minimum,
- 2. Smooth steel pipe, with 3/16 inch minimum wall thickness,
- 3. Smooth plastic pipe, polyvinyl chloride (PVC), with an SDR of 43 or less,
- 4. High-density polyethylene pipe (PE). Round pipe shall have an SDR of 43 or less. Square intakes shall have minimum wall thickness as shown in the following table:

Minimum <u>Thickness</u>
0.16 inch
0.21 inch
0.26 inch
0.31 inch

All plastic and polyethylene inlets shall include ultra-violet stabilizer to protect from solar degradation.

Perforations in the inlet shall be smooth and free of burrs. Unless otherwise specified, the above ground portion of the inlet shall have holes evenly spaced around the perimeter of the inlet in accordance with the following table:

Inlet	Minimum Number of 1" Diameter
Size	Holes per Foot of Inlet
4 inch	20
5 inch	24
6 inch	30
8 inch	40
10 inch	50
12 inch	60

If slots or round holes other than 1 inch in diameter are provided, the total cross sectional area of the openings per foot shall be equivalent to that provided by 1 inch diameter round holes meeting the above criteria.

The below ground portion of the inlet may be perforated with holes 5/16 of an inch in diameter or less to provide drainage around the inlet.

Appurtenances (i.e. tees and elbows) for polyvinyl chloride (PVC) inlets shall be schedule 40 or heavier.

Additional subsurface drainage tubing or tile may be used in conjunction with the surface inlet to improve access and farmability around the inlet. These underground extensions (when used) shall have a minimum length of 10 feet.

The inlet shall be offset from the main conduit except as noted below. A minimum of 8 feet of non-perforated conduit shall be installed between the inlet and the main conduit. The minimum diameter of the offset line shall be 3 inches. When conduit capacity is based on orifice flow from the inlet, such inlets shall be fabricated so that an orifice can easily be installed.

Only the top inlet in a terrace system may be placed directly on the main conduit. If the top most inlet in a terrace system is placed directly on the main conduit, the conduit shall be non-perforated from the inlet to the toe of the terrace back slope.

Outlet

A continuous section of non-perforated conduit at least 20 feet long shall be used at the outlet. Twothirds of the outlet pipe shall be buried in the ditch bank, and the cantilever section must extend to the toe of the ditch side slope or the side slope shall be protected from erosion. Acceptable materials for use at the outlet include the following:

- 1. Corrugated metal pipe, galvanized or aluminum, 16 gauge minimum;
- 2. Smooth steel pipe, with 3/16 inch minimum wall thickness;
- 3. Smooth plastic pipe, polyvinyl chloride (PVC), with a SDR of 26 or less or schedule 40 or heavier; or
- 4. Corrugated profile wall (dual wall) polyethylene (PE) pipe meeting or exceeding the requirements of ASTM F 2648 (2" to 60"), ASTM F 2306 (12" to 60"). Pipe conforming to AASHTO M 252 (3" to 10"), or AASHTO M 294 (12" to 60") is acceptable.

All plastic and polyethylene pipe outlets shall include ultra-violet stabilizer. PVC and PE pipe outlets shall not be used where burning vegetation on the outlet ditch bank is likely to create a fire hazard.

Connections with the outlet pipe shall be made watertight.

The outlet shall be equipped with a flap-gate type rodent guard.

3. TRENCH EXCAVATION

Trench excavation shall be sufficient to provide required cover after other construction is completed.

The trench bottom shall be smooth and free of exposed rock. If rock is encountered in the trench bottom, over-excavate the trench and place at least 6 inches of compacted earth or sand bedding in the trench to bring it up to the conduit grade. In stable soils, the bottom of the trench shall be shaped to form a semicircular, trapezoidal, or 90-degree "V" groove in its center. The groove shall be shaped to fit the size of conduit. The 90-degree "V" groove shall not be used on conduits greater than 6 inches in diameter.

Unless otherwise shown on the drawings, trench width at the top of the conduit should be the minimum required to permit installation and provide bedding conditions suitable to support the load on the conduit, but with not less than 3 inches of clearance on each side. Maximum trench width shall be the conduit diameter plus 12 inches measured at the top of the conduit, unless approved bedding is installed.

Plow installation is allowed except under the base width of the terrace or embankment. Trench width shall be at least two (2) inches wider than the conduit on each side to allow sufficient bedding to support the pipe.

4. INSTALLATION

The underground outlet system shall be installed to the line and grade shown in the plans or as staked in the field. Conduit lines shall be installed and properly blinded or bedded prior to placement of any other earthfill over the lines.

Conduit lines shall be joined with standard factory couplers, if applicable, to produce a continuous system. Internal couplers may be used if they do not cause excessive flow restrictions. Conduit ends shall be protected during installation.

All appurtenant structures, including trash and rodent guards, shall be installed promptly and provisions shall be made for protecting them during installation. All conduit ends except the outlet and inlets with screens shall be capped with standard factory end caps or concrete. When corrugated plastic tubing is used, no more than 5% stretch will be allowed.

Orifice plates, when specified, shall have smooth edges and fit tightly.

5. TRENCH BACKFILL

Conduits shall be bedded and backfilled throughout the base width of the basin embankment or terrace ridge. Friable soil material shall be placed in 4 inch layers and hand tamped to a depth of 2 feet above the conduit. The sides of the remaining trench shall be sloped no steeper than 3 horizontal to 1 vertical and backfill placed in 9 inch layers and machine compacted.

Water packing may be used as an alternative to mechanical compaction. If the conduit is nonperforated, it shall be filled with water during the water packing procedure. The initial backfill, before wetting, shall be of sufficient depth to ensure complete coverage of the pipe after consolidation has taken place. Water packing is accomplished by adding water in such quantity as to thoroughly saturate the initial backfill without inundation. The wetted fill shall be allowed to dry until firm before final backfill is begun. Final backfill shall be accomplished by placing friable soil material in 4 inch layers and hand tamping to a depth of 2 feet above the conduit. The sides of the remaining trench shall be sloped no steeper than 3 horizontal to 1 vertical and backfill placed in 9 inch layers and machine compacted.

Conduit which is not under the embankment or terrace ridge shall be backfilled with select bedding material containing no hard objects larger than 1½ inches in diameter to a minimum depth of 6 inches over the conduit. The conduit shall be held in place mechanically while select backfill material is placed around and over the conduit. This is to ensure that the proper conduit grade is maintained. All backfill material shall be placed so that deflection or displacement of the conduit will not occur. The remainder of the trench above the conduit shall be backfilled as rapidly as consistent with the soil conditions. Backfill shall extend above the ground surface and be well rounded over the trench. Large stones, frozen material, and large clods are not allowed in the backfill material.

6. FINISH

Work areas shall be smoothed and left in a workmanlike manner. Vegetation or other protective cover shall be established as specified.

7. SPECIAL SPECIFICATIONS

SECTION B: SUPPLEMENTAL SPECIFICATIONS UPPER IOWA RIVER WMA UI-018-LYONS-FERRING

EXPLANATION

- A. The purpose of this Section of the Specifications is to provide supplemental information which is required to complete the Standard Construction Specifications and to set forth supplementary requirements, modifications and/or deletions which are required to make the whole of the Construction Specifications project specific.
- C. Where there is any variance between the Standard Construction Specifications and these Supplemental Specifications, the Supplemental Specifications shall take precedence.
- D. Where any section of the Standard Construction Specifications is modified, or any Paragraph, Sub-paragraph or Clause thereof is changed or deleted by these Supplemental Specifications, the unaltered provisions of that Section, Paragraph, Sub-paragraph or Clause in the Standard Construction Specifications shall remain in effect. Unless these Supplemental Specifications make specific reference to the modification or deletion of a Paragraph, Sub-paragraph or Clause in the Standard Construction Specifications, no changes are intended, and paragraphs contained in these Supplemental Specifications are intended only to supplement, amplify, or clarify said Standard Construction Specifications.

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IOWA DOT SPECIFICATIONS

IA-1 SITE PREPARATION

A. Measurement and Payment

- 1. Compensation for Site Clearing, Preparation, & Waste Disposal (Bid Item 1) shall be made on a lump sum basis. Any work item described in the contract documents but not explicitly listed in the bid schedule will be included in the lump sum payment for the item of work to which it is made subsidiary. Such items and bid items to which they are made subsidiary are identified in the Items of Work and Construction Details section of this specification.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.
- B. Items of Work and Construction Details
 - 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Bid Item 1-Site Clearing, Preparation, & Waste Disposal
 - (1) This item will consist of the removal and proper off-site disposal of all woody growth within the construction area. Trees may also be burned and buried onsite in an owner and engineer approved location and manner.
 - (2) This item includes the removal and proper off-site disposal of existing pipes/outlets through the road embankment and existing pond embankment. This includes the removal of any granular materials or other unsuitable backfill materials encountered during removal. Removal of all pipes/outlets shall be completed in accordance with IA-1 and IA-3. Excavation required to remove existing pipes or unsuitable materials shall be considered incidental to IA-21 Excavation Subsidiary Item, Excavation for Structure and Pipe Removal and Installation.
 - (3) This item includes the removal of field tile located during excavation or general grading activities. Any field tile encountered within the project grading limits shall be removed by the contractor in accordance to IA-1, IA-3, and IA-9. Payment for the removal or salvage of fence shall be incidental to Bid Item 1.
 - a. Tiles encountered within the pool area should be daylighted one vertical foot above the normal pool elevation if possible.
 - (4) This item includes stripping, salvaging, and replacing the existing gravel surfacing on the roadbed inside the grading limits. This includes the length of roadway extending from the embankment fill zone to the borrow area, as shown on the plans. Additional removal beyond the limits shown on the plans is not included in this item.
 - (5) This item includes the removal and proper off-site disposal of all refuse and debris encountered on grade in areas being graded or seeded.
 - (6) This item includes the removal and proper off-site disposal of any fence indicated to be removed on the plans. Any fence removed for access and /or to provide work area shall be salvaged if practical or replaced with same or like materials as approved by the engineer and in accordance with specification IA-92. Removal or salvage shall be completed in accordance with IA-1 and IA-3. Payment for the removal or salvage of fence shall be incidental to Bid Item 1.
 - (7) All removals shall be completed in accordance with IA-5 Pollution Control.

SUPPLEMENTAL SPECIFICATIONS UI-018-LYONS-FERRING

IA-5 POLLUTION CONTROL

- A. Measurement and Payment
 - 1. Compensation for any work item described in the contract documents but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and bid items to which they are made subsidiary are identified Items of Work and Construction Details section of this specification.
 - 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.
- B. Items of Work and Construction Details
 - 1. Items of work to be performed in conformance with the specification and the construction details therefore are:
 - a. Subsidiary Item, Sediment Filters
 - (1) This item consists of all work to install, maintain and remove sediment filters for the project. Sediment filters to be removed once vegetation is established.
 - (2) No separate payment will be made for sediment filters. Compensation for this item will be incidental to other items of work.
 - (3) Contractor shall perform all construction activities in a manner that will minimize water pollution, air pollution, and soil erosion. Sediment filters shall be placed as needed where off-site erosion could occur.
 - b. Subsidiary Item, Pollution Control
 - (1) This item will consist of applying and performing all construction activities in a manner that will minimize water pollution, air pollution and soil erosion and shall be completed in compliances with all state, local and federal regulations.
 - (2) No separate payment will be made for Pollution Control. Compensation for this item will be incidental to other items of work.
 - c. Erosion Control, RECP 12' Width (Bid Item 2)
 - (1) Payment for this item shall include the cost to obtain, install, and maintain rolled erosion control products in the locations indicated in the plans.
 - (2) Rolled erosion control product shall be long term temporary double net rolled erosion control blanket consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two degradable synthetic or natural fiber nettings. Product shall meet or exceed ECTC Standard Specifications for Type 2.D classification.
 - (3) Measurement and payment of this bid item will be based on the quantity (in square yards) listed on the plans unless the WMA or Engineer directs the contractor to install a different amount in the field. In that case, payment shall be made based on the actual quantity (measured in square yards) installed, at the bid unit price.

IA-6 SEEDING AND MULCHING FOR PROTECTIVE COVER

- A. Measurement and Payment
 - 1. For items of work for which specific prices are established in the contract each area treated is measured and the area calculated to the nearest 0.1 acre.
 - 2. Payment for seeding is made at the contract unit price per acre for the designated treatment, which will constitute full compensation for completion of the work.
- B. Items of Work and Construction Details
 - 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Structure Seeding Hydro-Seeding (Bid Item 3)
 - (1) This item will consist of seeding structure areas as shown in the drawings.
 - (2) All seed must be cleaned and weed free. Seeding rates are expressed in bulk pounds per acre. Seed quality shall not drop below 70% Pure Life Seed (PLS) where PLS = (% germination + % dormant seed) times % purity.
 - (3) Seed mix shall be 25.0 lbs/ac Smooth Bromegrass.
 - (4) Prepare a firm seedbed for all planting methods:
 - (a) If the land was in soybeans, no additional tillage is required. If the land was in corn or other vegetation, till all areas to be seeded by disking or other approved methods; thoroughly loosen and pulverize the soil to a depth of three (3) inches. This may require multiple passes of the disk or other approved equipment. If the land was used for pasture and has a smooth surface, the preparation in non-disturbed areas to be seeded shall include mowing any vegetation taller than 12 inches and applying a burn down herbicide, such as glyphosate, at the labeled rates to emergent growth 2 to 4 weeks after mowing. After the vegetation has died, the area shall be disked as needed to thoroughly loosen and pulverize the soil to a depth of three (3) inches. If emergent growth occurs again prior to seeding, the area shall receive a second application of herbicide. Seeding shall not occur until the existing vegetation has died. If the pasture has a rough surface that would negatively impact the seeding, the area shall be thoroughly disked and the cultipacked prior to seeding.
 - (b) After the disking operation, and prior to seed application, firm the seedbed with a cultipacker or similar piece of equipment.
 - (5) Fertilizer shall be applied on the entire seeding area at the following rate:(a) Nitrogen: 30 lbs./acre
 - (b) Phosphorus (P2O5): 30 lbs./acre
 - (c) Potassium (K2O): 40 lbs./acre
 - (6) Complete hydraulic seeding in concurrence with hydro mulching. At the contractors preference and at no additional cost to the owner, conventional seeding may be performed separately to the hydro mulching operation.
 - (a) Hydraulic mulch shall be wood cellulose or Bonded Fiber Matrix (BFM).
 - (b) Products and installation for hydro mulch shall be according to SUDAS Section 9010.

SUPPLEMENTAL SPECIFICATIONS UI-018-LYONS-FERRING

- (7) Seeding will be completed during the follow seeding periods
 - Spring: March 1 to May 15
 - Summer: August 1 to September 15
 - Fall: November 15 to freeze up
- (8) Sow seeds with the contour using a grassland or rangeland drill set for the specified seeding rates. The drill shall be equipped with double coulter furrow openers. The drill shall be subject to acceptance by Engineer. Overlap each successive seeding pass to ensure complete coverage.
- (9) For seeding occurring in the spring, contractor shall ensure the seedbed remains moist until plant establishment. Moisture may be maintained during dry conditions through regular watering. Consult the engineer for recommended moisture control methods. Seeding should occur when rain is in the forecast when possible. Failure to make a good faith effort to maintain moisture may result in re-seeding by the Contractor at no additional expense to the Owner.
- (10) If seeding is completed during the spring seeding period, a companion crop of oats shall be seeded at ½ bushel per acre.
- (11) Plant seed using a drill between $\frac{1}{4}$ and $\frac{1}{2}$ inch deep
- (12) Broadcasting by centrifugal-type or hydroseeder broadcasters, or by hand shall also be allowed in areas no accessible to drills or other equipment. Once broadcast, the seed must be covered with soil to a depth no greater than one half (1/2) inch by means of hand rakes or other approved methods.
- (13) Upon completion of the seeding operation, cultipack the seedbed to provide a positive seed-soil contact. If the drill seeder is equipped with an approved cultipacker or press wheels, separate operations shall not be necessary. The type of cultipacker / seeder to be used shall be subject to acceptance by Engineer.
- (14) Measurement and payment will be based on the area successfully seeded.

- b. Pasture Seeding (Bid Item 4)
 - (1) This item will consist of seeding pasture areas as shown in the drawings.
 - (2) All seed must be cleaned and weed free. Seeding rates are expressed in bulk pounds per acre. Seed quality shall not drop below 70% Pure Life Seed (PLS) where PLS = (% germination + % dormant seed) times % purity.
 - (3) Seed mix shall be as specified in the pasture seed mix table on the following page.
 - (4) A seed mix different from the one provided below may be required when re-seeding disturbed areas within CRP contract limits.

Pasture Seeding Plan

Nume i detare ecourig			Date		Tract No.	
					Field No.	
Type of Seeding:		723		Prepared by Ma	Contract No	
Pasture						
	Seed	ing Percent F	Pure Live Seed=(% Germinat	ion + Hard Seed) * % Purit	ty	
			100			
					Critical area	•
Enter Acres: 1					Tota	al Needed
					T (1)	
Species	Acres	% of full rate	Pounds Per Acre of Pure	Live Seed (PLS)*	I otal No	eeded
Timothy 🔹	1	20	10.0	Pounds	2.00	Pounds
Red clover 🔹	1	25	16.0	Pounds	4.00	Pounds
Kentucky bluegrass 💌	1	40	25.0	Pounds	10.00	Pounds
Orchardgrass 🔹	1	20	10.0	Pounds	2.00	Pounds
-			-	Pounds		Pounds
Oats OR Cereal Rve	1	100	1.5	Bushels	15	Bushels
Fertilizer & Lime				Basiloio		Basiloio
Lime (ECCE)	0	l bs/Ac			0	Pounds
Nitrogen	30	Lbs/Ac			30	Pounds
Phosphate (P205)	30	Lbs/Ac			30	Pounds
Potash (K20)	40	Lbs/Ac			40	Pounds
		3			10020	
Additional Seeding Cr	iteria: Planting	3 jobsheet (342) for additional seed	ling and establishme	nt recommenda	tions.
Additional Seeding Cr Refer to Critical Area I eeding was completed acc By:	iteria: Planting cording t	3 g jobsheet (o the above re	342) for additional seed	ding and establishmer (Date)	nt recommenda	tions.
Additional Seeding Cr Refer to Critical Area I eeding was completed acc By:	iteria: Planting cording t	3 g jobsheet (o the above m nature)	342) for additional seed	ding and establishmer (Date)	nt recommenda (Date)	tions.
Additional Seeding Cr Refer to Critical Area I Reding was completed acc By:	iteria: Planting cording t	g jobsheet (o the above re nature)	342) for additional seed	ding and establishmer (Date)	nt recommenda (Date)	tions.

- (5) Prepare a firm seedbed for all planting methods:
 - (a) If the land was in soybeans, no additional tillage is required. If the land was in corn or other vegetation, till all areas to be seeded by disking or other approved methods; thoroughly loosen and pulverize the soil to a depth of three (3) inches. This may require multiple passes of the disk or other approved equipment. If the land was used for pasture and has a smooth surface, the preparation in non-disturbed areas to be seeded shall include mowing any vegetation taller than 12 inches and applying a burn down herbicide, such as glyphosate, at the labeled rates to emergent growth 2 to 4 weeks after mowing. After the vegetation has died, the area shall be disked as needed to thoroughly loosen and pulverize the soil to a depth of three (3) inches. If emergent growth occurs again prior to seeding, the area shall receive a second application of herbicide. Seeding shall not occur until the existing vegetation has died. If the pasture has a rough surface that would negatively impact the seeding, the area shall be thoroughly disked and the cultipacked prior to seeding.
 - (b) After the disking operation, and prior to seed application, firm the seedbed with a cultipacker or similar piece of equipment.
- (6) Fertilizer shall be applied on the entire seeding area at the following rate:(a) Nitrogen: 30 lbs./acre
 - (b) Phosphorus (P2O5): 30 lbs./acre
 - (c) Potassium (K2O): 40 lbs./acre
- (7) No mulch shall be applied.
- (8) Seeding will be completed during the follow seeding periods:
 - Spring: March 1 to May 15
 - Fall: November 15 to freeze up
- (9) For seeding occurring in the Spring seeding period, scarification of the seed must be completed by the seed provider.
- (10) Sow seeds using a broadcast seeder at the specified rates.
- (11) If seeding is completed during the spring seeding period, a companion crop of oats shall be seeded at ¹/₂ bushel per acre.
- (12) Broadcasting by centrifugal-type or hydroseeder broadcasters, or by hand shall also be allowed in areas no accessible to other equipment.
- (13) Upon completion of the seeding operation, lightly cultipack the seedbed to provide a positive seed-soil contact. The type of cultipacker / seeder to be used shall be subject to acceptance by Engineer.
- (14) Measurement and payment will be based on the area successfully seeded.

IA-8 MOBILIZATION AND DEMOBILIZATION

- A. Measurement and Payment
 - 1. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.
 - 2. Initial payment of 50% of the contract price will be made in the first pay application after mobilization of the contractor's equipment to the project site and commencement of the project work has started. Final payment of the remaining 50% of the contract price will be made in the pay application following when the project is considered substantially complete by the Engineer.

B. Items of Work and Construction Details

- 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Mobilization & Demobilization (Bid Item 5)
 - (1) This item shall consist of mobilizing and demobilizing personnel and equipment to and from the project location in preparation to perform the work within the scope of this contract.
 - (2) Any work that is necessary to provide access to the site including, but not limited to, grading, access road construction, temporary culverts, and clearing shall be included in this item. When construction is completed access areas will be restored, as close as practical, to its original condition unless approval is obtained from the Engineer and the landowner.
 - (3) The Contractor shall exercise caution to minimize the amount of damage caused by the grading and clearing operations.
 - (4) Portable toilets shall be provided at the construction site and used for the sanitary facilities. Toilets must be removed upon completion of the work.
 - (5) This item shall not include transportation of personnel, equipment and operating supplies within the work limits areas of this contract.
 - (6) Payment will constitute full compensation for related subsidiary items.
 - b. Traffic Control (Bid Item 6)
 - (1) This item includes all materials, equipment, and procedures for traffic control during construction.
 - (2) The costs to furnish, erect, operate, maintain, move, and remove all traffic control devices as required shall be included in this item.
 - (3) Execution of this item shall be according the Iowa Department of Transportation Standard Plans and Specifications.

IA-9 SUBSURFACE DRAIN INVESTIGATION, REMOVAL, AND REPAIR

A. MEASUREMENT AND PAYMENT

- 1. Compensation for any work item described in the contract documents but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and bid items to which they are made subsidiary are identified Items of Work and Construction Details section of this specification.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

B. ITEMS OF WORK AND CONSTRUCTION DETAILS

- 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Subsidiary Item, Drainage Tile Investigation and Removal
 - (1) Any drainage tiles encountered within the project area shall be traced to the upstream inlet or practice boundary, whichever is encountered first in accordance with this specification.
 - (2) This item shall consist of the excavation necessary to locate and remove all tile under the embankment, to remove tile at the other tile locations shown on the plans and locate the field tile lines in the practice. This item shall also consist of backfilling tile trenches if required.
 - (3) This item does not include the additional tile removal that occurs as part of the proposed project earthwork. Tile removal occurring in these areas is made subsidiary to specification IA-1, Site Preparation.
 - (4) The extent of tile investigation and removal shall be as required to locate and extend tiles as shown on the plans.
 - (5) The investigation should reveal where the tile crosses the embankment footprint or where it is located if it does not cross the embankment footprint.
 - (6) Removal shall be completed in accordance with IA-1, IA-3, IA-5, and IA-9.

IA-11 REMOVAL OF WATER

A. MEASUREMENT AND PAYMENT

- 1. Compensation for any work item described in the contract documents but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and bid items to which they are made subsidiary are identified Items of Work and Construction Details section of this specification.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

B. Items of Work and Construction Details

- 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Subsidiary Item, Dewatering
 - (1) This item shall include all costs to divert, pump, dam or other means to control water run-on, run-off, and accumulation within the construction site.
 - (2) No separate or additional payment will be made for control or removal of water from the project location. Compensation for this item shall be subsidiary to other work items.

IA-21 EXCAVATION

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section. Items of Work and Construction Details.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.
- B. Items of Work and Construction Details
 - 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Excavation, Core Trench Excavation (Bid Item 7)
 - (1) This item will consist of excavating the core trench as shown in the plans and construction details.
 - (2) Measurement and payment of this bid item will be based on the quantity (in cubic yards) listed on the plans unless the WMA or Engineer directs the contractor to excavate a different amount in the field. In that case payment shall be made based on the actual quantity excavated (measured in cubic yards), at the bid unit price. Depth and width of over-excavation may vary depending on the soils encountered. Over-excavation must terminate in suitable soils as determined by the Engineer.
 - (3) Fill for the streambank over-excavation shall be paid for under Earthfill, Embankment and Core Trench Fill (Onsite Material) (Bid Item 8).
 - b. Subsidiary Item, Excavation for Earthfill
 - (1) This item will consist of excavation of material in locations shown on the plans for use as Earthfill. All excavation required for the project will be balanced onsite, unless otherwise noted, in areas designated as Earthfill.
 - (2) No separate payment will be made for this item.
 - (3) Compensation for this item will be included in the payment for Earthfill, Embankment and Core Trench Fill (Onsite Material) (Bid Item 8).
 - c. Subsidiary Item, Excavation for Structure and Pipe Removal and Installation
 - (1) This item will consist of all excavation required to complete the project other than work included under Bid Item 7: Excavation, Core Trench Excavation and the subsidiary item Excavation for Earthfill. Examples of work included in this subsidiary item are all excavations required for the removal or installation of pipes, structures, and granular materials.
 - (2) No separate payment will be made for this item.
 - (3) Compensation for this item will be included in the payment for bid item(s) associated with the required excavation(s).

IA-23 EARTHFILL

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.
- B. Items of Work and Construction Details
 - 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Earthfill, Embankment and Core Trench Fill (Onsite Material) (Bid Item 8)
 - (1) This item shall consist of excavating, placing, and compacting the earthfill necessary to fill the core trench and to construct the embankment and adjacent fill areas as shown on the plans, using material borrowed from onsite.
 - (2) Earthfill approved soil material shall be taken from excavation and designated borrow areas unless other areas are approved by the engineer.
 - (3) Compaction shall be Method 2 unless otherwise noted on the plans.
 - (4) Rocks larger than 6" shall be removed prior to compaction.
 - (5) Measurement and payment for this bid item shall be on a plan "P" cubic yard basis. Plan basis means that the plan quantity listed in the proposal will be used to measure and pay for the bid item regardless of the actual quantity.
 - (a) This quantity may be adjusted to account for changes made to Bid Item 7: Excavation, Core Trench Excavation, if necessary.
 - (6) A 25% shrinkage factor was used to determine the plan quantity.
 - b. Earthfill, Embankment Fill (Import) (Bid Item 9)
 - (1) This item shall consist of placing and compacting the earthfill necessary to construct the embankment and adjacent fill areas as shown on the plans, using material supplied by Allamakee County.
 - (2) Earthfill material shall be approved by the engineer.
 - (3) Compaction shall be Method 2 unless otherwise noted on the plans.
 - (4) Rocks larger than 6" shall be removed prior to compaction.
 - (5) Measurement and payment for this bid item shall be on a plan "P" cubic yard basis. Plan basis means that the plan quantity listed in the proposal will be used to measure and pay for the bid item regardless of the actual quantity.
 - (6) A 25% shrinkage factor was used to determine the plan quantity.
 - (7) Contractor shall coordinate location and schedule of delivery with Allamakee County Engineer.

- c. Subsidiary Item, Backfill Required Excavation
 - (1) This item shall consist of backfilling the areas excavated to install other components related to the project such as piping or structures and to locate and remove the tile line.
 - (2) Compaction adjacent to the structures shall be as indicated above. All other compaction shall be Method 1 or equivalent.
 - (3) No separate payment will be made for Backfill of Structure Excavation. Compensation for this item will be included in payment for Corrugated Metal Pipe, Water Control Structure, Riser Inlet Structure, Tile Investigation and Removal, Corrugated Plastic Tubing Tile Drains, or Interceptor Drains if applicable.
- a. Subgrade Preparation (Bid Item 10)
 - (1) This item includes, but is not limited to, excavating, manipulating, replacing, compacting, and trimming to the proper grade.
 - (2) Execution of this item shall be according to the following specifications:
 - (a) Uniform Composition: Provide uniform composition of at least 12 inches below top of subgrade under new paving or subbase, plus 2 feet on each side. Use select subgrade materials unless granular stabilization materials or subgrade treatment is specified.
 - 1) Construct in two 6 inch lifts.
 - 2) Remove stones over 3 inches from subgrade.
 - 3) Construct to elevation and cross-section such that, after
 - rolling, surface will be above required subgrade elevation. (b) Subgrade Stability:
 - Perform proof rolling with a truck loaded to the maximum single legal axle gross weight of 20,000 pounds or the maximum tandem axle gross weight of 34,000 pounds. Operate trucks at less than 10 mph. Make multiple passes for every lane. The subgrade will be considered to be unstable if, under the operation of the loaded truck, the surface shows yielding (soil wave in front of the loaded tires) or rutting of more than 2 inches, measured from the top to the bottom of the rut at the outside edges.
 - 2) If soft or yielding areas are located, remove unstable materials and replace with suitable foundation materials as approved by the Engineer, meeting Section 2010, 2.04. Compact subgrade materials in cut sections as required by the Engineer. If stabilization material is used, place and compact as required for subbase.
 - (c) Final Subgrade: Complete final subgrade by excavation to grade by use of steel-shod template supported on side forms, support rollers, or by use of an automatically-controlled subgrade excavating machine.
 - (d) Subgrade Check: Check subgrade elevation and grade by method approved by Engineer prior to paving.
 - (e) Ruts: If ruts or other objectionable irregularities form in subgrade during construction, reshape and re-roll subgrade before placing pavement. Fill ruts or other depressions with material similar to other subgrade material, and compact.
 - (3) All soils required for subgrade materials must be approved by the Engineer. Approval of materials and their use will be based on SUDAS section 2010, subpart 2.03
 - (a) Density of 95 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
 - (b) AASHTO M 145 group index of less than 30.
 - (c) Liquid limit (LL) less than 50.
 - (d) Soils not meeting these requirements are considered unsuitable soils, regardless of classification.
 - (4) The Engineer may authorize a change in subgrade materials subject to materials available locally at time of construction.

IA-26 TOPSOILING

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

- 1. Items of work to be performed in conformance with this specification and the construction details therefore are:
 - a. Topsoil, Strip, Salvage and Re-spread (Bid Item 11)
 - (1) This item will consist of stripping, salvaging, stockpiling and spreading salvaged (stockpiled) topsoil as the surface layer of all excavations and earth fills that will be disturbed as shown on the drawings.
 - (2) All other areas being excavated or receiving fill should be stripped of the top six (6) inches of topsoil and stockpiled.
 - (3) Areas in the valleys upstream and downstream of the embankment where fill is being placed may need to be stripped to depths greater than 6" in order to remove deeper deposits of organic materials, which were indicated in the geotechnical soil borings.
 - (a) Additional stripping should be coordinated with the Engineer prior to execution.
 - (4) A minimum six (6) inch layer of topsoil shall be applied to all disturbed areas that will be seeded prior to project seeding.
 - (5) Measurement and payment for top soiling shall be on a plan "P" cubic yard basis. Plan basis means that the plan quantity listed in the proposal will be used to measure and pay for the bid item regardless of the actual quantity.
 - (a) If additional stripping is required, as defined in paragraph (3) of this specification, the additional volume shall be estimated and paid at the contracted bid item price.
 - (b) No additional payment will be granted for work not approved by the Engineer.

IA-51 CORRUGATED METAL PIPE CONDUITS

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

- 1. Items of work to be performed in accordance with this specification and the construction details therefore are:
 - a. Corrugated Metal Pipe, 24" (Bid Item 12):
 - (1) This item will consist of furnishing and installing the corrugated metal pipe outlet, including rodent guard.
 - (2) The corrugated metal pipe shall be 14-gauge aluminum coated with annular or helical corrugations as noted on the drawings. The minimum corrugation size shall be 2-2/3"x1/2".
 - (3) Pipe materials with recycled content that meet ASTM A 760 and A 929 for the specified size of pipe are preferred and should be used where feasible. Post-consumer Steel Content of 15 to 70% and total recoverable steel material of 25-100% is recommended if available. Engineer may request information regarding recycled content of pipe materials for review.
 - (4) Coupling bands, repair of damaged coatings, and other appurtenances are subsidiary to this item and shall not warrant separate payment.
 - (5) Linear foot measurement and payment will constitute full compensation for this bid item and related subsidiary items.
 - b. Corrugated Metal Pipe, 42" (Bid Item 13):
 - (1) This item will consist of furnishing and installing the corrugated metal pipe outlet including anti-seepage collars and rodent guard.
 - (2) The corrugated metal pipe shall be 14-gauge aluminum coated with annular or helical corrugations as noted on the drawings. The minimum corrugation size shall be 3"x1".
 - (3) Pipe materials with recycled content that meet ASTM A 760 and A 929 for the specified size of pipe are preferred and should be used where feasible. Post-consumer Steel Content of 15 to 70% and total recoverable steel material of 25-100% is recommended if available. Engineer may request information regarding recycled content of pipe materials for review.
 - (4) Coupling bands, anti-seep collars, repair of damaged coatings, and other appurtenances are subsidiary to this item and shall not warrant separate payment.
 - (5) Linear foot measurement and payment will constitute full compensation for this bid item as related subsidiary items.

- c. 48" CMP Riser with Trash Rack (Bid Item 14):
 - (1) This item will consist of furnishing and installing the corrugated metal pipe riser as shown on the drawings.
 - (2) The corrugated metal pipe shall be 12 gage aluminum coated with annular corrugations unless otherwise noted on the drawings. The minimum corrugation size shall be 3"x1".
 - (3) Pipe materials with recycled content that meet ASTM A 760 and A 929 for the specified size of pipe are preferred and should be used where feasible. Post-consumer Steel Content of 15 to 70% and total recoverable steel material of 25-100% is recommended if available. Engineer may request information regarding recycled content of pipe materials for review.
 - (4) Coupling bands, repair of damaged coatings, metal fabrication, trash rack, anti-vortex device, and other appurtenances are subsidiary to this item and shall not warrant separate payment.

IA-61 LOOSE ROCK RIPRAP

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

- 1. Items of work to be performed in accordance with this specification and the construction details therefore are:
 - a. Rip Rap, Class 'E' with Geotextile Fabric (Bid Item 15):
 - (1) This item shall consist of procurement and placement of rip-rap or revetment stone as shown on the drawings
 - (2) Rip-Rap Materials shall meet Iowa DOT Section 4130 Class E Revetment.
 - (3) Alternative materials, including natural field stone, may be substituted in place of rip-rap if the size, shape, and quantity is approved by the Engineer. Field stone may be sourced locally by the contractor or from the project landowner. Substitution requests shall be submitted to the Engineer and include photos showing the relative size and quantity of stone to be used.
 - (4) Measurement and payment shall be on an actual per ton basis of stone installed. Weigh tickets shall be provided to the Engineer.
 - (5) Subsidiary Item Geotextile Fabric, IA-95
 - (a) Geotextile shall be installed under all rip rap as shown on the drawings.
 - (b)No separate payment will be made for geotextile.
 - b. Granular Surfacing (Bid Item 16):
 - (1) This item shall consist of procurement and placement of 1" roadstone to as depth of 8", as shown on the drawings.
 - (2) Measurement and payment shall be on an actual per ton basis of stone installed. Weigh tickets shall be provided to the Engineer.
 - (3) Any costs associated with the respreading of existing granular material stripped as part of Site Preparation (Bid Item 1) shall be considered incidental to this bid item. No additional compensation shall be given.
 - (4) No additional compensation shall be given for the procurement or placement of additional granular material required to restore disturbed areas beyond the grading/construction limits. Any additional material shall be provided at the Contractor's expense.

IA-81 Metal Fabrication and Installation

- A. Measurement and Payment
 - 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
 - 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.
- B. Items of Work and Construction Details
 - 1. Items of work to be performed in accordance with this specification and the construction details therefore are:
 - a. Subsidiary Item- Metal and Metal Fabrication
 - (1) This item will consist of furnishing and installing all steel and aluminum shown on the drawings.
 - (2) No separate payment will be made for Steel, aluminum or metal fabrication. Payment for this item will be considered subsidiary to the following Bid Items:
 - (a) Corrugated Metal Pipe, 24" (Bid Item 12)
 - (b) Corrugated Metal Pipe, 42" (Bid Item 13)
 - (c) 48" CMP Riser with Trash Rack (Bid Item 14)

IA-92 FENCE

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

- 1. Items of work to be performed in accordance with this specification and the construction details therefore are:
 - a. Fencing, 5-Strands of Barbed Wire (Bid Item 17)
 - (1) This item will consist of furnishing and installation of fencing as shown on the project drawings.
 - (2) Fencing shall be 5 strands of barbed wire and in accordance with IA-92 (2) Standard Fence.
 - (3) Measurement and payment shall be on a per linear foot of fence installed and accepted.
 - b. Subsidiary Items Fence repair or replacement
 - (1) This item is subsidiary to Site Clearing, Preparation, & Waste Disposal (Bid Item 1).
 - (2) Any fence damaged or removed by the contractor that was not specified in the project drawings shall be replaced per IA-92. The fence type shall be determined by the type of existing fence that was damaged. Sufficient length of fencing shall be replaced to provide a seamless transition between the existing and replacement fence.

IA-95 GEOTEXTILE

A. Measurement and Payment

- 1. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in this specification Section.
- 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work.

- 1. Items of work to be performed in accordance with this specification and the construction details therefore are:
 - a. Subsidiary Item Geotextile Fabric
 - (1) This item shall consist of furnishing and placing geotextile on all earth surfaces that contact the rock riprap or roadstone as shown on the drawings.
 - (2) Geotextile shall be Class I, nonwoven.
 - (3) The geotextile shall be placed with the long dimension parallel to the channel.
 - (4) Geotextile shall not be measured and shall be considered subsidiary to Rock Riprap bid items.
 - (5) No additional payment will be made for geotextile.

TABLE 2. REQUIREMENTS FOR NONWOVEN GEOTEXTILES

Property	Test Method	Class I	Class II	Class III	Class IV ^{3/}
Tensile strength (pounds) ^{1/}	ASTM D 4632 grab test	180 minimum	120 minimum	90 minimum	115 minimum
Elongation at failure (%) $1^{1/2}$	ASTM D 4632	<u>>_50</u>	<u>></u> 50	<u>></u> 50	> 50
Puncture (pounds)	ASTM D 4833	<mark>80 minimum</mark>	60 minimum	40 minimum	40 minimum
Ultraviolet light (% residual tensile strength)	ASTM D 4355 150-hr exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent opening size – AOS	ASTM D 4751	As specified max. # 40 ^{2/}	As specified max. # $4\theta^{2/}$	As specified max. # 4 $\theta^{2/}$	As specified max. # 4 $\theta^{2/}$
Permittivity sec ⁻¹	ASTM D 4491	0.70 minimum	0.70 minimum	0.70 minimum	0.10 minimum

1/ Minimum average roll value (weakest principal

direction). 2/ U.S. standard sieve size

3/ Heat-bonded or resin bonded geotextile may be used for classes III and IV. They are particularly well suited to class IV. Needle punched geotextiles are required for all other classes.

IA-620 UNDERGROUND OUTLET

- A. Measurement and Payment
 - 1. For items of work for which specific unit prices are established in the contract, the length of pipe will be computed to the nearest foot along the centerline of pipe and shall include the length of the aprons. Payment will be made to constitute full payment for all labor, materials, equipment, and all other items necessary and incidental to the completion of the work.
 - 2. For items of work which lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for each item will be made at the contract lump sum prices and will constitute full compensation for completion of the work
- B. Items of Work and Construction Details
 - 1. Each of the following items shall be completed in accordance with IA-51 and IA-620. Measurement and payment for the following items shall be according to IA-51:
 - a. Corrugated Metal Pipe, 24" (Bid Item 12)
 - b. Corrugated Metal Pipe, 42" (Bid Item 13)
 - c. 48" CMP Riser with Trash Rack (Bid Item 14)

Section 2524. Highway Signing

DESCRIPTION. 2524.01

Erect traffic signs and delineators according to the contract documents.

2524.02 MATERIALS.

- A. Signing Materials: Apply Section 4186.
- B. Wood Posts: Apply Section 4164.
- C. Class A Crushed Stone: Apply Article 4120.04.
- D. Concrete Footings: Apply the provisions of Section 2403.

2524.03 CONSTRUCTION.

Ensure all parts used in construction of traffic signs and delineators are able to withstand a wind load of 30 pounds per square foot on the sign surface.

Fabrication of Signs. Α.

Traffic Signs. 1.

- Except as modified by the contract documents, fabricate signs according to the standards established in the Standard Highway Signs, 2004 edition, and 2012 Supplement as published by the US DOT.
- All traffic signs, except reference location signs and 6 inch by 6 inch route markers, are classified into two groups, b. Types A and B, as indicated in the contract documents.
 - Type A Signs. 1)
 - Comply with the following: a)
 - Aluminum, galvanized steel, plywood sheets mounted on wood posts or perforated square steel tubing.
 - Sign face material fabricated from reflective sheeting.
 - Sign legends accomplished with either the direct or reverse silk screen process, with black nonreflective sheeting that is direct applied, or transparent film, as approved for use by the retro reflective sheeting manufacturer.
 - b) Ensure the finished signs comply with the details specified in the contract documents.

Type B Signs. 2)

- Comply with the following: a)
 - Extruded aluminum highway sign panels mounted on either wood posts, perforated square steel tubing, or steel breakaway posts as specified in the contract documents.
 - Sign face material fabricated from reflective sheeting.
 - Sign legends accomplished through use of reflectorized or nonreflectorized letters, numerals, symbols, and borders that are direct applied.
- b) Ensure the finished signs comply with the details specified in the contract documents.
- Prior to fabrication, submit shop drawings for each Type B sign according to Article 1105.03. Each drawing is C) to be a scale drawing of the sign face, showing the size, arrangement, and spacing of all letters, numerals, symbols, and borders.
- Digital printing shall comply with the following: C.
 - Sign manufacturer shall be certified for digital printing by the retro reflective sheeting manufacturer.
 - All digital printing shall be done in a workmanlike manner and as recommended by the manufacturer of the retro reflective sheeting.
 - Appropriate manufacturer's recommended overlaminate films must be used in digital printing. Any noticeable deviation from the shades shall be cause for rejection of any sign.
 - Opaque or transparent inks shall be of the type and quality recommended by the manufacturer of the retro reflective sheeting.
 - A matched component system, recommended by the manufacturer shall be used in the digital printing process.

2 Reference Location Signs. a.

- Comply with the following:
 - Green reflectorized sheeting on flat aluminum or galvanized steel sheets as for Type A signs. .
- Reflectorized white message applied directly to the face material.
- Dimensions as specified in the contract documents.
- Mount reference locations signs on posts of the type specified for delineators. b.
- Prior to fabrication, submit shop drawings for each reference location sign according to Article 1105.03. Each drawing C, is to be a scale drawing of the sign face, showing the size, arrangement, and spacing of all letters, numerals, symbols, and borders.

Route Markers, 6 Inch by 6 Inch. 3.

- Comply with the following:
- Reflectorized sheeting on flat aluminum or galvanized steel sheets as for Type A signs.

Details as specified in the contract documents.

4. Delineators.

- a. Install a hermetically sealed, acrylic plastic, prismatic, reflex reflector, appropriately housed and contained on <u>Materials I.M. 486.07</u>.
- b. Mount above reference location signs on the same delineator post.

B. Erection of Signs, Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

1. Type A and B Signs.

- a. Accurately erect all Type A and B signs to comply with the dimensions and details shown in the contract documents. Obtain the Engineer's approval for all deviations from the contract documents before starting the work.
- b. After installation, modify each 4 inch by 6 inch wood sign post by field drilling holes as shown in the contract documents. All labor and equipment necessary for this modification is included in the price bid for the post and no separate payment will be made.
- c. Set wood posts in 12 inch diameter holes of the proper depth with a minimum embedment of 5.0 feet.
- d. Set posts to full depth at the required spacing. Align posts accurately both vertically and horizontally. Place backfill consisting of Class A crushed stone meeting the requirements of <u>Article 4120.04</u> into the post holes. Place material in layers no more than 6 inches in depth. Thoroughly compact each layer taking care to preserve the alignment of the posts.
- e. Where steel breakaway posts are specified in the contract documents, carefully drill or dig footing holes to the required size at the proper location. Spread the excavated earth within the right-of-way to blend uniformly with the existing surface to the Engineer's approval.
- f. Immediately before placing concrete, remove all loose and uncompacted material from the bottom of the hole. Some of the holes will be located in the bottoms of drainage ditches. In these cases conduct construction operations so that water will not enter excavated holes.
- g. For the breakaway base, tighten all bolts to maximum using a 12 inch to 15 inch wrench to bed washers and shims, and to clean bolt threads. Loosen each bolt in turn and retighten in systematic order to the torque specified in the contract documents. For the fuse plate assembly, tighten fuse bolts to the torque specified in the contract documents.
- h. Preposition stub posts and reinforcing to the proper depth as shown in the contract documents. Ensure stub posts and reinforcing are properly aligned and secured, complying with <u>Article 2405.03, H, 3</u>. Cast the footing to the elevation shown in the contract documents. Rod the concrete in place to fill all the voids. Form the exposed portion of the footing as shown in the contract documents. Shape the cap of the footing so that drainage is away from the base plate of the post. Apply the provisions of Section 2403.
- i. After the concrete has developed the strength required by <u>Article 2403.03, N, 2</u>, attach the post and adjust for correct alignment and elevation. Remove all excess concrete from around the holes.
- j. Erect extruded panels according to the details in the contract documents. Take necessary measures to prevent damage to sign faces. Repair (at no additional cost to the Contracting Authority) any mars, scratches, dents, or other damage to sign faces visible at a distance of 5 feet. Tighten locknuts on the post clip bolts by means of a torque wrench to 225 inch-pounds when using dry, clean, unlubricated threads. Draw the nuts on panel bolts tight.

2. Delineators, Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

- **a.** Drive the posts for delineators, reference locations signs, and 6 inch by 6 inch route markers. Provide a suitable driving cap. Attach signs and delineators after driving.
- **b.** Erect markers and delineators so that the signs and delineator reflectors will be at elevations called for in the contract documents. Ensure they are true to line and grade and are truly vertical. Where a reference locations sign is designated, attach the marker in place of a delineator. Where a 6 inch by 6 inch route marker is designated, attach it above the reference location sign on the same post.
- c. Ensure delineator posts for these signs are plumb and firm in the ground, spaced as shown in the contract documents, and driven to the required lines and grades. Ensure that after driving, the top of the post has substantially the same cross section dimensions as the body of the post. Battered heads will not be permitted. Remove from the site and replace (at no additional cost to the Contracting Authority) all posts which are bent or otherwise damaged to the extent that they are, in the Engineer's opinion, unfit in the finished work.

3. Perforated Square Steel Tube (PSST) Posts and Anchors.

- a. Position posts within anchor at furthest corner from likely point of impact from an errant vehicle.
- b. Embed post within anchor without any play.
- c. Provide minimum insertion length as required by manufacturer.
- d. Ensure inside of break-away and slip base anchors installed in concrete are free of concrete to allow drainage.
- e. Install triangular slip base assembly as required by manufacturer.

C. Sign Positioning.

The glossy surface on sign faces may produce specular reflection. Position signs to eliminate or minimize specular reflection in the following manner:

1. Overhead Signs.

- a. Adjust the sign face in the following manner, where the road grade approaching the sign is plus 2.0% or greater:
 - Vertical axis to be parallel to a plumb line.
 - Horizontal axis to be at right angles to the road.

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- **b.** Adjust the sign face in the following manner, where the road grade approaching the sign is less than plus 2.0%:
 - Vertical axis inclined to face upward at the rate of 1/8 inch per foot of vertical sign surface for each 1% the road grade differs from plus 2.0%.
 - Horizontal axis to be at right angles with the road.

2. Ground Installations.

- a. Ground installations will be shown in the contract documents.
- **b.** After installation of signs is complete, the signs will be inspected at night by the Engineer. If specular reflection is apparent on any sign, adjust its positioning to eliminate or minimize this condition.

D. Sign Identification.

Identify the signs as specified in Section 4186, with the following additions:

Sign No..... (Filled in by Sign Fabricator) Erection Date...... (Filled in by Sign Contractor)

2524.04 METHOD OF MEASUREMENT.

Measurement for signing, satisfactorily erected according to the contract documents, will be as follows:

A. Type A Signs.

- 1. Calculated in square feet of sign area completed in place based on the nominal dimensions of the signs.
- 2. The area of all regular, rectangular, triangular, octagonal, and circular shaped Type A signs will be measured from the nominal given dimensions. Cutouts for rounded corners, and so forth, will not be deducted. The area of all irregularly shaped Type A signs, such as U.S. and Interstate route markers, will be measured from the dimensions of a circumscribed rectangle around the route marker.

B. Type B Signs.

Calculated in square feet on the basis of area of the vertical, front face of the signs specified in the contract documents. Measurement will not be made for area in excess of this area.

C. Wood Posts for Type A or B Signs.

Each to the nearest foot for the various post sizes installed. When posts are placed to depths greater than the minimum depth specified, the measured length does not include any parts placed to depths greater than 1 foot more than the specified minimum.

D. Steel Breakaway Posts for Type A or B Signs.

- 1. Each to the nearest 0.1 foot for the various post sizes installed.
- 2. Unless specified otherwise in the contract documents, the measured length of steel breakaway posts includes no more than 1 foot over the length necessary to meet specified minimums.
- E. Concrete Footings for Breakaway Posts for Type A or B Signs.

Each will be counted by the various sizes installed.

F. Delineators, Reference Location Signs, and 6 Inch by 6 Inch Route Markers. Each will be counted by the various types installed.

G. Perforated Square Steel Tube Posts.

Linear feet, to nearest foot, measured from top of anchor to top of post. Embedded length will not be measured separately, but included in price bid for Perforated Square Steel Tube Posts.

H. Perforated Square Steel Tube Post Anchors. By count of each type installed.

2524.05 BASIS OF PAYMENT.

Payment for signing, satisfactorily erected according to the contract documents, will be at the contract unit price as follows:

A. Type A Signs.

- 1. Per square foot of sign area.
- 2. Payment is full compensation for furnishing, fabricating, and erecting the signs complete, including furnishing of the blank, application of reflective sheeting, application of the screened message, and all mounting hardware.
- B. Type B Signs.

- 1. Per square foot of sign area.
- 2. Payment is full compensation for:
 - Furnishing, fabricating, and erecting the complete signs, including furnishing aluminum extrusions or formed steel panel,
 - Applying reflective sheeting,
 - Furnishing and applying all letters, numerals, symbols, and border to the sign
 - Applying the sign to the post,
 - Furnishing all labor, and
 - Furnishing all other details necessary to provide signs complete and erected in place, except for the required footings and posts.

C. Wood Posts for Type A or B Signs.

- 1. Per linear foot.
- 2. Payment is full compensation for furnishing and erecting the posts, including treatment and other details necessary to provide the sign posts complete and erected in place.

D. Steel Breakaway Posts for Type A or B Signs.

- 1. Per linear foot for the various post sizes.
- 2. Payment is full compensation for furnishing, fabricating, and erecting the posts, including galvanizing and other details necessary to provide the sign posts complete and erected in place.

E. Concrete Footings for Breakaway Posts for Type A or B Signs.

- 1. Each for the various sizes.
- 2. Payment is full compensation for:
 - Excavating the hole,
 - · Furnishing and placing concrete, stub post, reinforcing bars, and so forth,
 - · Finishing, and
 - All other details necessary to provide a complete concrete footing.

F. Delineators, Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

- 1. Delineators and Reference Location Signs:
 - a. Each for the various types.
 - b. Payment is full compensation for:
 - Furnishing, fabricating, and erecting the delineators or reference location sign complete, including posts, reflector units, and frames for delineators, posts and reference location signs,
 - Furnishing all necessary fittings and attachments, and
 - All labor necessary to complete the work.
- 2. 6 inch by 6 inch Route Markers:
 - a. Each.
 - **b.** Payment is full payment for furnishing, fabricating, and erecting the route marker to a reference location sign post previously measured for payment, including all necessary fittings and attachments and all labor necessary to complete the work.

G. Perforated Square Steel Tube Posts.

- 1. Per linear foot.
- 2. Payment is full compensation for furnishing, fabricating, and erecting posts.

H. Perforated Square Steel Tube Post Anchors.

- 1. Each, by type.
- 2. Payment is full compensation for providing and installing anchor, coring pavement, backfilling with concrete, slip base hardware, and other details necessary to provide anchor complete and erected in place.

I. Excavation in Unexpected Rock.

Excavation in unexpected rock for wood posts for Type A or B signs, steel posts for Type A or B signs, concrete footings for Type A or B signs, delineators, perforated square steel tube posts, and reference location signs will be paid for as extra work in

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Article 1109.03, B. Unexpected rock will be considered as rock encountered during post erection, but neither visible from the roadway nor indicated in the contract documents.







END OF UI-018-LYONS-FERRING SUPPLEMENTAL SPECIFICATIONS

Upper Iowa WMA Watershed Improvements Shive-Hattery Project # 4185190

Issued for Construction 08/06/2021 SUPPLEMENTAL SPECIFICATIONS UI-018 -LYONS-FERRING

SECTION C: NRCS CONSERVATION PRACTICE 382: FENCING UPPER IOWA RIVER WMA UI-018-LYONS-FERRING



Fence: Barbed & Woven Wire

Iowa Job Sheet

Natural Resources Conservation Service (NRCS) Des Moines, Iowa Iowa Conservation Practice 382 September 2018

Definition

A constructed barrier to animals or people.

Purpose

Facilitate the application of conservation practices by providing a means to control movement of animals and people.

Conditions Where Practice Applies

This practice may be applied on any area where management of animal or people movement is needed. Fences are not needed where natural barriers will serve the purpose.

General Criteria and Specifications *A. Barbed Wire*

Barbed wire fences shall have a minimum of 4 wires for farm borders. A minimum of three wires shall be used for interior fencing, cross fencing, or excluding livestock from special areas such as wildlife areas, forested tracts, or other special use areas. Wires shall be placed approximately an equal distance apart. The top wire shall be at least 42 inches high and 2 inches below the top on wood posts and 1 inch below the top on steel posts. Wire shall be spaced no more than 12 inches apart.

Each barbed wire shall consist of 2 twisted strands of either $12 \frac{1}{2}$ gauge wire or $15 \frac{1}{2}$ gauge high tensile strength wire. The barbs shall be either 2-point barb or 4-point barb. Wire shall be stretched taut and attached after the posts are properly set and backfilled. Attached wire to the side of the post closest to the livestock, except on corners and curves where the wire should be placed on the outside of the corner or curve.

Barb wire fences shall not be electrified.

B. Woven Wire

Top and bottom strands of woven wire shall be a minimum of $12 \frac{1}{2}$ gauge. Wire for intermediate strands shall be $14 \frac{1}{3}$ gauge or heavier. Woven wire fences 32 inches or less in height shall have at least 2 barbed wires above the woven wire, spaced 8 to 12 inches apart. Fences constructed with woven wire 33-47 inches shall have at least 1 barbed wire above the woven wire. Woven wire fence 48 inches are not required to have barbed wire above except if it is needed to contain livestock or deter predators. The base of the woven



wire shall be placed near the ground surface. Optional barbed wire may be ran near the ground. The top wire shall be at least 42 inches above the ground level and 2 inches below the top of wood posts and 1 inch below top of steel posts. All wire shall be galvanized (Class 3). Wire shall be stretched and attached after the posts are properly set and backfilled. Attach wire to the side of the post closest to the livestock, except on corners and curves where the wire should be placed on the outside of the corner or curve.

C. Staples

Staples shall be 9 gauge steel or heavier with a minimum length of $1 \frac{1}{2}$ inches for soft woods and a minimum length of 1 inch for close grained hardwoods. Space should be left between the staple and the post to permit free movement of the wire. Wires may be attached to steel posts by use of manufacturer's clips or by 14 gauge galvanized wire twisted at least two turns.

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D. Posts

All wooden posts (except red cedar, osage orange, or black locust) shall be treated with creosote, pentachloraphenol, or chromate copper arsenate (CCA) by a method that ensures complete penetration of the sapwood. Quality of treated wood shall provide sufficient strength and quality to last for the expected life of the fence. At least half of the diameter of red cedar shall be heartwood.

E. Corner, Gate, Brace, and End Posts

Corner posts, gate posts, end posts, pull posts and brace posts shall be wood with sufficient length for the construction of at least a 42 inch high fence and permit setting the post at least 36 inches deep. Earth backfill shall be thoroughly tamped. Where soil depth is restricted to less than 36 inches, additional anchors or deadman applied against the direction of pull may be needed. Wood posts shall have a minimum top diameter of 5 inches. A 2 $1/_2$ -inch steel pipe with appropriate bracing or set in concrete of sufficient depth also may be used. Reinforced concrete or metal posts of equivalent strength may be substituted if they have suitable means of attaching wires and braces.

F. Line Posts

The maximum spacing of line posts shall be one rod (16 $\frac{1}{2}$ feet). Wood line posts shall have a minimum 3 inch top diameter. Wood line posts shall have a minimum length of $6 \frac{1}{2}$ feet and shall be set or driven to a minimum depth of 24 inches where conditions permit. When posts are set, earth backfill shall be thoroughly tamped. Steel line posts shall not weigh less than $1^{1/3}$ pounds per foot and shall have a steel anchor plate securely fastened to the plate. The posts shall be "T", "U", or "Y" shaped and have corrugations, knobs, studs, or grooves suitable for fastening fencing to the posts. Steel posts shall be rolled from high carbon steel and shall have a protective coating; either galvanized by the hot dip process, or painted with one or more coats of high grade weather resistant paint for steel, or enameled and baked. Steel line posts shall be at least 6 feet in length and shall be set in the ground a minimum of 20 inches. Steel posts shall be used as line posts at least once every 6 rods (99 feet) to act as a ground for lightning protection.

G. Bracing

End bracing will be installed at locations where the fence ends and on both sides of gate openings. Corner bracing should be installed where fence alignment changes 15 degrees or more. Bracing is required at all corner, gate, pull and end assemblies in a fence. The brace member shall be the equivalent of a wood post with a 3 $1/_2$ inch diameter at the top or a standard weight 2-inch diameter galvanized steel pipe. The brace shall be at least 3 feet above the ground and at least 8 inches below the top of the post. The brace member shall be 6 to 8 feet in length. A brace wire consisting of 2 complete loops of 9 gauge smooth wire, 2 loops of barbed wire or a single loop of $12 \frac{1}{2}$ gauge high tensile strength wire shall be installed. "H" braces or angle braces will be used in standard fences.

Pull post assemblies consisting of three posts with braces shall be installed in straight reaches of fence at intervals of 660 feet (40 rods), at any point where the vertical angle described by two adjacent reaches of wire is upward and exceeds 10 percent and at the beginning and end of each curve.

H. Crossings

For a narrow ditch or draw crossing with slopes steeper than 8 feet horizontal to 1 foot vertical, the fence shall be anchored with a concrete anchor weighing at least 150 pounds and buried with at least 18 inches of cover or a commercial screw-in type metal anchor 5 inches in diameter and not less than 48" long to position the fence to the contour of the ditch or draw.

I. Gates

Gates weighing less than 100 lbs. may be hung from single end posts properly installed. Heavy metal or wood gates more than 6 ft. wide shall best be attached to the pull post of an H-brace or diagonal floating brace.

All gates must be substantial enough to withstand expected pressures from livestock, predators, and/or wildlife.

Wire gates shall be made of the same materials as used for the fence. Panel or tube type gates shall be equivalent in quality to the fencing material and fitted with at least two hinges and a latch or chain for fastening.

Electrified perimeter fence gates may consist of a pair of 12 $^{1}/_{2}$ gauge straight or coiled wires installed to be non-electrified when opened. A 12 $^{1}/_{2}$ gauge overhead or insulated underground trans-mission line will be used to carry electricity across all gate openings (including electrified gates to charge the remain-der of the fence.

Operation and Maintenance

Regular inspection of fences should be part of an on-going management program. Inspection of fences at regular intervals and after storm events is needed to facilitate the function of the intended use of the fence. Maintenance and repairs will be performed as needed to facilitate the operation of the fence.

Specifications

Site-specific requirements are listed on the specifications sheet. Additional provisions are entered on the job sketch. Specifications are prepared in accordance with the NRCS Field Office Technical Guide. See Conservation Practice Standard – Fence (382).

Client:					Farm #:				
Field(s):				Tract #:					
Planned By:				Lo	ocatio	n:			
Date:				Le	ength	of Fence (ft)	:		
Landowner Objectives:									
Purpose: (check all that apply)									
Reduce erosion and improv	e water qua springs, w	ality by contro etlands, and	olling ponds.] Pro veh	tect sensitive	env trian	ironme . or an	ental areas and flora from imal traffic use.
Protect newly planted areas established.	from distur	bances until] Pro limi	tect the safet	y or	, people cess t	e, livestock, and wildlife by to hazardous areas.
Facilitate handling, moveme the pasture environment.	nt, and fee	ding of livest	tock in] Imp	orove distribut	tion a	and tin	ning of livestock grazing
Other (specify)									
Type of Fence – Barbed (check	all that ap	ply)							
3-strand barbed wire		4-strar	nd barbed	wire	9			5-str	and barbed wire
6-strand barbed wire		8-stran	nd barbed	wire	9			Othe	r:
Wire Gauge and Barbs					-				
12 ½ gauge wire] 2-p	oint barbs on	4" (or 5" ce	enters
☐ 15 ½ gauge wire				4-point barbs on 5" centers					
Type of Fence – Woven Wire			1						7
			Top/Bott	om	Wire	Gauge:			
Woven Wire Ht (ft):	# of Wire(s):	Intermediate Wire Gauge:		Wire Spacing (in):				
Woven Wire Type:			_	Top Deterrent Type:					
Attachment to Posts									
Staple Gauge:	Staple len	gth (in):			Ma	nufacturer clip	os		14 gauge wire
Line Posts (check all that apply		_							
Type: Size: Red Cedar or Osage Orange or Line posts are Black Locust or pressure treated or or longer 3" minimum or 6' Standard steel line posts (1 1/3 lb/ft posts) anchor plate			wood 6 $\frac{1}{2}$ feetSpacing: Wood line posts spaced a maximum of 16 $\frac{1}{2}$ feet apart set 2 ft deep minimum with a steel post every 99 ft for lightning protectionor Or maximum of 16 $\frac{1}{2}$ ft apart set to top of anchor plate or 20"			bod line posts spaced a n of 16 $1/_2$ feet apart set 2 ft imum with a steel post every ghtning protection seel line posts spaced a n of 16 $1/_2$ ft apart set to top of ate or 20"			
Braces, Corners, Ends, & Gates (check all that apply)									
Corners, Ends, & Gates (check all that apply) Corners, Ends, & Gates: (6 - 8 ft minimum length) 5" top diameter wood post or 2 1/2" galvanized steel pipe. Braces 3 ½ top diameter wood post or 2" galvanized steel pipe and Horizontal brace rails between 3' above ground and 8" below top of posts			Br or or		Vire 2 complete I 2 loops of ba Single loop of steel	loop: arbe of 12	s of 9 g d wire ^{2 1} / ₂ ga	gauge smooth wire uge high tensile, galvanized	

Iowa One Call

The contractor is required to follow Iowa One Call law.

IowaOneCall.com or Call 811

Ticket # _____

Layout Sketch and Drawing (Provide sketch, drawings, maps, and/or aerial photos)												
Scale 1" =	Scale 1" = ft. (NA indicates sketch not to scale: grid size = $\frac{1}{2}$ " by $\frac{1}{2}$ ")											
[[[

Attach IA-92 Fence Specifications and relevant fence drawings as needed.

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SECTION D: GEOTECHNICAL REPORT UPPER IOWA RIVER WMA UI-018-LYONS-FERRING

WATERSHED: Upper Iowa River	DATE: November 1, 2018	
LOCATION: Section 29, T98N, R	COUNTY: Allamakee	
STRUCTURE CLASS: III	TYPE: Aluminized CMP	SITE: Dan Lyons
PURPOSE: Grade Stabilization		GEOLOGIST: J. Thompson

SUMMARY OF GEOLOGIC INVESTIGATION

The geologic investigation for this site was conducted with a backhoe on May 24, 2018. In general, the site consists of loess colluvium/alluvium over bedrock residuum. The bedrock at this site is part of the of Ordovician aged (485 to 505 million years old) Galena Group and Platteville Formation, which consists primarily of marine dolomite.

Due to site topography and access a single test pit was excavated along the proposed centerline at this site. The test pit, TP-1, was excavated in the valley bottom on the right side of the ditch. In the ditch along centerline, there is about 10 feet of recent fine-grained colluvium/alluvium of the Holocene aged DeForest Formation (Camp Creek and Gunder Members). Holocene alluvium consists of 5 feet of silty clay (CL/ML) Camp Creek alluvium that is brownish gray in color, moist, with a firm consistency. Underlying the Camp Creek is another 5 feet of Gunder alluvium that is less silty, moist, firm clay (CL). At the bottom of the test pit at about 10-11 feet below the ground surface is sandy/gravelly clay (CL) bedrock residuum. This sandy/gravelly material was wet and soft.

Indications at the time of the investigation were that borrow material used to construct the dam would likely come from the pool area, so no additional borrow areas were considered. Additionally, the electrical resistivity of the borrow material was not measured at this site. It was suggested that aluminized corrugated metal would be used for the principal spillway pipe and this type of material should not need cathodic protection.

CONCLUSIONS AND RECOMMENDATIONS

- 1) A core trench of 4-5 feet, below the zone of influence by frost and roots, should be adequate across the centerline in the valley. Gunder alluvium at about 5 feet below the ground surface is slightly less silty than the material above it and therefore has a higher plasticity. If it is practical a core trench excavated a full 5 feet into the Gunder could provide a slightly better cutoff;
- 2) Surficial materials along centerline are firm clay and silty clay, so the site should need only routine stream channel cleanout beneath the footprint of the dam;

- 3) There should be adequate quantity and quality of clay borrow material available from the pool, but care should be taken to not excavate below the Gunder alluvium to avoid uncovering the sandy/gravelly residuum at around 10 feet below the ground surface;
- 4) There are two mapped sinkholes near the proposed structure; one located approximately 1,200 feet upstream of the centerline, and one located approximately 1,200 feet downstream of the centerline. Based on geologic mapping the bedrock along the centerline is marine limestone or dolomite, each of which are susceptible to karst sinkhole formation. Test pit excavation indicates that there is about 10 feet of alluvial sediment above the bedrock along the centerline, but care should be taken during construction to leave several feet of this alluvial material above the bedrock residuum to minimize the potential of additional sinkholes opening in the pool area. Although this structure is not intended to hold water in the pool for a significant length of time, any water stored even temporarily in the pool could create a pressure head on top of the bedrock surface, which may accelerate karst sinkhole development.



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Neil Sass, Area Soil Scientist 120 N Industrial Pkwy #4 West Union, IA 52175 Phone: (563) 412-3019

Date of Investigation:

Investigated by: Purpose: Landowner: Location: Boring Method/Equipment:

Overview of soils/area: Red arrow is proposed site(s): Neil's soil boring locations in red.



GPS Location:

Depth	Horizon	Matrix Color	USDA Texture	Additional observations	Estimated unified Classification
			Est. clay %	Redox features, clay films, etc	
0 to 14 i	nches - 1	.0YR 3/1 silt	loam topsoil		
14 to 21	inches -	10YR 4/3 si	lt loam		

Investigator's comments (topsoil depth, parent material, seasonal high water table, depth to bedrock, etc):

GPS Location:

Depth	Horizon	Matrix Color	USDA Texture	Additional observations	Estimated unified Classification
			Est. clay %	Redox features, clay films, etc	
0 to 13 i	nches - 1	.0YR 3/1 silt	loam. topsoi	I	
13 to 20	inches -	10YR 4/3 si	lt loam		

Investigator's comments (topsoil depth, parent material, seasonal high water table, depth to bedrock, etc):

Soil Description # ³ : West side - pasture

GPS Location:

Depth	Horizon	Matrix Color	USDA Texture	Additional observations	Estimated unified Classification					
			Est. clay %	Redox features, clay films, etc						
0 to 25	inches	- 10YR 3/	1 silt loam.	Topsoil						
25 to 32 inches - 10YR 4/3 silt loam										
32 to 48	inches -	10YR 4/4 s	ilty clay loar	n. clay estimate 27	-29%					
48 to 68	inches -	10YR 5/4 sil	t loam. clay e	estimate 22-26%						
68 to 84	68 to 84 inches - 10YR 5/4 with 5/2. silt loam. Clay estimate 18-22%									
84 inches	- probe r	efusal. bedr	ock.							

Investigator's comments (topsoil depth, parent material, seasonal high water table, depth to bedrock, etc):

thick topsoil in this area.

Best clay material starts at 32 and goes to 48 inches. Below this from 48 to 68 is less clay but should be usuable as well. recommend packing during construction.

GPS Location:

Depth	Horizon	Matrix Color	USDA Texture	Additional observations	Estimated unified Classification					
			Est. clay %	Redox features, clay films, etc						
0 to 17 inches - 10YR 2/1 & 3/1 silt loam. topsoil										
17 to 32 inches - 10YR 4/4 silty clay loam. clay estimate 27-30%										
32 to 87	inches - 2	10YR 5/4 wi	th 5/2 redox.	silt loam. clay estin	nate 16-22%					
87 to 120	37 to 120 inches - 7.5YR 5/6 clay loam/silty clay loam/silty clay. Clay estimate 32-38%									
120 inche	es - probe	refusal. be	drock							

Investigator's comments (topsoil depth, parent material, seasonal high water table, depth to bedrock, etc):

good clay borrow 17 to 32 inches. marginal borrow below this, clay content not as high. recommend extra packing or mixing during construction.

87 to 120 inches is paleosol/terra rosa material. bright red & high clay. suitable if you want to go this deep.

Bedrock at 10 feet.

Soil Descrip	ution # 5 : b	orrow on nort	h side of road:	GPS Location:						
Depth	Horizon	Matrix Color	USDA Texture	Additional observations Redox features, clay films, etc	Estimated unified Classification					
Same	Same as test hole #1									

Investigator's comments (topsoil depth, parent material, seasonal high water table, depth to bedrock, etc):

Profile same/similar to test hole #1

Investigator's summary of site: (suitable or not):

GPS Points Map – (also shows photo point and gelogic investigation location)



Photos of SB8 – Didn't probe because gulley had cut down to rock. See photos below.




Upper Iowa River Watershed Flood Mitigation Site Characterization Study – Site 11 (Lyons east)

Prepared for the Upper Iowa River Watershed Management Authority Coordinator and Shive-Hattery, Inc.



June 2020

Prepared by Ryan Clark, Jason Vogelgesang, and Phil Kerr

Iowa Geological Survey IIHR - Hydroscience and Engineering The University of Iowa



INTRODUCTION

This report summarizes the results of the desktop geologic review, field reconnaissance, geophysical survey, and interpretations of subsurface drilling activities conducted by the Iowa Geological Survey (IGS) for the Upper Iowa River (UIR) Watershed Management Authority (WMA) and Shive-Hattery, Inc. (Client). This work was initiated by the UIRWMA coordinator, Matt Frana, due to concerns of karst geology effecting the viability of water retention structures at three proposed sites (Fig. 1). The purpose of this work was to assess the depth to bedrock and the character of the underlying geology at the selected sites within the UIR watershed. This report covers Site 11 (Lyons east), hereinafter referred to as "the Site", which is located about four miles west of Waukon in Allamakee County, Iowa (Fig. 1).



Figure 1: Vicinity map showing the locations of all three sites. Basemap is colorized shaded relief (LiDAR).

Phase 1 of the project included conducting a desktop geologic review and field reconnaissance to gain a better understanding of the character of the underlying geology. Phase 2 involved conducting an electrical resistivity (ER) geophysical survey to image the depth to the bedrock surface and to identify possible anomalies within the bedrock that may reflect karst features. Phase 3 involved drilling at selected locations within the Site to reinforce the findings and interpretations gleaned in the previous phases.

Phase 1: Desktop Geologic Review and Field Reconnaissance

The desktop geologic review included an evaluation of all available geologic data as well as field reconnaissance of quarries and bedrock exposures in the vicinity of the Site. Figure 2 illustrates the topographic relief in the vicinity of the Site. Previous geologic mapping efforts in the UIRW (Wolter et al., 2011) provided the basis for the geologic assessment (Fig. 3).



Figure 2: Zoomed in view of Fig. 1 showing Site 11 (Lyons east) along with the cross-section line. Black dots are possible sinkholes. The lowest elevation at Site 11 is around 1,165' above sea level.



Figure 3: Bedrock geologic map over LiDAR hillshade map of Site 11 (Lyons east).

Water well records from the IGS GeoSam database and known bedrock exposures in the vicinity of the Site were utilized to construct a schematic geologic cross-section of the area (Fig. 4). The bedrock underlying the Site belongs to the Ordovician age Dunleith Formation of the Galena Group. The Dunleith Fm. in the vicinity of the Site consists of dolomite and limestone (Fig. 5A). The bedrock exposed at the Site is limestone of the Dunleith Fm. overlain, and intermingled with, a dense paleosol (Fig. 5 B-C).



Figure 4: Schematic geologic cross-section from west to east through Site 11 (Lyons east).

Karst Potential

The upper part of the Dunleith Fm. and overlying Dubuque/Wise Lake formations are susceptible to karst. According to the karst potential survey done as part of the UIRW mapping program (Wolter et al., 2011) the Wise Lake and Dunleith formations are highly susceptible to karst. The number of sinkholes identified within the watershed formed in the Dubuque/Wise Lake formations was 1,974 (19.64 sinkholes per square mile) and the Dunleith Fm. was 1,303 (13.01 sinkholes per square mile). However, the study did not differentiate the Dunleith Fm. into its upper, limestone-dominated facies, and the lower facies that has interbedded shale layers. Based on the locations of known sinkholes in the area, it appears that the lower part of the Dunleith Fm. does not host a significant number of sinkholes. It is unclear as to whether the Site is underlain by the upper or lower part of the Dunleith Fm.



Figure 5: Exposures of the Dunleith Formation. A) Dunleith Fm. exposed in the working face inside the Aske Quarry located about four miles west of the Site. Notice the abundance of vertical fractures/joints, some of which have been filled with overlying sediments. B) Limestone slabs of the Dunleith Fm. exposed at the Site where the former impoundment had apparently been washed out. C) Close up view of the washout area showing how the overlying sediments (paleosol) intermingle with slabs of bedrock within the weathering profile.

Phase 2: Geophysical Survey

ER geophysical investigations were completed to help identify current and developing karst hazards and/or large voids present in carbonate rock. Karst related voids filled with water can be anomalously conductive when compared to surrounding rock, while features filled with air can be anomalously resistive. On October 4, 2019, the IGS completed electrical resistivity geophysical surveys at the Site, as outlined in the project proposal. ER lines were centered around the general area of the proposed water retention structure. An Advanced Geosciences, Inc. (AGI) SuperSting R8 electrical resistivity meter was used for this investigation. An electrode spacing of 13 feet (4 meters) was utilized to ensure high-resolution data were collected and adequate depths were imaged. A Juniper Systems Geode precision GPS was used to determine starting and ending locations for ER lines. Field data were collected using a dipole-dipole array and processed using AGI EarthImager 2D software. Transects of sufficient length were run to obtain electrical resistivity data to depths of more than 70 feet below the ground surface at the Site. Results and associated information from the IGS geophysical surveys are shown in Figure 7. Interpretations of the bedrock surface and bedrock characteristics are labeled on annotated images. Transect coordinates are given in Table 1.

ER results show the top of bedrock as being variable across the Site, with deeper depths to rock generally observed toward the southwest side of the Site and shallower depths to rock toward the northeast. No major anomalous resistive or conductive features were present, which can be indicative of water or soil-filled voids (conductive) or air-filled voids (resistive). Therefore, based on the available information, no major karst related voids were interpreted to reside in the shallow subsurface at the Site. Minor anomalous features were drilled to determine the competency of the underlying rock (see Phase 3: Confirmation Drilling). Anomalous features observed in the geophysical results are interpreted in greater detail below. While subsurface moisture and groundwater can greatly affect the resistivity of materials, a consistent water table depth could not be interpreted from the geophysical results. The water table was not encountered in any of the boreholes drilled for this project.

Point ID	Latitude (WGS84)	Longitude (WGS84)	UTM X (NAD83 Zone 15N)	UTM Y (NAD83 Zone 15N)	Elevation (FASL)
East Line 1 - Start	43.283674	-91.569034	616098.445567	4793311.185260	1177.7
East Line 1 - End	43.283690	-91.567906	616189.884888	4793314.503580	1174.1
East Line 2 - Start	43.283190	-91.569331	616075.288013	4793257.005210	1178.7
East Line 2 - End	43.283372	-91.568230	616164.193503	4793278.736880	1167.8
East Line 3 - Start	43.283163	-91.568524	616140.774487	4793255.103980	1172.4
East Line 3 - End	43.283692	-91.568226	616163.906958	4793314.263610	1166.6
East Line 4 - Start	43.283071	-91.569120	616092.628632	4793244.109970	1173.3
East Line 4 - End	43.283678	-91.568591	616134.343336	4793312.257350	1167.4

Table 1. Electrical resistivity line locations.



Figure 6: Map of Site 11 (Lyons east) showing the locations of the ER lines, boreholes, and spots where bedrock was either exposed and the land surface or encountered while deploying electrode stakes during the ER survey (within about 18" from the surface).



Figure 7: Results of the electrical resistivity survey.

Line Interpretations

Descriptions of anomalies and features imaged in each line are as follows:

- Boreholes: Each borehole drilled along a line was plotted and labeled at the top of each figure. The depth at which bedrock was encountered is shown by the bottom of each vertical line.
- Dashed line: The soil and bedrock interface is depicted as a dashed line near the top of each figure. While the ER survey was able to identify the interface most of the time, no clear bedrock interface was found in some cases. This is likely due to ER model uncertainty, as the land surface represents the model domain edge. Since there are no ER data "above" the ground surface (all data are gathered from the subsurface), the model attempts to best-fit data along that edge. When bedrock is very shallow (within ten feet or less), ER surveys generally cannot define the bedrock surface reliably. For this reason, ER was proposed to image the study area for potential karst related voids and not necessarily to image the bedrock surface. The drilling results and the ER data were used to estimate the bedrock surface along this line.
- "R2" labels Less competent carbonate rock (~100 ohm-m). These are areas where sinkholes may be more likely to occur. They are not interpreted as being current karst related voids.
- "R3" labels Massive, competent carbonate rock (>400 ohm-m). These areas are interpreted as having competent, in-tact bedrock, and are less likely to experience karst related issues.

Phase 3: Confirmation Drilling

On May 12, 2020 a total of five boreholes were drilled at the Site to evaluate the competency, type, and depth of the bedrock in potentially anomalous areas identified in the geophysical survey (Fig. 8). Descriptive logs of each boring are provided in Appendix A. Surficial materials overlying the bedrock were characterized on-site from cuttings generated by the solid stem flight augers (Fig. 9). Auger refusal was highly variable and is not considered to be directly related to the competency of the limestone bedrock due to the variations in down pressure and rotational speed from one boring to the next. The depth to the bedrock surface was based on drill stem response and auger cuttings. Boring L-1 encountered bedrock at two feet below ground surface (bgs) so the rig was offset about ten yards and another boring was drilled (L-1 off) to provide a better assessment of the surficial materials. The water table was not encountered at any of the boreholes.



Figure 8: Drill rig at Site 11 (Lyons east).



Figure 9: Limestone cuttings at the base of the flight auger indicative of bedrock.

Conclusions

This report summarizes the findings of the desktop geologic review, geophysical survey, and drilling services conducted for the purpose of evaluating the suitability of the Site for a flood water retention structure. The results of the desktop geologic review and field reconnaissance determined that the bedrock underlying the Site is the Dunleith Formation. The Dunleith Fm. is considered slightly less susceptible to karst as the overlying Dubuque/Wise Lake formations. The ER geophysical survey was conducted in areas selected by the IGS, in consultation with the UIRWMA coordinator, to image the surficial and bedrock characteristics at the Site. Results from the geophysical survey were used to guide the drilling of boreholes, which confirmed geophysical results and identified potential features. Limestone bedrock was encountered at each borehole location at depths ranging from two to eight feet bgs.

Based on field data collected at the Site and information gathered from the geologic assessment of the area, the IGS concludes that no apparent karst-related hazards (voids) exist beneath the Site at this time. Although the possibility for karst-related subsidence always exists in areas with shallow carbonate rock, the IGS deems the Site as being suitable for a flood retention structure.

References

- Wolter, C. F., McKay, R. M., Liu, H., Bounk, M. J., and Libra, R. D., 2011: Geologic Mapping for Water Quality Projects in the Upper Iowa River Watershed. Iowa Geological Survey Technical Information Series No. 54, 34 p., 15 figs, 1 table.
- Water well information including driller's logs and geologic strip logs can be accessed via GeoSam: https://www.iihr.uiowa.edu/igs/geosam/home
- Geospatial data such as LiDAR, digital elevation models (DEM), historic aerial photography, geologic maps, etc. can be accessed via Iowa GEODATA: <u>https://geodata.iowa.gov/</u>

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IOWA GEOLOGICAL SURVEY 1 R Client Project UIRW- Flood Mitigation Site Characterization Study **UIRW & Shive-Hattery** Core Location L-2 Lyon graphic log material color texture other 0 dark brown solum silt loam to tan 5 silt tan to silt loam dark brown limestone no water table encountered tan 10 Depth (ft) 15 20

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