Iowa Storm Water Management Manual

Design Standards Specifications

Includes specifications for the following subjects found in the indicated design chapters and sections:

INFILTRATION TRENCHES
CHAPTER 5 - SECTION 2

These specifications compliment the infiltration trench design portion of the Iowa Stormwater Management Manual in Chapter 5, section 2 of the Design Standards.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

Infiltration Trench

1.2 DESCRIPTION OF WORK

Construct infiltration trenches for storage and treatment of stormwater runoff

1.3 SUBMITTALS

Comply with the requirements of the contract documents

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents

1.7 SPECIAL REQUIREMENTS

None

1.8 MEASUREMENT AND PAYMENT

A. **Class 10, Class 12, or Class 13 Excavation:** Refer to SUDAS Section 2010, 1.08, E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Observation Well:

1. **Measurement:** Each observation well will be counted.
2. **Payment:** Payment will be made at the unit price for each observation well.
3. **Includes:** Unit price includes, but is not limited to, concrete pad, supplying and installing pipe, couplings, and fittings.

C. Filter Sand:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of filter sand furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing filter sand material.

D. Storage Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.

2. **Payment:** Payment will be made at the unit price per ton of storage aggregate furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing storage aggregate material.

E. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard.
3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

F. Filter Aggregate:

1. **Measurement:** Each type of filter aggregate will be measured in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton for each type of filter aggregate furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing filter aggregate material.

PART 2 - PRODUCTS

2.1 OBSERVATION WELL

A. Pipe: Perforated or slotted 6 inch diameter pipe complying with one of the following.

1. Solid wall PVC pipe complying with ASTM D 1785, Schedule 40.
2. Solid wall PVC pipe complying with ASTM D 3034, SDR 35.
3. Corrugated PVC pipe complying with ASTM F 949, with a minimum pipe stiffness of 46 psi.

B. Cap: Provide PVC cleanout fitting with removable threaded plug.

C. Concrete Pad: Provide a 12 inch by 12 inch precast concrete patio block to support the observation well.

2.2 FILTER SAND

Provide sand complying with Iowa DOT Section 4110, Gradation No. 1.

2.3 STORAGE AGGREGATE

Washed river gravel/river rock with 100% passing the 2 ½ inch sieve and 100% retained on the 1 ½ inch sieve.

2.4 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.5 FILTER AGGREGATE

A. **Type 1:** Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 57).

B. **Type 2:** Provide aggregate complying with one of the following:

1. ½ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 20 (AASHTO M 43/ASTM D 448, Size 7).
2. ⅜ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 21 (AASHTO M 43/ASTM D 448, Size 8).

PART 3 - EXECUTION

3.1 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating the infiltration trench.

B. Prior to installing the infiltration trench, install sediment control practices upstream to protect the infiltration trench from sediment in stormwater runoff from disturbed soil.

3.2 INFILTRATION TRENCH INSTALLATION

A. Excavate infiltration trench to the length, width, and depth specified in the contract documents. Do not compact the bottom of the trench and do not operate heavy machinery on the bottom of the trench.

B. If an observation well is specified, install according to 3.3 below.
C. Place a 6 inch layer of filter sand over the bottom of the trench and lightly tamp.
D. Place the storage aggregate in 8 inch lifts to an elevation 1 foot below the finished elevation specified in the contract documents. Compact each lift to 50% Relative Density. Do not over-compact.
E. Install engineering fabric over the top of the storage aggregate layer. Overlap adjacent strips of fabric a minimum of 6 inches.
F. Place filter aggregate on top of the engineering fabric, up to finished elevation. Do not compact filter aggregate.
G. Upon completion of infiltration trench, immediately install sediment control practices around infiltration trench as required to protect the trench from sediment in stormwater runoff from disturbed soil.
H. Do not place soil, mulch, sand, aggregate, or stockpile other materials on or near the surface of the infiltration trench.

3.3 OBSERVATION WELL INSTALLATION

A. Cut perforated PVC pipe 6 inches longer than the specified depth of the infiltration trench.
B. Install cleanout fitting and threaded plug in top end of the pipe. Leave the bottom end of pipe open; do not install plug or cap on bottom end of pipe.
C. After excavating for the infiltration trench, set concrete pad on subgrade and place observation well on the pad at location specified in the contract documents.
D. Temporarily brace observation well pipe in a vertical position and maintain during placement of the filter sand, storage aggregate, and filter aggregate.
E. Do not wrap pipe with engineering fabric.

BIORETENTION SYSTEM
CHAPTER 5 - SECTION 4

These specifications compliment the bioretention system design portion of the Iowa Stormwater Management Manual in Chapter 5, section 4.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

Bioretention System

1.2 DESCRIPTION OF WORK

Construct bioretention system for storage and treatment of stormwater runoff.

1.3 SUBMITTALS

Comply with the requirements of the contract documents.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

None

1.8 MEASUREMENT AND PAYMENT

A. **Class 10, Class 12, or Class 13 Excavation:** Refer to SUDAS Section 2010, 1.08 for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Choker Aggregate:

1. **Measurement:** Each type of choker aggregate will be measured in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton for each type of choker aggregate furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing choker aggregate material.

C. Aggregate Subbase:

1. **Measurement:** Each type of aggregate subbase will be measured in tons based upon scale tickets for the material delivered and incorporated into the project.

2. **Payment:** Payment will be made at the unit price per ton for each type of aggregate subbase furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing aggregate subbase.

D. Underdrain:

1. **Measurement:** Measurement will be in linear feet for each type and size of pipe installed. Pipe will be measured from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts and observation wells will be included in the length of pipe measured. Lengths of elbows, tees, wyes and other fittings will be included in length of pipe measured.
2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe and pipe fittings.

E. Underdrain Cleanout:

1. **Measurement:** Each type and size of underdrain cleanout will be counted.
2. **Payment:** Payment will be made at the unit price for each underdrain cleanout.
3. **Includes:** Unit price includes, but is not limited to, furnishing and installing pipe, couplings, and fittings.

F. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing engineering fabric and any overlapped areas.

G. Modified Soil Layer:

1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. The plan quantity will be based upon the proposed excavated area to be filled with modified soil, plus an additional 5% to account for anticipated shrinkage. Adjustments may be made to the plan quantities if agreed to by both the engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of modified soil.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, blending, and placing modified soil. If compaction by soaking is specified for modified soil, unit price includes supplying and applying water to compact the material.

H. Hardwood Mulch:

1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of hardwood mulch.
3. **Includes:** Unit price includes, but is not limited to, supplying, hauling, and placing mulch.

PART 2 - PRODUCTS

2.1 UNDERDRAIN CLEANOUT

A. Pipe and Fittings: Minimum 6 inch diameter pipe complying with one of the following.

1. Solid wall PVC pipe complying with ASTM D 1785, Schedule 40.
2. Solid wall PVC pipe complying with ASTM D 3034, SDR 35.
3. Corrugated PVC pipe complying with ASTM F 949, with a minimum pipe stiffness of 46 psi.

B. Cap: Provide PVC cleanout fitting with removable threaded plug.

2.2 AGGREGATE SUBBASE

Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability crushed stone (AASHTO M 43/ASTM D 448, Size 57).

2.3 UNDERDRAIN

Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040. Provide 4 inch diameter pipe unless otherwise specified in the contract documents.

2.4 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196.b, requirements for subsurface drainage.

2.5 CHOKER AGGREGATE

Comply with one of the following:

1. ½ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 20 (AASHTO M 43/ASTM D 448, Size 7).
2. ⅜ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 21 (AASHTO M 43/ASTM D 448, Size 8).

2.6 MODIFIED SOIL

A. Organic Material: Provide suitable organic material composed of products from plant material such as:

i. Compost complying with the requirements for mulch for pneumatic seeding in SUDAS Section 9010, 2.07.C.
ii. Finely chipped bark (⅜" diameter or less)
iii. Finely shredded, partially decomposed mulch
iv. Peat and sphagnum peat moss

Other organic material specified by a design engineer or landscape architect provided it has no detrimental chemical compounds, does not have high nutrient content that would increase nutrient loading in leachate, will increase the water holding capacity of the soil media and will enhance the ability of the media to capture and hold pollutants to facilitate breakdown is also acceptable. Compost shall comply with the requirements for mulch specified in the Iowa SUDAS Specifications Manual, Division 9, Section 9010, Part 2.07C.

B. Sand: Provide clean sand complying with Iowa DOT Section 4110, Gradation No. 1.

C. Soil: Provide soil taken from the top 6 inches of the A-horizon, have a dark brown to black color, have a granular structure and clay content less than 25% verified with a ribbon test that yields no more than 1".

D. Mixture: The texture of the modified soil mixture will be loamy sand or sandy loam according to the USDA Soil Classification system, soil textural triangle. A laboratory analysis for particle size or a simplified dispersal method for sand content only can also be used to verify soil texture. Thoroughly blend organic materials, sand and soil to provide a mixture with 0-10% suitable organic material, 75-90% sand and 0-25% soil by volume.

2.7 WOOD MULCH

Provide shredded, hardwood mulch with a 4" maximum length complying with the following:

- Free from leaves, twigs, dust, toxic substances, and any other foreign material.

2.8 WATER

Supply potable water for consolidating the modified soil layer. In lieu of potable water, supply clean, clear water, free of harmful contaminates, from a source approved by the engineer.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating for the bioretention system.
B. Prior to installing the bioretention system, install erosion and sediment control practices upstream to protect the bioretention system from sediment in stormwater runoff from disturbed soil.

3.2 BIORETENTION SYSTEM INSTALLATION

A. Excavate bioretention system area to the length, width, and depth specified in the contract documents. Do not compact the bioretention area subgrade and do not operate heavy machinery on the subgrade. Do not operate heavy machinery in the excavated area while placing the modified soil.
B. Place the first 2 inches of the aggregate subbase evenly over the bottom of the bioretention area.
C. If underdrain is specified in the contract documents, install slotted pipe at the elevation specified. Install cleanouts at locations specified in the contract documents.
D. Place remaining aggregate subbase layer to the elevation specified in the contract documents.
E. If a choker aggregate layer is specified in the contract documents, install over stone aggregate subbase layer to

the depth specified.

F. If nonwoven geotextile fabric is specified in the contract documents, install over the top of the aggregate subbase and up the sides of the excavation. Overlap adjacent strips of fabric a minimum of 6 inches.
G. Place modified soil in 8-12 inch lifts to the elevation specified in the contract documents. Overfill area with modified soil by 5% of the specified depth to allow for natural settlement.
H. Avoid over compaction by allowing time for natural settlement. If the project schedule does not allow for natural settlement of soil and the contract documents require compaction by soaking, compact the filter soil matrix by soaking as described below:
    1. Apply water to uniformly saturate surface by spraying or sprinkling.
    2. Ensure entire bioretention area is saturated.
    3. Add modified soil as required to restore settled surface to finished elevation.
I. Uniformly grade and rake the top of the modified soil layer to a flat, smooth, uniform surface.
J. If contract documents specify seeding for the surface of the of bioretention system, install seeding as specified. Mulch seeded areas with bonded fiber matrix or rolled erosion control products as specified in the contract documents.
K. When specified in the contract documents, place a 3 inch layer of hardwood mulch over area filled with modified soil. Do not place hardwood mulch over seeded areas. If the contract documents specify plants for the surface of the modified soil layer, install prior to placing mulch.
L. Do not stockpile materials on or near the surface of the completed bioretention cell.
M. Protect completed bioretention area from heavy machinery and other construction equipment.

BIOSWALES
CHAPTER 5 - SECTION 5

These specifications compliment the bioswale design portion of the Iowa Stormwater Management Manual in Chapter 5, section 5.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

Bioswales.

1.2 DESCRIPTION OF WORK

Construct bioswale for treatment of stormwater runoff.

1.3 SUBMITTALS

Comply with the requirements of the contract documents.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

None.

1.8 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010, 1.08, E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Choker Aggregate:

1. **Measurement:** Each type of choker aggregate will be measured in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton for each type of choker aggregate furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing choker aggregate material.

C. Aggregate Subbase:

1. **Measurement:** Each type of aggregate subbase will be measured in tons based upon scale tickets for the material delivered and incorporated into the project.

2. **Payment:** Payment will be made at the unit price per ton for each type of aggregate subbase furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing aggregate subbase material.

D. Subdrain: Refer to SUDAS Section 4040, 1.08, A for measurement and payment information for subdrains.

E. Subdrain Cleanout: Refer to SUDAS Section 4040, 1.08, C for measurement and payment information for subdrain cleanouts.

F. Nonwoven Geotextile Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with geotextile fabric. Both horizontal and vertical areas covered with geotextile fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of geotextile fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing geotextile fabric and any overlapped areas.

G. Modified Soil Layer:

1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. The plan quantity will be based upon the proposed excavated area to be filled with modified soil, plus an additional 5% to account for anticipated shrinkage. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of modified soil.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, blending, and placing modified soil. If compaction by soaking is specified for modified soil, unit price includes supplying and applying water to compact the material.

H. Check Dams:

1. Rock Check Dams:

a. **Measurement**: Measurement will be in ton of stone installed.
b. **Payment**: Payment will be at the unit price per ton of stone installed.
c. **Includes**: Unit price includes, but is not limited to, engineering fabric (if specified).

2. Earthen Check Dams:

a. **Measurement**: Measurement will be in cubic yards.
b. **Payment**: Payment will be made at the unit price per cubic yard of material installed.
c. **Includes**: Unit prices includes, but is not limited to, furnishing, hauling, excavation for placement of revetment materials, and engineer fabric (if specified).

I. Surface Roughening:

1. **Measurement:** Measurement will be in square feet of surface roughening, including directional tracking or grooving/furrowing.
2. **Payment:** Payment will be at the unit price per square foot of surface roughening.

J. Hardwood Mulch:

1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of hardwood mulch.
3. **Includes:** Unit price includes, but is not limited to, supplying, hauling, and placing mulch.

PART 2 - PRODUCTS

2.1 SUBDRAIN CLEANOUT

Comply with SUDAS Section 4040, 2.06, A for Type A-1 Cleanouts. Match diameter of the adjacent subdrain.

2.2 AGGREGATE SUBBASE

Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability crushed stone (AASHTO M 43/ASTM D 448, Size 57).

2.3 SUBDRAIN

Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040, 2.02. Pipe size as specified in contract documents, should match diameter of pipe used for subdrain cleanouts.

2.4 NONWOVEN GEOTEXTILE FABRIC

Comply with Iowa DOT Article 4196.01, B, 2, meeting the requirements for subsurface drainage.

2.5 CHOKER AGGREGATE

Comply with the following:

- ⅜ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 21 (AASHTO M 43/ASTM D 448, Size 8).

2.6 MODIFIED SOIL

A. Organic Material: Provide suitable organic material composed of products from plant material such as:

i. Compost complying with the requirements for mulch for pneumatic seeding in SUDAS Section 9010, 2.07.C.
ii. Finely chipped bark (⅜" diameter or less)
iii. Finely shredded, partially decomposed mulch
iv. Peat and sphagnum peat moss

Other organic material specified by a design engineer or landscape architect provided it has no detrimental chemical compounds, does not have high nutrient content that would increase nutrient loading in leachate, will increase the water holding capacity of the soil media and will enhance the ability of the media to capture and hold pollutants to facilitate breakdown is also acceptable. Compost shall comply with the requirements for mulch specified in the Iowa SUDAS Specifications Manual, Division 9, Section 9010, Part 2.07C.

B. Sand: Provide clean sand complying with Iowa DOT Section 4110, Gradation No. 1.

C. Soil: Provide soil taken from the top 6 inches of the A-horizon, have a dark brown to black color, have a granular structure and clay content less than 25% verified with a ribbon test that yields no more than 1".

D. Mixture: The texture of the modified soil mixture will be loamy sand or sandy loam according to the USDA Soil Classification system, soil textural triangle. A laboratory analysis for particle size or a simplified dispersal method for sand content only can also be used to verify soil texture. Thoroughly blend organic materials, sand and soil to provide a mixture with 0-10% suitable organic material, 75-90% sand and 0-25% soil by volume.

2.7 WOOD MULCH

Provide shredded, hardwood mulch with a 4 inch maximum length. Ensure the mulch is free from leaves, twigs, dust, toxic substances, and any other foreign material.

2.8 CHECK DAMS

A. Rock Check Dams:

1. **Bulk Revetment Materials:** Class E Revetment, complying with Iowa DOT Section Article 4130.02. Revetment should be clean and free of fine materials.
2. **Choker Course:** Washed clean stone, 1 inch nominal diameter.
3. **Engineering Fabric:** When use of engineering fabric is specified in the contract documents, comply with Iowa DOT Article 4196.01, B for embankment erosion control.

B. **Earthen Check Dams:** Refer to SUDAS Section 2010, 2.04, A for embankment soils.

2.9 WATER

Supply potable water for consolidating the modified soil layer. In lieu of potable water, supply clean, clear water, free of harmful contaminates, from a source approved by the Engineer.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION PROTECTION

A. Complete upland grading, utility installation, and other earth disturbing operations prior to excavating for the bioswale.
B. Construct pre-treatment practices as specified in the contract documents.
C. Prior to installing the bioswale, install erosion and sediment control practices upstream to protect the bioswale

from sediment in stormwater runoff.

3.2 BIOSWALE INSTALLATION

A. Complete rough grading activities to excavate the bioswale area to the length, width, and depth specified in the contract documents. Do not compact the bioswale subgrade and do not operate heavy machinery on the subgrade.
B. Perform topsoil re-spread, fine grading operations, and seedbed preparation as specified in the contract documents.
C. Excavate the trench for the subdrain similar to SUDAS Figure 4040.231 for Type 1 Subdrain applications.
D. Excavate across the bottom of the bioswale for placement of the modified soil layer as specified in the contract documents.
E. Verify that the bottom of the subdrain trench is clear of debris or other material and remains at the proper subgrade elevation to allow for subdrain installation.
F. If nonwoven geotextile fabric is specified in the contract documents, install over the bottom of the trench and up the sides of the excavated area with enough materials to overlap 18 inches over the top of the aggregate. Overlap adjacent strips of fabric a minimum of 6 inches.
G. Place the first 2 inches of the aggregate subbase evenly over the bottom of the subdrain trench. Do not operate machinery directly on the excavated subgrade of the modified soil layer during aggregate subbase or subdrain installation.
H. Install subdrain at the elevation specified in the contract documents. Install cleanouts at locations specified in the contract documents.
I. Place remaining aggregate subbase layer to the elevation specified in the contract documents.
J. If a choker aggregate layer is specified in the contract documents, install over stone aggregate subbase layer to the depth specified.
K. Install check dams as specified in the contract documents. Protect subdrain and aggregate subbase layers during check dam construction. Do not operate heavy machinery directly on subgrade of the modified soil layers during check dam installation.
L. Place modified soil in 8 to 12 inch lifts to the elevation specified in the contract documents. Do not operate heavy machinery directly on the subgrade of the modified soil layers during placement. Overfill area with modified soil by 5% of the specified depth to allow for natural settlement.
M. Avoid over compaction by allowing time for natural settlement. If the project schedule does not allow for natural settlement of soil and the contract documents require compaction by soaking, compact the filter soil matrix by soaking as described below:
    1. Apply water to uniformly saturate surface by spraying or sprinkling.
    2. Ensure entire bioswale is saturated.
    3. Add modified soil as required to restore settled surface to finished elevation.
N. Roughen surface of side slopes that are 4(H):1(V) or steeper to reduce potential for rill erosion along equipment tracks.
O. Perform stabilization measures and install landscaping (seed, sod, native plants, trees, shrubs, etc.) as specified in the contract documents.
P. Install side slope erosion and sediment control measures as specified in the contract documents.
Q. Uniformly grade and rake the top of the modified soil layer to a flat, smooth, uniform surface.
R. When specified in the contract documents, place a 3 inch layer of hardwood mulch over area filled with modified soil. Do not place hardwood mulch over seeded areas. If the contract documents specify plants for the surface of the modified soil layer, install prior to placing mulch.
S. Ensure good housekeeping measures are taken throughout construction, until final acceptance of improvements by owner, to prevent erosion and sedimentation that could reduce the effectiveness of the bioswale. Address any such erosion or sedimentation should it occur, until final acceptance.
T. Do not store materials or operate heavy equipment within or near the footprint of the bioswale practice after installation has been completed.

SOIL QUALITY MANAGEMENT AND RESTORATION
CHAPTER 5 - SECTION 6

These specifications complement the soil quality management and restoration design portion of the Iowa Stormwater Management Manual in Chapter 5, Section 6 (7.03 new format).

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

Soil quality management and restoration.

1.2 DESCRIPTION OF WORK

Utilize soil quality management and restoration for infiltration and treatment of stormwater runoff and to support desired vegetation.

1.3 SUBMITTALS

A. Comply with the requirements of the contract documents.
B. For each type of product include the following:
   1. Test data substantiating that supplied products comply with specified requirements.
   2. Sieve analyses for aggregate materials.
   3. Provide material certificates for topsoil, compost and sand before delivery to the site, according to the manufacturer's qualified testing agency's certified analysis of standard products.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of the contract documents.
B. Do not dump or store bulk materials near utilities, storm sewer intakes, permeable pavements, or landscaped areas to be protected.
C. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of sediment laden stormwater runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
D. Do not move or handle materials when they are wet or frozen.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

None.

1.8 MEASUREMENT AND PAYMENT

The contract documents shall specify measurement and payment based on "A", or a combination of "B, C, D, E, F" below.

A. Soil Quality Restoration (specify which method(s) to be used)
1. **Measurement:** Measurement will be the planned quantity in square feet without final field measurement, based on the method and depths of materials specified in the contract documents. A separate bid item shall be provided for each method specified.
2. **Payment:** Payment will be made at the unit price per square feet.
3. **Includes:** Includes all labor, equipment, materials and testing required to complete the specified method.

B. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010-1.08-E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

C. Compost:
1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. The plan quantity will be based upon the proposed area where the soil will be amended. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of compost.
3. **Includes:** Unit price includes, but is not limited to testing, furnishing, hauling, blending, and placing compost.

D. Sand:
1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. The plan quantity will be based upon the proposed area where the soil will be amended. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of sand.
3. **Includes:** Unit price includes, but is not limited to testing, furnishing, hauling, blending, and placing sand.

E. On-site Topsoil:
1. **Measurement:** Measurement will be in cubic yards of topsoil stripped, salvaged, and spread, and will be computed as specified.
2. **Payment:** Payment will be at the unit price per cubic yard.
3. **Includes:** Unit price includes, but is not limited to testing, preparation, furnishing, hauling, blending, placing, and incorporation of other materials.
4. Topsoil salvaged from excavated areas and paid as topsoil will not be included in excavation quantities for which payment is made.
5. Overhaul will not be paid.

F. Off-site Topsoil:
1. **Measurement:** Measurement will be in cubic yards for furnishing, excavating, hauling, and incorporating the material.
2. **Payment:** Payment will be at the unit price per cubic yard.
3. **Includes:** Unit price includes, but is not limited to testing, preparation, furnishing, hauling, blending, placing, and incorporation of other materials.

PART 2 - PRODUCTS

2.1 COMPOST

Provide compost complying with the requirements for mulch for pneumatic seeding in SUDAS Section 9010, 2.07, C.

2.2 SAND

Provide clean sand complying with Iowa DOT Section 4110, Gradation No. 1.

2.3 TOPSOIL

A. A healthy soil profile is defined as having an A-horizon layer with a depth of at least 8 inches underlain by intact B- and C-horizon layers meeting the following requirements:
1. The healthy soil profile has a bulk density of 80 lb/ft^3 (1.3 gm/cm^3) or less.
2. Soil is not hydric and has at least 2 feet of separation from the normal high water table.

3. A soil profile with less than 8 inches of undisturbed topsoil may still be considered healthy if the topsoil layer has good structure and if measured percolation rates exceed 1 inch/hour. The soil shall not be hydric and have at least 2 feet of separation from the normal high water table.

B. The source of topsoil materials shall be from an A-horizon layer of a healthy soil profile with a clay content less than 25% and meeting the definition of off-site topsoil as per SUDAS Section 2010-2.01-C.

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION PROTECTION

A. A copy of the Soil Management Plan (SMP) and Stormwater Pollution Prevention Plan (SWPPP), if required, shall be available on-site at all times while construction activities are occurring.
   1. Construction activities include non-land disturbing actions such as material delivery and storage, equipment mobilization, etc.
   2. While construction activities are occurring, the Contractor shall have qualified personnel on-site who are familiar with both the SMP and SWPPP and are responsible to ensure that these plans are being implemented, and that areas designated to be protected are not being impacted by construction.

B. Protection measures as part of Soil Quality Management shall be installed prior to mobilization of heavy equipment to the site, material deliveries or any other significant construction activities.

C. Install any other erosion or sediment control practices which are necessary to prevent tracking or washing of sediment or other pollutants into Soil Quality Management areas designated to be protected or completed Soil Quality Restoration areas.

D. The Contractor shall be responsible for removal of sediment and associated repairs to Soil Quality Management and Restoration areas caused by inadequate installation and maintenance of sediment and erosion control measures at no additional cost to Owner.

3.2 SOIL QUALITY MANAGEMENT

A. Soil Quality Management involves the protection and preservation of areas of healthy soils from either disturbance or compaction while construction activities are occurring on adjacent areas. Investigate existing site soil conditions by visual assessment and/or information from resources such as county soil maps, geotechnical reports, soil test results, and other available data. Utilize this information to determine which method(s) of Soil Quality Management and Restoration are to be used and identify where they will be employed. Refer to Chapter 5 Section 6 (7.03 new format) of the Iowa Stormwater Management Manual for definitions and additional descriptions of each method.
   1. Unless specified by the contract documents, Soil Quality Management is not a separate item to be measured and paid. Equipment, labor and materials used for its implementation should be listed under separate pay items (i.e. construction fence, barricades, etc.) and quantified, unless contract documents specify that Soil Quality Management is incidental to the contract.
   2. Should the Contractor fail to provide protection of areas designated to be preserved within the contract documents, they shall apply Soil Quality Restoration techniques to the disturbed, compacted or otherwise impacted area to restore its soil profile to a condition similar to that immediately prior to the impact at no additional cost to the Owner.

B. **Methods 1 and 2 (Soil Quality Management):**
   1. Install protection fencing, barricades, signage or other methods to protect designated Soil Quality Management preservation areas consistent with part 3.01 of this section.
   2. Protection measures shall be maintained throughout construction and replaced as needed until project completion or until the Engineer is notified and agrees that the risk of further disturbance or compaction of the preservation area is sufficiently low to warrant removal of protection measures.
   3. After installation of protection measures, no material storage or entry by construction equipment and vehicles shall be permitted, unless a specific exception is granted by the Engineer.
   4. Upon completion of construction activities and full stabilization of the project area (or as otherwise directed by Engineer), protection measures shall be removed from the site, prior to final acceptance by Owner and submittal of the project Notice of Discontinuation of construction activities to the Iowa DNR.
   5. If the area to be protected has no perennial vegetation, then stabilize as specified per the contract documents.

3.3 SOIL QUALITY RESTORATION

A. Soil Quality Restoration involves restoration of a healthy soil profile through the application of specified methods using topsoil, compost and sand materials as specified. Refer to Chapter 5 Section 6 (7.03 new format) of the Iowa Stormwater Management Manual for definitions and additional descriptions of each method.

B. **Method 3.** Apply as designated on the SMP where 8 inches or more of topsoil is present but has been compacted by previous site work or construction activities.

1. To prevent re-compaction of the SQR area, complete this method near the end of construction activities, or provide protection measures similar to part 3.02 of this section. Unless protection measures are specified within the contract documents, obtain approval from Engineer for their use, prior to completion of this SQR method.
2. Till the compacted area to a depth of at least 8 inches to achieve a bulk density of 80 lb/ft^3 (1.3 gm/cm^3) or less. Do not till soils when wet. Bulk density can be verified if specified elsewhere in the contract documents.
3. Install sediment and erosion control measures as specified or as directed by Owner or inspection personnel to prevent erosion within and sediment migration from the SQR area.
4. Perform field quality control as per Part 3.04 of this section. Seeding, sodding or other forms of stabilization shall be performed as specified.

C. **Method 4.** Apply as designated on the SMP where sufficient topsoil is available to be salvaged and re-spread over designated areas to a depth of 8 inches or more.

1. Mow all weeds, grass, and growing crops or other herbaceous vegetation close to the ground and remove from the site. Shred sod by shallow plowing or blading and thorough disking. Thoroughly shred to allow the soil to be easily spread in a thin layer over areas to be covered. If specified by the Engineer, herbicides may be applied, and treated vegetation may be incorporated into the topsoil.
2. Remove an amount of topsoil from the A-horizon of an existing healthy soil profile to allow finish grading with 8 inches or more of salvaged topsoil. The topsoil may be moved directly to an area where it is to be used or may be stockpiled for future use.
    a. Stockpile site soils in an approved location as identified in the Soil Management Plan.
    b. Stripping and stockpiling should occur before other site grading or construction activities are initiated to keep topsoil separate from the lower B and C horizons which often have heavier clay content.
    c. Protect downstream perimeters of stockpiles using appropriate erosion and sediment controls.
    d. Test stockpiled topsoil material to verify that amendments are not needed to achieve desired organic matter content.
3. Finish excavation and embankment work according to the specified grades and cross-sections.
    a. Grade and slope all surfaces to drain away from buildings and prevent ponding.
    b. Conform to the grading plan ± 2 inches unless otherwise specified.
4. To prevent disturbance or re-compaction of the SQR area, complete this method near the end of construction activities, or provide protection measures similar to part 3.02 of this section. Unless protection measures are specified, obtain approval from Engineer for their use, prior to completion of this SQR method.
5. Decompact surface using tillage and/or ripping to a minimum depth of 4 inches to reduce compaction.
6. Place the topsoil after all construction activities in the area have been completed.
7. Place topsoil at least 8 inches deep; smooth and finished grade according to the contract documents.
    a. If topsoil is being amended with compost, thoroughly blend compost with onsite topsoil at the rate needed to achieve desired organic matter content.
    b. Do not place topsoil materials when wet or frozen. (If ruts form from wheeled equipment, then soils are too wet).
8. After finish grading the topsoil, remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (½ inch for turfgrass).
9. Perform field quality control as per Part 3.04 of this section. Seeding, sodding or other forms of stabilization shall be performed as specified.
10. Install sediment and erosion control measures as specified or as directed by Owner or inspection personnel to prevent erosion within and sediment migration from the SQR area.

D. Method 5. Apply as designated on the SMP where there is not enough topsoil available to re-spread at least 8 inches of topsoil over designated areas. This method uses a combination of topsoil and tillage to create a total healthy soil profile depth of at least 8 inches.

1. Mow all weeds, grass, and growing crops or other herbaceous vegetation close to the ground and remove from the site. Shred sod by shallow plowing or blading and thorough disking. Thoroughly shred to allow the soil to be easily spread in a thin layer over areas to be covered. If specified by the Engineer, herbicides may be applied, and treated vegetation may be incorporated into the topsoil.
2. Remove available topsoil from the area specified.
   a. Stockpile site soils in an approved location as identified in the Soil Management Plan.
   b. Stripping and stockpiling should occur before other site grading or construction activities are initiated to keep topsoil separate from the lower B and C horizons which often have heavier clay content).
   c. Protect downstream perimeters of stockpiles using appropriate erosion and sediment controls.
   d. If specified in the contract documents, test stockpiled topsoil material to verify that amendments are not needed to achieve desired organic matter content.
3. Finish excavation and embankment work according to the specified grades and cross-sections.
   a. Grade and slope all surfaces to drain away from buildings and prevent ponding.
   b. Conform to the grading plan within ±2 inches unless specified.
4. Review the quantity of available topsoil material and define the depth that can be re-spread uniformly over the SQR area. Refer to the table below for the required tillage depth based on available topsoil.

Available Depth of Topsoil Material (inches)	Required Tillage Depth (inches)
7	1
6	2
5	3
4	4

5. To prevent disturbance or re-compaction of the SQR area, complete this method near the end of construction activities, or provide protection measures similar to part 3.02 of this section. Unless protection measures are specified, obtain approval from Engineer for their use, prior to completion of this SQR method.
6. Till or scarify footprint of the SQR area to the determined depth.
7. Place topsoil to required depth; incorporate topsoil into the surface with tillage; smooth and finish grade according to the contract documents.
   a. If topsoil is being amended with compost, thoroughly blend compost with onsite topsoil at the rate specified as needed to achieve desired organic matter content.
   b. Do not place topsoil when wet or frozen.
8. After finish grading the topsoil, remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (½ inch for turfgrass).
9. Perform field quality control as per Part 3.04 of this section. Seeding, sodding or other forms of stabilization shall be performed as specified.
10. Install sediment and erosion control measures as specified or as directed by Owner or inspection personnel to prevent erosion within and sediment migration from the SQR area.

E. Method 6. Apply as designated on the SMP when there is not enough topsoil onsite and/or compost readily available. One inch of compost is used in place of 3 inches of topsoil. The equivalent of four inches of topsoil can be achieved through a blend of 1 inch of topsoil and 1 inch of compost. This soil blend is spread as a surface blanket over 6 inches of tilled subsoil to result in an 8 inch healthy soil profile.

1. Mow all weeds, grass, and growing crops or other herbaceous vegetation close to the ground and remove from the site. Shred sod by shallow plowing or blading and thorough disking. Thoroughly shred to allow the soil to be easily spread in a thin layer over areas to be covered. If specified by the Engineer, herbicides may be applied, and vegetation may be incorporated into the topsoil.
2. Remove available topsoil from the area specified.

a. Stockpile site soils in an approved location as identified in the Soil Management Plan.
b. Stripping and stockpiling should occur before other site grading or construction activities are initiated to keep topsoil separate from the lower B and C horizons which often have heavier clay content).
c. Protect downstream perimeter of stockpiles using appropriate erosion and sediment controls.
d. If specified in the contract documents, test stockpiled topsoil material to verify that amendments are not needed to achieve desired organic matter content.

3. Finish excavation and embankment work according to the specified grades and cross-sections.
   a. Grade and slope all surfaces to drain away from buildings and prevent ponding.
   b. Conform to the grading plan within ±2 inches unless otherwise specified.
4. To prevent disturbance or re-compaction of the SQR area, complete this method near the end of construction activities, or provide protection measures similar to part 3.02 of this section. Unless protection measures are specified, obtain approval from Engineer for their use, prior to completion of this SQR method.
5. Till or scarify footprint of the SQR area to a depth of at least 6 inches.
6. Thoroughly blend compost with topsoil as needed to provide sufficient quantity to cover the tilled area with a depth of 2 inches of amended topsoil.
   a. Place the amended topsoil to required depth.
   b. Incorporate topsoil into the surface with tillage
   c. Smooth and finish grade according to the contract documents.
   d. Do not place amended topsoil when wet or frozen.
7. After smoothing, finish grading the amended soil mix, remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (½ inch for turfgrass).
8. Perform field quality control as per Part 3.04 of this section. Seeding, sodding or other forms of stabilization shall be performed as specified.
9. Install sediment and erosion control measures as specified or as directed by Owner or inspection personnel to prevent erosion within and sediment migration from the SQR area.

F. Method 7. Apply as designated on the SMP where topsoil is absent. A healthy soil profile is to be created using a combination of soil materials, compost and sand.

1. To prevent disturbance or re-compaction of the SQR area, complete this method near the end of construction activities, or provide protection measures similar to part 3.02 of this section. Unless protection measures are specified, obtain approval from Engineer for their use, prior to completion of this SQR method.
2. Upon completion of site grading and construction activities, the area where soil is to be amended should be inspected. The surface should be free of any debris and stones larger than 1 inch in diameter (½ inch if permanent vegetation is to be turf grass). Remove smaller rocks or gravel if they densely cover the surface in a given area, or as directed by Engineer.
3. Spread at least 2 inches of compost prior to tillage.
   a. If specified, sand may be added to change the texture of topsoil to increase infiltration and percolation rates.
   b. If sand is to be added, spread a minimum of 1 inch or the specified depth of sand (whichever is greater) to change the soil texture class to at least that of a loam or sandy loam soil.
   c. Sand should be added in a uniform layer before tillage.
   d. Alternatively, sand and compost can be thoroughly blended elsewhere into an amended soil mix and then spread evenly over the SQR area prior to tillage.
4. Incorporate the compost or amended soil mix through tillage to a minimum depth of 8 inches.
   a. Smooth and finish grade according to the contract documents.
   b. Do not place or till soil materials when wet.
5. Upon completion, remove any clods, lumps, roots, litter or other undesirable material, or any stones larger than 1 inch in diameter (½ inch if the permanent vegetation is to be turf grass).
6. Perform field quality control as per Part 3.04 of this section. Seeding, sodding or other forms of stabilization shall be performed as specified.
7. Install sediment and erosion control measures as specified or as directed by Owner or inspection personnel

to prevent erosion within and sediment migration from the SQR area.

G. Method 8. Apply as designated on the SMP where existing vegetation is present and is not to be disturbed, but soils need to be amended to provide additional organic matter to enhance the health of desired vegetation. A compost blanket is to be applied over the existing vegetation.

1. This method should be performed during the seeding window for turf grass during spring and late summer/fall months. If performed during warm weather (above 70°F) then compost should be raked or harrowed into the grass and the area should be irrigated.
2. Mow existing vegetation to a height of less than 2 inches. Avoid mowing if there is a risk of frost.
3. Do not apply pre-emergent if planning to seed.
4. Aerate existing soils to a depth of at least 4 inches (6 inches preferred), unless specified otherwise by the contract documents.
5. Apply no less than ½ inch to no more than ¾ inch compost blanket over the mowed area as specified. Compost applications exceeding ¾ inches may kill existing vegetation.
   a. The lawn should be raked after compost application as/if needed to ensure a uniform application that migrates downward and doesn't smother existing vegetation. After raking, the grass should be poking through the compost.
   b. If overseeding, make sure selected seed matches the existing lawn species.
   c. For pneumatic installation, specified seed and fertilizer may be incorporated into the compost blanket.
   d. Otherwise, apply specified seed and fertilizer after installation of the compost blanket.
   e. Refer to contract documents for seeding dates, mixes and other requirements. Refer to SUDAS Section 9010 as applicable.
6. Water twice daily (morning and evening) to moisten soil to a depth of 1 inch until new vegetation is established. (Watering should be considered as a separate pay item unless contract documents specifically note that it is incidental to application of this method.)
7. Inspect seed application within 1 month of installation. Reseed as necessary if seeding has failed to establish or lacks sufficient density.

3.4 FIELD QUALITY CONTROL

All items and procedures listed within this section shall be considered incidental to contract work, unless otherwise specified within the contract documents.

A. SOIL QUALITY MANAGEMENT (METHODS 1 AND 2)

1. Prior to construction, confirm that soil quality management areas are protected by construction fences, barriers or other means as described within the contract documents or deemed acceptable by the Engineer/Owner.
2. Throughout construction, verify that no tracking, storage of materials or other disturbance or compaction has occurred within the protected area.
   a. Should any of the preceding occur within the protected area, the Contractor shall immediately contact the Engineer/Owner. A site meeting shall be convened to determine which Soil Quality Restoration methods will need to be applied to the impacted area to restore its soil profile to a condition similar to that immediately prior to the impact.
   b. Any such methods shall be completed by the Contractor at no additional cost to the Owner.

B. SOIL QUALITY RESTORATION (METHODS 3 THROUGH 7)

1. The Contractor shall be responsible to verify that, if required, project SWPPP management and inspections are being carried out and adequate pollution prevention measures have been installed and are maintained throughout construction.
2. Prior to construction, the Contractor shall review the SMP, and compare observed site conditions with those listed within the plan.
3. When on-site topsoil is to be used, the Contractor shall verify that the topsoil stockpile has been properly located and other site soils, debris, revetment stone or other materials are not mixed with the topsoil stockpile.

4. At appropriate times (as described within Section 3.03), the Contractor will verify that the surface where SQR is to be completed has been prepared.
    a. The surface shall be free of debris, rocks larger than 1 inch in diameter (½ inch for turfgrass) or other areas densely covered with smaller rocks and/or gravel.
    b. The surface has been tilled to the required depths, based on the SQR method to be employed.
    c. Wet or frozen soils should not be tilled or graded. The surface shall be free of ruts or other indications that grading, tilling or other scarifying activities have occurred when soils or materials were wet or frozen.
    d. The Contractor shall refer to any other requirements of SUDAS Specifications Section 2010, related to the stripping, stockpiling and spreading of topsoil which are not amended by this section.
    e. Prior to placement of approved soil and amendments, the Contractor will allow the Engineer's/Owner's representatives to inspect the prepared area, to verify that these preceding conditions have been met.
5. The Engineer/Owner shall be notified before tillage is initiated and topsoil or amended soil materials are placed.
6. The Contractor shall provide the Engineer with copies of delivery tickets, tags and other submittal information to verify that installed materials are consistent with approved submittals, and to verify the volume of compost, sand or other materials has been installed as specified.
    a. The Engineer or Owner shall verify that delivery tickets match the delivery location, material quantity, product description and approved material source. Any deviation from specified materials will require laboratory testing to verify that delivered materials are equivalent to those specified. Such testing will be completed at the Contractor's expense.
    b. Any increase in supplied volumes shall be brought to the attention of the Engineer prior to installation. The Contractor shall not be due payment for installed quantities which are in excess of those listed within contract documents, if said increases are not reviewed and approved by the Engineer prior to installation.
7. Throughout construction, verify that no tracking, storage of materials or other disturbance or compaction has occurred within the protected area.
    a. Should any of the preceding occur within the protected area, the Contractor shall immediately contact the Engineer/Owner.
    b. If a protected area is disturbed, a site meeting shall be convened by the Engineer/Owner to determine which Soil Quality Restoration methods will need to be applied to the impacted area to restore its soil profile to a condition similar to that immediately prior to the impact.
    c. Any such methods shall be completed by the Contractor at no additional cost to the Owner.
8. Unless specified otherwise, a qualified testing professional shall be employed by the Contractor to verify post-construction conditions using both shovel and rod penetrometer tests.
    a. Shovel test sites:
        i. Unless specified otherwise, at least 1 test hole per acre (a minimum of 1 test hole on smaller sites), shall be dug with a shovel.
            a. Test holes should extend at least 2 inches below the specified tillage depth and/or topsoil layer and be at least 1 square foot in area.
            b. Amended soils and/or topsoil layers should be easy to dig, driven solely by the weight of the observer.
            c. The soil should be darker than subsoil layers below.
            d. Particles of organic matter are likely to be visible.
            e. Soil that requires vigorous chipping with the shovel does not meet the specification.
            f. Where topsoil has been placed, the next 2 inches of soil depth below should be loose enough to penetrate with the shovel.
        ii. Samples shall be collected by the testing professional from each test hole location. The testing professional shall have tests completed to determine that the organic matter content assumed in design has been met or exceeded. A weighted average method shall be used to determine the organic matter content for the entire installation.
    b. Rod penetrometer:
        i. Use a rod penetrometer to confirm the soil is uncompacted to the desired tillage depth at a

minimum of 10 locations per acre (with a minimum of 10 on sites less than 1 acre).

ii. Locate test spots by dividing the site (or each acre) in half lengthwise, then dividing each half into 5 nearly equal sections.

iii. Conduct the test near the center of each section.

iv. The rod penetrometer should enter the soil to a depth 2 inches below the amended soil depth and/or topsoil layer, driven solely by the weight of the observer.

v. Irregular scarification or rocks in subsoils may require probing a few spots at each location.

vi. If the soil is extremely dry the area may need to be wetted before using the rod penetrometer.

c. Record the results of the shovel and penetrometer tests on a field verification form to be included with project Record Documents.

i. Test results shall be reported to the Engineer/Owner.

ii. If a given site does not fulfill the intent of the SMP, corrective action will need to be taken prior to site stabilization.

iii. The Engineer/Owner shall direct the Contractor on how to address any deficiencies. Any required action, repairs and reseeding shall be completed by the Contractor at no additional expense to the Owner.

d. Seeding, sodding or other stabilization techniques shall be performed as specified. Refer to contract documents, or relevant section of SUDAS for quality control requirements related to those activities.

e. The Contractor shall not allow vehicular traffic, storage of materials or other compaction or disturbance within the SQR area during or after application of stabilization measures.

f. SWPPP management and inspections shall continue and pollution prevention measures shall be maintained until final stabilization of upstream areas. Should surface erosion occur, repair such areas with compost or appropriate topsoil-compost blends. Hand rake and re-seed as necessary to repair surface erosion areas. Such repairs shall be considered incidental to the work.

C. SOIL QUALITY RESTORATION (METHOD 8)

1. Verify that existing vegetation has been mowed to a height of 2 inches or less.
2. Observe the type of aeration equipment used and that the SQR area has been aerated to the specified depth.
3. Verify that a compost blanket has been applied to the designated area, ranging in depth from ½ to ¾ inches and that the existing grass is poking through the
4. compost.
5. Use visual observation and collect delivery tickets or tags to determine that the appropriate volume of compost is applied to the SQR area.
6. Compare delivery tickets to match delivery location, total quantity of material, product description and source of material with the contract documents and/or SMP. Any deviation from specified materials will require laboratory test results to verify that the delivered materials are equivalent to those specified.
7. Seeding shall be performed as specified. Refer to contract documents, or relevant section of SUDAS for quality control requirements related to those activities.

DRY SWALES
CHAPTER 9 - SECTION 3

These specifications compliment the dry swale design portion of the Iowa Stormwater Management Manual in Chapter 9, section 3 of the Design Standards.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

Dry Swales.

1.2 DESCRIPTION OF WORK

Construct dry swales for conveyance and treatment of stormwater runoff.

1.3 SUBMITTALS

Comply with the requirements of the contract documents.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

None.

1.8 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010, 1.08, E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Filter Aggregate:

1. **Measurement:** Each type of filter aggregate will be measured in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton for each type of filter aggregate furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing filter aggregate material.

C. Underdrain:

1. **Measurement:** Measurement will be in linear feet for each type and size of pipe installed. Pipe will be measured from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts and observation wells will be included in the length of pipe measured. Lengths of

elbows, tees, wyes and other fittings will be included in length of pipe measured.

2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe, cleanouts, observation wells, and pipe fittings.

D. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

E. Filter Soil Matrix:

1. **Measurement:** Measurement will be the plan quantity in cubic yards, without final field measurement. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
2. **Payment:** Payment will be made at the unit price per cubic yard of filter soil matrix.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, blending, and placing filter soil matrix layer.

PART 2 - PRODUCTS

2.1 FILTER AGGREGATE

A. Type 1: Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 57).

B. Type 2: Provide aggregate complying with one of the following:

1. ½ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 20 (AASHTO M 43/ASTM D 448, Size 7).
2. ⅜ inch aggregate complying with Iowa DOT Section 4125, Gradation No. 21 (AASHTO M 43/ASTM D 448, Size 8).

2.2 UNDERDRAIN

Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040. Provide 4 inch diameter pipe unless otherwise specified in the contract documents.

2.3 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.4 FILTER SAND

Provide sand complying with Iowa DOT Section 4110, Gradation No. 1.

2.5 FILTER SOIL MATRIX

A. Compost: Provide compost complying with the requirements for mulch for pneumatic seeding in SUDAS Section 9010, 2.07.

B. Sand: Provide clean sand complying with Iowa DOT Section 4110, Gradation No. 1.

C. Mixture: Thoroughly blend sand and compost materials to provide a mixture with 60-80% sand by volume.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating the dry swale. Protect dry swale trench from accumulating sediment during rainfall events.

B. Prior to installing the dry swale, install sediment control practices upstream to protect the dry swale from sediment in stormwater runoff from disturbed soil.

3.2 DRY SWALE INSTALLATION

A. Excavate dry swale to the length, width, and depth specified in the contract documents. Do not compact the bottom of the trench and do not operate heavy machinery on bottom of the trench. Do not operate heavy

machinery in the trench while placing filter soil matrix.

B. Place 2 inches of filter aggregate over the bottom of the trench.
   1. If engineering fabric is specified between the filter aggregate layer and the filter soil matrix, utilize Type 1 filter aggregate.
   2. If a filter sand layer is specified between the filter aggregate layer and the filter soil matrix, utilize Type 2 filter aggregate.
C. Install slotted underdrain pipe on top of the filter aggregate. Install cleanouts and observation wells at locations specified in the contract documents.
D. Place remaining filter aggregate to the top of the underdrain pipe.
E. If engineering fabric is specified in the contract documents, install over the top of the filter aggregate layer and up the sides of the excavation. Overlap adjacent strips of fabric a minimum of 6 inches.
F. If a filter sand layer is specified in the contract documents, install over storage aggregate layer to the depth specified in maximum 8 inch lifts. Tamp each lift with a vibratory plate compactor.
G. Place filter soil matrix in 8-12 inch lifts to the elevation specified in the contract documents. Lightly compact each layer with one or two passes from a vibratory plate compactor.
H. Smooth and prepare the finished surface for seeding. Install seeding or plants as specified in the contract documents.
I. Install rolled erosion control product, bonded fiber matrix, or other surface stabilization practice, as specified in the contract documents, to protect the surface of the swale from erosion.
J. Upon completion of the dry swale, immediately install sediment control practices as required to protect the swale from sediment in stormwater runoff from disturbed soil.
K. Construct an impermeable soil control berm complying with Figure C9-S3-1, if specified.
L. Do not stockpile materials on or near the surface of the completed dry swale.
M. Protect completed dry swale from heavy machinery and other construction equipment.

PERVIOUS PORTLAND CEMENT CONCRETE (PCC) PAVEMENT
CHAPTER 10 - SECTION 2

These specifications compliment the pervious PCC pavement design portion of the Iowa Stormwater Management Manual in Chapter 10, Section 2.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- Iowa DOT Materials Instructional Memorandum: The Iowa Department of Transportation's Materials Instructional Memorandum effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- American Concrete Institute, Specification for Pervious Concrete Pavement, ACI 522.1-08.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Subgrade Preparation for Pervious Portland Cement Concrete (PCC) Pavement
B. Placement of Filter Aggregate
C. Placement of Pervious PCC Pavement
D. Testing of Pervious PCC Pavement

1.2 DESCRIPTION OF WORK

Construct pervious PCC pavement for treatment of stormwater runoff.

1.3 SUBMITTALS

A. Concrete Materials:

1. Proposed concrete mixture proportions including all material weights, volumes, fresh design unit weight per 3.09, B, water-to-cement ratio, in-place design density, and in-place design void content.
2. Aggregate types, sources, and gradations from a qualified testing agency.
3. Material certifications signed by manufacturers certifying that each of the following materials complies with the specified requirements:
    a. Cement.
    b. Supplementary cementitious materials.
    c. Chemical admixtures.
    d. Fiber reinforcement.

B. Filter Aggregate: Including aggregate type, source, gradation, and compacted void content.
C. Project Details: Including jointing plan, schedule, construction procedures, and quality control plan.
D. Qualifications: Comply with 1.07 below for contractor and concrete producer.
E. Involved Parties: Submit a list of all subcontractors, material suppliers, and testing laboratories.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

A. Quality Control:

1. **General:** Test and inspect concrete materials and operations as work progresses. Failure to detect defective work or material early could result in rejection if a defect is discovered later.
2. **Contractor Qualifications:**
   a. Provide employees who have a minimum of one of the following National Ready Mixed Concrete Association (NRMCA) certifications:
      i. One certified Pervious Concrete Craftsman, or
      ii. Two certified Pervious Concrete Installers, or
      iii. Three certified Pervious Concrete Technicians.
   b. Certified employees must be overseeing placement or working as part of the placement crew during all pervious PCC placement.
   c. Alternative qualifications or previous project experience, in lieu of required certification, may be submitted to Engineer for approval prior to submitting the bid.
3. **Ready Mixed Supplier Qualifications:**
   a. Manufacturer of ready mixed concrete products who complies with ASTM C 94 for production facilities and equipment.
   b. Manufacturer must supply a current gradation of the fine, coarse, and combined aggregate gradation performed by a certified ACI Aggregate Testing Technician Level 1 or an Iowa Department of Transportation Certified Aggregate Technician
   c. Ready mixed plant must have current Iowa DOT plant calibration.
   d. Provide at least one employee overseeing production of pervious PCC mix who is a NRMCA certified Pervious Concrete Technician.
4. **Testing Laboratory Qualifications:** Testing laboratory field personnel must have current ACI Concrete Field Testing Technician Grade I and at least NRMCA Pervious Concrete Contractor Technician Certification.
5. **Test Panel:**
   a. Prior to installation of pervious PCC at the site, construction of a test panel is required.
      i. Construct a minimum 150 square foot pervious PCC panel similar in dimensions to the planned construction, equal to the proposed thickness, and over the same drainable base materials.
      ii. Install, consolidate, joint, and cure the test panel using the materials, mixture proportions, equipment, and personnel proposed for the project.
      iii. During test panel installation, provide density and workability testing complying with 3.09, B.
      iv. Test panel may be constructed on-site and demolished after test approval or may be constructed at an off-site location. If constructed off-site, mixing and delivery time in the ready-mixed concrete truck shall be equivalent to that for the selected site.
      v. Upon approval of the Engineer, the test panel may be constructed on-site and incorporated as part of the project. When the test panel is used as part of the project, it must be placed a minimum of 7 days prior to placement of the main pervious PCC sections to allow for approval of the hardened section.
      vi. Acceptance of the test panel will be based on the following:
         1. Organized construction team with proper equipment and installation practices.
         2. Unit weight of mixture within 5 pounds per cubic foot of the design weight, tested according to 3.09, B.
         3. Acceptable surface finish, joint details, thickness, and curing procedures.
      vii. If the Engineer determines the test panel is unacceptable, the test panel will be removed and reconstructed until accepted.
   b. Experienced pervious PCC contractors and suppliers may submit written documentation of previous successful pervious PCC installations.

6. **Pre-placement Conference:**
    a. Schedule a pre-placement conference with the Engineer, Architect, General contractor, Concrete Supplier, Admixture supplier, Pervious Concrete Contractor, and Testing Laboratory personnel within one week prior to beginning placement. Preferably, the meeting will take place before the test section has been placed. The testing laboratory technician, pervious PCC supplier, and the placement crew supervisor, who will be on-site during pervious PCC placement, must attend.
    b. During the pre-placement conference, explain knowledge and understanding of how pervious PCC placement differs from traditional concrete. Explain how unexpected conditions (weather, equipment breakdowns, etc.) will be handled.

B. Weather Restrictions:

1. Do not place pervious PCC when the forecast minimum ambient air temperature is 45˚F or lower during the 7 days following the placement.
2. Do not place pervious PCC when the ready mixed supplier has switched to heated mixing water for winter production and is unable to use cooler water.
3. Do not place pervious PCC when the ambient air temperature is 85˚F or higher.
4. Additional hydration stabilizing admixture is required in hot weather.

1.8 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010, 1.08, E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

C. Underdrain:

1. **Measurement:** Measurement will be in linear feet for each type and size of pipe installed. Pipe will be measured from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts and observation wells will be included in the length of pipe measured. Lengths of elbows, tees, wyes, and other fittings will be included in length of pipe measured.
2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe and pipe fittings.

D. Filter Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of filter aggregate.
3. **Includes:** Unit price includes, but is not limited to, engineering fabric and furnishing, hauling, and placing filter aggregate.

E. Pervious Portland Cement Concrete:

1. **Measurement:** Measurement will be in square yards for each thickness of pervious PCC pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. **Payment:** Payment will be made at the unit price per square yard for each thickness of pervious PCC pavement.
3. **Includes:** Unit price includes, but is not limited to, construction of test panel(s), mixture testing, final trimming of subbase, surface curing, pavement protection, safety fencing, and boxouts for fixtures.

PART 2 - PRODUCTS

2.1 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.2 UNDERDRAIN

A. Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040.
B. Provide 6 inch diameter collector pipes unless otherwise specified in the contract documents.
C. Provide 4 inch diameter lateral pipes unless otherwise specified in the contract documents.

2.3 TYPE 1 FILTER AGGREGATE

Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 57).

2.4 PERVIOUS PORTLAND CEMENT CONCRETE

A. Portland Cement: Type I or Type II complying with Iowa DOT Section 4101 and Materials I.M. 401.

B. Supplementary Cementitious Materials:
1. Fly ash complying with Iowa DOT Section 4108.
2. Ground Granulated Blast Furnace Slag (GGBFS) complying with Iowa DOT Section 4108.

C. Aggregate:
1. Coarse Aggregate:
   a. With at least 36% voids calculated on a compacted dry bulk density basis complying with ASTM C 29.
   b. Washed, clean, and free of dirt and excess fines.
   c. Specific gravity greater than 2.5.
   d. Absorption of less than 2.5%.
   e. Ensure aggregate moisture is not in an absorptive state otherwise adjust it to achieve a saturated surface dry condition.
   f. Use crushed stone with an Iowa DOT Class 2 durability or better. River gravel is not allowed.
2. Fine Aggregate: Concrete sand complying with Iowa DOT Section 4110, Gradation No. 1 (ASTM C 33).
3. Combined Aggregate:
   a. Combine coarse and fine aggregate to comply with gradation limits in the table below.
   b. Provide at least 5% of combined aggregate weight from fine aggregate.

Sieve Size	Percent Passing	
	Min.	Max.
1 ½"	100	---
¾"	100	---
½"	94	100
3/8"	38	99
No. 4	5.5	44
No. 8	4.5	13
No. 16	3.5	11
No. 30	2	7
No. 50	0.5	4
No. 100	0	2

D. Admixtures:
1. Air Entraining Admixture: Comply with ASTM C 260.
2. Chemical Admixtures:
   a. Mid-Range Water Reducing Admixtures:
      i. Polycarboxylate type water reducer complying with ASTM C 494, Type A.
      ii. Provide one of the following, or approved equal:
         1. Catexol Hydrosense, Axim Concrete Technologies
         2. Duralflux 77, Axim Concrete Technologies
         3. Polyheed 1725, BASF Admixtures, Inc.
         4. Sikaplast 500, Sika Corporation

b. Extended Control Admixtures (hydration stabilizers):
   i. Comply with ASTM C 494, Type B (Retarding) or Type D (Water Reducing / Retarding).
   ii. Provide one of the following, or approved equal:
      1. Delvo Stabilizer, BASF Admixtures, Inc.
      2. Recover, WR Grace & Company
c. Make water reducer and/or hydration stabilizer available at the project site for re- dosing if required.

E. Fiber Reinforcement:
1. Comply with ASTM C 1116.
2. Provide fibers with a maximum length of 1 ½ inches.

F. Water:
1. Comply with Iowa DOT Section 4102.
2. Do not use heated water.

G. Mixture Proportions: Develop and furnish a proposed concrete mixture complying with the requirements below. Trial mixtures should be placed to establish proper proportions and determine expected behavior.
1. Concrete mixture density between 115-130 pcf determined by ASTM C 1688.
2. Volumetric void content from 15-25%.
3. Cementitious content from 500-600 pcy.
4. Supplementary Cementitious Material (SCM):
   a. Up to 50% replacement for cement.
   b. Maximum of 25% for class C fly ash and 50% for GGBFS.
   c. SCMs are recommended at 35% slag and 15% fly ash by weight of total cementitious materials.
5. Water-to-cementitious materials (w/c) ratio from 0.30-0.34.
6. Admixture Dosing (for all mixes):
   a. Air Entraining Agent: Air content of pervious PCC cannot be measured. Dose typically at 2 oz. per hundred pounds of cementitious material or in accordance to admixture company recommendations for concrete exposed to severe freeze/thaw conditions.
   b. Mid-range Water Reducer: Dose typically at 6 ounces per 100 pounds of cementitious material or according to admixture company recommendations.
   c. Hydration Stabilizer:
      i. Delvo: 6-12 ounces per 100 pounds of cementitious material.
      ii. Recover: 7.5-15 ounces per 100 pounds of cementitious material.
      iii. Use higher dosage rates for placement in hot weather.
   d. Fiber reinforcement at 1.5 pounds per cubic yard.

2.5 ISOLATION JOINT MATERIAL

Comply with SUDAS Section 7010, 2.02, L.

2.6 CURING

A. Polyethylene sheeting complying with ASTM C 171.
B. Minimum 4 mil thickness.
C. Provide sheeting with a width at least 2 feet wider than pavement being placed. Roll sheeting onto a tube prior to concrete placement.
D. Provide 2 by 4 lumber and sand bags at 6 feet on center or as needed to anchor polyethylene sheeting to prevent air infiltration or approved equivalent.
E. Provide soybean oil based concrete curing compound or equivalent.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Forms: Comply with SUDAS, Section 7010, 2.07.

B. Roller Screed: Powered (hydraulic or electric) roller screed weighted with sand or water to achieve a weight of approximately 20 pounds per linear foot. Weight should be adjusted to allow the screed to cut through the concrete rather than rolling over the concrete.

C. Cross Rollers: Maximum weight of 100 pounds.

D. Rolled Joint Former: Cross roller with a flange welded around its circumference at the midsection. Depth of the flange is between 1.5 and 2.0 inches.

E. Hand Tamper: 8 inch by 8 inch cast iron.

3.2 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating for the permeable paver system.

B. Prior to placing pervious PCC, install sediment control practices upstream to protect the area from sediment in stormwater runoff from disturbed soil.

3.3 SUBGRADE PREPARATION FOR PERVIOUS PCC

A. Do not compact or subject the subgrade area under the pervious PCC pavement to excessive construction equipment prior to placement of the engineering fabric.

B. Excavate area to the elevations and grades specified in the contract documents.

C. In areas where cuts are required, do not compact surface. After final elevation is achieved, scarify surface to a minimum depth of 3 inches to reduce compaction caused by construction equipment.

D. Where fill materials are required, compact material to 92% of maximum Standard Proctor Density. Do not over-compact.

E. Fill and lightly regrade any areas damaged by erosion, ponding, or traffic compaction prior to placing the engineering fabric.

3.4 ENGINEERING FABRIC

A. Install engineering fabric over completed subgrade, including trench for underdrain.

B. Overlap adjacent strips of fabric a minimum of 6 inches.

C. Extend fabric up the sides of the subbase trench to at least the bottom of the proposed pavement.

D. Engineering fabric may be omitted if specified in the engineering design.

3.5 UNDERDRAIN

A. Underdrain Collector Pipes:

1. Place 2 inches of filter aggregate in the bottom of the underdrain trench over engineering fabric.
2. Begin underdrain collector installation at the outlet and continue upgrade.
3. Lay underdrain collector pipe to the proper line and grade. Place pipe with perforations down.
4. Place filter aggregate over installed pipe in layers not more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.
5. Provide cleanouts where specified in the contract documents. Comply with SUDAS Figure 4040.232.
6. Connect underdrain collector to outlet. Comply with SUDAS Figure 4040.233. Install rodent guard on all underdrain pipe 6 inches or smaller.
7. Install underdrain cleanout pipes and observation wells as specified in the contract documents.

B. Underdrain Lateral Pipes:

1. Place the lateral piping at the locations and elevations specified in the contract documents.
2. Lay underdrain lateral over filter aggregate to the proper line and grade. Place pipe with perforations down.
3. Connect underdrain laterals to underdrain collector with wye or tee fitting.
4. Install plug or cap on upstream end of lateral pipe.

3.6 FILTER AGGREGATE

A. Place filter aggregate, to the depth and elevation specified in the contract documents, in lifts no greater than 6 inches. If underdrain system is specified, take care not to damage or displace pipe during placement of the filter aggregate.

B. Compact each lift with a maximum of two passes from a vibratory plate compactor or vibratory drum roller, or specified equivalent.

C. Proof roll completed filter aggregate subbase with a maximum 5 ton static roller.

3.7 PERVIOUS PCC PLACEMENT

A. Forms:

1. The vertical face of previously placed adjacent concrete may be used.
   a. Protect previously placed concrete from damage.
   b. Do not apply form release agent to previously placed concrete.
2. Where adjacent pavement does not create a perimeter for the pervious PCC area, provide paving forms as follows:
   a. Set, brace, and secure forms to the lines, grades, and elevations specified in the contract documents.
   b. Extend forms to the full depth of the pavement.
   c. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
   d. Immediately before placing concrete, apply form release agent to form faces that will be in contact with concrete.

B. Mixing and Hauling: Batch, mix, and deliver in compliance with ASTM C 94, with the following exceptions.

1. Deliver and discharge mixture completely within 60 minutes of the addition of mix water to the cement.
2. Delivery time may be extended to 90 minutes when dosages of hydration stabilizer are increased.
3. After 30 minutes of mixing time, re-dosing of admixtures at project site may be required to achieve workability.

C. Initial Inspection and Adjustments:

1. Visually inspect each load for consistency and workability.
2. Perform inverted slump-cone test on each load as described in 3.9 until uniform consistency is achieved for all loads.
   a. If mixture flows from cone, workability is acceptable and mix may be placed.
   b. If mixture flow is unacceptable, adjust as follows:
      i. Add ½ gallon of water per cubic yard.
      ii. Mix for 3 minutes.
      iii. Retest mix for workability.
      iv. If mixture is still unworkable, add 50% of the original dosage of hydration stabilizer and ½ gallon of water per cubic yard.
      v. Mix for 3 minutes.
      vi. Retest mix for workability. If mixture is still unworkable, the load will be rejected.
      vii. Adjust subsequent loads at the plant.
3. Perform at least one fresh density test according to 3.9 at the mid-point of the load for the first concrete truck and for every five loads thereafter.
4. Perform at least one estimated in-situ unit weight (3.9, C) test each day pervious PCC is placed and after each mix adjustment.

D. Placing and Finishing:

1. Moisten subbase and subgrade thoroughly prior to placement. Immediately before placement, re-moisten subbase material.
2. Deposit concrete into the forms by mixer truck chute, conveyor, or buggy. Do not pump pervious PCC.
3. Do not place concrete on frozen subgrade or subbase.
4. Do not push or drag concrete into place or use vibrators to move concrete into place. Spread concrete with a square-ended shovel or rake.
5. Do not allow foot traffic on fresh concrete.
6. Hand tamp at edges of pour and refill to about ½ inch greater than the height of forms then strike off the surface and compact the concrete with a roller screed.
7. Maintain a 1-2 inch depth of concrete across the width of the front of the roller screed during the initial pass.
8. After the initial pass with the roller screed, hand place an additional 6 inch wide by ½ inch thick strip until level with the adjacent surface. Additional passes of the roller will be allowed to smooth surface if necessary.
9. Roll the surface perpendicular to the direction of the roller screed with overlapping passes of the cross roller. Operate the cross roller on top of the polyethylene sheeting installed for curing.

10. Do not finish pervious PCC with floats or trowels; however, a magnesium float may be used to hand tamp in minor surface imperfections.
11. Finish all edges of pervious PCC with a ½ inch radius edging tool.

E. Jointing:

1. Pre-mark joint locations prior to beginning paving.
2. After finishing with the roller screed, immediately construct joints installed with an approved jointing cross roller (pizza-cutter type). Only one pass of the jointing cross roller is allowed for each joint. Early-entry or traditional sawing may be used; however, determine timing to minimize raveling. For sawed joints, limit the time polyethylene sheeting is removed in order to prevent excessive evaporation. Immediate cleaning will be required to remove sawdust or slurry.
3. Soybean oil cure may be placed prior to forming joints.
4. Install isolation (expansion) joints where the pavement abuts the fixed vertical structures such as buildings, manholes, and light poles.

F. Curing:

1. Begin curing procedures within 10 minutes of the concrete being discharged or within 10 feet behind the compaction roller, whichever comes first.
2. Apply soybean oil cure at rate recommended by manufacturer. Apply cure from two different directions to ensure complete surface coverage.
3. Cover surface with polyethylene sheeting. Concrete must be covered within 10 minutes of discharging.
4. Additional rolling with cross roller, if necessary, may be completed after covering concrete with
5. polyethylene sheeting. Wet the polyethylene sheeting with water before cross-rolling for lubrication.
6. Anchor sheeting by placing 2 by 4 lumber along the edge of the sheeting and weighting the lumber with sand bags at 6 feet on center minimum or approved equivalent to prevent air infiltration. Do not place lumber or anchors directly on newly finished concrete.
7. Do not use mud clods, concrete chunks, or other debris to anchor the sheeting.
8. Additional anchoring will be required if the wind causes billowing of the sheeting during the curing period.
9. Keep the sheeting in place and maintain during the minimum 7 day curing period.
10. Do not allow vehicular traffic on the pavement until curing is completed.

3.8 POST PLACEMENT PAVEMENT PROTECTION

A. Erosion and Sediment Control: Maintain erosion and sediment control practices until vegetation is established to prevent sediment in stormwater runoff from clogging the concrete pores.

B. Pavement:

1. Keep polyethylene sheeting in place, properly secured, for at least 7 days after placement.
2. Protect the pavement from heavy construction traffic, including trucks, skid steers, loaders, and all tracked vehicles until project completion.
3. Do not stockpile soil, mulch, compost, sand, gravel, crushed stone, or other loose materials on pervious PCC, or in areas where uncontrolled stormwater runoff could carry these materials to the pervious PCC and contaminate the pervious surface.

3.9 TESTING

A. Inverted Slump Cone Test: The purpose of the inverted slump cone is to determine if the delivered pervious PCC has sufficient workability for rapid discharge and to achieve the desired compaction using methods outlined in 3.7, D.

1. Fill inverted slump cone with plastic pervious PCC. Do not rod or compact.
2. Lift the cone to knee height with a smooth motion. If necessary, give the cone a jostle or mild shake to initiate flow.
3. If material flows from the cone, its workability is acceptable.
4. If material remains lodged in the cone, it does not have adequate workability. Remediation or rejection of the mix is required.
5. Comply with 3.7, C for remediation of mixtures determined to be unworkable.

B. Verification of Fresh Design Unit Weight Using ASTM C 1688: After verifying acceptable workability using the inverted slump cone test in 3.9, A, determine the fresh concrete density and compare with the design fresh

density submitted by the concrete producer.

1. Fill a unit weight container (commonly the bottom ¼ cubic foot of an air pressure meter) of known weight and volume with fresh pervious PCC in two lifts.
2. Compact each layer with 20 drops of a standard proctor hammer.
3. Strike off the surface flush with the top of the unit weight bucket.
4. Calculate the fresh density.
5. Compare fresh density to the ASTM C 1688 design density specified for the mixture proportions. The allowable variation is plus or minus 5 pounds per cubic foot from the design unit weight.

C. Estimated In-situ Unit Weight: Determine the estimated in-place, in-situ unit weight from the loose, uncompacted concrete state.

1. Fill a unit weight container (commonly the bottom ¼ cubic foot of an air pressure meter) of known weight and volume with fresh pervious PCC concrete in two lifts.
2. Evenly distribute the concrete in the container but do not compact or consolidate.
3. Strike off the surface even with the top of the container.
4. Weigh the filled container and determine the unit weight of the uncompacted mix.
5. Calculate the estimated in-situ density by multiplying the uncompacted unit weight by the appropriate compaction factor provided in the table below:

Pavement Thickness (inches)	Compaction Factor
4	1.25
6	1.17
8	1.13

6. Compare estimated in-situ density to the design unit weight specified for the mix design. The allowable variation is plus or minus 5 pounds per cubic foot from the design unit weight.

POROUS HOT MIX ASPHALT (HMA) PAVEMENT
CHAPTER 10 - SECTION 3

These specifications compliment the porous HMA pavement design portion of the Iowa Stormwater Management Manual in Chapter 10, section 3.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- National Asphalt Pavement Association's Information Series 131.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Subgrade Preparation
B. Placement of Storage Aggregate
C. Placement of Filter Aggregate
D. Placement of Porous HMA Pavement
E. Testing of Porous HMA Pavement

1.2 DESCRIPTION OF WORK

Construct porous HMA pavement for treatment of stormwater runoff.

1.3 SUBMITTALS

A. Porous HMA Materials:

1. A statement from the polymer-modified asphalt supplier certifying that the polymer- modified asphalt complies with these specifications and indicating the following:
   a. Type of elastomer polymer used to modify the asphalt.
   b. Quality control sampling and testing procedures used to certify the polymer modified asphalt prior to shipping to the contractor's asphalt plant.
   c. Information on storage and stability of the polymer modified asphalt.
   d. Recommended mixing and compaction temperatures.
2. Aggregate types, sources, and gradations from a qualified testing agency.
3. Results of proposed asphalt mix testing for resistance to stripping and draindown.
4. Depending on the type of aggregates used, submit binder content determination results.

B. Filter and Storage Aggregates: Including aggregate type, source, gradation, and void content.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

None.

1.8 MEASAUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010, 1.08, E for measurement and payment information for Class 10, Class 12, or Class 13 Excavation.

B. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

C. Underdrain:

1. **Measurement:** Measurement will be in linear feet for each type and size of pipe installed. Pipe will be measured from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts and observation wells will be included in the length of pipe measured. Lengths of elbows, tees, wyes and other fittings will be included in length of pipe measured.
2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe, cleanouts, observation wells, and pipe fittings.

D. Storage Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of storage aggregate.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing storage aggregate.

E. Filter Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of filter aggregate.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing filter aggregate.

F. Porous HMA Pavement:

1. **Measurement:** Measurement will be in square yards for each thickness of porous HMA pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. **Payment:** Payment will be made at the unit price per square yard for each thickness of porous HMA pavement.
3. **Includes:** Unit price includes, but is not limited to, testing, asphalt binder, final trimming of subbase, pavement protection, and safety fencing.

PART 2 - PRODUCTS

2.1 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.2 UNDERDRAIN

A. Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040.
B. Provide 6 inch diameter collector pipes unless otherwise specified in the contract documents.
C. Provide 4 inch diameter lateral pipes unless otherwise specified in the contract documents.

2.3 STORAGE AGGREGATE

Aggregate complying with Iowa DOT Section 4122, Gradation No. 13, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 2).

2.4 TYPE 1 FILTER AGGREGATE

Aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 57).

2.5 POROUS HOT MIX ASPHALT

A. Asphalt Binder:

1. Provide polymer-modified asphalt binder complying with PG 76-22 or 82-22.
2. Modify asphalt binder with a styrene-butadiene-styrene (SBS) elastomeric polymer.
   a. Ensure polymer-modified asphalt binder is heat and storage stable.
   b. Apply elastomeric polymer at a rate of 3% by total weight of binder.
   c. Thoroughly blend binder materials at asphalt refinery or terminal prior to being loaded into transport vehicle.

B. Aggregate:

1. Provide aggregate with a minimum of 90% crushed particles.
2. Provide an aggregate gradation as required to develop a mixture with a 20% or greater void ratio. The following gradation is recommended but must be verified:

Sieve Size	Percent Passing	
	Min.	Max.
¾"	100	---
½"	85	100
⅜"	55	75
No. 4	10	25
No. 8	5	10
No. 200	0	2

C. Porous HMA Mixture:

1. Provide a binder content between 5-6% by weight of dry aggregate.
2. If more absorptive aggregates, such as crushed limestone, are used, determine the required binder content according to the testing procedures in the National Asphalt Pavement Association's Information Series 131.
3. Perform testing of proposed mixture as follows:
   a. Test draindown of mixture according to ASTM D 6390. Ensure draindown of binder is no greater than 0.3%.
   b. Test mixture for resistance to stripping by water according to ASTM D 3625. If estimated coating area is not above 95%, add anti-stripping agents to the asphalt.
   c. Test mixture for air void content by dimension according to ASTM D 3203 or ASTM D 6857. Do not determine the density using saturated surface dry procedures.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating for the porous asphalt system.

B. Prior to placing porous asphalt pavement, install sediment control practices upstream to protect the area from sediment in stormwater runoff from disturbed soil.

3.2 SUBGRADE PREPARATION FOR POROUS HMA

A. Do not compact or subject subgrade area under porous HMA pavement to excessive construction equipment prior to placement of the storage aggregate.

B. Excavate area to the elevations and grades specified in the contract documents.

C. When underdrain is specified, excavate a minimum 12 inch wide by 8 inch deep trench at locations specified in

the contract documents.

D. In areas where cuts are required, do not compact surface. After final elevation is achieved, scarify surface to a minimum depth of 3 inches to reduce compaction caused by construction equipment.
E. Where fill materials are required, compact materials to 92% of maximum Standard Proctor Density. Do not over-compact.
F. Fill and lightly re-grade any areas damaged by erosion, ponding, or traffic compaction prior to placing the engineering fabric.

3.3 ENGINEERING FABRIC

A. Install engineering fabric over completed subgrade, including trench for underdrain when specified in the contract documents.
B. Overlap adjacent strips of fabric a minimum of 6 inches.
C. Extend fabric up the sides of the subbase trench to the bottom of the proposed pavement.

3.4 UNDERDRAIN

A. Underdrain Collector Pipes:
   1. Place 2 inches of filter aggregate in the bottom of the underdrain trench over engineering fabric.
   2. Begin underdrain collector installation at the outlet and continue upgrade.
   3. Lay underdrain collector pipe to the proper line and grade. Place pipe with perforations down.
   4. Place filter aggregate over installed pipe in layers not more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.
   5. Provide cleanouts where specified in the contract documents. Comply with SUDAS Figure 4040.232.
   6. Connect underdrain collector to outlet. Comply with SUDAS Figure 4040.233. Install rodent guard on all underdrain pipe 6 inches or smaller.
   7. Install underdrain cleanout pipes and observation wells as specified in the contract documents.
B. Underdrain Lateral Pipes:
   1. Place 2 inches of filter aggregate over the bottom of the prepared subgrade at lateral pipe locations specified in the contract documents.
   2. Lay underdrain lateral over filter aggregate to the proper line and grade. Place pipe with perforations down.
   3. Connect underdrain laterals to underdrain collector with wye or tee fitting.
   4. Install plug or cap on upstream end of lateral pipe.
   5. Place additional filter aggregate along each side of the lateral pipe to the springline of the pipe.

3.5 STORAGE AGGREGATE

A. Place storage aggregate in 6 inch maximum lifts. If underdrain system is specified, take care not to damage or displace pipe during placement of storage aggregate.
B. Compact each lift with a vibratory drum roller. Do not operate compaction equipment directly over underdrain, until a minimum of 12 inches of storage aggregate is placed over the underdrain.
C. Install storage aggregate to the elevation specified in the contract documents.

3.6 FILTER AGGREGATE

A. Place filter aggregate directly over storage aggregate.
B. Install material in a single lift with a thickness of 4 inches.
C. Lightly compact filter aggregate with one or two passes from a vibratory plate compactor or vibratory roller.

3.7 POROUS HMA PAVEMENT

A. Transporting Porous HMA:
   1. Transport the mixture to the site in vehicles with smooth, clean dump beds that have been sprayed with a non-petroleum release agent.
   2. Cover mixture during transport to control cooling.
B. Placing Porous HMA:
   1. The use of a polymer-modified binder requires higher placement temperatures than normal HMA. Ensure mix temperature is between 300°F and 350°F during placement.

2. The use of a remixing material transfer device between trucks and the paver to eliminate cold lumps in the mix is highly recommended but not required.
3. The polymer-modified asphalt is difficult to rake. Ensure a well heated screed is utilized to minimize the need for raking.
4. Place porous HMA pavement in a single lift directly over the granular subbase.
5. Begin compaction when the pavement surface is cool enough to resist a 10 ton roller. One or two passes are all that is normally required to achieve proper compaction.

3.8 PROTECTION OF PAVEMENT

A. After final rolling, protect pavement from all vehicular traffic for at least 48 hours.
B. Protect pavement from heavy construction traffic, including trucks, skid steers, loaders, and all tracked vehicles.
C. Provide barriers and protection as necessary.
D. Do not place soil, mulch, sand, or aggregate, or stockpile other materials that may contaminate the pavement and plug the porous surface, on or near the pavement surface.

PERMEABLE INTERLOCKING CONCRETE PAVERS
CHAPTER 10 - SECTION 4

These specifications compliment the permeable pavers design portion of the Iowa Stormwater Management Manual in Chapter 10, section 4 of the Design Standards.

Sections of the following documents, as referenced within these specifications, are hereby made a part of these specifications:

- SUDAS Standard Specifications: The standard specifications issued by the Iowa Statewide Urban Design and Specifications Program effective at the date of publication of the Notice to Bidders, unless a different effective date is identified in the contract documents.
- Iowa DOT Standard Specifications for Highway and Bridge Construction: The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.
- American Society for Testing and Materials (ASTM) standards.
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Subgrade Preparation
B. Placement of Storage Aggregate
C. Placement of Filter Aggregate
D. Placement of Bedding Course
E. Placement of Permeable Interlocking Concrete Pavers

1.2 DESCRIPTION OF WORK

Construct permeable interlocking concrete pavers for treatment of stormwater runoff.

1.3 SUBMITTALS

A. Sample pavers: Representative of the type and color proposed for the project.
B. Installation instructions: Manufacturer's published installation instructions.
C. Material Certification: Submit certification letter from paver manufacturer indicating compliance with the ASTM specifications and the contract documents.
D. Bedding, Filter, and Storage Aggregates: Include aggregate type, source, gradation, and compacted void content.
E. Project Details: Include schedule, construction procedures, and quality control plan.
F. Involved Parties: Submit a list of all subcontractors, material suppliers, and testing laboratories.

1.4 SUBSTITUTIONS

Comply with the requirements of the contract documents.

1.5 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of the contract documents.

1.6 SCHEDULING AND CONFLICTS

Comply with the requirements of the contract documents.

1.7 SPECIAL REQUIREMENTS

None.

1.8 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Refer to SUDAS Section 2010, 1.08, E for measurement and payment

information for Class 10, Class 12, or Class 13 Excavation.

B. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.
3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

C. Underdrain:

1. **Measurement:** Measurement will be in linear feet for each type and size of pipe installed. Pipe will be measured from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts and observation wells will be included in the length of pipe measured. Lengths of elbows, tees, wyes and other fittings will be included in length of pipe measured.
2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe, cleanouts, observation wells, and pipe fittings.

D. Storage Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of storage aggregate.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing storage aggregate.

E. Filter Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. **Payment:** Payment will be made at the unit price per ton of filter aggregate.
3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, and placing filter aggregate.

F. Permeable Interlocking Concrete Pavers with Bedding Course:

1. **Measurement:** Measurement will be in square yards for the area of permeable interlocking concrete pavers. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. **Payment:** Payment will be made at the unit price per square yard of permeable interlocking concrete pavers.
3. **Includes:** Unit price includes, but is not limited to, testing, placement of bedding course, installing permeable interlocking concrete pavers, and pavement protection.

PART 2 - PRODUCTS

2.1 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.2 UNDERDRAIN

A. Provide slotted pipe(s) complying with the requirements for Type 1 Subdrain in SUDAS Section 4040.
B. Provide 6 inch diameter collector pipes unless otherwise specified in the contract documents.
C. Provide 4 inch diameter lateral pipes unless otherwise specified in the contract documents.

2.3 STORAGE AGGREGATE

Aggregate complying with Iowa DOT Section 4122, Gradation No. 13, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 2).

2.4 FILTER AGGREGATE

Provide aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability gravel or crushed stone (AASHTO M 43/ASTM D 448, Size 57).

2.5 BEDDING AGGREGATE

Provide crushed stone complying with Iowa DOT Section 4125, Gradation No. 21 (AASHTO M 43/ASTM D 448, Size

8).

2.6 PERMEABLE INTERLOCKING CONCRETE PAVERS (PICP)

A. Comply with ASTM C 936.
B. Provide PICP system from list of approved products specified in the contract documents.

2.7 PAVER EDGE RESTRAINTS

Provide paver manufacturer's recommended edge restraint system.

2.8 PERMEABLE PAVER VOID FILLER

If required by the contract documents or the PICP system manufacturer, provide void filler complying with Iowa DOT Section 4125, Gradation No. 21 (AASHTO M 43/ASTM D 448, Size 1) or other aggregate, as recommended by the paver manufacturer. Do not add cement to void filler.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating for the permeable paver system.
B. Prior to placing permeable interlocking concrete pavers, install sediment control practices upstream to protect the area from sediment in stormwater runoff from disturbed soil.

3.2 SUBGRADE PREPARATION FOR PERMEABLE INTERLOCKING CONCRETE PAVERS

A. Do not compact or subject subgrade area under proposed permeable paving area to excessive construction equipment prior to placement of the storage aggregate.
B. Excavate area to the elevations and grades specified in the contract documents.
C. When underdrain is specified, excavate a minimum 12 inch wide by 8 inch deep trench at locations specified in the contract documents.
D. In areas where cuts are required, do not compact surface. After final elevation is achieved, scarify surface to a minimum depth of 3 inches to reduce compaction caused by construction equipment.
E. Where fill materials are required, compact materials to 92% of maximum Standard Proctor Density. Do not over-compact.
F. Fill and lightly re-grade any areas damaged by erosion, ponding, or traffic compaction prior to placing the engineering fabric.

3.3 ENGINEERING FABRIC

A. Install engineering fabric over completed subgrade, including trench for underdrain when specified.
B. Overlap adjacent strips of fabric a minimum of 6 inches.
C. Extend fabric up the sides of the subbase trench to the bottom of the proposed pavement.

3.4 UNDERDRAIN

A. Underdrain Collector Pipes:

1. Place 2 inches of filter aggregate in the bottom of the underdrain trench over engineering fabric.
2. Begin underdrain collector installation at the outlet and continue upgrade.
3. Lay underdrain collector pipe to the proper line and grade. Place pipe with perforations down.
4. Place filter aggregate over installed pipe in layers not more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.
5. Provide cleanouts where specified in the contract documents. Comply with SUDAS Figure 4040.232.
6. Connect underdrain collector to outlet. Comply with SUDAS Figure 4040.233. Install rodent guard on all underdrain pipe 6 inches or smaller.
7. Install underdrain cleanout pipes and observation wells as specified in the contract documents.

B. Underdrain Lateral Pipes:

1. Place 2 inches of filter aggregate over the bottom of the prepared subgrade at lateral pipe locations specified in the contract documents.

2. Lay underdrain lateral over filter aggregate to the proper line and grade. Place pipe with perforations down.
3. Connect underdrain laterals to underdrain collector with wye or tee fitting.
4. Install plug or cap on upstream end of lateral pipe.
5. Place additional filter aggregate along each side of the lateral pipe to the springline of the pipe.

3.5 STORAGE AGGREGATE

A. Place storage aggregate in 6 inch maximum lifts. If underdrain system is specified, take care not to damage or displace pipe during placement of storage aggregate.
B. Compact each lift with a vibratory drum roller. Do not operate compaction equipment directly over underdrain, until a minimum of 12 inches of storage aggregate is placed over the underdrain.
C. Install storage aggregate to the elevation specified in the contract documents.

3.6 FILTER AGGREGATE

A. Place filter aggregate directly over storage aggregate.
B. Install aggregate in a single lift with a thickness of 4 inches.
C. Lightly compact filter aggregate with one or two passes from a vibratory plate compactor or vibratory roller.

3.7 BEDDING AGGREGATE

A. Place bedding aggregate directly over filter aggregate.
B. Install aggregate in a single lift with a thickness of 1 ½-2 inches.
C. Lightly compact bedding aggregate with one or two passes from a vibratory plate compactor or vibratory roller. Ensure surface is even, smooth, and at the proper elevation to accommodate permeable pavers.

3.8 INSTALLING INTERLOCKING PERMEABLE CONCRETE PAVER SYSTEM

Place and install pavers according to paver manufacturer's published installation specifications and the following:

A. Where pavers are placed against a curb and gutter or other pavement, installation of an edge course or soldier course is required if the pavement edge is not straight. Trim pavers as required to compensate for deviations in the adjacent pavement edge.
B. Where pavers are placed against an unrestrained edge, install edge restraint system.
C. Place chalk lines on the bedding course to maintain straight joint lines.
D. After pavers have been installed on the bedding course, and all cut pavers have been inserted to provide a full
E. and complete surface, inspect pavers for damaged units and irregular joint lines. Remove and replace pavers as required.
F. After inspection and replacement of damaged pavers, install void filler if required by paver manufacturer or contract documents. Place filter aggregate to the bottom of the chamber on the paver and sweep the surface clean.
G. Compact pavement surface with two passes of a vibratory plate compactor. Do not operate plate compactor within 3 feet of an unrestrained pavement edge.
H. Re-inspect pavers, and remove and replace all damaged units.

3.9 PROTECTION OF PAVEMENT

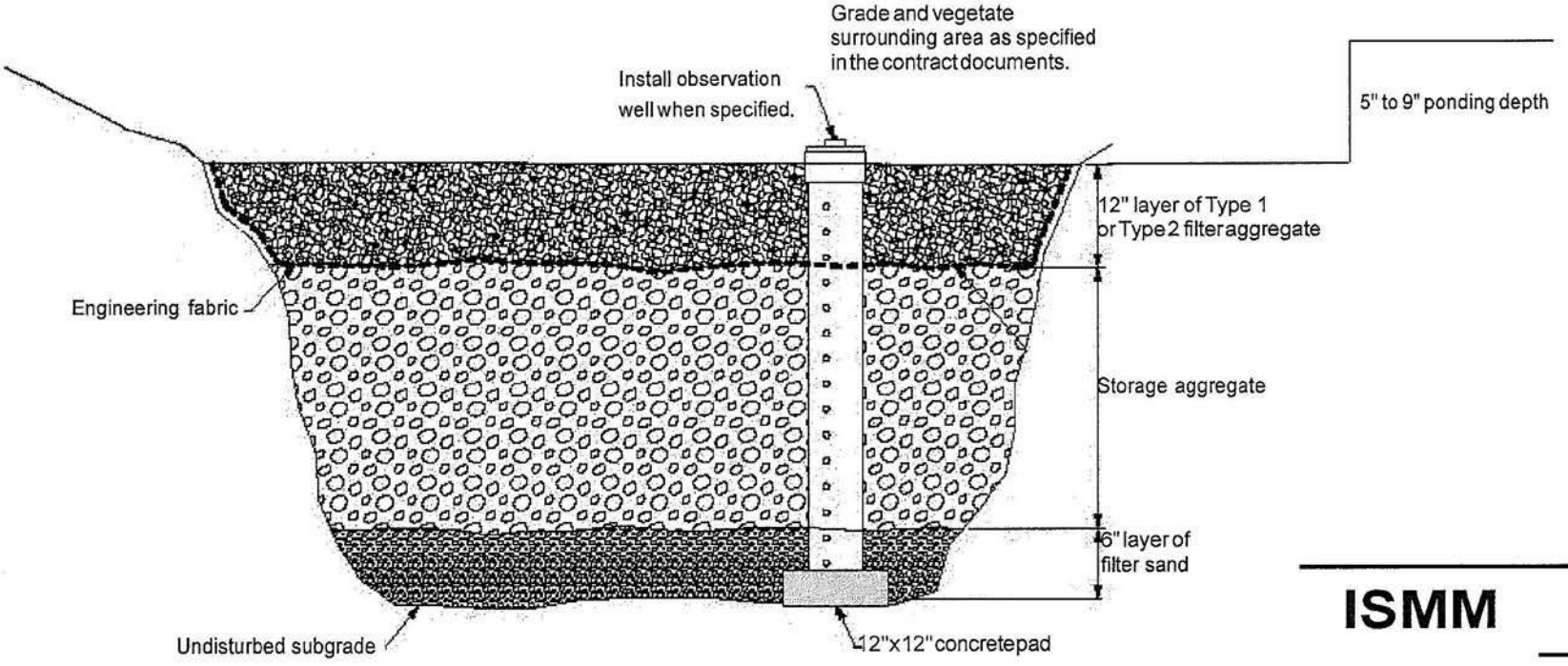
A. Protect pavement from heavy construction traffic, including trucks, skid steers, loaders, and all tracked vehicles. Provide barriers and protection as necessary.
B. Do not place soil, mulch, sand, aggregate, or stockpile other materials on the pavement surface that may contaminate the pavement and plug the porous surface.

GENERAL NOTES:

Refer to the contract documents for dimensions, grades, and additional requirements for infiltration trenches and associated improvements.

Install a layer of enginering fabic to separate the filter aggregate from the storage aggregate.

Storage aggregate materialthickness as specified in the contract documents.



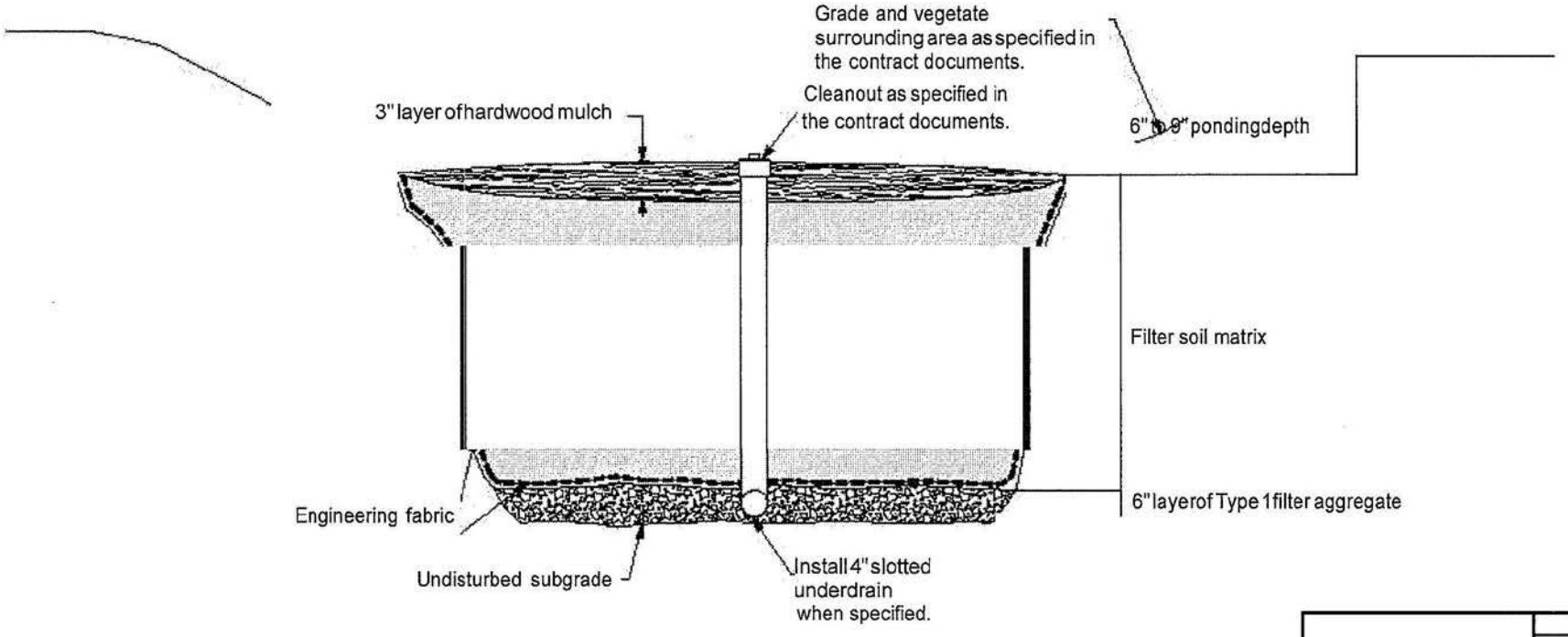
ISMM

INFILTRATION TRENCH

GENERAL NOTES:

Refer to the contract documents for dimensions, grades, and additional requirements for retention systems and associated improvements.

Filter soil matrix thickness as specified in the contract documents.



ISMM

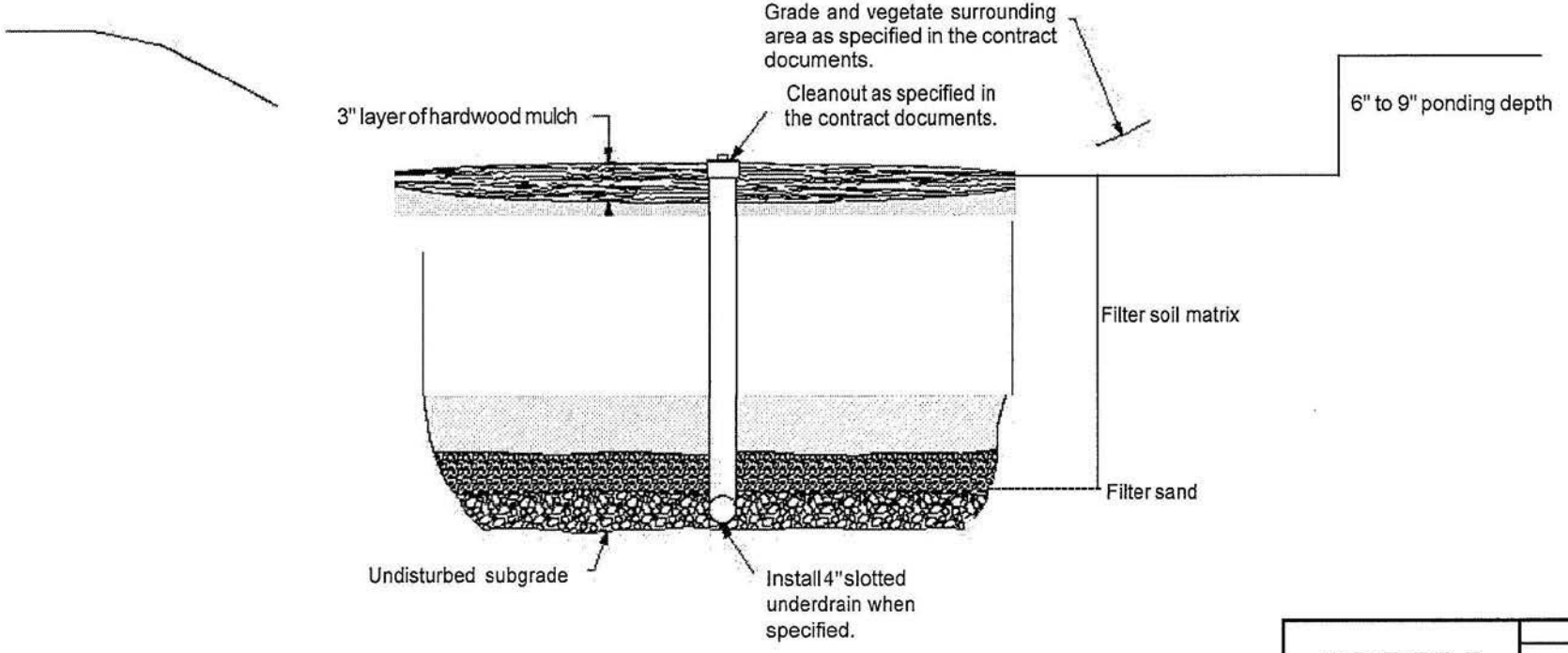
INFILTRATION SYSTEM WITH ENGINEERING FABRIC

GENERAL NOTES:

Refer to the contract document for dimensions, grades, and additional requirements for retention systems and associated improvements.

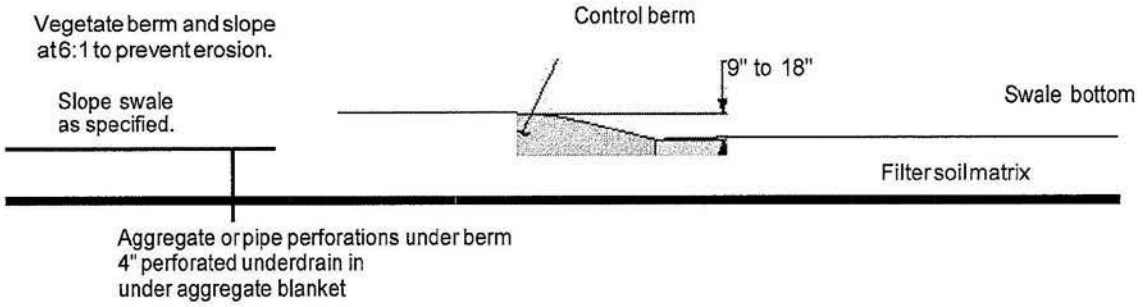
Filter soil matrix thickness as specified in the contract documents.

Filter sand layer thickness as specified in the contract documents.

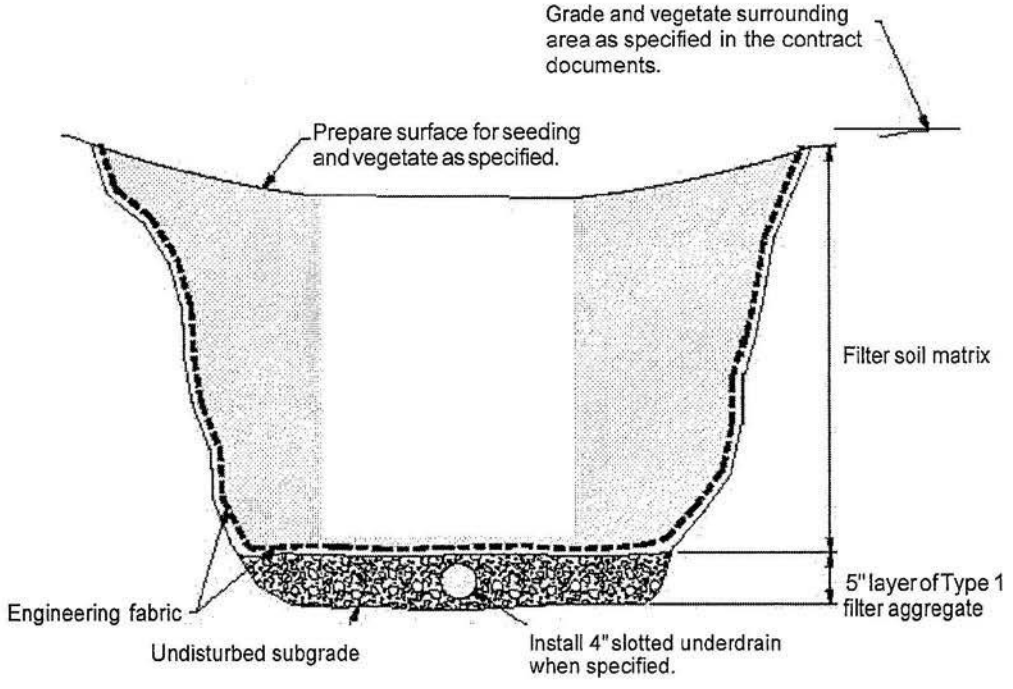


ISMM

FILTRATION SYSTEM WITH FILTER SAND LAYER



SWALE PROFILE



CROSS-SECTION

GENERAL NOTES:

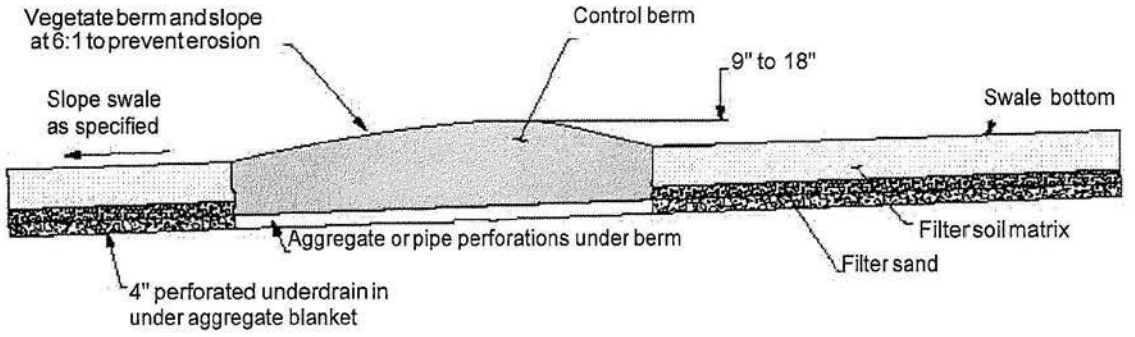
Refer to the contract documents for dimensions, grades, and additional requirements for dry swales and associated improvements.

Construct control berm as specified in the contract documents.

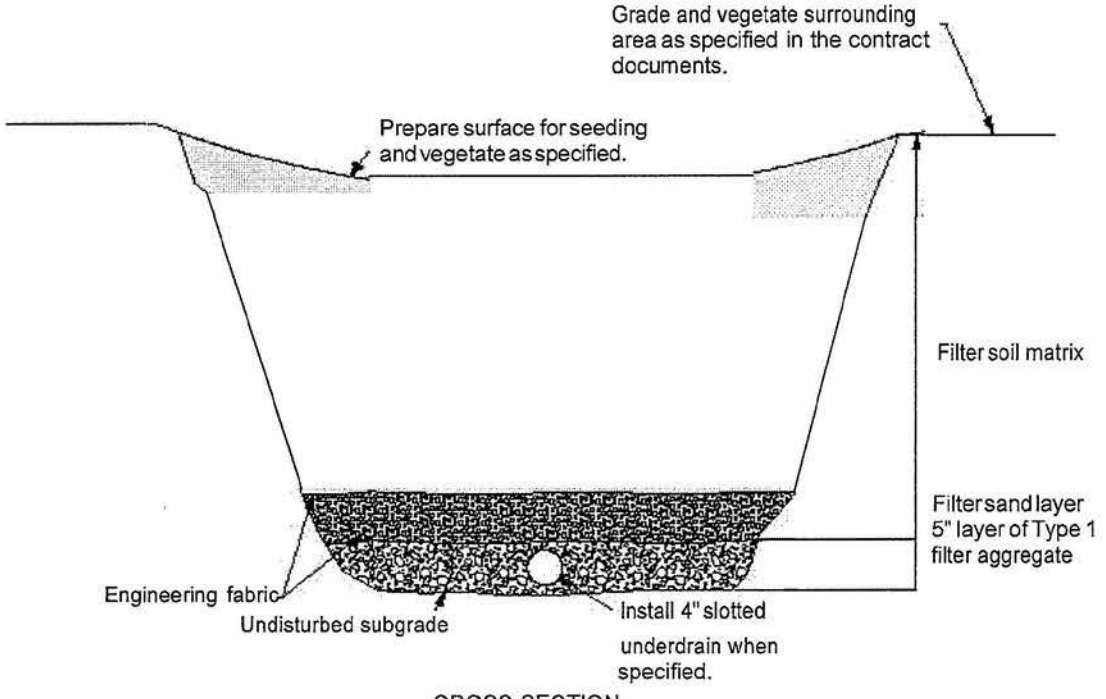
Filter soil matrix thickness as specified in the contract documents.

ISMM

DRY SWALE WITH ENGINEERING FABRIC



SWALE PROFILE



CROSS-SECTION

GENERAL NOTES:

Refer to the contract documents for dimensions, grades, and additional requirements for dry swales and associated improvements.

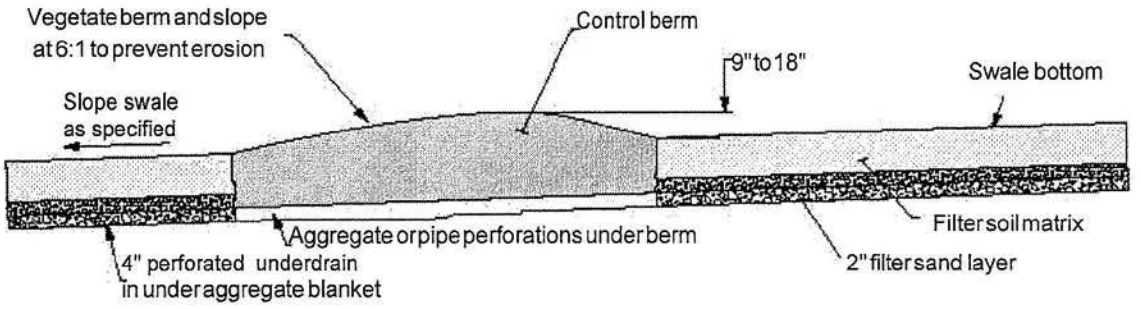
Construct control berm as specified in the contract documents.

Filter soil matrix thickness as specified in the contract documents.

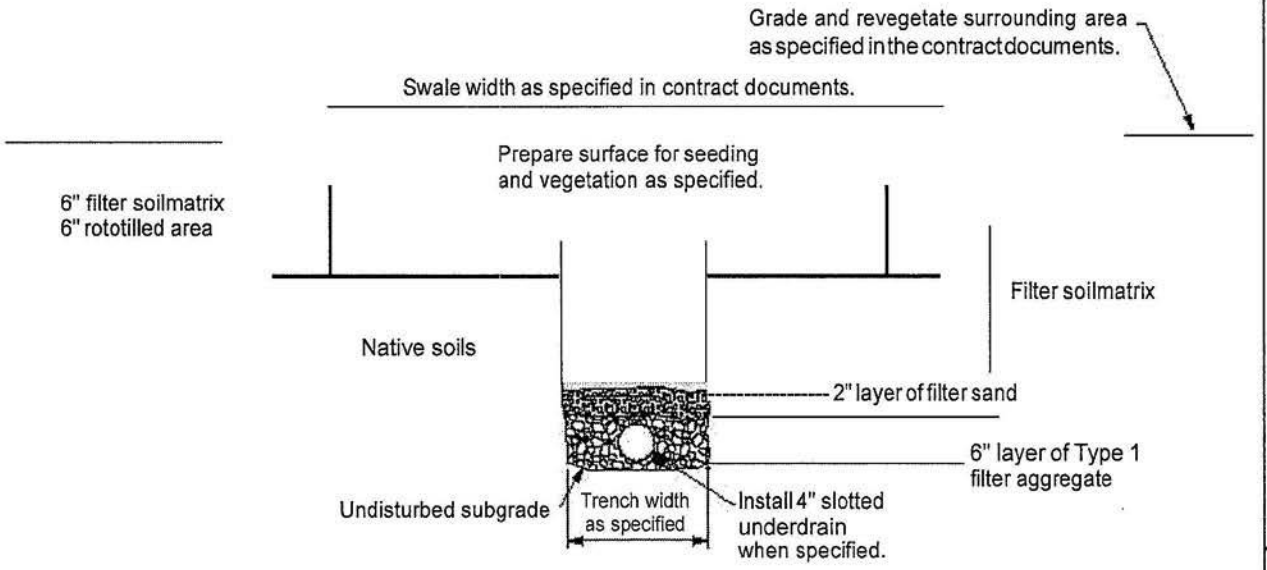
Filter sand layer thickness as specified in the contract documents.

ISMM

DRY SWALE WITH FILTER SAND LAYER



SWALE PROFILE



CROSS-SECTION

GENERAL NOTES:

Refer to the contract documents for dimensions, grades, and additional requirements for dry swales and associated improvements.

Construct control berm as specified in the contract documents.

Soil matrix thickness as specified in the contract documents.

ISMM

DRY SWALE WITH FILTER SAND LAYER

GENERAL NOTES:

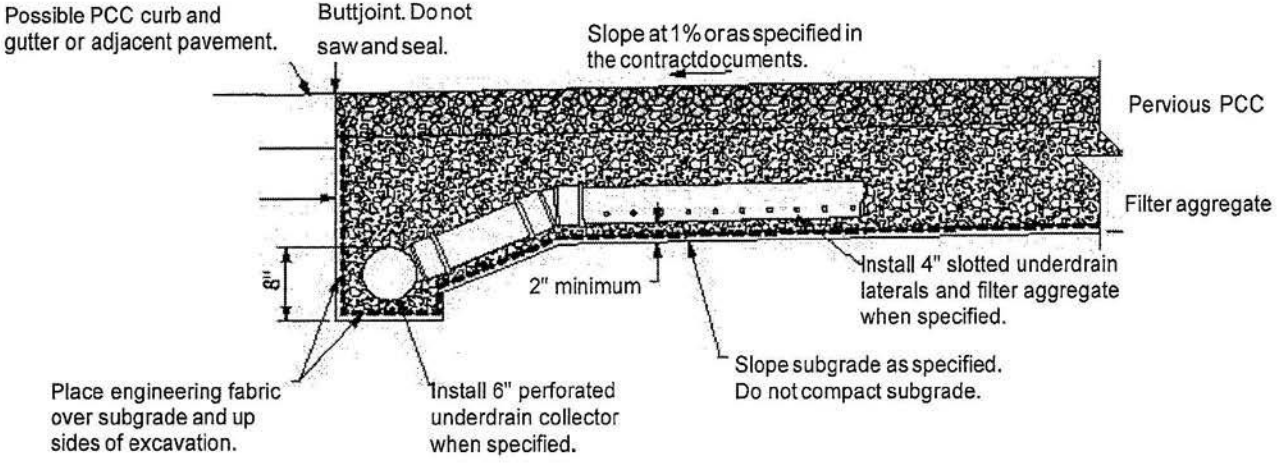
Refer to the contract documents for dimensions, grades, and additional requirements for pervious PCC pavement and associated improvements.

Pervious PCC pavement thickness as specified in the contract documents.

Permeable pavement filter aggregate thickness as specified in the contract documents.

When underdrain collectors and/or laterals are required, install to the line and grade specified in the contract documents.

Subgrade and/or subbase under curb and gutter as specified in the contract documents.



ISMM

PERVIOUS PCC PAVEMENT

GENERAL NOTES:

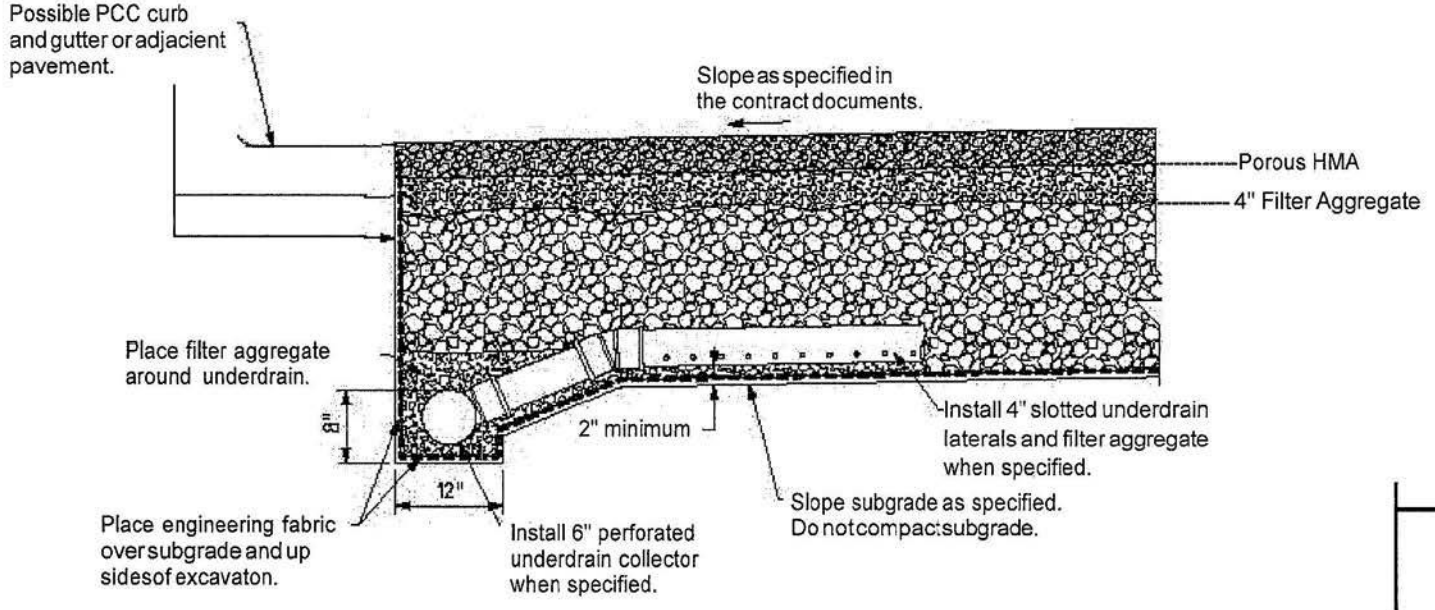
Refer to the contract documents for dimensions, grades, and additional requirements for porous HMA pavement and associated improvements.

Porous HMA thickness as specified in the contract documents.

Permeable pavement storage aggregate thickness as specified in the contract documents.

When underdrain collectors and/or laterals are specified, install the line and grade as specified in the contract documents. Place permeable pavement filter aggregate to springline of pipe.

Subgrade and/or subbase under curb and gutter as specified in the contract documents.



ISMM

POROUS HMA PAVEMENT

GENERAL NOTES:

Refer to the contract documents for dimensions, grades, and additional requirements for permeable interlocking concrete pavers and associated improvements.

Permeable interlocking concrete pavers as specified in the contract documents.

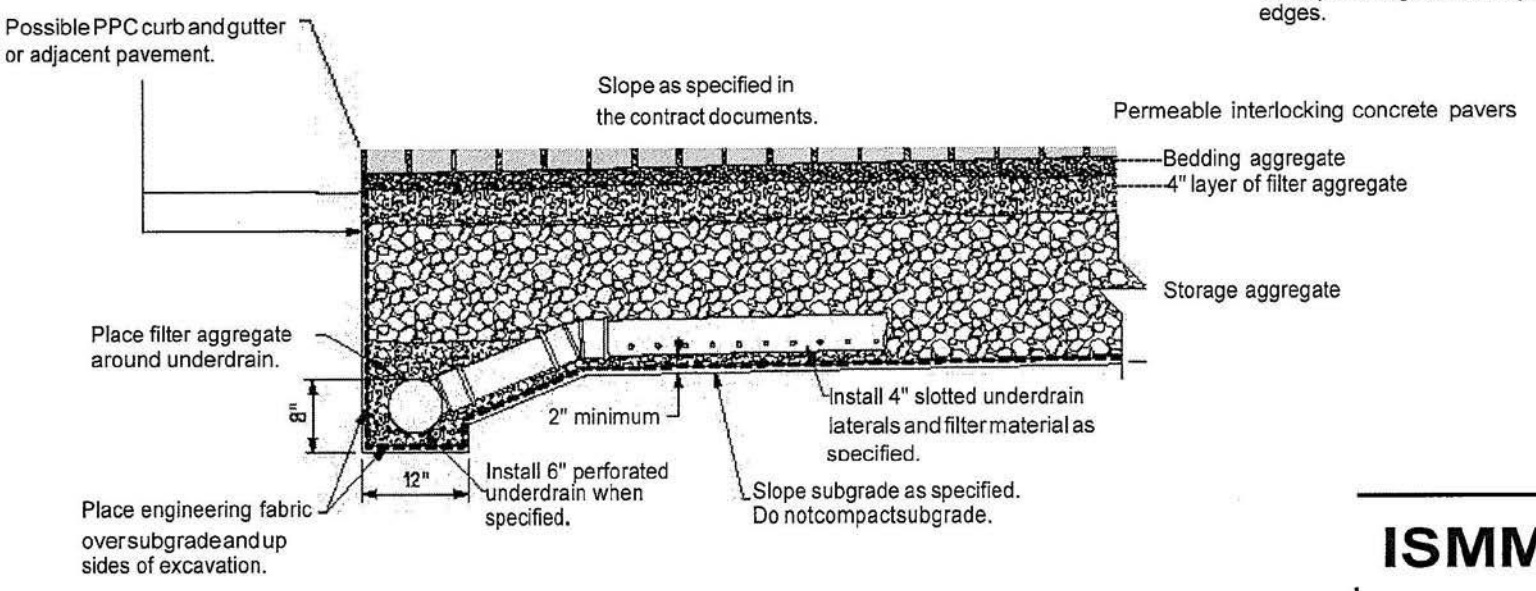
1 1/2" to 2 permeable pavement bedding aggregate to accomodate imperfections in the permeable pavement filter aggregate layer.

Permeable pavement storage aggregate thickness as specified in the contract documents.

When underdrain collectors and/or laterals are specified, install to the line and grade specified in the contract documents. Place permeable pavement filter aggregate to springline of pipe.

Subgrade and/or subbase under curb and gutter as specified in the contract documents.

Install paver edge restraint system along unrestrained edges.



ISMM

PERMEABLE INTERLOCKING CONCRETE PAVERS