NATURALIZED DETENTION BASIN MAINTENANCE MANUAL

Pope John High School
Naturalized Detention Basin Implementation Project

November 2022

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NATURALIZING PRACTICES USING GREEN INFRASTRUCTURE

Naturalizing practices involve placing native species into existing basin bottom and the surrounding sloped edges. This Best Management Practice (BMP) helps improve water quality, enhance groundwater recharge, and reduce stormwater volumes that discharge to waterways.. This secured the plants with nutrients and the chance for better root growth.By using tall grasses and native perennial plants, the basin can better manage stormwater runoff, clean water impurities, enhance wildlife habitat, and support native pollinators. Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Naturalizing replace mowed turfgrass in existing retrofit basins with the native plantings, which are adapted to flood plain and wetland conditions.

Green infrastructure practices capture, filter, absorb, and/or reuse stormwater to help restore the natural water cycle. When used as components of a stormwater management system, green infrastructure practices such as detention basins, retention basins, and turfgrass swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating runoff, these practices can help filter air pollutants, improve stormwater quality, reduce energy demands, and sequester carbon while also providing communities with aesthetic and natural resource benefits.

WHAT IS A DETENTION BASIN?

Detention basins are designed to detain stormwater runoff during a storm and slowly release the stormwater after the storm. The systems prevent downstream flooding, removes pollutants only through settling, and typically goes dry 48 hours after storm. The basins usually contain turfgrass that is regularly mowed often containing a concrete low-flow channel. A traditional detention basin is designed to detain stormwater runoff to reduce peak flow and to prevent downstream flooding. Detention basins are typically dry except during and immediately following a storm event. Detention basins are regularly maintained by mowing and sediment removal.

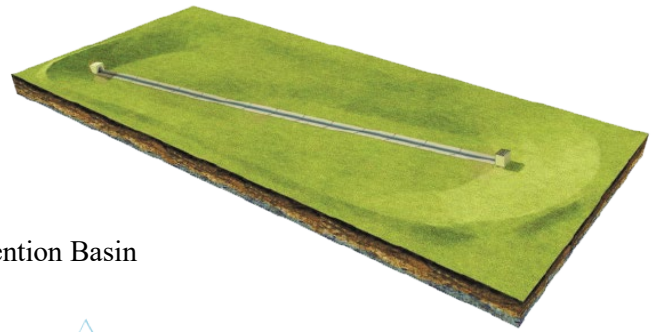

Figure 1. Standard Detention Basin
Graphic Courtesy:

pennsylvania environmental council
stormwater solutions

By installing tall grasses and native perennial plants in the basin bottom, the detention basin can better manage stormwater runoff, improve water quality, enhance wildlife habitat, and support native pollinators. Various types of basin naturalization can be achieved using alternative planting types such as seed mix, plug-planting, and larger plants species. Naturalized detention basins capture, filter, and infiltrate stormwater runoff. The native plant species removes nonpoint source pollutants from stormwater runoff while recharging groundwater. Naturalized detention basins are an important tool for communities and neighborhoods to create diverse, attractive landscapes while protecting the health of the natural environment.

Design Parameters

- Determine System consists of existing detention or retention basin
- Inlet and outlet structures are visible for inflow and outflow of stormwater
- Site Specific – concrete low-flow channel within existing basin
- Basin contains sloped sides leading to lower basin area
- Basin Bottom visible with side embankments/slopes
- Seed mix and plant material can be applied to bare soil, over-seeded, or sites treated with glysophate herbicide
- Seed mix and plant material should contain warm-season companion grasses in combination with wildflowers
- Require a single annual mowing at a height of no less than 6 inches

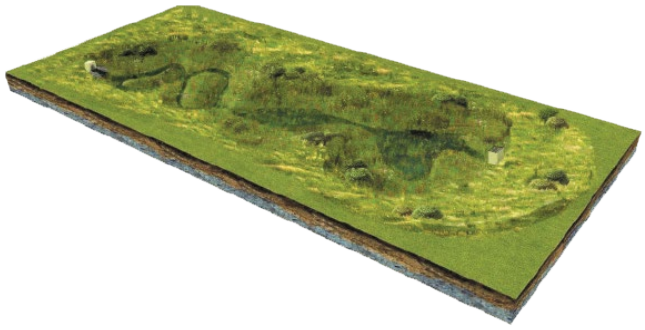

Figure 2. Naturalized Detention Basin
Graphic Courtesy:

pennsylvania environmental council
stormwater solutions

Construction Details

It may be helpful for maintenance staff to understand better how naturalized detention basin are installed. The diagram for a naturalized detention basin is shown below:

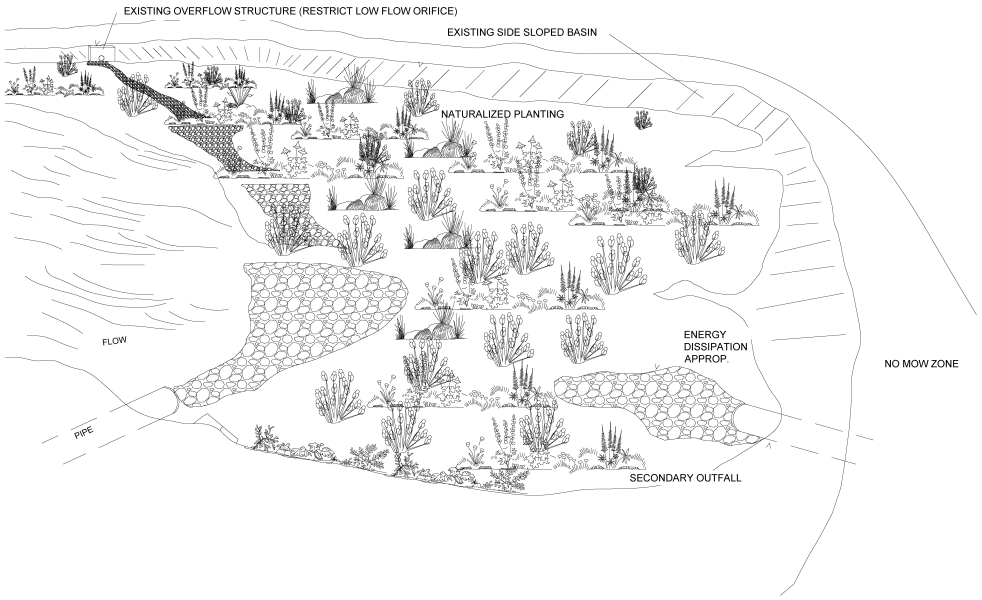

Figure 2: Diagram of naturalized detention basin

- Amend soil with coarse sand and/or compost if necessary
- Seed in the mid spring or fall at a minimum rate of 10-15lbs/acre
- Can be applied via hand broadcasting, hydroseeding, or with a native 'TRUAX' seed drill
- Need to be mulched during establishment with weed free straw or wood fiber mulch
- Basin Bottom visible with side embankments/slopes
- Biodegradable coir mating to be applied on top of seed mix and straw to prevent seed erosion
- Inlet / Outlets should contain a temporary check dam such as straw bale or sandbag to slow down the rate of stormwater

NATURALIZED DETENTION BASIN MAINTENANCE GUIDELINES

SEED / PLANT MANAGEMENT

When seeds, plugs, or large plant material are first planted, it is important to care for them appropriately to ensure their establishment. These maintenance procedures include key responsibilities prior to establishment and during the growth period.

WEEDS

Remove unwanted weeds from the garden by hand. Pull them from the base of the weed to remove the roots. As your garden becomes established, the rain garden plants will spread and out-compete unwanted weeds.

WATER MANAGEMENT

Water the new planting during the first three months post-planting and as needed throughout the future in times of drought. Plants should be watered every day for the substantial rainfall.

VEGETATION MANAGEMENT

Please inspect the rain garden's inlets monthly, and be sure to remove any leaves, trash, or debris that may prevent water from passing through. Observe the inlet during rainstorms to make sure stormwater is flowing into the rain garden. After rainstorms, please check the garden to be sure drainage outlet paths are clear and that water is not ponding for more than 72 hours.

MOWING MANAGEMENT

The advantage to these systems is the reduction of mowing required to maintain their effectiveness. Reduce mowing frequency of the basin bottom and embankments to a single monthly mowing at a height of 6-8 inches during the months of May through September. Eliminate any use of commercial fertilizers and pesticides in stormwater management facilities. After plant and vegetation is established, Avoid 'NO MOW ZONES' within the basin.

SUPPLEMENTAL PLANTING

Please remove and replace any dead plants in the basin and replace as needed.

Please photograph your green infrastructure practice and share pictures with the Rutgers Cooperative Extension (RCE) Water Resources Program! In addition, document the maintenance of the practice, and be sure to contact the RCE Water Resources Program at water@envsci.rutgers.edu if you need assistance or have any questions.

For more information, please visit www.water.rutgers.edu.

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New Jersey Agricultural Experiment Station

NATURALIZED DETENTION BASIN MAINTENANCE

First, refer to the copy of the As-Built Plan **(See Appendix A1)**

Inspections:

A. Litter / Debris Removal: Litter and debris must be removed to keep inlet/outlet structures clear of obstructions.
    - Visual inspection required
    - Remove litter from plant material prior to mowing

B. Sediment Removal: Removal and proper disposal of sediment buildup around inlet/outlet structures keeps the detention basin functioning properly.
    - Visual inspection required
    - Check inlet/outlet, low flow channel if applicable, gabions if present

C. Erosion Control: Inspect for loss of excessive sedimentation. Address gullying areas near steep embankments. Slopes should remain at ratios no greater than 3:1.
    - Visual Inspection should be twice a year

D. Drainage / Functionality of Basin: Detention basins are designed to hold water between 48 and 72 hours. Make sure to monitor after storm events to determine if basin is functioning. Locate areas that delay the flow of the stormwater.
    - Ponding issues may arise due to sediment or vegetation buildup

Vegetation Maintenance

- Post Installation year 1 – observe and inspect
- Post Installation year 2 – observe and inspect
- Ongoing: Mowing, invasive, woody
- Check for debris Inlet, outlet/Riprap
- No pesticides/herbicides/fertilizers

Moving Maintenance

- Identify Edge of Basin
- Edge/Perimeter: Regularly (Monthly)
- Determine no mow zone
    - Typical around Basin Base only, or basin slopes
    - Signage, fence, marking paint
- Initial Mow: No lower than 6-8” cut height
- End of Season Mow: Leave vegetation one over winter season for wildlife habitat.

Plant Material General Maintenance: Weeding

Healthy naturalized detention basins should be able to withstand minor disease and insect damage without controls. Routine application of pesticides shall not be practiced, as this destroys natural predator- prey relationships in the environment. Where unusually high infestations or infections occur, an accurate identification of the disease or insect shall be made and the control selected with care, prior to application. All chemical controls must be applied under the supervision of a licensed and qualified pest control applicator, following the procedures set forth in the labeling of the product, as required by law.

Type of Maintenance: Preventative

Tools and Supplies:

- Hand pruners
- Pitchfork
- Rake
- Spade shovel
- Pitchfork or spade
- Weeding fork
- Plant and weed photo identification sheet
- Trash bag, gloves

Frequency:

- Inspection: 1x/year minimum (Late May to early July, and/or late August to early September)
- Weeding: 3x/year minimum (spring cleanup, summer maintenance, fall put to bed)

Labor Hours: 2 people for approximately 4-6 hours depending on basin size

Maintenance Procedure:

A. Safety: Set up a safety perimeter. Protect existing plants from damage due to landscape operations and maintenance and operations of other contractors and trades.

B. Inspection: Visually inspect for any bare areas of vegetation or for specimen vegetation that has died and needs to be removed and/or replaced. Inspect for signs of frost heave and note any plants that may need to be replaced. Inspect plants for signs of excessive drought, disease, nutrient deficiency, and/or pest problems. Inspect planting areas for signs of soil compaction, soil subsidence, excessive salt deposits, or ponding of water. Inspect any areas of standing water for mosquito larvae. Also inspect areas (e.g., stabilized outfalls) that may experience erosion or increased sediment deposits which would inhibit infiltration.

    i. Record observations in the Green Infrastructure Maintenance Report Form and report as necessary. If possible, take photographs to document site conditions.

    ii. Based on the above observations, determine if it is necessary for a skilled horticulture professional to conduct a follow up visit to assess any potential plant health issues. Note this in the Green Infrastructure Maintenance Report Form.

C. Remove trash/debris: Remove any leaves, debris, and trash that may have accumulated in or around the plant beds/planters and legally dispose trash/debris off of the owner's property.

   i. All refuse resulting from the maintenance operation of properties shall be disposed of at locations designated by the manager/owner.

D. Weed: Weeding shall occur 3x/year at minimum (spring, summer, and fall).

   i. Weeding is easiest if done when soil is moist. It is also recommended to pay attention to specific sites and keep track of weed presence on the Green Infrastructure Maintenance Report Form for each site. Weeding is easier and more effective if done consistently throughout the growing season and done BEFORE weeds go to seed.

   ii. Refer to the project's plant identification sheet for photographs of plants to be able to identify what plants should remain and what plants are weeds and should be removed.

   iii. All planting areas shall be kept free of weeds, using either mechanical or chemical methods defined below.

      a. Carefully hand pull or dig out weeds and invasive plants taking care not to damage surrounding plants.

      b. For control of invasive species, spot spraying with herbicide may be employed by a Certified Pesticide Applicator only after notifying the proper authorities and getting approval to apply herbicides. Spraying is allowed only after receiving approval. Before applying herbicides, the type of weed shall be identified, and the control shall be selected accordingly, using the most effective control for the species, the location, and the season.

   iv. Weeds shall not be allowed to grow in paved areas such as driveways, walks, curbs, gutters, etc. Dead weeds shall be removed from the paved areas.

E. Cleanup: Remove surplus waste material including trash and debris, and legally dispose of surplus and waste material off of the owner's property

F. Record: Make note of any additional observations in the Green Infrastructure Maintenance Report Form.

G. Safety completion: Remove safety perimeter.

Shrub and Herbaceous Groundcover Pruning, Division, Cut Back, Removal of Dead Vegetation

Plants are chosen for their natural shape and growth habit. Maintenance should encourage vegetation health and enhance the natural form of plant material. Activities such as trimming and pruning should not alter plant form considerably.

Type of Maintenance: Preventative

Tools and Supplies:

- Hand pruners
- Trowel
- Spade shovel
- Pitchfork
- Bow saw (if necessary)
- Trash bag, gloves

Frequency: 1x/year, see below:

- Shrubs: 1x/year in March/April or September/October depending on species
- Perennials: 1x/year cut back in March/April or September/October (March/April recommended)
- Grasses: 1x/year cut back as needed in March/April

Labor Hours: 2 people for approximately 1-8 hours per site depending on site size

Maintenance Procedure:

A. Safety: Set up a safety perimeter. During pruning, keep adjacent paving and construction area clean and work area in an orderly condition. Protect plants from damage due to landscape maintenance operations and operations of other contractors and trades.

B. Inspection: Visually inspect for any bare areas of vegetation or for specimen vegetation that has died and needs to be removed and/or replaced. Inspect plants for signs of excessive drought, disease, and/or pest problems. Inspect any areas of standing water for mosquito larvae. Record observations in the Green Infrastructure Maintenance Report Form, and report as necessary. If possible, take photographs to document site conditions.

C. Remove trash/debris: Remove any large debris and trash that has accumulated in and around planters/plant beds, and legally dispose of large debris and trash off of the owner's property.

D. Prune:

<u>Shrubs</u>

Prune, thin, and shape shrubs according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by an arborist, remove only injured, dying, or dead branches from shrubs and prune to retain natural character/form. Do not prune for shape.

Shrubs shall be pruned to maintain growth within space limitations, to maintain or enhance the natural growth habit, or to eliminate diseased or damaged growth. Some species shall be trimmed appropriately to influence flowering and fruiting or to improve vigor.

Shrubs must be trimmed as needed to permit unobstructed passage to residents or vehicles. Trimming shrubs within site clearance restricted areas at intersections is appropriate and shall have a maximum height of 2.5 feet from vehicular surface. Any curbs or raised planting areas shall be factored into the maximum 2.5-feet height. Shrubs must be trimmed 4″ from the edges of sidewalks and curbs.

Shrubs shall be pruned to conform to the design concept of the landscape. Individual shrubs shall not be clipped into balled or boxed forms except where specifically instructed.

Perennials and Herbaceous Plants

Established plants bordering sidewalks or curbs shall be edged as often as necessary to prevent encroachment. Plants shall not be allowed to cover the crowns of shrubs or trees.

Refer to a plant identification sheet to identify weeds from intended plants.

Perennial cut back/cleanup/removal of dead vegetation: Removing dead vegetation (on perennials) shall occur a minimum of 1x/year during the spring or fall, with a recommendation towards mid-spring before new vegetated growth has emerged or when plant is dormant. Use hand shears to remove dead vegetation and cut back perennials to 6-8″ above root crown.

If dried seed pods or dried flowers are considered desirable by the property owner, then the dead vegetation may be allowed to remain through the winter and should be cut back in the spring.

Some species have seed pods that act as food for birds/wildlife and/or decorative dried features; however, other species may spread seed or look unkempt when dried, and this may not be desired.

Perennial division and thinning: Depending on the species, perennials may need dividing every 3–5 years. This is because as certain plants get older, they die back starting from the center.

Division is also done to prevent crowding as a plant grows and becomes larger in size. To divide perennials, dig up the old plant, remove the dead vegetation entirely, and replant the healthier sections. To thin perennials, selectively remove individual plant stems (either healthy or dead) if overcrowding is occurring. Thinning of perennials is done to prevent overcrowding and mildew by encouraging air circulation between individual plants.

Grasses

Refer to a plant identification sheet to identify weeds from intended plants.

Grass cut back: Cut back foliage to 6–10″ above root crown in mid-spring before warm season grasses emerge but when cool season weeds are actively growing. Leave a minimum 4-6″ of previous growing season's growth depending on the ornamental grass

species. Shorter species such as Blue Fescue will be 4″ while taller species such as Switchgrass will be 6″.

Grass division: Ornamental and/or clumping grasses shall also be divided every 3 to 5 years to increase vigor. Groundcover grasses and meadow grasses do not need dividing.

List of example grasses that require division:

Sedges (*Carex* spp.)
Pennisetum (Fountain Grass)
Andropogon gerardii (Big Bluestem)
Schizachyrium scoparium (Little Bluestem)
Panicum virgatum (Switchgrass)
Calamagrostis x acutiflora (Feather Reed Grass)

E. Record: Make note of any additional observations in the Green Infrastructure Maintenance Report Form.

F. Safety completion: Remove safety perimeter

Shrub and Herbaceous Plant Material Plant Replacement

Plant (shrub and herbaceous plant material) replacement involves replacing missing, dead, or diseased shrubs and herbaceous plant material (perennials, forbs, grasses) in planter beds, planters, rain gardens, and/or bioswales if replacement has been deemed necessary.

NOTE: Tree replacement is not part of this procedure and will occur separately.

Type of Maintenance: Replacement

Tools and Supplies:

- Safety cones
- Safety gear (clothing, gloves, etc.)
- Planting equipment – shovels, pitchfork, rake, etc.
- Shrubs, plants, and seeds (to be planted)
- Trash bags for debris, weeds, etc.

Frequency: Spring and fall, replacement as necessary

Labor Hours: 2 people for approximately 2-6 hours per site depending on scope of replacement

Maintenance Procedure:

A. Safety: Set up a safety perimeter. Protect existing plants from damage due to landscape operations and maintenance.

B. Inspection: Visually inspect for any bare areas of vegetation or specimen vegetation that has died and needs to be removed and/or replaced. Inspect areas where plants will be planted (replaced), and note signs of soil subsidence, soil compaction, standing water, evidence of disease/fungus, and animal burrowing.

   a. Record observations in the Green Infrastructure Maintenance Report Form, and report as necessary. If possible, take photographs to document site conditions.

C. Remove trash/debris: Remove any leaves, debris, and trash that have accumulated in or around the plant beds/planters.

   a. All refuse resulting from the maintenance operation of properties shall be disposed of at locations designated by the manager/owner.

D. Replacement: Follow the below instructions if shrub and herbaceous groundcover replacement has been deemed necessary. Tree replacement will occur separately.

   a. Replacement requirements for shrubs and groundcover:

      - Shrubs: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
      - Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required.

- Set balled and potted and container-grown stock plumb and in center of planting pit or trench with the root flare at 1 inch (25 mm)
- Pit should be twice as wide as it is deep above adjacent finish grades.
  - Use planting soil for backfill for types specified and scheduled.
  - Carefully remove root ball from container without damaging root ball or plant.
  - Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - If amending soil, place amendment tablets or incorporate amendments in each planting pit when pit is approximately half filled in amounts recommended in soil reports from soil testing laboratory. If using amendment tablets, place tablets beside the root ball about 1 inch (25 mm).
  - Continue backfilling process. Water again after placing and tamping final layer of soil.
- Groundcover and Perennial Plugs: For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
  - Set out and space ground cover and plants in swaths to fill in vegetated gaps in plant bed.
  - Dig holes large enough to allow spreading of roots.
  - Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
  - Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
  - Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
  - Planting Restrictions: Plant during one of the following periods listed below. Coordinate planting periods with maintenance periods to provide required maintenance from date of substantial completion.

    Shrubs:

    - spring planting: March 1 to May 1
    - fall planting: September 1 to November 1

    Grass & Perennial Plugs:

    - spring planting: April 1 to June 15

- fall planting: August 1 to September 15

Bulbs:

- fall planting: September 15 to October 30

E. Cleanup: Stones, debris, tools, equipment, rope, pruned branches, tree debris, etc. shall be removed from the site upon completion of work. Excess soil outside of the saucer areas shall be removed and the area raked smooth. Paved areas shall be broom cleaned.

F. Record: Make note of any additional observations in the Green Infrastructure Maintenance Report Form**.**

G. Safety completion: Remove safety perimeter.

Invasive Species Inspection and Control Measures

Invasive species inspection consists of a visual inspection, trash/debris removal, and invasive species management.

Healthy plants and lawns should be able to withstand minor disease and insect damage without controls. Routine application of pesticides shall not be practiced, as this destroys natural predator-prey relationships in the environment. Where usually high infestations or infections occur, an accurate identification of the disease or insect shall be made and the control selected with care prior to application. All chemical controls must be applied under the supervision of a licensed and qualified pest control applicator following the procedures set forth in the labeling of the product as required by law.

Type of Maintenance: Preventative

Tools and Supplies:

- Hand pruners
- Trowel
- Spade
- Pitchfork and weed fork
- Plant and weed photo identification sheet
- Trash bag, gloves

Frequency:

- Inspection: Minimum 3x/year (spring, summer, fall)
- Monitor monthly during growing season for invasive species during the first 2 to 3 years

Labor Hours: 2 people for approximately 4-8 hours depending on site size

Maintenance Procedure:

A. Safety: Set up a safety perimeter. Protect existing plants from damage due to landscape operations and maintenance.

B. Inspection: Visually inspect for any bare areas of vegetation or specimen vegetation that has died and needs to be removed and/or replaced. Inspect plants for signs of excessive

drought, disease, nutrient deficiency, and/or pest problems.

i. Inspect any areas of standing water for mosquito larvae. Inspect meadow area for evidence of invasive species and woody plant establishment. Monitor meadow monthly during growing season for invasive species during the first 2 to 3 years. Examples of invasive species include thistle, knapweed, *Phragmites*, and general weeds such as dandelions.

ii. Record observations in the Green Infrastructure Maintenance Report Form and report as necessary. If possible, take photographs to document site conditions.

iii. Based on the above observations, determine if it is necessary for a skilled horticulture professional to conduct a follow up visit to assess any potential plant health issues.

Note this in the Green Infrastructure Maintenance Report Form.

A. Control of Invasive Species:

i. Managing invasive species in meadows is primarily done through mowing. Mowing helps prevent/control woody plant and weed establishment, and helps to disperse seeds of desirable species.

ii. Refer to the project's plant identification sheet for photographs of plants to be able to identify what plants should remain and what plants are weeds and should be removed.

iii. For the control of certain types of invasive species not able to be managed by mowing, such as crown vetch, spot spraying and hand pulling should be conducted as directed below:

B. Carefully hand pull or dig out invasive plant species taking care not to damage surrounding plants.

C. For control of invasive species, spot spraying with an herbicide may be employed only by a certified pesticide applicator after notifying the proper authorities and getting approval to apply herbicides. Spraying is allowed only after receiving approval. Before applying herbicides, the type of weed shall be identified and the control selected accordingly, using the most effective control for the species, the location, and the season. Suggested herbicides for control of invasive plants include:

i. **Glyphosate**

Glyphosate herbicide may be used for total vegetation control and is safe to use immediately prior to planting and up to four days after seeding. Glyphosate may also be used to target individual weeds as a careful spot spraying after planting, but some non-target plants are likely to be damaged and killed as well. A specific formulation can be used for total vegetation control prior to planting in the grassland and mow strip areas. A formulation approved for wetland use can be used in stormwater infiltration basins and swales.

ii. **Plateau** (best application for areas near rain gardens)

Plateau herbicide is a very good herbicide for pre- and post-emergent weed control for

establishing warm-season grasses. Pre-emergent application prior to planting is best. Plateau's utility is limited when wildflowers or cool season grasses are incorporated into the seeding mix. Native forbs, depending on the species, may or may not be tolerant of Plateau. Cool season grasses are not very tolerant of Plateau. Switch grass is not as tolerant to Plateau as other warm season grasses.

iii. **Transline**

Transline is a selective herbicide for the control of composites, polygonums, and legumes such as crown vetch. If carefully used as directed, it is an effective post-planting spot spray, because it will not kill all the desired vegetation that is touched by over-spray. Transline can be sprayed over the top of grass plantings where crown vetch is abundant and where there are no desired composite wildflowers or legumes. Control of crown vetch will likely require at least 2 to 3 years of scouting and retreating with spot spray applications. Legumes and composites should be planted sparingly in the successional grassland in treated crown vetch areas.

Note: All products mentioned here are for information only and are not an endorsement of a particular brand.

D. Remove trash/debris: Remove any leaves, debris, and trash that have accumulated. All refuse resulting from the maintenance operation of properties shall be disposed of at locations designated by the manager/owner.

E. Record: Make note of any additional observations in the Green Infrastructure Maintenance Report Form**.**

F. Safety completion: Remove safety perimeter.

APPENDIX A

Naturalized Basin Maintenance Report Form

RUTGERS
New Jersey Agricultural Experiment Station
Water Resources Program

Green Stormwater Infrastructure Assessment Program
Stormwater Basin Inspection Checklist

GENERAL INFORMATION	Site ID:
Name(s) person inspecting the basin:	Date:
Location Address and Cross Streets:	Watershed:
Name of Creek, Stream, or area into which the basin discharges:	Property Owner / Tax Parcel Block & Lot:
Contact information:	
STRUCTURAL COMPONENTS	
Basin description, size and depth:	Is the basin accessible to maintain? Yes / No Is it maintained: Mowed, clear of woody plants, inlet/outlet blockages?
Number of inlets:	Outlet diameter:

GENERAL OBSERVATIONS	**YES**	**NO**	**NOTES/REMARKS**
1) Any reports on the basin not functioning?			
2) Are there any unauthorized or malfunctioning structures in the basin?			
3) Are there concrete low flow channels. Is the water entering the basin directly exiting the basin outlet without coming in contact with the basin bottom soil and vegetation?			
4) Is there standing water or evidence of standing water in the basin?			
INLET/S			
1) Signs of breakage, damage, corrosion or rusting of inlet structure/pipe?			
2) Debris or sediment accumulation in or around the inlet clogging the inlet opening/pipe?			
3) Signs of erosion, scour or gullies; rock or vegetation above or around the inlet structure?			
4) Tree roots, woody vegetation growing close to or through the inlet structure or a situation impacting the structure's integrity?			
5) If the inlet has a pretreatment structure (trash rack, forebay) is it filled w/ debris or sediment?			
BASIN			
1) Accumulation of debris or litter within basin?			
2) Exposed dirt or earth visible, are there areas without vegetation or where turf is damaged?			
3) Excess sediment accumulation in the basin?			
4) Basin walls/embankment eroded, slumping, caved or being undermined?			

RUTGERS
New Jersey Agricultural Experiment Station
Water Resources Program

Green Stormwater Infrastructure Assessment Program
Stormwater Basin Inspection Checklist

OUTLET	YES	NO	NOTES/REMARKS
1) Breakage, damage, corrosion or rusting to outlet pipe or conveyance?			
2) Signs of erosion, scour or gullies; rock or vegetation above or around the outlet structure?			
3) Debris or sediment accumulation in or around the outlet pipe (i.e. debris or sediment)?			
4) Accumulation of debris or litter in or around outlet?			
5) Tree roots or woody vegetation impacting the outlet or causing potential damage to the structure?			
SECONDARY/EMERGENCY OVERFLOW SPILLWAY			
1) Are pipes, conduits, or conveyances free of debris, clogs and in good condition? (i.e. no visible cracks, breakage slumping)			
2) Large tree or root growth close to pipes or conveyances with the potential to crack structure or impede flow?			
3) Signs of erosion, scour or gullies; rock or vegetation above or around the spillway?			
BASIN OUTFALL AREA			
1) Signs of stormwater exiting the basin in an uncontrolled manner over or through wall or berm?			
2) Signs of erosion, scour or gullies; rock or vegetation at or down slope of the outfall?			

RECOMMENDATIONS FOR WATER QUALITY IMPROVEMENTS	
1) Reduce mowing 2) Plant buffers 3) Establish meadows 4) Retrofit with infiltration structures or other strategies 5) Other	

SUMMARY AND NOTES: Identify unique characteristics and/or opportunities

APPENDIX B

Plant Fact Sheets

Asclepias incarnata
Swamp milkweed

Summer Foliage

Summer Flower[a]

Characteristics: Herbaceous, perennial, nonpersistent

Appearance:

Height - up to 6 ft.
Flower color - pink to purplish red
Flowering Period - June through August

Habitat (Community): fresh tidal marshes, nontidal marshes, wet meadows, shrub swamps, forested wetlands (clearings), shores and ditches

Hydrology

Indicator Status - Obligate wetland
Salinity - prefers fresh water
Nontidal regime: Irregularly, seasonally, or regularly inundated or saturated. When flooding is regular, only ground saturation is tolerated.

Wildlife Benefits: (Roots) food sparingly used for muskrats; **(Nectar)** food for butterflies.

Distribution: Nova Scotia to Manitoba and Utah, south to Florida, Louisiana, and New Mexico (varieties occur across this range)

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[a] Jennifer Anderson. United States, IA, Scott Co., Davenport, Nahant Marsh. 2002

Carex vulpinoidea
Fox sedge

Foliage and Flower[ab]

Characteristics: Herbaceous, Perennial, Nonpersistent

Appearance:

Height - up to 3.5 ft.
Flowering Period - June through August

Habitat (Community): Fresh water marshes, wet meadows

Hydrology:

Indicator status - Obligate wetland
Salinity - Freshwater
Non-Tidal Regime - Seasonally to regularly inundated

Wildlife Benefits: Food for sora rail; swamp, tree sparrows; grouse, snipe, seed eating songbirds, larkspurs, redpoll, ruffed grouse chicks, ducks.

Distribution: Newfoundland to southern British Columbia, Washington, Oregon, south to Florida, west to Rocky Mountains

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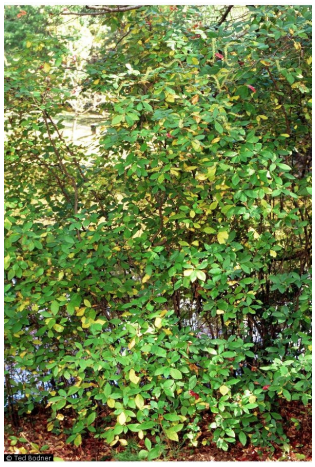
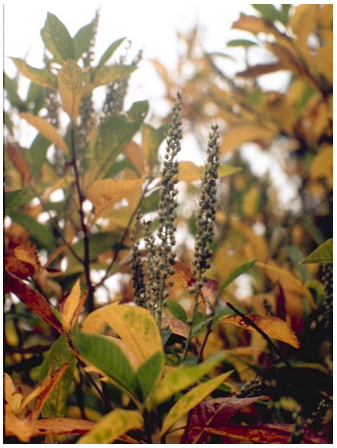
[a] http://plants.usda.gov/java/largeImage?imageID=cavu2_002_avp.tif
[b] http://www.pinelandsnursery.com/2015/02/carex-vulpinoidea-fox-sedge.html

Clethra alnifolia
Sweet Pepperbush/ Summersweet



Spring Foliage

Summer Foliage



Fall Fruit

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height – 6-12 ft.
Aerial Spread – 3 to 6 ft.
Flower Color – White
Flowering Period – Early July through mid-August
Fruit Color – Brown
Fruiting Period – Early September persisting through February

Habitat (Community): Tidal and nontidal forested wetlands, shrub swamps, sandy woods, and coastal river floodplains

Hydrology:

Indicator status – Facultative wetland
Salinity – Resistant; tolerates infrequent flooding by water containing some salt
Non-Tidal Regime – Seasonally to regularly inundated or saturated

Wildlife Benefits: Provides food and cover for songbirds, shorebirds, waterfowl, upland gamebirds, and small mammals.

Distribution: Southern Maine, south to Florida and eastern Texas

Echinacea purpurea
Purple Coneflower

Summer Foliage

Summer Flowers

Characteristics:
Perennial herb

Appearance:
Height – 2-4 ft.
Aerial Spread – 1.5 to 2 ft.
Flower Color – Purplish pink
Flowering Period – June - August

Habitat (Community):
Rocky open woods and dry prairies

Hydrology:
Indicator Status – N/A
Salinity – Low salinity tolerance
Non-Tidal Regime – Low tolerance of drought conditions, but will grow in a wide range of soil textures (prefers well-drained, sandy or richer soils). Will not tolerate water logging.

Wildlife Benefits:
Excellent nectar species for many butterflies; goldfinches eat seeds from late summer into fall

Distribution:
Chiefly in Ozarks and Midwest, from Illinois and southern Iowa to eastern Oklahoma, extreme northeastern Texas, and central Louisiana, east irregularly to southern Michigan, Kentucky, Tennessee, and Georgia, and less commonly to Virginia and North Carolina

Ilex glabra
Inkberry

Foliage and Fall Fruit

June Foliage and Flower

Characteristics: Broad-leaved, evergreen shrub

Appearance:

Height - 6 to 8 ft.
Aerial Spread - 6 to 12 ft.
Flower Color - Greenish to white
Flowering Period - Early May through late June
Fruit Color - Black
Fruiting Period - Late September to lat Mach

Habitat: Forested seasonal wetlands, shrub swamp and sandy woods

Hydrology:

Indicator status - Facultative wetland
Salinity - Resistant, tolerates infrequent flooding by water containing some salt
Non-Tidal Regime - Seasonally inundated or saturated

Wildlife Benefits: **(Fruit)** is food for wild turkey, bobwhite, common flicker, hermit thrush, eastern bluebird, cedar waxwing, rufous-sided towhee, waterfowl; **(Food, Cover, and Nesting)** for mockingbird and American robin.

Distribution: Nova Scotia to Florida and Louisiana along coastal plain

Ilex verticillata
Common winterberry


Summer Foliage


Fall Foliage


Fall/Winter Fruit


Summer Flower

Characteristics: Broad-leaved, deciduous shrub

Appearance:

Height - 6 to 12 ft.
Aerial Spread - 6 to 12 ft.
Flower Color - Greenish to white
Flowering Period - Early through late June
Fruit Color - red to orange
Fruiting Period - Late August persisting through February

Habitat (Community): Fresh tidal swamps, shrub swamps, and forested wetlands

Hydrology:

Indicator status - Facultative wetland
Salinity - Freshwater
Non-Tidal Regime - Irregularly to seasonally inundated or saturated

Wildlife Benefits: Important for emergency food in winter; **(Berries, other)** food for mockingbird, gray catbird, brown thrasher, black duck, bobwhite, common flicker, American crow, American robin, cedar waxwing, cottontail rabbit, raccoon, squirrel, an eastern bluebird; **(Food, Cover, and Nesting)** for veery, and red-winged blackbird.

Distribution: Newfoundland to Minnesota, south to Georgia and Mississippi

Iris versicolor
Blue flag, Blue water iris

Spring/Summer Flower

Green Summer Foliage

Characteristics: Herbaceous, Perennial, Nonpersistent

Appearance:

Height - 2 to 3 ft.
Flower Color - Blue or violet
Flowering Period - May

Habitat: Swamps, Marshes, and Wet Shores

Hydrology:

Indicator status - Obligate wetland
Salinity - Fresh to moderately brackish
Non-Tidal Regime - Regularly to permanently inundated up to 0.5 feet or saturated

Wildlife Benefits: Food for wildfowl, marsh birds, and persists as cover within a growing season under heavy grazing. Favorite to hummingbirds.

Distribution: Newfoundland to Manitoba, south to Virginia and Minnesota.

Juncus effusus
Soft rush

Foliage and Flowers

Characteristics: Herbaceous, Perennial, Persistent

Appearance:

Height - Up to 3.5 ft.
Flowering Period - July through September

Habitat (Community): Fresh tidal marshes, non-tidal marshes, shrub swamps, wet meadows, and ditches

Hydrology:

Indicator status - Facultative wetland
Salinity - Freshwater
Non-Tidal Regime - Regularly to permanently inundated

Wildlife Benefits: Food for wildfowl, upland game birds, marsh birds, songbirds, and waterfowl; spawning grounds for rock bass, bluegills, and others

Distribution: Throughout the United States

Lobelia cardinalis
Cardinal flower

Foliage and Summer/Fall Flower

Characteristics: Herbaceous, Perennial, Nonpersistent

Appearance:

Height - 2 to 4 ft.
Flower Color - Scarlet
Flowering Period - June through September

Habitat (Community): Fresh tidal marshes, non-tidal marshes, wooded swamps, seeps, pond, river, and stream banks

Hydrology:

Indicator status - Facultative wetland
Salinity - Freshwater
Non-Tidal Regime - Regularly to permanent saturated

Wildlife Benefits: Food **(nectar)** for hummingbird, oriole, and butterflies.

Distribution: New Brunswick to Michigan and Minnesota, south to Florida and Texas

Monarda fistulosa
Wild bergamot / Bee-balm

Summer Flower

Summer Foliage [1]

Characteristics: Perennial herb, aromatic

Appearance:

Height – 2-3 ft**.**
Flower Color – Pale pink to lavender
Flowering Period – July through September

Habitat (Community): Found in upland woods, dry fields, prairies, thickets, and woodland borders.

Hydrology:

Indicator Status – Upland

Wildlife Benefits: Nectar source for bees, hummingbirds, and butterflies.

Distribution: Quebec to Manitoba and British Columbia south to Georgia, Louisiana, and Arizona.

[1] Patrick J. Alexander, hosted by the USDA-NRCS PLANTS Database

Panicum virgatum
Switchgrass

Foliage[ab]

Characteristics: Herbaceous, Perennial, Persistent

Appearance:

Height - Up to 6'
Flowering Period - August through November
Bloom Color - Green to Brown

Habitat (Community): fresh and brackish tidal marshes non-tidal marshes wet meadows open woods, prairies, dunes

Hydrology:

Indicator status – Facultative (prefers moderate conditions)
Salinity – Fresh to brackish water; up to approximately 10 ppt
Tidal – above mean high water to upland
Non-Tidal Regime – irregularly to seasonally inundated or saturated (up to approximately 25% of the growing season)

Wildlife Benefits: Food for teals, wigeon, black duck, snow goose, snipes, ground dove, bobwhite, wild turkey, red-winged blackbird, cowbird, blue grosbeak, longspurs, sparrows (tree, savannah, Lincoln etc.), white-footed mouse, muskrat, rabbit and deer.

Distribution: Quebec to Saskatchewan, south to Florida, Texas, and Arizona

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[a] http://www.pinelandsnursery.com/2015/02/panicum-virgatum-switchgrass.html

[b] Jeff McMillian, hosted by the USDA-NRCS PLANTS Database

Penstemon digitalis
Foxglove Beardtongue

Summer Flower & Foliage

Characteristics: herbaceous perennial; deer resistant

Appearance:

Height - 3 to 5 ft.
Spread - 18 in.
Flower Color - white or light pink
Flowering Period - May through July

Habitat (Community): wild and perennial gardens, woodland edges, xeriscaping, and naturalized areas

Hydrology:

Indicator Status - facultative
Salinity Tolerance - medium
Drought Tolerance - high

Wildlife Benefits: attracts bees, butterflies, and hummingbirds

Distribution: USDA hardiness zones 3-8

Rudbeckia fulgida
Orange coneflower


Summer Flower & Foliage

Characteristics: herbaceous perennial; deer resistant; self seeds

Appearance:

Height - 2 to 3 ft.
Spread - 1 to 2 ft.
Flower Color - yellow orange
Flowering Period - July through September

Habitat (Community): open woods, meadows, and pastures; native or rain gardens

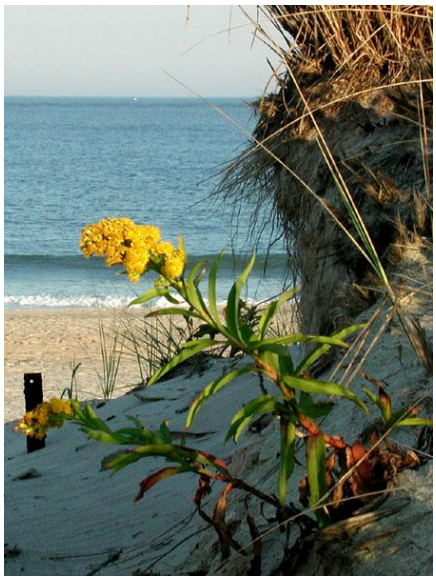
Hydrology:

Indicator Status - facultative upland

Wildlife Benefits: attracts butterflies

Distribution: USDA hardiness zones 3-9

Solidago sempervirens
Goldenrod



Characteristics: Persistent, herbaceous perennial

Appearance:

Height – 1-8 ft**.**
Flower Color – Yellow
Flowering Period – August to November

Habitat (Community): Well-drained soils.

Hydrology:

Indicator Status – Facultative wetland
Salinity Tolerance – High
Shade Tolerance – Intolerant

Distribution: Northeast west to Texas and Michigan

Sorghastrum nutans
Indiangrass

Characteristics: Native, perennial, warm-season grass

Appearance:

Height – 3-5 ft**.**
Flower Color – Golden brown
Flowering Period – June to September

Habitat (Community): Deep, well-drained floodplain soils. However, it is highly tolerant of poorly to excessively well-drained soils, acid to alkaline conditions, and textures ranging from sand to clay.

Hydrology:

Indicator Status – Upland (prefers dry conditions)
Salinity Tolerance – Medium
Shade Tolerance – Intolerant

Wildlife Benefits: **Cover and food (seeds or rhizomes)** for deer

Distribution: Northeast west to Texas and North Dakota

Symphyotrichum novi-belgii
New York Aster

Foliage and Summer/Fall Flower

Characteristics: Herbaceous, Perennial

Appearance:

Height – 1 to 3 ft
Flower Color – purple
Flowering Period – August to October

Habitat (Community): open, forested seasonal wetlands moist soils and shores

Hydrology:

Indicator status - Facultative wetland
Salinity – Not applicable, prefers freshwater
Non-Tidal Regime – irregularly to seasonally inundated or saturated (up to approximately 25% of the growing season)

Wildlife Benefits: **(cover)** for many small wild game animals.

Distribution: Maine to southern Maryland and Washington D.C.