IOWA STORMWATER MANAGEMENT MANUAL

5.02 GRASS SWALES

IOWA Department of Natural Resources

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Refer to the glossary for words in **bold black text.**
Some items of emphasis are in **bold blue text.**

5.02-1 LAYOUT AND DESIGN

A. SUMMARY

Grass swales are a **pretreatment** practice that consists of vegetated, shallow open channels that temporarily receive and convey stormwater. They are used to collect and convey stormwater runoff to storm inlets and downstream Best Management Practices (BMPs). These swales should be designed to be dry between rainfall events, water should not stand or pool after the rainfall event has ended.

Grass swales may be used for pretreatment for small watershed areas (see Part B. Applications of this Section). They should be paired with other BMPs as needed to meet site water quantity and quality treatment goals. They are best applied where surface grades are flatter and in watershed subareas with less directly connected impervious areas.

DESIGN PROCESS OVERVIEW

1. Complete Site Evaluation and Planning
2. Divide Site Into Watershed Subareas and Identify Locations for BMPs
3. Locate Pretreatment Practices
4. Develop Maintenance Plan
5. Integrate into Stormwater Plan

MAINTENANCE REQUIREMENTS

1. Designate Responsible Parties for Maintenance
2. Complete Construction Sequencing
3. Remove Accumulated Sediment and Debris Frequently from Pretreatment Area
4. Perform Regularly Occurring Maintenance on Pavement Surfaces, Inlets and Plant Materials

Example of a grass swale.

B. APPLICATIONS

MOST SUITABLE LOCATIONS

Grass swales may be best suited as pretreatment areas. They are best applied in watershed subareas with minimal directly connected impervious areas. They have traditionally been used as a low-cost stormwater conveyance practice in low-to-medium density developments, along roadways, or in rural areas. This practice is not well-suited to address either the Recharge volume (Rev) or the **Water Quality volume** (WQv), but it is intended to provide pre-treatment for downstream stormwater BMPs. The following recommended guidance is provided for the locations of grass swales:

- Rear yard swales in residential areas (within an easement)
  - **Impervious cover** in these areas is generally less than 50% of the tributary watershed area and impervious surfaces such as rooftops and patios typically flow across pervious lawn and landscape areas before entering the swale. TARGET
  - Swales may be used for pretreatment when sufficient **Soil Quality Restoration** is not already planned to be used in the tributary area to meet Water Quality volume (WQv) goals.
    - Use of SQR to meet WQv goals may already satisfy the need for pretreatment in the subwatershed area to which it is properly applied.
- Other areas (commercial, industrial)
  - The total impervious cover in the area tributary to the grass swale should not exceed one (1) acre. ESSENTIAL

KEY POLLUTANTS OF CONCERN

Grass swales used as a pretreatment practice typically are focused on reduction of heavier suspended sediments. However, some nutrient removals may be provided, which will be variable depending on the length of the swale and the properties of the tributary area.

UNIFIED SIZING CRITERIA

Grass swales as described in this section are intended for use as pretreatment measures. While pollutant reductions may occur, these practices are not expected to be applied toward meeting Water Quality volume requirements. They are not applicable to other elements of the **Unified Sizing Criteria.**

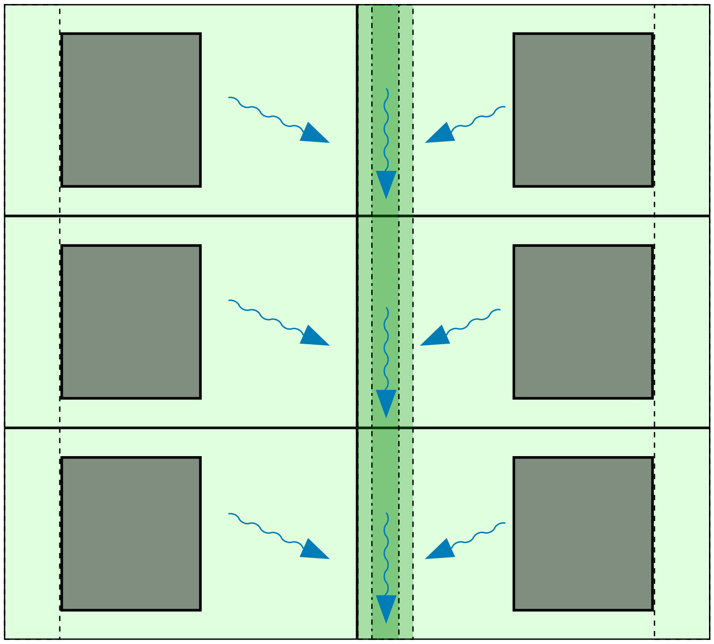


Illustration of grass swales in a rear yard swale.

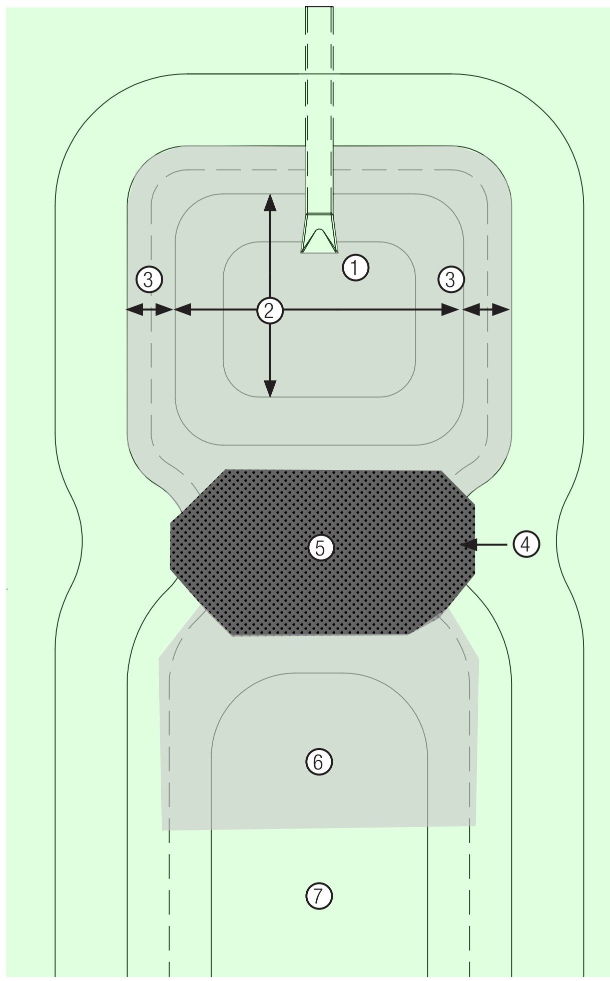
C. DESIGN ELEMENTS AND CRITERIA

CONCENTRATED ENTRY POINTS

- When runoff enters the swale from impervious surfaces at a concentrated point (such as a curb cut or pipe outfall) there should be a sediment collection area at that location where heavier sediments can collect before entering the swale. TARGET
  - – The sediment collection area should be sized so that five percent (5%) of the Water Quality volume could be stored at a depth of one (1) foot over the collection area. TARGET
    - » For example, for a one (1) acre, 100% impervious area:
      - ○ WQv = Rv * P = 0.95 * 1.25 inches
        - = 1.1875 watershed-inches = 4,311 cubic-feet
      - ○ 5% of WQv = 216 cubic feet
      - ○ 216 cubic feet divided by a one (1) foot depth = 216 square feet
      - ○ This would be an area approximately 15 feet x 15 feet in size
  - – The sediment collection area should be set with 0.5% to 1.0% slope toward the swale TARGET
  - – The surface of the collection area should be one of the following materials: TARGET
    - » Erosion stone (as per Iowa SUDAS Specification 9040)
    - » Other durable landscape stone materials between three (3) and six (6) inches in size
    - » Paver blocks
    - » Articulated concrete blocks
    - » Vegetated concrete block mats
    - » PCC Concrete
  - – When placed next to a paved surface (such as a curb cut), the sediment collection area should be recessed two (2) to three (3) inches below the edge of the paving, so sediment doesn't build up on the adjacent paved surface. TARGET
  - – The designer may consider placing a small check dam or other restriction of flow at the downstream end of the sediment collection area to reduce flow velocity and encourage deposition to occur in the collection area.
    - » The flow restriction should be designed with small openings or open-graded stone materials so that water can slowly drain out of the sediment collection area (it should be dry between rainfall events).

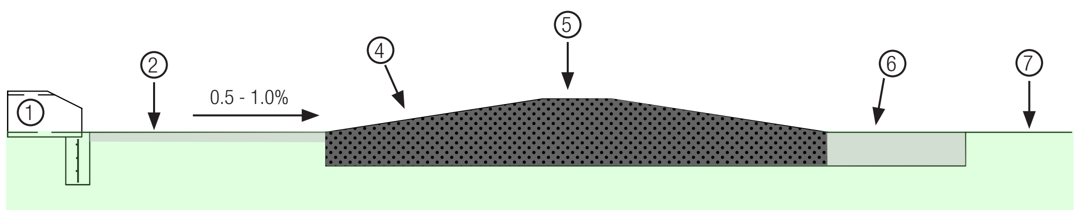
NOTE

To convert watershed-inches to cubic feet, multiply watershed-inches value by 43,560 (square feet / acre), then divide by 12 (inches / foot).

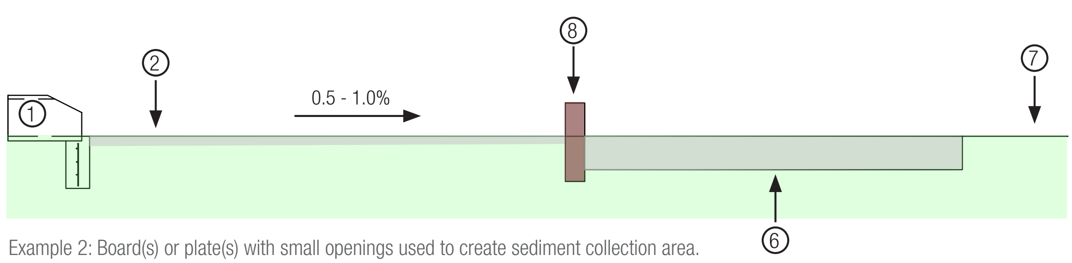


1 - Upstream Pipe Outlet (shown with footing)
2 - Level Bottom of Sediment Collection Area
3 - Extend Surface Protection Material of Collection Area Up Side Slope at Least 1 Foot
4 - Check Dam
5 - Lower Crest of Check Dam to Focus Flow Into Swale
6 - Provide Scour Protection Along Toe of Check Dam
7 - Downstream Grass Swale
8 - Plate or Boards with Small Openings with Footing or Adjacent Posts

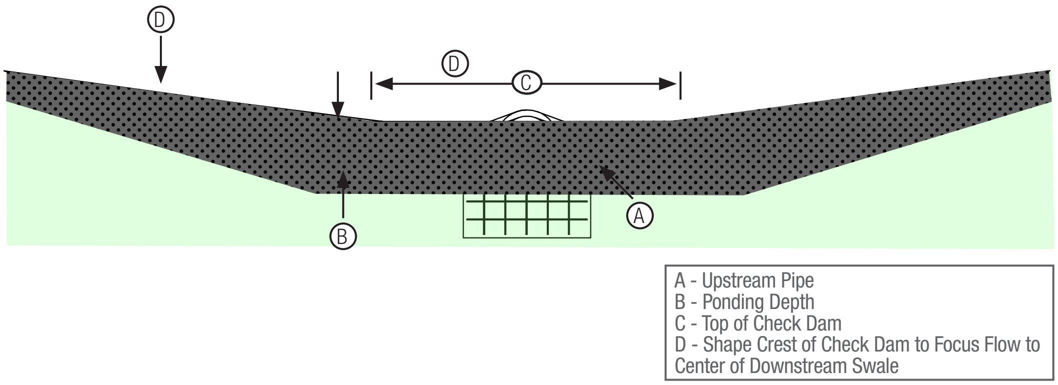
Plan view of an example of a sediment collection area at a pipe outfall.



Example 1: Check dam used to create sediment collection area.



Example 2: Board(s) or plate(s) with small openings used to create sediment collection area.

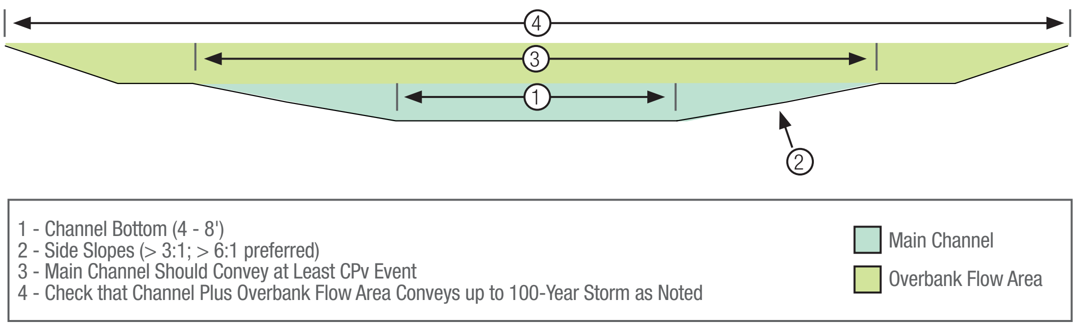


CROSS-SECTIONAL GEOMETRY

Grass swales for pretreatment should follow the parameters described below:

- The channel should be trapezoidal in shape. TARGET
- The bottom should range between four (4) and eight (8) feet in width. The side slopes of the channel should be four (4) horizontal to one (1) vertical, or flatter. ESSENTIAL
  - Side slopes of six (6) to one (1) or flatter are preferred. TARGET
- The channel shape should be designed to convey the peak flow from the WQv event at one (1) foot per second (fps) or less. ESSENTIAL
  - The main channel should be able to convey at least the CPv storm event without leaving the banks of the channel. TARGET
  - The 10-year storm event should be able to be conveyed (either within the channel or the overbank flow area) without surface erosion. TARGET
  - The 100-year storm event should be able to be conveyed (including flow in the adjacent overbank "floodplain") without impacting private or public property and infrastructure. ESSENTIAL

Swale Cross-Section



NOTE

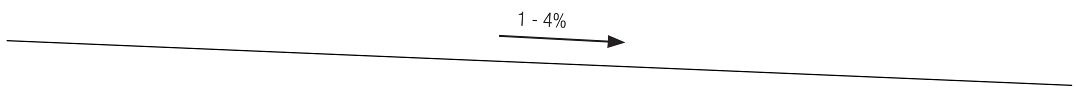
See additional information in Section 5.02-2.

CHANNEL LONGITUDINAL GEOMETRY

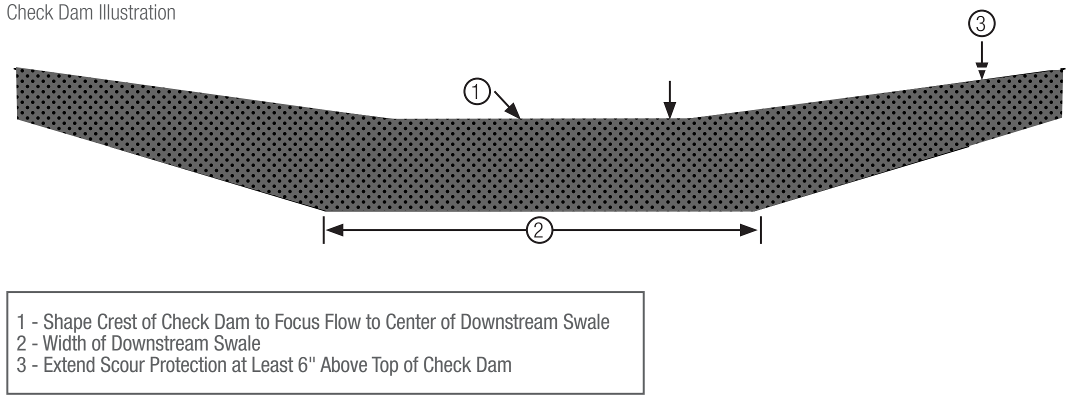
Grass swales for pretreatment should follow the parameters described below:

- The slope of the channel should fall between one and four percent (1 – 4%). If channel slope is less than 2%, an underdrain should be provided (similar to SUDAS Figure 4040.231 (Case A, Type 1). TARGET
- The minimum channel length should be selected to pass the WQv design flow through the swale at a velocity of no greater than one (1) foot per second (fps) for a travel time of at least 60 seconds in the swale (outside of any sediment collection areas). ESSENTIAL
- The channel should be checked for scour potential for storm events up to the 10-year storm event. ESSENTIAL
- Check dams are not required but may be used to provide additional restrictions to velocity. TARGET
  - Check dams should extend across the channel cross-section, with an **overflow crest** no wider than the bottom width and a rise of at least six (6) inches where it intercepts the side slope finished grades. The lowest crest elevation of any check dams should be at least 12 inches above the bottom of the swale.

Grass Swale Longitudinal Slope



Check Dam Illustration



VEGETATION

Permanent vegetation within the swale may be sod, turf seeding or native seeding. The designer should consider the expected moisture conditions and expected maintenance routine when selecting permanent vegetation.

UTILITY COORDINATION

The grass swale should provide adequate cover over any existing or proposed utilities. In some cases it may be necessary to reinforce the channel with articulated concrete blocks or vegetated concrete block mats at locations where maintenance vehicles or equipment will need to routinely cross the swale. ESSENTIAL

Sediment collection area upstream of a grass swale.

NOTE

Refer to ISWMM Section 11 for native seed mix alternatives. Refer to Section 5.02-3 for information about temporary seeding and pollution prevention measures recommended during construction.

5.02-2 SIZING CALCULATIONS

A. CALCULATION PROCEDURE

1. Determine the watershed area for which the grass swale is expected to provide pretreatment . Assess the parameters of that area, including total area, impervious cover, soil type and level of soil quality restoration (or existing soil quality).
2. Calculate the Water Quality volume (WQv) parameters. Determine the Water Quality volume to be treated and the peak rate of flow during the WQv event.
3. Design the sediment collection area, as applicable.
4. Select and test a design slope and cross-section. The swale should be able to convey the storm event at one (1) foot per second (fps).
5. Verify the length of the grass swale. The swale needs to be long enough to sustain flow at 1 fps for at least 60 seconds.
6. Check the channel for scour potential during a 10-year storm event.
7. Locate the grass swale pretreatment area on the proposed site plan or construction drawings.
8. Check capacity to convey the 100-year event

B. DESIGN EXAMPLE

For this example, it is given that part of a parking lot will drain to a storm sewer inlet which will outlet to a grass swale for pretreatment upstream of a proposed bioretention cell.

NOTE

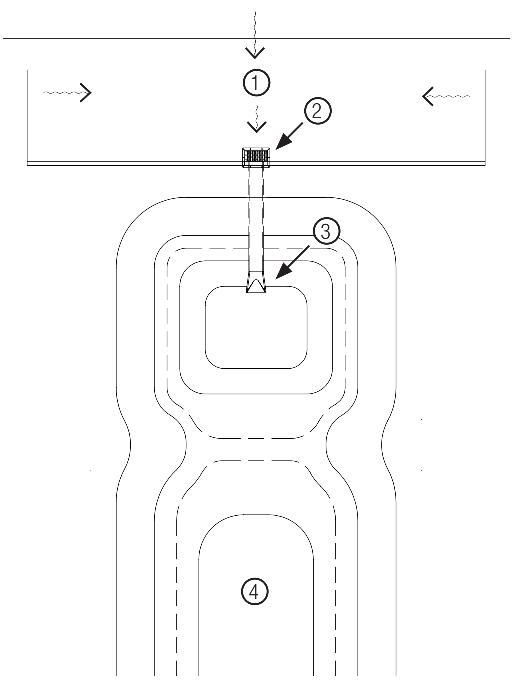
Refer to ISWMM Section 2.03 (currently Chapter 3, Section 3) for methods used to calculate time of concentration.

1. Determine the watershed area that the grass swale is expected to provide pretreatment for. Assess the parameters of that area, including total area, impervious cover, **time of concentration**, soil type and level of soil quality restoration (or existing soil quality).

   For this example, it is given that the watershed to the inlet has the following parameters:

   - Area = 1.25 acres
   - Impervious surfaces = 1.00 acres (80%)
   - Time of concentration (Tc) = 5 minutes
   - Soils:
     - **Hydrologic Soil Group** B
     - Method of Soil Quality Restoration: Stripping and respread of 8" topsoil with 5% organic matter

2. Calculate the Water Quality volume (WQv) parameters. Determine the Water Quality volume to be treated and the peak rate of flow during the WQv event.



1 - Watershed to Inlet = 1.25 acres, 100% IMP.
2 - Intake
3 - Outlet to Swale
4 - Downstream Grass Swale

Water Quality volume calculations:

- Runoff coefficient (Rv) = 0.05 + 0.009 (I) I = impervious cover (%)

Rv = 0.05 + 0.009 (80) = 0.77

- Water Quality volume (WQv) = Rv x P P =WQv precipitation (1.25 inches)

WQv = Rv x P = 0.77 x 1.25 inches = 0.9625 watershed-inches

= 0.9625 watershed-inches x 1.25 acres x 43,560 (square feet / acre) / 12 (inches / foot)

= 4,368 CF (cubic feet)

- Water Quality volume adjusted **Curve Number** (CN):

$$CN = \frac{1000}{[10 + 5P + 10Q_a] - 10\left(Q_a{}^2 + 1.25Q_aP\right)^{\frac{1}{2}}}$$

(From Equation C3-S6-3, ISWMM Small Storm Hydrology Section)

P = rainfall (1.25 inches)

Qa = Water Quality volume (inches) = 0.9625 inches

Solving the equation above, CN = 97

- Calculate Water Quality volume peak flow rate

Software running the NRCS TR-55 method to compute peak flows may be used. For this example Hydraflow Hydrographs was used with the following parameters:

- Area = 1.25 acres
- CN (adjusted) = 97
- Tc = 5 minutes
- Time interval = 1 minute

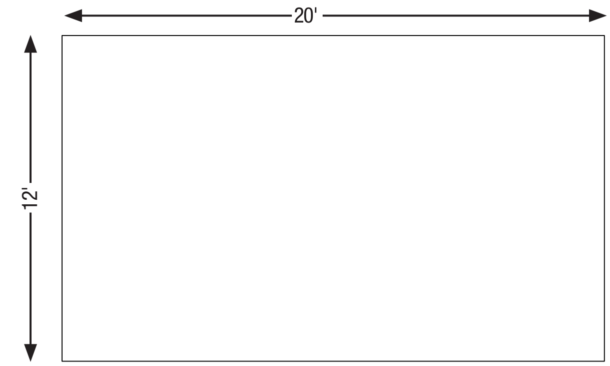
Results:

- Peak flow = 2.05 cfs (cubic feet per second)
- Volume = 4,411 CF
  - This value is similar to the 4,368 cubic feet solved above
  - The 4,368 cubic feet value is the value to use for design of water quality BMPs, but making sure these values are similar is a good double check that the adjusted CN is correct.

3. Design the sediment collection area, as applicable.

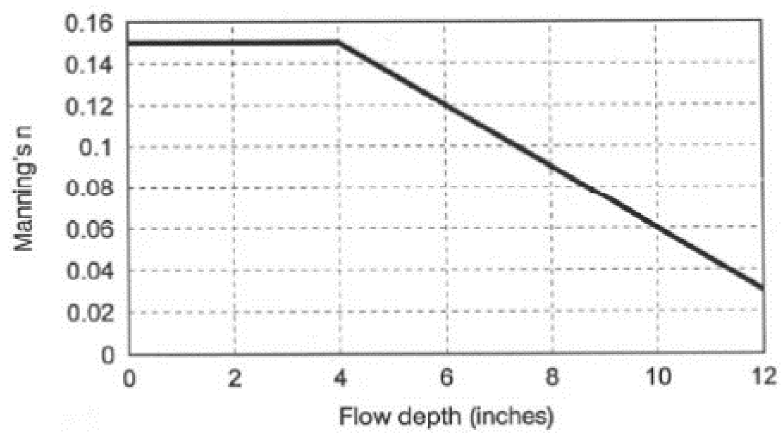
- Calculate 5% of the WQv:
  - 4,368 cubic feet x 5% = 218 CF
  - Spread this volume over 1 foot depth = 218 SF (square feet)
  - Use 20’ long x 12’ wide sediment collection area = 240 SF

Sediment Collection Area Footprint Example



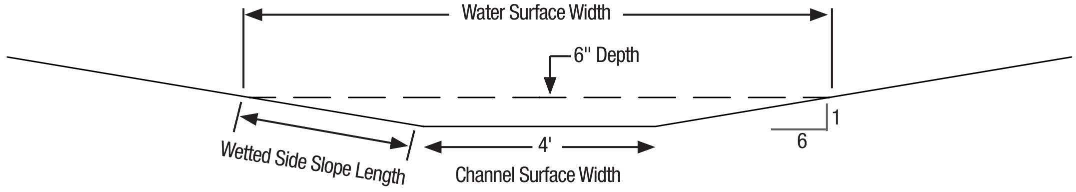
4. Select and test a design slope and cross-section. The swale should be able to convey the storm event at one (1) foot per second (fps).

- Initial swale parameters to test:
  - Bottom width = 4 feet
  - Side slopes = 6 (horizontal) to 1 (vertical) on each side
  - Longitudinal slope = 2%
  - Initial depth estimation = 0.50 foot (6 inches)
  - Select Manning's n-value based on target depth from chart below. For depth = 6 inches, Manning's coefficient "n" = 0.12.



Variable Manning's n with flow depth
Source: Claytor and Schuler

Design Example Cross-Section



NOTE

Depth in this example is measured from the channel bottom to the high water level caused by the WQv storm event.

Solving using the Manning's equation (software programs may be used to perform these calculations):

. **Manning's Equation.** **Equation 5.02-2-1**

$$V = \left(\frac{1.49}{n}\right) R^{2/3} S^{1/2}$$

Where:
V = the mean velocity (fps)
R = the hydraulic radius (ft)
S = the slope of the energy line (channel invert)
n = the coefficient of roughness.

Further, hydraulic radius, R, of the swale is defined as:

$$R = \frac{A}{P}$$

Where:
A = cross sectional area of swale (ft^2)
P = wetted perimeter of swale (ft).

- For the parameters above, at a flow depth of 6 inches, flow velocity (V) would be 0.87 fps (feet per second) and capacity (Q) would be 3.0 cfs.

<u>Calculation Example</u>

- A = Depth x (Channel Bottom Width + Water Surface Width) / 2
- A = 0.5 feet x (4 feet + [4 feet + 6 feet x 0.5 feet x 2])/2 = 0.5 feet x (14 feet) / 2 = 3.5 square feet (SF)

- P = Wetted Surface of Channel = Channel BottomWidth + Wetted Side Slope Length
- P = 4 feet + 2 x $[(0.5 \text{ feet})^2 + (0.5 \text{ feet x } 6 \text{ feet})^2]^{1/2}$
- P = 4 feet + 2 x 3.04 feet = 10.08 feet
- R = A/P = 3.5 feet / 10.08 feet = 0.347

V = (1.49 / 0.12) x $(0.347)^{2/3}$ cfs x $(0.02 \text{ feet./foot})^{1/2}$

V = 0.9 fps

Q = V x A = 0.9 fps x 3.5 feet = 3.1 cfs.

- This is greater than the WQv peak flow rate of 2.05 cfs, so adjust the expected flow depth down to 5 inches and adjust the Manning's coefficient "n" to 0.135.
  - Solving with those parameters, V = 0.70 fps and Q = 1.9 cfs. This is slightly less than the WQv peak flow rate.
- Therefore, the design flow depth in the channel will be 5 to 6 inches and the velocity will be between 0.7 and 0.9 fps. Since the velocity is less than 1.0 fps, the swale as designed can be used for pretreatment.

5. Verify the length of the grass swale. The swale needs to be long enough to sustain flow at 1 fps for at least 60 seconds. The length of the swale will be defined by:

$$L_{swale} = 60 \times V_{WQv}$$

- For this example, use the 6 inch depth channel design since the velocity is quicker.
- L = 60 x 0.9 fps = 54 feet
- Design the pretreatment swale to be at least 54 feet long downstream of the end of the sediment collection area.

6. Check the channel for scour potential during a 10-year storm event.

- Calculate 10-year storm peak flow rate
- NRCS TR-55 method, 24-hour storm; Rainfall = 4.42” (Region 6 – East Central Iowa)
- Software running the NRCS TR-55 method to compute peak flows may be used. For this example, Hydraflow Hydrographs was used with the following parameters:
- Area = 1.25 acres
- CN calculation:
  - 1.00-acre impervious surfaces CN = 98
  - 0.25-acre open space in good condition (based on 8” SQR) CN = 61
  - Weighted CN = (1.00 acre x 98 + 0.25 acres x 61) / 1.25 acres = 90.6
    - » (round CN up to 91)
- Tc = 5 minutes
- Time interval = 1 minute

The peak flow output from the program is 7.4 cfs.

- Solving the Manning’s equation with the design cross-section and slope and at a flow depth of 8 inches (n = 0.09), the expected velocity would be 1.4 fps and the channel capacity would be 7.2 cfs (very close to the 10-year peak flow rate).

The Iowa Statewide Design Standards and Specifications (SUDAS) Design Manual has guidance for channel design scour protection in Section 2F-2. Tables 2F-2.03 and 2F-2.04 provide guidance on permissible velocities in channels to avoid scour.

Even without vegetation, all surface types listed below should be able to pass a flow of 1.4 fps without significant erosion. When vegetation is evaluated, the potential for surface erosion is even further reduced.

Table 5.02-2-1: Permissible Velocities for Channels with Erodible Linings, Based on Uniform Flow in Continuously Wet, Aged Channels

Soil Type or Lining (earth; no vegetation)	Maximum Permissible Velocities for...		
	Clear Water *(fps)*	Water Carrying Fine Silts *(fps)*	Water Carrying Sand and Gravel *(fps)*
Fine sand (non-colloidal)	1.5	2.5	1.5
Sandy Loam (non-colloidal)	1.7	2.5	2.0
Silt loam (non-colloidal)	2.0	3.0	2.0
Ordinary firm loam	2.5	3.5	2.2
Volcanic ash	2.5	3.5	2.0
Fine gravel	2.5	5.0	3.7
Stiff clay	3.7	5.0	3.0
Graded, loam to cobbles (non-colloidal)	3.7	5.0	5.0
Graded, silt to cobbles (colloidal)	4.0	5.5	5.0
Alluvial Silts (non-colloidal)	2.0	3.5	2.0
Alluvial silts (colloidal)	3.7	5.0	3.0
Coarse gravel (non-colloidal)	4.0	6.0	6.5
Cobbles and shingles	5.0	5.5	6.5
Shales and hard pans	6.0	6.0	5.0
Fabric and excelsior mat	7.0	7.0	7.0
Dry rip rap/gabions	10.0	10.0	10.0
Concrete pilot channel	Use grass permissible velocity - Table 5.02-2-2		

NOTE

Table 5.02-2-1 is based on Iowa SUDAS Design Section 2F-2, Table 2F-2.03.

NOTE

Table 5.02-2-2 is based on Iowa SUDAS Design Section 2F-2, Table 2F-2.04.

Table 5.02-2-2: Permissible Velocities for Channels Lined with Uniform Stands of Various Grass Covers, Well Maintained [1]

Cover	Slope Range *(percent)*	Permissible Velocity on...	
		Erosion Resistant Soils *(fps)*	Easily Eroded Soils *(fps)*
Buffalograss Kentucky bluegrass Smooth brome Blue grama	0 to 5 5 to 10 Over 10	7 6 5	5 4 3
Grass mixture	0 to 5 5 to 10	5 4	4 3
Lespedeza sericea Weeping lovegrass Yellow bluestem Alfalfa	0 to 5	3.5	2.5
Sudangrass	0 to 5[3]	3.5	2.5

[1] Use velocities of 5 fps only where good covers and proper maintenance can be obtained.

[2] Annuals, used on mild slopes or as temporary protection until permanent covers are established.

[3] Use on slopes steeper than 5% is not recommended.

Source: from Handbook of Channel Design for Soil and Water Conservation

7. The final design step would be to locate the grass swale pretreatment area on the proposed site plan or construction drawings.

5.02-3 CONSTRUCTION

A. POLLUTION PREVENTION

If the grass swale is part of a project whose total disturbed area exceeds one acre (including all parts of a common plan of development) a stormwater pollution prevention plan (SWPPP) is required by state and federal law to be prepared.

Prior to construction, coverage under the State of Iowa's NPDES General Permit No. 2 shall be obtained (or, if required, coverage through an individual permit).

The SWPPP document will meet state and local regulatory requirements and will detail the structural and non-structural pollution prevention best management practices (BMPs) that are to be employed at the site.

EXTERIOR PROTECTION

All perimeter and site exit controls should be installed prior to any land-disturbing activities. Such controls may include (but are not limited to) site construction exits, perimeter sediment controls, construction limit fencing, waste collection, sanitary facilities and concrete washout containment systems.

INTERIOR PROTECTION

As construction activities begin, internal controls will be added to prevent erosion and sediment loss from the site area.

Erosion controls (mulches, rolled erosion control products, turf reinforcement mats, etc.) prevent detachment of soil particles from the surface. RECPs and TRMs may be beneficial along grass swales to protect surface soil or seed materials from being washed away prior to the establishment of temporary or permanent vegetation.

Sediment controls (wattles, filter socks, silt fences, sediment basins, etc.) capture sediments after they have become suspended in runoff. Installation of controls may need to be staged to be implemented immediately after construction operations have ceased or are paused in a certain area.

If the grass swale is associated with a project with other stormwater best management practices, refer to the relevant section of ISWMM for more pollution prevention information.

Grass swale with check dams after construction and establishment of vegetation.

B. CONSTRUCTION SEQUENCING

Pretreatment grass swales are often constructed as a small part of a larger project. Because they usually serve a stormwater conveyance function, they typically will be created during rough site grading. During later construction phases, fine grading will be needed prior to placement of topsoil materials.

Seedbed preparation should be performed prior to the installation of permanent seed materials. In some cases, temporary seeding may be needed if permanent seeding can't be immediately applied or if the desired permanent seeding is slow to fully establish. In those cases, seedbed preparation may be needed before installing temporary seeding so that temporary seed materials will not need to be disturbed to perform seedbed preparation.

After seeding, install any specified RECPs or TRMs. If RECPs or TRMs need to be installed earlier during construction to reduce surface erosion, perform seedbed preparation and apply a temporary cover crop seed mix before installation. Permanent seeding application rates may need to be increased when seeding over RECPs and TRMs.

Establish permanent vegetation within the grass swale before construction of any infiltration based BMPs that are immediately downstream of the swale. This is necessary to prevent sediment materials from being washed into those types of BMPs, which can reduce their infiltration potential, leading to failures.

C. CONSTRUCTION OBSERVATION

A designated representative of the owner should observe construction operations on a frequent basis to confirm the following:

- Topsoil stripping, stockpiling and respread activities have been completed as specified.
- Rough grading generally conforms to plan elevations and test results have been provided that demonstrate that compaction requirements have been met.
- Storm sewer and pipe structures or adjacent paved surfaces leading to the swale are installed to the dimension, location and elevations specified on the plans and proper installation techniques and trench compaction techniques have been followed.
- The sediment collection area is installed to the dimension, location and elevations specified on the plans.
- The correct surface protection material is installed within the sediment collection area.
- Verify that the **underdrain** is the specified material, perforation type and is installed properly.
- Verify that the grass swale is graded to the dimension, location and elevations specified on the plans.
- Verify that the required methods of soil quality restoration are completed and that surface roughening and seedbed preparation are completed prior to seeding.
- Confirm that seed, plug and other landscape materials (trees, shrubs, etc.) delivered to the site are in accordance with the contract documents.
- Observe that the rate of temporary and permanent seed and mulch materials are in compliance with the contract documents, and that activities are completed within the specified seeding dates.
- Complete a walk-through with the designer and contractor to identify any items which are not in compliance with project requirements. Document issues in a punch list and confirm when all items are installed or repaired.
- As needed by the local jurisdiction, author a letter of acceptance noting either conformance with construction documents, or any allowed deviation thereof.
- Be present during vegetation establishment and maintenance operations to verify that required duties are completed.
- Check that vegetation has been established as specified.

D. AS-BUILT REQUIREMENTS

During construction, records should be kept by the contractor (and site observer) that will allow record drawings of as-built improvements to be provided to the owner. To demonstrate that the project has complied with contract documents, these records should include, but not be limited to, the following:

- Spot elevations defining the cross section and slope of the grass swale.
- The flowline elevations of any storm pipes or structures leading into or out of the grass swale.
- The perimeter and elevation of the sediment collection area.
- The position and crest elevation of any check dams.
- Underdrain

Sediment collection area just after construction.

5.02-4 MAINTENANCE

During the design process, the entity responsible for routine and long-term maintenance should be identified. These tasks are necessary to maintain the function of the grass swale. Invasive growth, storage loss, surface erosion and pollution of downstream stormwater BMPs may occur if these tasks are not completed.

Activity	Schedule
Inspect for weeds, undesirable plants and brush.	Seasonally, at least three times per year.
Look for signs of sediment accumulation, flow channelization and erosion damage. Check surface water entry points for signs of surface erosion.	At least annually AND after rain events of 1.25" or larger.
Inspect the sediment collection areas.	After rain events of 1.25" or larger for the first year. At least three times annual after that, but more frequently as needed if sediment buildup is often observed.
Remove sediment from the collection area.	When 50% of the sediment collection capacity is filled.
Clean and remove debris as necessary.	When observed.
Repair undercut or eroded areas within the swale.	When observed.
Mow the swale.	As needed if turf grass is used. Refer to Section 11 when native landscaping is used.
Inspect check dams for stability and needs for repair.	Seasonally, at least three times per year.
Remove dead or dying vegetation.	Annually.
Perform controlled burns.	Refer to Native Landscaping Section for guidance.
Re-grade or re-shape the swale.	If erosion occurs, when observed.
Inspect underdrain.	If standing water is observed.

- Sediments excavated from grass swales that do not receive runoff from designated **hotspots** are not considered toxic or hazardous material and can be safely disposed of by either land application or at a permitted landfill.
- Sediment testing may be required prior to sediment disposal when a hotspot land use is present.
- Sediment removed from grass swales during construction should be disposed of according to an approved SWPPP.

5.02-5 SIGNAGE RECOMMENDATIONS

Signage for pretreatment areas is not required, as it is less commonly used than at stormwater quality BMPs. However, signage could be provided as an educational tool to detail the purpose and function of the grass swale to the general public. Signage can also be used to advise maintenance staff on maintenance requirements.

Illustration of an educational sign.

5.02-6 GLOSSARY

Best Management Practice (BMP)	A feature designed to meet stormwater water quality or quantity management goals.
Curve Number	A parameter used in NRCS Technical Release 20 or 55 (TR-20 or TR-55) that is used to estimate the rate and volume of stormwater runoff that will be created from rainfall, based on the soil types and land uses at a given location. Values range from around 30 to 100, with higher values resulting in more runoff being predicted from the equations used by TR-20 and TR-55 methods. See the NRCS TR-55 Methodology section of ISWMM for more information.
Hotspot	Land uses or activities that have the potential to generate higher pollutant loads than typical urban land uses. Gas stations and some industrial sites are examples of hotspots.
Hydrologic Soil Group (HSG)	Categories shown on County Soils Maps that describe the runoff potential of common soil groups. HSG categories range from A to D, with HSG A soils generating the least amount of runoff from rainfall events and HSG D soils generating the most.
Impervious cover	Surfaces on the landscape that do not allow water to pass through, such as roofs and paved surfaces.
Overflow crest	The elevation where water can overtop a surface to continue flowing downstream, such as at the top of a check dam or overflow structure.
Pretreatment	Use of practices or features to capture the heaviest sediment particles, trash or debris out of stormwater flows before it can enter a downstream BMP.
Time of concentration	The length of time it takes stormwater runoff to pass from the farthest upstream point in a drainage area to the outlet after runoff from rainfall has started.
Soil Quality Restoration (SQR)	Creating a healthy soil profile through methods of respreading topsoil materials or using blends of compost and sand to improve soil properties. (See the Soil Quality Management and Restoration Section of ISWMM.)
Underdrain	A perforated pipe installed below the surface intended to collect water that has infiltrated into the ground.
Unified Sizing Criteria (USC)	The set of stormwater management quality and quantity goals recommended by ISWMM.
Water Quality Volume (WQv)	One of ISWMM's USC, defined as the runoff generated by a 1.25-inch rainfall event. Over 90% of all rainfall events in Iowa are at or less than this amount of rain.

5.02-7 RESOURCES

Iowa SUDAS. https://cdn-wordpress.webspec.cloud/intrans.iastate.edu/uploads/sites/15/2020/03/2F-2.pdf

U.S. Department of Transportation. Design Charts for Open-Channel Flow. Hydraulic Design Series, No. 3. 1961.

U.S. Soil Conservation Service. Handbook of Channel Design for Soil and Water Conservation. 1947.

5.02-8 APPENDIX

KEY DESIGN PARAMETER CHECKLIST

There are important aspects of this manual to consider when jurisdictions seek to create stormwater ordinances or policies that reference or adopt this manual. The Iowa Department of Natural Resources (IDNR) is responsible for the creation and maintenance of this manual, working with a technical committee of local volunteers. However, regulation and enforcement of post-construction stormwater management is primarily left to local jurisdictions.

Therefore, the IDNR does not enforce as requirements, the sizing and design criteria set for this document. For this reason, the language used within this manual has purposefully been written as a guideline, rather than a standard. This means certain language that conveys something is required (i.e. shall, must, etc.) is generally avoided. This has the potential to leave "gray areas" as to what may be interpreted to be required and what is recommended or optional, if this manual is adopted and referenced by local jurisdictions as a standard.

Throughout this section, different design parameters or considerations have been grouped into key categories:

ESSENTIAL

An element of the design of a BMP seen as critical to its proper performance, operation or aesthetics. **These aspects should be most important for inclusion and compliance and should rarely be deviated from.**

TARGET

An element of the design of a BMP seen as important to its proper performance, operation or aesthetics. **These aspects should be included in designs, if at all possible.** However, there is more flexibility to allow deviations if it can be demonstrated that it is infeasible to meet the requirement at a given location, or if a certain requirement is in conflict with other requirements. **Designers should explain any reason for deviation from targets, for the consideration of the jurisdiction as part of their review.**

IDEAL

An element of the design of a BMP seen as the recommended approach for its proper performance, operation or aesthetics. Designers are encouraged to include these in designs as best practice. However, these items are seen as less critical as those noted as essentials or targets.

CAUTION

These are notes or design guidance to highlight items for the designers' careful consideration.

ADVISORY

These are practices, techniques or potential deviations from the design ethic that should be avoided in most circumstances.

GRASS SWALE - QUICK REFERENCE CHECKLIST

ESSENTIAL

1. Grass swales are best applied in rear yard swales within easements and other areas where the total impervious cover in the area tributary to the grass swale does not exceed one (1) acre. (page 2)
2. The side slopes of the grass swale should have a slope of four (4) to one (1) [horizontal to vertical] or flatter. (If Target Item #4 can't be provided) (page 5)
3. The channel shape should be designed to convey the peak flow from the WQv event at one (1) foot per second (fps) or less. (page 5)
4. The 100-year storm event should be able to be conveyed (including flow in the adjacent overbank flow area) without impacting private or public property and infrastructure. (page 5)
5. If channel slope is less than 2% an underdrain should be provided. (page 6)
6. The channel should be checked for scour potential for storm events up to the 10-year storm event. (page 6)
7. The minimum channel length should be selected to pass the WQv design flow through the swale at a velocity of no greater than one (1) foot per second (fps) for a travel time of at least 60 seconds in the swale (outside of any sediment collection areas). (page 6)
8. The grass swale should provide adequate cover over any existing or proposed utilities. In some cases it may be necessary to reinforce the channel with articulated concrete blocks or vegetated concrete block mats at locations where maintenance vehicles or equipment will need to routinely cross the swale. (page 7)

TARGET

1. Impervious cover in these areas is generally less than 50% of the tributary watershed area and impervious surfaces such as rooftops and patios typically flow across pervious lawn and landscape areas before entering the swale. (page 2)
2. A sediment collection area should be provided at points where flow enters the grass swale at a concentrated point. (page 2)
    a. The sediment collection area should be sized so that five percent (5%) of the Water Quality volume can be stored at a depth of one (1) foot over the collection area. (page 3)
    b. The sediment collection area should be set with a slope of 0.5 to 1.0% slope toward the swale and should have a surface constructed of one of the materials listed in Section 5.02-1, Part C. (page 3)
    c. When placed next to a paved surface, the sediment collection area should be recessed two (2) to three (3) inches below the edge of the paving. (page 3)
3. The channel should be trapezoidal in shape. (page 5)
4. The bottom of the grass swale should range between four (4) and eight (8) feet in width. (page 5)
5. The side slopes of the grass swale have a preferred slope of six (6) to one (1) [horizontal to vertical] or flatter. (See Essential Item #1) (page 5)
6. The main channel should be able to convey the peak flow from the CPv storm event. (page 5)
7. The 10-year storm event should be able to be conveyed without surface erosion. (page 5 and 6)
8. The slope of the channel should fall between two and four percent (1 – 4%).
    a. If channel slope is less than 2%, a subdrain should be provided (similar to SUDAS Figure 4040.231 (Case A, Type 1).
9. Check dams are not required but may be used to provide additional restrictions to velocity. (page 6)