

**Summary of Comments & Changes to
Charlotte-Mecklenburg BMP Design Manual
(updated July 1, 2013)**

The table below contains the comments and changes made to the Charlotte-Mecklenburg BMP Design Manual since July 1, 2007.

#	<i>BMP Manual Changes</i>	<i>Date BMP Manual Updated</i>
1	Minor modifications made to the Bioretention Figure 4.1.3.	7-25-07
2	Changed bioretention underdrain specifications	7-25-07
3	For the bioretention BMPs, eliminated the requirement for filter fabric on the side walls and removed reference to the pea gravel layer.	7-25-07
4	Placement of bioretention media changed from 8-inch lifts to 12-inch lifts.	7-25-07
5	Added specifications to pea gravel curtain for bioretention pretreatment	7-25-07
May 23, 2008 changes		
6	The manual was modified to designate that grow to 3' - 5' in height are allowed to be substituted for shrubs if planted in 5 or 7 gallon pots and count towards the minimum number of plantings, but limit the grass use to a maximum of 25% of the shrub requirement	4-30-08
7	The use of ASTM C-144 sand was added as a recommendation for use in preparing bioretention soil media.	4-30-08
8	For bioretention, the design permeability rate of the soil media is 0.5 ft/day. Clarifying language was added to the manual to distinguish between the design permeability (used to size the bioretention area) and the actual permeability of the media.	4-30-08
9	A proprietary BMP section (Section 4.10) was added to the manual that meets the state minimum requirements and our local requirements for proprietary BMPs. Provisions include monitoring (a minimum of 12 storms of at least 0.5-inch intensity will be required to be monitored for approval. A minimum of 10 days between storm events is required)	4-30-08
10	For the bioretention design examples, the maximum ponding stage is labeled as elevation 702 (2 feet of ponding) while only 1 foot of ponding is allowed This ponding depth was changed to reflect 1 foot of ponding as the maximum ponding stage.	4-30-08
11	Several changes were made to the Chapter 6.0 (vegetation chapter) and the plant lists (Appendicies A to D), as appropriate. Changes include removal of certain invasive species, addition of flower, fruit, and leaf color, and clarification of plant spacing.	4-30-08
12	For bioretention and enhanced grass swale soil media, the acceptable parameters list for the media was changed. A table of parameters, acceptable ranges and tests was included in the manual. <u>Only testing for phosphorus and grain size analysis</u> on the soil media mixture is required. However, a statement was added that the City/County reserves the right to test suspect material and disapprove it for use if parameters lie outside listed acceptable ranges.	4-30-08

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13	The mulch material used in bioretention BMPs was changed to require <u>screened</u> mulch to remove fines.	4-30-08
14	For design of level spreaders used prior to filter strips or wooded buffers, a level spreader specification was added that requires a maximum slope of 0.5 inches per 20 feet or 0.2 %.	4-30-08
15	Section 2.4.4 was added to the manual to explain how the built-upon area for redevelopment projects is to be calculated.	4-30-08
16	Embankment specifications were added as section 4.0.6 of the manual for all embankments and references to this section of the design manual were added as design requirements in each of the individual BMP sections, as applicable.	4-30-08
17	Change the manual title to “Charlotte-Mecklenburg Best Management Practices Design Manual” and revise the footnotes with the updated version date	4-30-08
18	Added a statement under the purpose to indicate that the CM BMP Manual is to be used for the design of BMPs throughout the City, Towns and Mecklenburg to demonstrate compliance with BMPs required by Phase I and Phase II Post-Construction ordinances, Watershed Protection overlay ordinances, rezoning notes, and BMPs required by State 401 Water Quality Certifications	4-30-08
19	For the bioretention and sand filter design examples, the design steps were rearranged and renumbered to reflect step numbers consistent with the design procedure forms.	4-30-08
20	An underdrain design procedure step was added to the two design examples in the bioretention chapter and in the sand filter chapter.	4-30-08
21	For sizing bioretention BMPs, the design detention time is shown as 1.3 days or 1.0 days. To clarify the detention time to be used in Darcy’s equation for sizing bioretention areas, clarifying language was added to the bioretention chapter and design examples to reflect the correct detention time to be used in Darcy’s equation (design detention time plus 3 hours for the center of the storm).	4-30-08
22	For soil media in bioretention gardens and in enhanced grass swales, the acceptable % passing for the No. 200 sieve was changed from 5% to 10%.	5-23-08
September 15, 2008 changes		
23	To allow flexibility for additional innovative BMPs, Section 4.10 was amended to include permeable pavement systems and rooftop management systems as innovative BMPs that would not require testing or design of alternative measures on a case-by-case basis. These measures would need to conform to design criteria contained in the most recent version of NCDWQ’s Stormwater Best Management Practices Manual.	9-15-08
October 10, 2008 changes		
24	So that designers can use one manual for the design of water quality and quantity BMPs within Charlotte-Mecklenburg, language in Section 1.0 was revised to clarify that the BMP designs contained in Charlotte-Mecklenburg BMP Design Manual are to be used to achieve compliance with detention ordinances as well as other listed ordinances.	10-10-08

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25	Language within Section 4.0 was revised to clarify the need for recordation of Maintenance Agreements and Plans for BMPs. Additionally, the language was revised to clarify that the BMP designs are to be used to comply with minimum storm water management requirements and policies of BMPs required by post-construction ordinances, watershed protection overlay ordinances, detention ordinances, rezoning notes, and BMPs required by State 401 water quality certifications constructed within the Charlotte-Mecklenburg area.	10-10-08
26	The design detention times (Tf) used in the Darcy equation for sizing bioretention gardens are design values. Language in the bioretention garden chapter was changed from “minimum detention times” to “design detention times” for clarity throughout Section 4.1 of the manual.	10-10-08
27	For sizing bioretention gardens, the language in Section 4.1 was revised to allow routing calculations of the water quality volume (WQv) to be used to reduce the initial footprint size of the bioretention garden as long as the maximum ponding depth above the filter media does not exceed 12 inches. This revision allows a decreased footprint size from that of the Darcy’s equation for bioretention gardens, especially those that are designed to accept the WQv and divert larger storm events. Optional design steps showing the routing calculations are included in the design example in Section 4.1.9	10-10-08
July 1, 2010 changes		
28	The language was modified in Section 4.2.4 to require a littoral shelf slope of 10:1.	07-01-10
29	Forebay height design specifications were added to dry detention basins, Section 4.9.2.	07-01-10
30	In Section 2.4.4, the density calculation was modified so that re-built existing built-upon area (BUA) will be removed from the denominator to give credit for re-built BUA.	07-01-10
31	In Section 2.4.4, an additional example (Example 7) was added to demonstrate credit for removal of BUA.	07-01-10
32	Section 4.10 Proprietary and Innovative Devices was modified to amend the design element for the minimum monitoring protocol. The antecedent conditions for monitoring were changed from a storm event of at least a 0.5-inch intensity preceded by a minimum of ten dry days to at least a 0.1-inch intensity storm preceded by a minimum of three (3) days.	07-01-10
33	The bioretention cross-section (Figure 4.1.3) was modified to allow a trenched underdrain.	07-01-10
34	Text was added to Section 4.1.4 to allow low ground pressure track equipment on soil media during construction of a bioretention garden.	07-01-10
35	The bioretention cross-section was modified to reflect a 1:1 slope of native material for support of structural components. Mecklenburg County Land Development Standards (LDS) and City LDS standards have been updated to reflect the slope.	07-01-10
36	Text was added to Section 4.1.4 to recommend discharge of level spreaders into bioretention gardens at or below the ponding depth.	07-01-10
37	Chapter 6.0 was revised to remove upper story trees from being planted in the soil media of a bioretention garden.	07-01-10

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38	Section 4.0.3.3 was added to describe special considerations for BMPs to be used within the Goose Creek watershed.	07-01-10
39	Text was added to several chapters of the design manual to clarify that the time period required to hold the CPv within the City of Charlotte and its ETJ is 48 hours (which is different than the 24 hours required within the six Towns and Mecklenburg County).	07-01-10
40	Several changes were made to vegetation requirements in Chapter 4.1, Chapter 4.2, and Chapter 6.0 regarding planting seasons, plant size, and vegetation management.	07-01-10
41	The bioretention cross-section was modified to require the 3:1 side slopes to be constructed of in-situ soils, not of soil media. MCLDS and City LDS standards have been updated to reflect the slope.	07-01-10
42	The bioretention cross-section was modified to allow an optional curtain constructed of #57 stone.	07-01-10
43	Chapter 4.0 was modified to prohibit utilities from being located within or under storm water BMPs.	07-01-10
44	Text was added to Section 4.1.4 to clarify specifications for terracing bioretention gardens.	07-01-10
45	Section 4.1.4A was updated to require a concrete or rip-rap forebay (sized to 0.2% of the drainage area) for inlets draining greater than 1 acre.	07-01-10
46	Level spreader designs were updated to refer to NCDENR's design requirements in Section 5.5.	07-01-10
47	Text was added to Section 4.1.4 to recommend designers to consider the potential for freezing in bioretention garden siting.	07-01-10
48	For wet ponds the following was added: forebay embankment specifications/weir lengths and an option for mechanical pumping in lieu of a bottom drain valve.	07-01-10
49	For wet ponds, language was added requiring outlet structures / pipe connections to be water tight.	07-01-10
50	For bioretention gardens and sandfilters, cleanout pipe spacing requirements were made consistent and additional underdrain specifications were included to allow for commercially-available slotted piping.	07-01-10
51	For bioretention BMPs, maximum ponding depths were changed to 15 inches for storms larger than the CPv. Maximum ponding depths for WQv and CPv remained at 12 inches.	07-01-10
52	For bioretention BMPs, language was added to clarify that the surface area (SA) is to be measured from the top of the soil media and the bioretention cross-section was modified to prohibit amended soil from being used on the side slopes.	07-01-10
53	For bioretention BMPs, the concrete curb spillway detail was removed and language was added that requires designers to prevent bypass.	07-01-10
54	Language concerning widths of storm drainage easements or post-construction controls easements were removed from the manual and the reader is directed to the appropriate land development standards manual for widths.	07-01-10
55	For wet pond BMPs, language was added to recommend clay liners in high permeable soils.	07-01-10

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56	The design requirement for at minimum 1% bottom slope was clarified in the Fact Sheet as well as the design requirements (Section 4.9.4A) for extended dry detention basins.	07-01-10
57	For wetland BMPs, planting zones were modified to four zones.	07-01-10
58	For wetland BMPs, requirements for planting of plugs during the fall season was added.	07-01-10
59	Language was added to Section 3.5.1 (Introduction to Downstream Flood Analysis) to clarify in what situations peak control can be waived.	07-01-10
60	For bioretention BMPs, planting densities were changed to 1,000 stems per acre and the mix of plant types was modified.	07-01-10
61	In section 2.5.3, language was added to allow existing ponds to be used for BMPs if all design standards are met.	07-01-10
62	The language was modified for clarity in Section 2.5.4.	07-01-10
63	Various typographical errors were corrected in the entire manual.	07-01-10
January 21, 2011 changes		
64	Website address was updated in Section 2.1	01-21-11
65	In Section 2.4.4, text and calculations were added to distinguish differences in calculating BUA percentages for redevelopment projects in Mint Hill and Cornelius.	01-21-11
66	In Examples 2, 4, 5, and 7, BUA values were changed to help clarify calculations.	01-21-11
67	In Section 2.4.4, Example 9 was added to highlight how relocated BUA would be handled in BUA percentage calculations.	01-21-11
68	Various typographical errors were corrected in Chapter 2.0.	01-21-11
July 1, 2013 changes		
69	3.0 Hydrology – Alternative methodology for 5% volume remaining was added for Huntersville and Charlotte.	07-01-13
70	3.0 Hydrology – Water Balance calculations were modified to take into account the amount of rainfall discharged through the outlet structures.	07-01-13
71	4.1 Bioretention Garden – Language added to require a watertight seal of underdrain to the outlet structure.	07-01-13
72	4.1 Bioretention Garden – Language added to allow for Internal Water Storage (IWS) and include associated hydraulics to account for infiltration, voids, and storage within media similar to NCDWQ Manual.	07-01-13
73	4.1 Bioretention Garden – Methodology for sizing bioretention gardens was changed to be similar to the NCDWQ Manual for the TSS-only design.	07-01-13
74	4.1 Bioretention Garden – Language added to allow use of sodded bioretention gardens and to further clarify the pretreatment requirement.	07-01-13
75	4.2 Wet Ponds – To ensure wet ponds remain wet, the minimum drainage area was increased to 25 acres, conditions added for requiring permanent pool elevation near the water table, conditions added for requiring soil analysis and permeability tests, and water balance calculations were revised to take into account the amount of rainfall discharged through the outlet structures.	07-01-13

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76	4.2 Wet Ponds –Language added allow irrigation, water re-use, and floating islands as part of the wet pond design.	07-01-13
77	4.2 Wet Ponds – Language added to require watertight seal of outlet structure and piping joints.	07-01-13
78	4.2 Wet Ponds – Updated Figure 2.2.2 to include a rip-rap forebay embankment.	07-01-13
79	4.3 Wetlands – To ensure wet ponds remain wet, conditions added requiring permanent pool elevation near the water table and water balance calculations were revised to take into account the amount of rainfall discharged through the outlet structures.	07-01-13
80	4.4 Enhanced grass swale – Language added to allow for Internal Water Storage (IWS) and include associated hydraulics to account for infiltration, voids, and storage within filtration media.	07-01-13
81	4.6 Infiltration Trench – Language added to require in-situ testing of infiltration rate, a minimum number of observation wells, and infiltration calculations following NCDWQ BMP Manual.	07-01-13
82	4.10 Permeable Pavement, etc.– Referenced permeable pavement and green roof design according to NCDWQ BMP Manual and allowed similar BUA credit with the exception of watershed caps.	07-01-13
83	5.5 – Outlet Pipes / Level Spreaders – Added language to reference design according to NCDWQ BMP Manual and added language to define “diffuse flow” and design methods to prevent erosion within buffers.	07-01-13
84	4.8 Sand Filters – Language added to allow for Internal Water Storage (IWS) and include associated hydraulics to account for infiltration, voids, and storage within filtration media.	07-01-13
85	4.8 Sand Filters – Language added to allow for other surface cover such as sod or stone.	07-01-13
86	4.8 Sand Filters - Revised Figure 4.8.2 to allow a surface sand filter be oversized such that the sand media is only a portion of the bottom to allow for additional storage.	07-01-13
87	4.9 Dry Detention – Language added to allow for underground detention including a requirement for a pretreatment device.	07-01-13
88	4.10 – Green Roofs – Changed the minimum depth of media from 5-in to 4-in with a cup system.	07-01-13
89	4.10 – Added language to allow storm water harvesting systems.	07-01-13