

INDIANA DEPARTMENT OF TRANSPORTATION



**Stormwater Post-Construction
Best Management Practice
Operations and Maintenance Manual**

For

Wet Swales



Wet Swale Overview

Wet swales can be utilized as a Stormwater Post-Construction Best Management Practice (PCBMP) to treat stormwater collected from INDOT project sites after construction is completed. Wet swales are broad, shallow, channels planted with grass designed with a permanent pool. A berm, with or without an outlet structure, is typically required. In areas above the permanent pool elevation, turf grasses will typically be planted if a wet swale is located within 30 feet of the edge of pavement, but native grasses should be planted if a wet swale is more than 30 feet from the edge of pavement. In areas below the permanent pool elevation, the Emergent Plant Seed Mixture should be used.

Inspections

All wet swales shall be inspected at a minimum one time per 5-year INDOT Stormwater permit cycle. Values below are typical indicators for the need of maintenance for the structure. Inspections will use the form attached in Appendix A as an inspection checklist to note the following:

- Vegetation – cover should be approximately 90% of areas without a permanent pool
 - barren areas
 - dead plants which are preventing vegetative growth
 - presence of invasive plants or weeds
 - presence of woody vegetation
- Erosion and scour
 - erosion on embankments of swale
 - scour at inflow or outflow points
- Trash and debris – swale should be free of trash
 - presence of litter or debris in swale
 - inspector shall remove trash if possible
 - refer to material disposal section
- Inflow – If present, inlet structure and/or pipes should be able to convey flow
 - pipe is clogged
 - pipe is collapsed
- Outflow – If present, outfall structure and/or pipes should be able to convey flow
 - pipe is clogged
 - pipe is collapsed
- Sediment buildup
 - sediment buildup is reducing amount of water that can be stored in swale
 - refer to material disposal section
- Algal growth – wet swale should be free of algal growth

Initial inspections should place a particular focus on ensuring the vegetation has established as designed. Issues identified during inspections shall require maintenance as soon as possible, per noted rating condition.

Maintenance

All wet swales shall be mowed to the water line once yearly during the typical INDOT mowing and vegetation management cycle for their associated road and shall be performed in a manner which will direct clippings away from the wet swale. Additionally, maintenance shall be performed on an as needed or directed basis from inspection observations. Typical corrective actions consist of:

- Vegetation
 - reseed areas to bring vegetative coverage to 90% (seed mixtures provided in Appendix B)
 - use a snake and turtle safe erosion protection blanket as seed cover and protection
 - clear dead vegetation that is preventing plant growth, if necessary, reseed cleared areas until cover has again reached 90%
 - use a snake and turtle safe erosion protection blanket as seed cover and protection
 - remove invasive plants identified during inspection
 - remove woody vegetation identified during inspection
 - if spraying of woody vegetation is required, all applications of herbicide spray shall meet all local, state, and federal regulations
 - all herbicide sprayers shall be licensed by the Office of the Indiana State Chemist
- Erosion and scour
 - fill in erosion on embankments, regrade, replace rip rap, and reseed to bring cover to 90%
 - use a snake and turtle safe erosion protection blanket as seed cover and protection
 - fill in scour hole and replace/install protection around inlet
- Trash and debris
 - remove any trash or debris remaining in swale after inspection
 - dispose of all materials per material disposal section
- Inflow
 - unclog pipe by removing debris
 - repair or replace collapsed pipe
- Sediment buildup
 - remove excess sediment from permanent pond
 - dispose of all materials per material disposal section
- Algal growth – check with the INDOT Stormwater Team prior to any chemical application to retention pond
 - apply aquatic herbicide to treat excessive algal growth or cyanobacteria (must be Category 5 certified)
 - all herbicide applications shall meet all local, state, and federal regulations
 - all herbicide sprayers shall be licensed by the Office of the Indiana State Chemist

As well as issues related to the inspection criteria, maintenance will be required to address any problem which does not fall into these categories that threatens the functionality of the wet swale as a stormwater treatment device.

Material Disposal

All materials removed from maintenance and/or operation activities shall be disposed of according to all local, state, and federal requirements. If material observed in PCBMPs exhibits odor (petroleum, gas, oil, etc.), color, or other physical features that may indicate non-stormwater origins, do not remove this material, and contact the INDOT Stormwater Team for further investigation, identification, and proper disposal.

APPENDIX A – INSPECTION FORM



INDIANA DEPARTMENT OF TRANSPORTATION
INSPECTION & MAINTENANCE
POST-CONSTRUCTION STORMWATER MEASURE



INSPECTION & MAINTENANCE

POST-CONSTRUCTION STORMWATER MEASURE

Structure Type	Wet Swale	Asset ID
Typical Corrective Actions	<ul style="list-style-type: none">Vegetation – re-establish as needed so that cover is approximately 90%Erosion and scour – re-grade as needed, install erosion protection if requiredTrash and debris buildup – remove trash and debris as neededInflow and outflow points and/or structures – repair structures and remove debris or blockage as neededSediment buildup – should be ≤ 25% of original design volume – remove sediment as needed	
Maintenance Recommendations		



INSPECTION & MAINTENANCE

POST-CONSTRUCTION STORMWATER MEASURE

Structure Type	Wet Swale	Asset ID
Plans and Plan Cross Section(s)		



INDIANA DEPARTMENT OF TRANSPORTATION

INSPECTION & MAINTENANCE

POST-CONSTRUCTION STORMWATER MEASURE

Structure Type	Wet Swale	Asset ID
Photographs & Maps		
INSPECTED BY		APPROVED BY
_____ Printed Name/Title		_____ Printed Name/Title

APPENDIX B – SEED MIXES

NATIVE GRASS SEED MIX

Common Name	Botanical Name	Pure Live Seeds (Oz/Acre)
Common Milkweed	<i>Asclepias syriaca</i>	2
Frank's Sedge	<i>Carex frankii</i>	6
Spreading Oval Sedge	<i>Carex normalis</i>	6
Bottlebrush Sedge	<i>Carex lurida</i>	6
Awl-fruited Sedge	<i>Carex stipata</i>	6
Fox Sedge	<i>Carex vulpinoidea</i>	8
Common Rush	<i>Juncus effusus</i>	2
Canada Wild Rye	<i>Elymus canadensis</i>	36
Virginia Wild Rye	<i>Elymus virginicus</i>	36
Stiff Goldenrod	<i>Oligoneuron rigidum</i>	1
Switch Grass	<i>Panicum virgatum</i>	4
Little Bluestem	<i>Schizachyrium scoparium</i>	96
Woolgrass	<i>Scirpus cyperinus</i>	2
Reddish Bulrush	<i>Scirpus pendulus</i>	4
Prairie Cord Grass	<i>Spartina pectinata</i>	2
Common Spiderwort	<i>Tradescantia ohiensis</i>	6
	Total	223

TURF GRASS SEED MIXES

(a) Seed Mixture R

This seed mixture shall be applied at the rate of 202.5 lb/ac consisting of 100 lb/ac of low endophyte Tall Fescue, 50 lb/ac of turf type Perennial Ryegrass, 50 lb/ac of Creeping Red Fescue, and 2.5 lb/ac of White Dutch Clover. Seed used in this mixture shall be drought tolerant. Fertilizer and mulching material, where specified or directed, shall be applied in accordance with 621.05.

(b) Seed Mixture U

This seed mixture shall be applied at the rate of 196.5 lb/ac consisting of 100 lb/ac of a 4-way blend of turf type Tall Fescue, 50 lb/ac Creeping Red Fescue, 45 lb/ac Perennial Ryegrass, and 1.5 lb/ac White Dutch Clover. Fertilizer and mulching material, where specified or directed, shall be applied in accordance with 621.05.

EMERGENT PLANT SEED MIX

Common Name	Botanical Name	Pure Live Seeds Oz/Acre
Common Water Plantain	<i>Alisma subcordatum</i>	1
Swamp Milkweed	<i>Asclepias incarnata</i>	2
River Bulrush	<i>Bolboschoenus fluviatilis</i>	2
Bluejoint Grass	<i>Calamagrostis canadensis</i>	3
Common Fox Sedge	<i>Carex stipata</i>	3
Fox Sedge	<i>Carex vulpinoidea</i>	6
Blunt Spike Rush	<i>Eleocharis obtusa</i>	1
Great Spike Rush	<i>Eleocharis palustris</i>	1
Virginia Wild Rye	<i>Elymus virginicus</i>	16
Spotted Joe Pye Weed	<i>Eutrochium maculatum</i>	1
Fowl Manna Grass	<i>Glyceria striata</i>	3
Canadian Rush	<i>Juncus canadensis</i>	1
Common Rush	<i>Juncus effusus</i>	2
Rice Cut Grass	<i>Leersia oryzoides</i>	2
Chairmakers Rush	<i>Schoenoplectus pungens</i>	1
Softstem Bulrush	<i>Schoenoplectus tabernaemontani</i>	2
Dark Green Rush	<i>Scirpus atrovirens</i>	1
Wool Grass	<i>Scirpus cyperinus</i>	1
Red Bulrush	<i>Scirpus pendulus</i>	1
Wild senna	<i>Senna hebecarpa</i>	2
Common Bur Reed	<i>Sparganium eurycarpum</i>	4
Prairie Cord Grass	<i>Spartina pectinata</i>	3
New England Aster	<i>Sympyotrichum novae-angliae</i>	0.5
Blue vervain	<i>Verbena hastata</i>	1
Total		60.5

Cover Crop	Pure Live Seed Oz/Acre
Common Oats	540