UNRBA Responses to Questions Raised by DWR Planning Staff Regarding the Use of the Soil Improvement Practice for New Development

Question 1

As a non-structural, one-time practice, what sort of regulatory framework does DEQ need to ensure proper design and implementation? Clearly the current All-SCM MDC cannot apply to this.

There are already minimum design criteria (MDC) in place for disconnected impervious surface (DIS) and level-spreader filter strips. These are similar to soil improvement.

Virginia, Maryland, and Pennsylvania include urban soil restoration in their stormwater best management practices manual that provide useful context for establishing a regulatory framework in North Carolina:

- The Pennsylvania Stormwater Best Management Practices Manual includes this as a practice and addresses applicability across varying levels of urban intensity, design considerations, volume reduction calculations, and specifications. An example of soil amendment incorporated into a stormwater management plan for a pipeline project in Pennsylvania is here - 07 Site Restoration and PCSM report SC.pdf (state.pa.us). This includes specifications, scheduling, inspection, and maintenance requirements.
- VA DEQ STORMWATER DESIGN SPECIFICATION NO. 4 SOIL COMPOST AMENDMENT includes construction sequences, maintenance agreements, and first-year maintenance operations. BSE-272.pdf (vt.edu) indicates that lawn areas that undergo soil restoration and do not receive runoff from other areas can remove as much as 75 percent of runoff volume.
- The Maryland Department of the Environment Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated manual specifies design criteria for urban soil restoration in Appendix G.

Please see the Design Criteria and Recommendations section of the Soil Improvement Crediting Document. Approved by NCDEQ on 03-10-2017 (text copied below for reference):

Prerequisites and Qualifying Conditions:

1. Option-specific prerequisites and requirements:

   a. The default credit (Option 1) may be awarded for soil improvement on Hydrologic Soil Group (HSG) B, C, or D soils, or soils classified as Urban. The default credit is not applicable to HSG A soils, which are assumed to have relatively high infiltration rates such that soil improvement would offer limited benefit. The default credit is limited to developed sites that are less than 30 years old because the assigned credit is based on site development age, and sites that are 30 years old and older are assumed to have good infiltration rates that would see no benefit from soil improvement.

b. Practitioners may choose the site monitoring option (Option 2) for any site including those developed more than 30 years prior and those with soils mapped as HSG A, recognizing that development can impact soils for extended timeframes or impact soils with high native infiltration rates such that soils previously mapped as HSG A may have poor infiltration after development. Specific requirements for Option 2 include the following:

i. Conduct post-improvement monitoring no earlier than three months after turfgrass has established or six months after non-turfgrass vegetation (i.e., shrubs and trees) have established

ii. Conduct bulk density tests over the depth of improvement: depth-integrate results for each sampling location and spatially average them over the site to estimate the average change in porosity.

iii. Consult with a soil scientist and/or professional (e.g., hydrologist or soil conservation specialist, geotechnical engineer) experienced with measuring bulk density to develop the pre- and post-condition study plan. The study plan will need to describe the methods (including density of measurements) for the project.

2. Credits for this practice are not applicable for high use areas that would become re-compacted (e.g., sports fields, playgrounds, grassed parking lots, grassed fire lanes, walking paths).

3. Credits for this practice are not applicable for sites with greater than 10 percent slope.

4. To prevent injury to trees, tillage and application of topsoil shall not occur within the root zone of existing trees which may be approximated by the canopy drip line. Young trees that are failing to establish may benefit from careful soil improvement under the canopy drip line. Placement of mulch around trees is allowed. A certified arborist may be consulted for site specific concerns regarding compacted soil and tree health. Local tree ordinances must be followed.

5. Improvement depths greater than 13 inches are not eligible for further credit.

6. Improvement done to comply with the design criteria for another approved nutrient practice may not be awarded additional credit pursuant to the specifications of this practice.

Installation Requirements:

1. Treatment consists of tillage, or scarification of the soil surface followed by addition of topsoil, or a combination of the two. When combined, the treatment depth is cumulative for calculation of credits.
2. Minimum treatment depth is 3 inches for areas planting turfgrass or 6 inches for areas planting other non-turfgrass vegetation (i.e., landscaped plants or woody/perennial vegetation combined with turfgrass).
3. Before improvement, conduct nutrient testing on the soil to be improved and additional topsoil by an approved lab such as the N.C. Department of Agriculture and Consumer Services (NCDA&CS) soil testing laboratory. An explanation of the NCDA soil testing report is available online at http://www.ncagr.gov/agronomi/pdffiles/ustr.pdf.
4. The soil phosphorus index is a unitless measure of the amount of phosphorus available to plants in a soil. An explanation of the phosphorus index is available online at http://www.ncagr.gov/agronomi/pdffiles/ustr.pdf. To determine the appropriate amount of supplemental phosphorus fertilizer and prevent export of phosphorus from the site, the phosphorus index shall be analyzed over the depth of improvement before treatment. Soils with a phosphorus index greater than 50 do not require supplemental

phosphorus fertilizer. Topsoil brought onsite should have a phosphorus index of 50 or less. If compost is incorporated into the soil, then the nutrient analysis should also be factored into fertilizer requirements (refer to Installation Recommendations section). Compost shall not contain materials with high nutrient content such as plant food (i.e., fertilizer) or biosolids (i.e., the by-product of wastewater treatment).

5. When applying topsoil, the in-situ soil shall be scarified prior to application. Topsoil may originate from the development site and be stockpiled before application or brought in from offsite.
6. Phosphorus and potassium fertilizer and lime/sulfur shall be tilled-in or mixed with the topsoil at the rates recommended by the soil testing laboratory. Vegetation type is specified at the time the soil sample is submitted to the soil testing laboratory. The agronomist evaluates the soil test results for the plant to be grown. An area with many different types of plants may require additional consultation with the agronomist providing the report.
7. This practice requires establishment and maintenance of healthy vegetation to stabilize soil and maintain the benefits of this practice. Plant-based mulches are also allowed around woody shrubs and trees. After soil improvement, establish region-appropriate turfgrass or low-maintenance plants such as perennials, woody shrubs or trees. High maintenance turfgrass or other vegetation is discouraged. Recommendations for low maintenance turfgrass vary by region and are provided online at http://www.turffiles.ncsu.edu/Files/Documents/Publications/2008/carolina_lawn s.pdf
8. Avoid damage to trees. If treatment area borders tree root zones, monitor tree health. Replace trees inadvertently killed by treatment.
9. Current applicable Local governments may require additional or more stringent requirements as part of their approval of this practice

Installation Recommendations:

1. Treatment may include the addition of compost to improve the nutrient and organic matter content of the soil.
2. The nutrient and organic matter content of the compost needs to be considered along with the soil nutrient content. The US Composting Council recommends purchasing certified compost from a supplier that provides a Seal of Testing Assurance (STA) that includes analysis of pH, nutrient content, organic matter content, and other properties of the compost. If the compost does not come with a nutrient and organic content analysis, send a sample to the NCDA&CS waste laboratory.
3. If an STA report is not provided, analyses may be conducted at the NCDA&CS waste laboratory.
4. County Cooperative Extension and/or professional (e.g., hydrologist or soil conservation specialist) may be consulted to determine the volume of compost to achieve approximately 5 percent to 10 percent of organic matter (by dry weight) in the amended soil while minimizing nutrient levels. Incorporate compost into the entire tilled depth. The higher range of percent compost (10 percent) is more appropriate for plants other than turfgrass. Alternatively, the following equation may be used to estimate the volume of compost needed for a specific depth of soil improvement over a 1000 sq. ft. area to achieve the target percent organic matter (by dry weight) . The equation estimates the volume of compost needed based on the dry weight percent organic matter associated with the compost and soil:

Compost (cuyd)/1000s.f. improvement area = $9.35 * D * [(\%OM_T - \%OM_S)/(\%OM_C - \%OM_T)]$

Assuming:
soil bulk density = 2000 lb/cuyd dry weight
compost bulk density = 660 lb/cuyd dry weight
Where:
D is the improvement depth (inches),
$\%OM_T$ is the target percent organic matter after soil improvement,
$\%OM_S$ is the percent organic matter of the soil before improvement, and
$\%OM_C$ is the percent organic matter of the compost
5. For best results compost should be tilled to a minimum depth of 3 to 6 inches for turfgrass and landscape plants, respectively.
6. Compost shall be tilled-in with the topsoil and fertilizer and lime/sulfur prior to application at the rates recommended by the soil testing laboratory.
7. Topsoil should have a minimum of 5 percent organic matter. Topsoil that is removed prior to construction for post-construction application should be tested and amended if it has been stored for a length of time.

Question 2

Do current state statutes limit the regulatory feasibility? Can this be integrated with an existing regulatory approach?

Similar practices are currently allowed in NC: **DIS and level-spreader filter strips.** Current statutes and guidance documents encourage this activity:

- Statutes: 15A NCAC 04B .0106, 15A NCAC 04B .0107, 15A NCAC 04B .0113, 15A NCAC 04B .0120
- NC Erosion and Sediment Control Planning and Design Manual which addresses soil testing, topsoil, soil amendments, tillage, surface preparation, and use of compost blankets to prepare a seedbed for good vegetation establishment. Maintenance requirements are also addressed.
- North Carolina Erosion and Sediment Control Field Manual
- Erosion and Sediment Control - Inspector's Guide
- NCDEQ Stormwater Design Manual, Soils

Question 3

As a practice oriented towards qualitatively lowering Curve Numbers in stormwater calculations, what aspects of local government-implemented stormwater regulation could actually use this?

The UNRBA is not proposing to lower the Curve Numbers for stormwater calculations. Rather, we are proposing that this practice receive credit for volume reduction and potentially decrease the required size of stormwater control measures or the cost of offsite credits depending on the extent of application at a site. This would be similar to the DIS practice which allows that "by following DIS MDC 1, an applicant can use lawn areas to reduce the size of SCMs needed to treat a high-density development. Please note that DIS MDC 3: Vegetated Receiving Area Specifications shall also apply, as well as the Operation and Maintenance requirements that are associated with all types of SCMs."

The Town of Hillsborough has used soil improvement/amendment practices including compost blankets, soil amendment and soil aeration. These sites have been monitored qualitatively to ensure they remain adequately vegetated. These sites have also been visually monitored during rainfall events and during smaller storms very little runoff, if any has been observed. Some examples of these projects are provided at the end of this document.

Question 4

As the HRL stormwater approach is considering partial stormwater volume reduction, can this be translated (outside of runoff volume match) to Nutrient Management Strategies that use a pounds-counting approach to nutrients?

Yes, the Soil Improvement Crediting Document provides methods and example calculations for volume reduction credits and associated nutrient reduction credits. For example:

Table 1. Soil Improvement Option 1: Perpetual Annual Percent Runoff Volume Reduction Amounts Varied By Site Development Age[1] and Improvement Depth

Depth of Improvement (in)	Annual Runoff Reduction (%)						
	New Development	Site Development Age					
		5 year	10 year	15 year	20 year	25 year	30 year
3	23	19	15	12	8	4	0
4	30	25	20	15	10	5	0
5	35	29	23	18	12	6	0
6	40	33	27	20	13	7	0
7	45	38	30	23	15	8	0
8	49	41	33	25	16	8	0
9	53	44	35	27	18	9	0
10	57	47	38	28	19	9	0
11	60	50	40	30	20	10	0
12	63	52	42	31	21	10	0
13	65	54	44	33	22	11	0

[1]Site development age is used to assign the volume reduction credit for this practice in the absence of monitoring data. Once this credit is established, it does not decline as the site ages.

Table 4. Option 1: Annual Volume Stored and Reduction in Runoff Associated with Soil Improvement over 1 acre of Pervious Area

Depth of Improvement (inches)	Volume of additional water stored per storm (ft^3/ac)[1]	Storm depth that can be stored (in)[2]	Annual Runoff Reduction (percent)[3]
3	544.5	0.15	23
4	726.0	0.20	30
5	907.5	0.25	35
6	1,089	0.30	40
7	1,270	0.35	45
8	1,452	0.40	49
9	1,634	0.45	53
10	1,815	0.50	57
11	1,996	0.55	60
12	2,178	0.60	63
13	2,359	0.65	65

[1] The volume stored for each acre of improved soil is calculated as

Depth of improvement (in) * 1 ft/12 in * 43,560 ft^2 / acre * Net change in effective porosity (5 percent) / 100 percent.

[2] The storm depth that can be stored over an acre of amended soil is calculated as

Volume stored (ft^3) * 1 acre/43,560 ft^2 * 12 in/ft.

[3] The annual runoff reduction is based on the frequency of storms observed at RDU Airport from 1980 to 2013 that are less than the storage depth resulting from the soil improvement. Depths greater than the storage depth are assumed to generate runoff from the site.

And from Section C (example for nutrient reduction credit

Interpreting Results

On the *Overall Summary* page, the *Total Nitrogen & Phosphorus Loading* (lbs/yr) should show the following values:

- *Pre-Development Conditions*
  - *Total Nitrogen Loading (lbs/yr)* = 14.1
  - *Total Phosphorus Loading (lbs/yr)* = 3.91
- *Post-Development Conditions w/BMPs*
  - *Total Nitrogen Loading (lbs/yr)* = 3.94
  - *Total Phosphorus Loading (lbs/yr)* = 1.09

These values are information that the tool outputs in pounds per year. The user completes the remaining steps by hand to calculate the credits (reductions in loading):

8. Compute the nutrient reductions in pounds per year, which would be used towards compliance with the Nutrient Management Strategy:
   - Compute the reduction in loading rates
     - Nitrogen -> 14.1-3.94=10.16 lbs/yr
     - Phosphorus -> 3.91-1.09= 2.82 lbs/yr

Question 5

As a non-structural, one-time practice that is implemented by developers, but overseen by local governments, and critical to meeting stormwater objectives that are permitted for each development, what are the processes and steps needed to implement it efficiently and reliably? (This issue and the next one may be the most difficult to resolve based on stakeholder input.)

One of the simplest ways to monitor long-term success is vegetative cover. Basically, if the vegetation is healthy the soil is healthy.

Most local government staff are already inspecting the entire drainage area to an SCM as part of the SCM inspection process. This is something that DEQ staff evaluate during MS4 audits of post-construction programs. Implementation for this practice would be similar to how local governments currently implement sediment and erosion control and post-construction requirements. See guidance documents under question 2 that address practice requirements including maintenance and inspections.

An example **Soil Improvement Operation and Maintenance Agreement** is included in the Soil Improvement Crediting Document.

Other states address this practice in their stormwater best management practices manuals:

- The Pennsylvania Stormwater Best Management Practices Manual includes this as a practice and addresses applicability across varying levels of urban intensity, design considerations, volume reduction calculations, and specifications.
- An example of soil amendment incorporated into a stormwater management plan for a pipeline project in Pennsylvania is here - 07 Site Restoration and PCSM report SC.pdf (state.pa.us). This includes specifications, scheduling, inspection, and maintenance requirements.
- VA DEQ STORMWATER DESIGN SPECIFICATION NO. 4 SOIL COMPOST AMENDMENT includes construction sequences, maintenance agreements, and first-year maintenance operations. BSE-272.pdf (vt.edu) indicates that lawn areas that undergo soil restoration and do not receive runoff from other areas can remove as much as 75 percent of runoff volume.
- The Maryland Department of the Environment Accounting for Stormwater
- Wasteload Allocations and Impervious Acres Treated manual specifies design criteria for urban soil restoration in Appendix G.

The NC Soil Improvement Crediting Document also addresses maintenance and verification requirements:

Operation and Maintenance Requirements:

1. Protect surface soils from erosion, drying, and cracking by establishing and maintaining healthy vegetation. Maintain at least 75 percent vegetative cover (tree/shrub canopy included). Planting of trees and shrubs should occur doing the dormant season beginning in the late fall through winter. Apply annual application of mulch to landscape bedding areas or around trees, as applicable post-treatment.
2. Protect soils from re-compaction: do not allow driving or parking of vehicles and use methods to exclude treatment areas from use as trails. Periodic vehicle-based mowing and maintenance is allowed.
3. To reduce/prevent the need for future fertilization, practitioners may mulch grass clippings in place and may mulch leaf litter from deciduous plants in landscaped areas rather than removing it.
4. Conduct soil tests every three years to determine fertilization requirements for phosphorus and potassium. Unless re-compaction occurs, this practice does not involve a maintenance schedule beyond

the continued maintenance of healthy vegetation. Phosphorus and potassium fertilizer and lime/sulfur application shall be applied at rates recommended by the soil testing laboratory.
5. Nitrogen fertilizer shall be applied at rates required for healthy plant growth. Consult with County Cooperative Extension for guidance on selecting appropriate fertilizer and applying it at appropriate times and intervals. For various species of turfgrass, these rates are provided online at http://www.turffiles.ncsu.edu/Files/Documents/Publications/2008/carolina_lawn s.pdf.
6. The following practices shall be followed when the area is fertilized to prevent nutrient export from the area: a. Fertilizer shall be kept off or removed from impervious surfaces in the vicinity of the improved area such as sidewalks, driveways, patios, and roads. Removal of fertilizer, if needed, shall be accomplished either by the use of specialized application equipment and/or removal by blower, broom, etc.
7. Fertilizer shall not be applied before moderate or heavy rain.
8. Per the Buffer Rule, fertilizer shall not be applied within 50 feet of an intermittent steams, perennial streams and perennial waterbodies, with the exception of an initial application for plant establishment.

Verification Requirements:
Each local government or entity applying for nutrient credits is responsible for verifying that soil improvement practices continue to be maintained as a justification for continued crediting. The verification procedures may be established by the local government or applying entity in coordination with their existing programs and protocols. The size of the jurisdiction, number of practices installed, and staffing resources will likely dictate the type of program**. The program shall include some form of maintenance agreement, and credits shall be renewed at least every 5 years. During credit renewal, jurisdictions shall confirm that each practice is being maintained per the agreement. Confirmation and renewal may be based on site inspections, notification and documentation submitted by mail, or other similar means acceptable to the Division, to ensure that the site is being maintained and credit renewal is appropriate.** These verification requirements may be relaxed in the future once the practice has been implemented and more information is available regarding the success and persistence of maintenance at the site level. The Division will revisit these requirements at the request of the local government(s) implementing these practices, or of its own accord based on the compilation of maintenance and verification information from multiple local governments.

Question 6

As a very widely distributed practice, how does this get implemented across the entirety of a permitted development (the managed pervious parts) in a systematic fashion? Who is responsible for proper implementation and what are the consequences for not doing so? What are the available enforcement mechanisms?

The UNRBA is not recommend requiring implementation across the entirety of a permitted development due to site constraints or other factors like steep slopes, areas with sandy soils that already have high infiltration, etc. The volume reduction and nutrient reduction could be calculated based on the area where the practice was implemented and maintained.

Proper implementation, maintenance, and verification requirements are described under previous questions. Enforcement actions similar to disconnected impervious surfaces and level-spreader filter strips would be appropriate.

Question 7

Should the management objectives for a new development practice be different than those for retrofitting an existing development? The current practice does not identify a performance standard for soil improvement (it allows high flexibility) and is not specific to the kinds of soil impairments encountered in ongoing development sites, such as a compacted layer or mass grading.

The management objectives for this practice are the same for new development as existing development. The goal of this practice is to address the impacts to soils that were caused by development including mass grading and soil compaction.

The Operation and Maintenance Requirements section of the Soil Improvement Crediting Document includes vegetation requirements including quantitative percent coverage and soil testing every three years. An example operations and maintenance agreement is also included. The verification section requires that credits be renewed every five years and that jurisdictions shall confirm that each practice is being maintained per the agreement.

Bulk density measurements would be a relatively easy and inexpensive way to ensure the soils maintain an improved condition. Testing multiple samples before practice implementation, at some reasonable period after (good question for the soil scientists at NCSU), and then maybe every 5 years to get that credit renewal. Along with the verification requirements already listed in the practice, this would provide a quantitative basis that the measure was still working. However, visual inspection of vegetation coverage is likely sufficient since soil compaction after the fact would likely harm the plantings and not allow good growth in subsequent years. Neither DIS nor level-spreader filter strips nor use of soil improvement in the Chesapeake Bay states required bulk density testing – they all rely on maintenance of healthy vegetation.

Question 8

Do the practice options need to be narrowed to ensure fidelity in implementation? Are there technical requirements and limitations needed beyond the issues identified in the UNRBA practice?

We worked with a relatively large Technical Advisors Group that included three soil scientists from NCSU. After discussing this practice for over a year, we are confident that the technical requirements and limitations have been adequately addressed to begin implementation on new development sites. The Design Criteria and Recommendations section of the NC Soil Improvement Practice are similar to those in other state's stormwater best management practices in terms of installation, operation, and maintenance requirements (Virgina, Maryland, and Pennsylvania). **Only the NC document requires verification and credit renewal every five years.** The NC requirements for implementation for existing development retrofits are in some ways more restrictive than those in other states for new development requirements. However, anytime a new practice is developed and implemented, lessons learned will inform additional best practices. The stormwater crediting manual has been designed to provide flexibility in adding new practices and updating content when needed.

Question 9

Are there any studies of soil restoration on development sites? To enter the NEST, this practice would need (or have in the works) two independent studies.

In addition to the literature cited in the Soil Improvement Crediting Document, soil scientists at NCSU have researched this topic including monitoring studies and literature reviews. A few examples follow:

- **F. Mohammadshirazi, V.K. Brown, J.L. Heitman, and R.A. McLaughlin – 2016 - Effects of tillage and compost amendment on infiltration in compacted soils**
  https://www.jswconline.org/content/jswc/71/6/443.full.pdf
  The objective of this study was to determine the efficacy of tillage and adding compost to reduce stormwater runoff and sediment loss by improving infiltration in simulated postconstruction soils. Tillage treatments were tested at two sites in the Piedmont region of North Carolina (Piedmont 1 and 2). Prior to applying tillage and amendment, soils at both sites were graded to remove the surface horizon and compacted with a vibratory roller. Runoff volumes (RV) and total suspended solids were measured after each of the first 12 and 13 storm events at Piedmont 1 and 2, respectively. Infiltration rate (IR) and bulk density (BD) were determined five and seven months after establishment at Piedmont 1 and 2, respectively. At both sites, RV and total amount of soil loss were reduced with tillage by 60% to 82% during the monitoring period. At Piedmont 1, over the course of the first 12 storms, almost a third of rainfall ran off the compacted soil, and this was reduced by more than 82% with the tillage treatments. Up to 81% of rainfall in individual storms ran off of the compacted treatment, while in all but the first storm less than 10% left the tilled treatments. The overall reduction in RV due to tillage was similar to Piedmont 1, with about 83% less runoff compared to the compacted treatment.
- **Matthew A. Haynes, Richard A. McLaughlin, Joshua L. Heitman – 2013 - Comparison of Methods to Remediate Compacted Soils for Infiltration and Vegetative Establishment**
  https://www.scirp.org/pdf/ojss_2013090215094343.pdf. The goals of this preliminary study were to quantify the impacts of soil compaction remediation methods on infiltration, runoff water quality, and vegetation establishment. The objectives were to measure: 1) steady state infiltration rate (IR); 2) quantity and quality of storm water runoff; and 3) ground cover, biomass production, and rooting depth of vegetation during early establishment. This study suggests that the combination of tillage and rapid vegetation establishment can greatly reduce runoff from treated areas (84% in DT compared to compacted treatment). However, the importance of vigorous vegetation appears to be critical to the success of deep tillage over time, as demonstrated by the failure of our second site in maintaining high IR due to very poor grass growth during a cold, wet period in the winter.
- **Christina N. Kranz, Richard A. McLaughlin, Amy Johnson, Grady Miller, Joshua L. Heitman – 2020 - The effects of compost incorporation on soil physical properties in urban soils – A concise review**. https://www.sciencedirect.com/science/article/pii/S0301479720301444
  Incorporation of compost into soil can significantly alter soil physical properties, nutrient dynamics, and vegetation establishment. Strategic compost application to disturbed, degraded urban soil may provide benefits to soil properties. This review compared twenty-five peer-reviewed studies that evaluated changes in soil bulk density, infiltration rate, hydraulic conductivity, and water retention where compost was incorporated into urban soils. A wide

range of compost rates and incorporation depths were evaluated in these studies across many soil types. Compost incorporation generally reduced bulk density, enhanced infiltration and hydraulic conductivity, and increased water content and plant available water, compared to unamended controls. Compost was largely reported to have a positive effect on degraded urban soils.

Town of Hillsborough Soil Improvement Examples

Example 1 – Town of Hillsborough Town Hall – Existing Development

Hillsborough Stormwater and Environmental Services Division staff designed a fix for a stormwater runoff issue that included an "enhanced" infiltration area. Town hall has a circular drive and at the low end there was an undersized catch basin with a blocked pipe. Rather than replacing the catch basin and upsizing the pipe, staff designed a weir cut through the existing sidewalk and using volunteers created an enhanced infiltration area through aeration and adding a mulched area. This resolved the nuisance flooding in the circle drive and based on visual monitoring most storm events under ½ inch of rainfall did not result in stormwater runoff. Pictures below show the area during no rainfall and also during a rainfall event. In the rainfall picture, no runoff is evident as it is soaking into the ground prior to reaching the street.

Example 2 – Cates Creek Park Compost Blanket – Existing Development

The Waterstone Development in Hillsborough was required to build a park and turn it over to the Town of Hillsborough. At the park entrance soil was removed to get to the correct grades. These “cut slopes” were barren of any topsoil and could not support a healthy stand of grass. The slopes, while not steep were badly eroded and soil was washing into storm drains and an intermittent stream.

Town Stormwater and Environmental Services utilized compost blankets fix the issue. The areas were scarified and compost wattles were installed to keep the compost from washing away. About 2 inches of compost was applied and native grass/wildflower seed was mixed into the compost. The result was amazing! The compost blankets acted as a sponge and now the slopes are fully vegetated. The slopes are now only mowed once annually and provide pollinator plants and wildlife habitat in addition to reducing stormwater runoff and nutrients.

This project was so successful, the town has installed 3 other compost blankets with equal success. Another is proposed for a large cut slope at the town’s wastewater treatment plant. Staff is also looking at including this as a required practice on all cut and fill slopes in new development.

Pictures below show one of the worst slopes in Cates Creek Park.


September 2019


July 2020

Example 3 - Elin's Pond – New Development

The developer had stockpiled topsoil during construction and asked Hillsborough's Stormwater and Environmental Services Division staff if they could "waste" it on site. Staff suggested that they use it to bolster vegetation growth on slopes that lead to the stormwater pond. Staff requested that they lightly rip the soil before placing it on the slopes. The result was remarkable. The photos below show the results. On the left, is a slope where the contractor placed topsoil from the site. The grass is thick and healthy. The picture on the right shows an area of the same development that did not receive the topsoil amendment because they ran out. The differences are amazing. This area has been visually monitored by staff and in small storms there is very little runoff from the slope on the left, while the slope in the right picture has caused issues for the pond. The HOA is now having to remediate this. Having soil improvement/amendment as a creditable practice would have ensured that all the area around the pond were sufficiently vegetated and did not cost residents additional money.