6.0 Vegetation and Landscaping

This section is included for applicable chapters, please see NCDEQ manual for individual SCM planting requirements and recommendations.

6.1 General

This chapter sets forth general requirements and recommendations for the installation and use of vegetation in the Stormwater Control Measures (SCMs) listed in this manual (Chapter 4). This chapter has been organized to lead the designer through the plant selection and plant design process that takes place after the selection of a specific SCM. The intent is to help the designer consider the unique hydrological characteristics of a SCM which can affect the ability of vegetation to grow and survive. By reviewing this chapter the designer will have a better understanding of factors that can impact plantings in a SCM which in turn will help ensure that SCM plant selection and placement is successful.

The function of plants in water quality improvement is important to consider when selecting the most appropriate vegetation types for a given SCM. This is because the role of vegetation in water quality improvement is complex and requires combining soil types, hydrology, and plants to achieve a desired resultant water quality parameter. Other important functions of plants in SCMs include aesthetics, wildlife habitat, biodiversity, and safety or accessibility. However, without healthy plants the overall SCM structure will probably fail to achieve its design goals. **Therefore, Charlotte-Mecklenburg has determined that the emphasis in this manual should be on selecting plants with high survival and low maintenance requirements with some consideration given to aesthetic appeal.** This approach is considered the core component to a successful SCM design and requires a paradigm shift for developers and homeowners who typically select plants for use in new developments based soley on their aesthetic appeal.

With the above in mind, developing the vegetation portion for a SCM plan begins with review of an approved list of plants. Factors to consider in selecting appropriate plants are discussed in section 6.2. Once plants are selected, the designer can then determine vegetation placement and develop a planting plan using general guidance provided in section 6.3 along with SCM specific information provided in Chapter 4 of this manual. In completing this process, the designer is reminded that the requirements and recommendations set forth in this chapter are based on the best available information. Changes and improvements in the process of establishing SCM vegetation are ongoing and it is incumbent on the designer to maintain professional awareness of those changes.

6.2 General Plant Selection Criteria

A list of plants meeting the criteria for high survival and low maintenance is provided in Appendix A of this manual. Use of specific plants on this list, for a specific SCM, is dependent on multiple factors including environmental conditions (ability of plant to survive in a particular environment), suitability (the suitability to a location and the plants relationship to the surrounding landscape) and aesthetic considerations (attractiveness to the viewing public). These factors have been prioritized in order of importance which allows the designer to systematically select the appropriate plants. **The priority of plant selection is: survivability first; suitability (with respect to plant height and form vs. SCM location); and finally aesthetics.** Indicators for each of these factors are tabulated by plant and can be used to develop the plant list for a specific SCM at a specific location. Taking the following in sequence will allow the designer to effectively select plants for a SCM:

- **Survivability.** Survivability of plants will be determined by its tolerance of water, soils, and salinity (with respect to storm water that contains deicing salts) coupled with anticipated exposure (or lack of exposure) to sun. Tolerance of water will be determined by location in each SCM with respect to soil moisture or, in case of wet ponds, depth of water. Plants placed in conditions that are not suited will not survive.
- **Suitability.** Consideration for planting in specific SCMs must take into account: plant height, type (tree, shrub etc.), minimum size, and typical on-center spacing. While not critical to survival,

these factors allow the landscaper/designer to select those plants that will provide functional vegetative cover that does not interfere with public activity in the vicinity of the SCM or create a safety hazard by restricting sight lines with respect to traffic or criminal activity. The listed factors for suitability include form, mature height/diameter, typical on-center spacing and minimum size.

- **Aesthetics.** The final selection criteria include aesthetic considerations. While aesthetics is a lower priority for the function of SCMs, the vegetative component of the SCM may be a primary determining factor in the public perception of SCM success. Public perception is difficult to predict but may be positively influenced by planning for traditional aesthetic features associated with showy flowers, attraction of desirable wildlife (e.g., birds, butterflies, and dragonflies), and evergreen. These aesthetic characteristics can be determined by reviewing suitably factors (listed above) and the additional information provided in Appendix A related to showy flowers, fall foliage or fruit color to the unique characteristics of the plants.

6.3 General Planting Criteria

The selection of plants is supported in the design process with the development of a planting plan, planting specifications and other design considerations. The designer will need to consider a broad range of issues relating to spacing, plant mix, etc. Therefore, this section sets forth general planting requirements and recommendations, for SCM facilities presented in this manual that address those issues. The information presented in this section is generally applicable to all planting scenarios and should always be considered in the design process. The issues discussed include the following:

- **6.3.1 Design Considerations** General design recommendations that should be considered in developing plans and specifications
- **6.3.2 Site Preparation and Vegetation Management During Construction** General recommendations and requirements for procuring and handling plant material and steps required or recommended during the construction process
- **6.3.3 Herbivore Control** Actions taken to avoid invasive or herbivore damage to the newly constructed SCM
- **6.3.4 Other landscaping considerations** Additional considerations that should be considered by the designer
- **6.3.5 Importance of Using Native Plant Species** General discussion on why a designer must consider native plants

These five subject areas are all important components of the SCM design process, and the designer should be familiar with each one to the extent that he can then successfully provide a viable and practical vegetation design for a SCM.

6.3.1 Design Considerations

Site Inventory

During the earliest design phases, the designer should visit and inventory the proposed SCM site to gain a better understanding of the factors that may impact his final design. Factors to consider and review include:

- Identify on-site and nearby sources of invasive vegetation (if any), in order to plan for their eradication, and to prevent their return later, when they may damage the newly installed plantings.
- Consider design features which limit herbivory – 6.3.3 by wildlife, including buffers and edge plantings and placement of enclosure fencing,
- Review and consider aesthetics that can help to blend the SCM facilities with the surrounding landscape, as well as possibly enhance ease of maintenance.

Plant Spacing and Placement Considerations

General spacing and placement considerations are important for trees and /or woody vegetation in a SCM design. The recommended placement guidelines presented here are applicable to most cases.

However, the final design spacing may be adjusted to account for SCM type, slope, and overall width of the SCM. The guidelines are as follows:

- Trees or shrubs known to have long taproots should not be within the vicinity of the earth dam or subsurface drainage facilities.
- For embankments used to impound water, herbaceous plantings should be limited to 10 inches in height. Species selection is critical in order to prevent maintenance costs.
- To reduce thermal warming, shade inflow and outflow channels as well as southern exposures of ponds. If areas to be shaded are near embankments, non-woody vegetation should be used so that embankment stability is not compromised.

Note: Spacing may also be influenced by SCM type, slope, and overall SCM width.

Erosion Control with Vegetation

The designer should also consider the following recommendations when developing SCM plans and specifications. These recommendations are provided as supplemental steps and will enhance the survivability of new planted material and the long-term integrity of the SCM.

- Root material should be fibrous and substantial.
- Divert flows temporarily from seeded areas until fully stabilized if attainable.
- Stabilize aquatic and safety benches with emergent wetland plants and wetland seed mixes.
- Plant stream and water buffers and filter strips with trees, shrubs, grasses, and other herbaceous materials where possible, to stabilize banks.
- Provide a planting area that can withstand the compaction of vehicles using maintenance access roads.
- Use plants to prohibit pedestrian access to pools or steeper slopes in areas where foot traffic would cause excessive erosion.

Vegetation Management

The designer should carefully consider the long-term vegetation management strategy for the SCM, keeping in mind the maintenance legacy for the future owners. Make sure the facility maintenance agreement includes requirements to ensure vegetative cover in perpetuity. The following should be considered by the designer:

- Avoid plantings that will require routine or intensive chemical applications (i.e. turf area).
- Use plants to prohibit pedestrian access to pools or steeper slopes to avoid damage to plants by heavy foot traffic, but do not block maintenance access to structures with trees or shrubs.
- Provide signage to help educate the public and to designate maintenance limits.
- The natural cycle of decay will lead to the accumulation of plant material in detention ponds. The designer should consider that this material may reduce capacity of the SCM and require periodic removal.
- Decrease the areas where managed grass (turf) is used. Use low maintenance ground cover to absorb run-off.

Planting Zone Considerations

Refer to NCDEQ manual for information on planting zones.

6.3.2 Site Preparation and Vegetation Management during Construction

Site preparation and vegetation management during construction are critical to the overall success of a well-constructed SCM. Therefore, the following items should be considered by the designer and specified in construction plans and documents:

Existing Vegetation Management

A key factor to consider in the construction process is managing existing vegetation on site to avoid follow-on problems with invasive species or the needless damage/destruction of existing vegetation that can enhance or complement a SCM. Issues to consider are as follows:

- Where appropriate and cost effective, transplant individual specimen trees or shrubs that cannot be saved to a permanent location on site.
- Identify and protect significant populations of, and individual specimens of trees and shrubs. This will include incorporating vegetation protection measures into initial erosion and sediment control plans, or site protection plans.
- Hire a professional to locate invasive species listed in Appendix B and eradicate them prior to beginning site clearing, or other land disturbing operations. This will prevent the unneeded propagation of these plants within the SCM site.
- Never chip and redistribute chipped plant parts from clearing operations when invasive species are present, as they may re-infest the site through spreading of the mulch.

New Plant Procurement

All plants should be well grown and healthy, and free from disease and infestation by invasive species. All plants, whether supplied in nursery container, balled-in-burlap, small plant container or plug, shall conform to the specifications in The American Standards for Nursery Stock, ANSI Z60.1 - 2014, or latest edition. The document is available from the American Nursery and Landscape Association, for purchase of the hard copy, or for downloading (free) from their website at www.americanhort.org

- **Seeding.** Seed mixes for stabilization are commercially available for a wide variety of terrestrial habitats, including basin bottoms, wet meadow, and dry meadow, to name several. Wetland mixes of seeds for herbaceous emergents, such as those plantings for planting in aquatic zones 1, 2 and 3, have met with very limited success as some species need a wintering period. It is preferable to confine the use of seed mixes to wet meadows, upland seeding, and other habitat areas above the permanent or temporary pools of most of the SCMs described in this manual. SCMs' which incorporate extended dry detention are the exception to this rule, where Wetland Seed Mix – Appendix C for the basin bottoms may be appropriate.
- **Plugs and Container-Grown Plants.** In all zones, plugs and container grown plants are favored, and may be installed at the correct time of the season (see 6.3.4), however planting in the winter and early spring allows the greatest chances for establishment. Container-Grown Plants installed late in the spring may not have adequate time for establishment and may be more likely to require replacement the following year. Plugs should be planted after the last Spring frost and prior to Fall.
- **Balled-in-Burlap Plants.** In Bioretention areas, , Balled-in-Burlap plants may be installed at the correct time of the season (see 6.3.4), however planting in the winter and early spring allows the greatest chances for establishment. Plants installed late in the spring may not have adequate time for establishment and may be more likely to require replacement the following season.

New Plant Delivery, Handling and Storage

All plants should be fresh and healthy and be delivered to the site with their rootstocks preserved in similar conditions to those in the growing nursery.

- Trees and shrubs should be left natural and unpruned prior to delivery. Bark, branches, and root systems should be protected from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage which destroys their natural shape. Protective covering for plants should be provided during shipping and delivery.
- Store bulbs, corms, tubers, and rhizomes in conditions similar to those in the growing nursery, at approximately 60 to 65 °F, until planting.

- Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed, set plants in the appropriate exposure for each species (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist. Depending on the length of delay, plants may need to be heeled in.
- Do not remove container-grown stock from containers before time of planting, and water as often as necessary to maintain root systems in a moist condition.

Planting Procedures

Conform to all applicable specifications for plantings of trees and shrubs, as detailed in sections 40.01 through 40.14, inclusive, of the Charlotte Land Development Standards Manual. Lay out all plants according to species mixes, and at specified spacings and densities. Herbaceous emergents, grasses and sedges for Zones 1, and 2are often best laid out at regular spacing in a recognizable pattern. Regular spacings are easier to evaluate and provide for more uniform and rapid coverage. Trees and shrubs in Zones 3 and 4should also be laid out according to the species mixes, and at the specified spacings and densities, but appear more natural when a "random" pattern of spacings are used, replicating a more natural pattern. Maintaining minimum and maximum distances between plants is necessary for adequate coverage. Please refer to Plant Spacing Guideline Diagram in Appendix D, for an explanation of triangular and square spacing layouts and for an explanation of layout for "random planting".

Weed and Invasive Species Control

It is strongly advised that any invasive plant species populations be controlled throughout the course of the work. Where bare ground exists, and where mud flats exist in drawn-down wet planting zones, invasive species such as cattail, Japanese Hops, Porcelainberry, and other noxious weeds can easily gain a foothold, quickly displacing the desirable plantings, leading to a partial failure of the planting site. An integrated pest management (IPM) approach is recommended for control of invasive plant species. Monitoring for the presence of invasive species should be a component of all SCM establishment programs. Maintenance, including the removal of invasives can be critical to the success of the plantings and prevents the spread of those species downstream of the SCM. Some weeds may be removed with herbicides used with the "glove technique".

6.3.3 Herbivore Control

Newly planted vegetation is susceptible to damage by local wildlife especially geese, muskrats, beavers, and deer. There are strategies that can be employed to ensure a successful establishment of vegetation. The following is a list of specific actions that can be taken to reduce damage:

Geese Control

- Access to plants from the shore is best controlled by placing a nylon twine fencing at the interface of open water and the planted areas. These "Goose Exclusion Fences", are currently recognized as one of the best ways to keep the geese from swimming into the newly vegetated area, and eating or destroying the new plants (even when geese do not find plants particularly palatable, they may pull them out). Fencing helps prevent the worst of the goose damage. It may be advisable to fence both sides of the planting shelf for the SCM. Fences should be between 24 and 42 inches in height.
- To prevent shore line access from the water side it is recommended that the contractor place long strings of nylon twine, marked with flagging across open areas of water, to discourage geese flying in and out of the newly planted area.
- Geese are also known to avoid heavily vegetated areas that may hide predators (i.e. fox). Therefore, in areas geese are known to inhabit, a zone of heavy shoreline vegetation (as opposed to mowed grass lawn, for example) may discourage the geese from entering the newly planted areas of emergent vegetation and destroying the young, tender plants.
- Control of water levels within the SCM is another option for goose control. The approach reduces water levels so that aquatic benches are exposed during vegetation establishment phase while maintaining sufficient soil saturation for healthy plant growth. This approach takes advantage of the geese' preference for swimming, rather than walking, in its feeding area. The technical approach to this design feature is described in this chapter of the manual.

Deer Control

- In less developed areas, deer control may be required to reduce browse on newly planted vegetation. Protection of vegetation is typically attempted through the use of fencing. The preferred approach, where practical, includes the use of randomly placed 'zigzag' fencing through the planted site. However, it is important to remember that deer can clear a fence that is as high as 8 feet. Any deer control in which fencing is considered should be planned with this in mind. Deer may avoid twin, parallel fences which are less than 8 feet in height, and which are 4 or 5 feet apart. This option may be preferred in locations where a higher fence would be unsightly or impractical.
- Past approaches to deer control have included various chemical sprays, however, there is little evidence that chemical sprays deter deer browsing for long enough to get the plants established. Therefore, chemicals sprays are not recommended for use on SCM vegetation.
- There is some encouraging research to suggest that certain chemical deterrents (systemic) can be sown along with the trees and shrubs. These are taken up by the plant root systems, and which render the plants unpalatable to the browsing deer. The use of these types of chemical deterrents can be approved on a case-by-case basis by the PCSO Administrator.
- An alternative to fencing for deer control, is the use of tree shelters. Tree shelters are translucent plastic tubes, several feet in height and several inches in diameter. They can damage young trees and shrubs if left in place too long, but do provide a good measure of protection until the young plants have gained sufficient height to withstand deer browsing. Tree shelters cannot be used on certain tree types.

6.3.4 Other Landscaping Considerations

Mulching

Mulching for herbaceous emergents located in areas which will be permanently or regularly inundated is not desirable. The mulch can float away in the first rain event, potentially clogging SCM outlets, or smothering young plants. Trees and shrubs in bioretention areas, and in Zones 4, will benefit from mulching, however, because it maintains adequate moisture in the root zones for plant establishment, and keeps down competition from weedy species. Mulch will need to be replenished if it floats away.

Watering

Regardless of the plant zone, when plants do not receive at least an inch of water from rainfall each week, or when soils in which the herbaceous emergent plants are located is no longer in a saturated state, it will be necessary to water the plantings. This will differ according to the age of the plants. Once established, no watering is anticipated. Also, balled in burlap stock will need more water than one gallon or herbaceous stock. Potable water is preferable, unless the source of the water is known to be free of impurities and the salinities are suitable for the species being grown. City water from hydrants, or water trucks, or water pumped from safe sources are all potentially useful in keeping the plantings alive during the establishment period. A moisture meter installed and maintained by a landscape professional is strongly encouraged to determine watering needs as too much water can cause problems as well.

Planting Seasons

For planting seasons, conform to the following general guidelines:

- Seeding Grasses and Meadows: Fall Season
- Installing Plugs (Herbaceous Emergents) Spring, Summer
- Installing Container Grown Plants: Dormant Season
- Installing Balled-in-Burlap Plants Dormant Season

6.3.5 Importance of Using Native Plant Species

An invasive species is defined as an alien or non-native species, not under human control, whose introduction does or is likely to cause economic or environmental harm or harm to human health. An invasive species may have an unfair competitive advantage due to lack of natural controls (i.e.herbivores). Invasive weeds can harm the overall function and appearance of SCMs when the invasive plants are able to out-compete native plants, remove the function of planted vegetation, and displace the associated animal communities.

For this chapter of the manual, a native plant species is defined as one that originates (or originated) or occurs (or occurred) naturally in a particular region, such as the Southeastern United States, or the Piedmont region of the eastern United States. The use of native plant species should always be specified for SCM projects. The use of the plants listed in Appendix A will satisfy this requirement and preclude the accidental introduction of invasive plant species into an otherwise well-designed SCM. The importance of avoiding invasive species cannot be over-emphasized as the ultimate success of a SCM can be impacted by use of non-native plants

Invasive plants should be identified at the earliest stages of planning, and eradicated prior to site clearing and disturbance. Following planting, it is often necessary to control weeds and other invader plants to ensure the successful establishment of the desired vegetative communities.

A list of invasive plant species to avoid when preparing the designs for SCM projects, and to eradicate when possible during pre-construction and post construction maintenance, is included as Appendix B in this chapter.

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