**Minimum Design Criteria (MDC) Team
12/15/2014
Triangle J COG, Durham**

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| **Attendees** |  |
| ***Team Members*** |  |  | ***Others*** |  |
| Eban Bean Bradley Bennett Jonathan BivensTim ClinkscalesTracy DavisBoyd DevaneHunter FreemanMike GallantJoe Hinton Marc HouleRon HorvathBill HuntLinda Lewis | **[x]** **[x]** [ ] [ ] [ ] [x] [ ] [x] [x] [x] [ ] [x] [x]  | Brian LipscombAnnette Lucas Mike MacIntyreTodd Miller Cameron MooreTom MurrayRobert PattersonDerek PielechPeter RaabeLarry RaglandJD SolomonVirginia SpillmanToby VinsonRob Weintraub | [x] [x] [x] [x] [ ] [ ] [x] [x] [x] [ ] [x] [x] [ ] [x]  | Julie Ventaloro, NC DEMLRJosh Baird, Town of MorrisvilleNatalie Carmen, NC StateMike Randall, NC DEMLRBen Brown, City of RaleighAndrew Anderson, NC State |

**Updates**RULE REVIEW AND READOPTION
DEMLR is going to combine this rulemaking with our legislative requirement to review and readopt all our rules, which includes 2H (Stormwater) and 2B (stormwater parts of Water Supply Watershed). We need to have stakeholder input for this process as well. Would MDC members be willing to participate in rule review process?

TIMELINE
Feb 1, 2015 Submit MDC to the Environmental Review Commission (ERC)

Jul 8, 2015 Water Quality Committee (WQC) approves rule text

Jul - Oct 2015 DEMLR develops fiscal note

Nov 1, 2015 Office of State Budget & Management (OSBM) certifies fiscal note

Nov 12, 2015 WQC (30-day wavier) / Environmental Management Commission (EMC) approves rule & fiscal note

Nov 20, 2015 DEMLR files rule & fiscal note in *NC* *Register*

Dec 15, 2015 Comment period begins (hearing after 12/29)

Feb 16, 2016 Comment period ends

May 2016 WQC (30 day waiver) / EMC adopts rule (*The fast-track rule must be adopted no later than May 2016.*)

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**Disconnected Impervious**

Natalie – Research on downspout disconnection. Wanted to see if infiltration rates changes when water released over lawn area instead of underground/direct to storm sewer system. Previous research on vegetated filter strips have similar mechanism to disconnected downspouts. Research in conjunction with City of Durham Rain Catchers program. Focused on volume and peak flow reduction. Phase 1 looked at existing conditions; Phase 2 looked at soil amendments.

Phase 1: Slope of lawn; loading ratio; distance traveled. Locations all in Durham County, highly impervious area (55% impervious). Watershed was developed between 1900 and 1940. Soil has had lots of time to develop, healthy roots, water can infiltrate (different from soils at new construction). Looked at 4 sites. Results: 56-99% volume reduction. Loading ratio was strongest indicator for performance, so we recommend this for basis of design crediting.

Phase 2: Looked at soil amendments, effects on infiltration rate. Removed existing vegetation, broke up soil, applied lime if acidic, applied compost, distributed local seed mix, covered with fiber matting, watered, then took systems offline for 3 months. Results: Didn’t see much difference in infiltration rate from soil amendment. Two of the four sites no difference in volume reduction or peak flow reduction. Two other sites did see improvement in infiltration from soil amendment.

Summary: Benefit of downspout disconnection is ability to infiltrate 100% of small storms (up to 0.75 inch); smaller downstream treatment facilities; reduce number of CSO events; peak flow reduction; soil amendment improves infiltration in some conditions; cost to disconnect is very low.

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Annette – On to the potential MDC for disconnected impervious surfaces --
**Item 1**
For disconnected roofs, a maximum of 300 square feet of roof shall drain to each disconnected downspout unless a device (like a level spreader) is provided to spread flow evenly across the entire width of the vegetated receiving area. If there is a spreading device, then the drainage area may be increased to 500 square feet.
Rob W – So can you not use disconnected impervious on large homes because of maximum amount of impervious? 1200 SF ranch house with gable roof, that’s 600 SF on front, 600 SF on back. Can’t really split drainage in middle.
Peter – If you have two downspouts on front, that will work.
Todd – Did you all think about having ratio of receiving area to size of drainage going to it?
Annette – Main way we considered size was with crediting, so there’d be more credit with bigger drainage area. But we didn’t create a ratio.
Natalie – Two issues: scouring at downspout, and roofer said 300 SF is typical.Peter – If you are putting more volume, does that negatively impact – are you infiltrating same amount of water?
Natalie – I didn’t look at it specifically that way. I looked at it from annual basis, pre/post. But that would be interesting to look at.
Peter – Other MDCs, we have bypass requirements, so wondering if you could still put it on 800 SF roof, but only get credit for 300 SF.
Natalie – I saw scouring on steep slopes, and I think that might happen with high volume scenarios as well.
JD – If you’re looking at year-round soil loading rate in Durham, which is middle of state, Triassic soils – is 300 SF base case that could be applied to whole state?
Annette – These were well established lawns with nice root system. Soil had improved over the years. So what you’re saying is if you have a sandy soil with higher infiltration rate, could you increase loading ratio?
Natalie – If you have A soils, can increase slope to 15%. We are starting research in Wilmington in January to look at different soil types.
JD – The whole hydrology, saturated wet times of year – would they be worse than dry times of year? So this is more of a year-round number?
Natalie – Right. Study was only January to September, so only partial year.
Todd – Curious if credits remain same if designing for different design storms?
Natalie – Not designing for a design storm. It’s considered a pretreatment, not standalone. So it should be used in tandem with other stormwater controls.
Annette – Here’s the credit in the Manual right now. There is differentiation between A & B soils and C & D soils. Not much difference in design between soil types; just the slope that can be increased.
Todd – If you’re designing for 3.7” vs 1.5”, would you still get a 45% reduction?
Annette – We haven’t linked that.
Natalie – In each period, we had one 3.5’ storm. Some of the systems were completely overwhelmed to the weir, so we gave it 0% reduction because we weren’t able to measure it. These are designed to meet pre-development hydrology.
Annette – Similar to LS-VFS, we let research speak for itself. So we don’t have calculations out there so much. Designed for flow rate rather than volume.
JD – Not like we’re against it. It’s nonlinear equation. We’re trying to understand how you come to one 300 SF number.
Todd – Also, how to encourage it on commercial sites. This is very directed toward residential.
Annette – We can also disconnect roads and parking lots as well. That’s in the Manual too.
Peter – Preference in draft MDC to level spreader. I know from my experience, my driveway slopes away from the street into the yard. As developers doing development, they’ll use level spreader by default. I would encourage a word change there.
Annette – For pavement, you already have a sort of level spreader.
Boyd – Have any other states come up with algorithms for this kind of thing?
Natalie – City of Portland is a pioneer with a robust downspout disconnection program that they provide free of charge. Chesapeake Bay recognizes it, and includes it in all of its states. City of Toronto and City of Boston, it’s mandatory. Not a lot of literature out there.
Annette – In Manual right now regarding pavement, you can have 100 foot max run of pavement with 3 foot stilling area with aggregate or matting, then either a 10 foot or 15 foot wide area of vegetated, grassed receiving area. Max slope is 7%, including longitudinal slope in order to get sheet flow coming off pavement. Fairly simple and can be done easily if your density is low enough, not trying to build close to roadway.
Marc – Is grade separation necessary?
Annette – Would be good to have a lip.
Robert – Having any vertical separation is an issue for greenways. We’re doing this for greenway project, and parks is not happy about that because people will complain about twisting ankles.
Annette – Depending on length of pavement, for 10 foot greenway, may not be necessary.
Mike Randall – Greenways are considered public transportation, so they may not be subject to these requirements *per se*.
Annette – We can probably exempt people who have shorter run of pavement.
Rob W- I see they’re different parts of development – roof and pavement. I like the idea of disconnected impervious surfaces. I don’t see how anything in Item 1 would cause a builder to want to disconnect the gutters from underground drainage system. No real incentive if they have to be such small areas on the bigger houses. On scouring – most of time with big houses and gutters – you also have sod coming down. Has anyone looked at – if it’s hitting splashblock, then sod, would you get scouring enough to discourage this? Also, on size factor with new construction – has anyone looked at new construction? Is there incentive? Chesapeake Bay rules address this for new construction? The more we can do to encourage this – Do we have to ban downspouts going directly to the sewer?
Annette – High density development would still need some sort of treatment, but it could significantly reduce the size of the practice. When you look at draft credits, even small footprint disconnection would be 30 or 45%, depending on the soils.
Natalie – There has not been other research done. There has been observed issues with sod; the water has tendency to run under it. So that’s a concern with sod. We recommend seeded lawns, not sod. A splashblock does work to dissipate some energy. I’ve seen in Lowes -- they have downspout extensions that are flattened. I think we should think creatively about what is meant by “level spreader.”
JD – Two things that bother me. If you have cut up front of house they get cut up into points. But one straight line, they send all water to one side or the other. To go statewide, it does seem to depend on place. There would have to be some curve here, some algorithm, but I’m good if we want to settle on 300 or 500 SF.
Robert – Virginia has design for entire Chesapeake Bay area, but they have tight slope constraints. But they bump up area to 1000 SF for 2% slope.
Natalie – They’re very restrictive.
JD – I think we’ll get asked what other states are doing.
Annette – If you do algorithm, it makes implementation more challenging. If staff inspects it, they might not know what standard is. Oh, here they have 10 by 10, they have good soil sand low slopes – but over here they need 12 by 24 because don’t have good conditions. Trade off between customization and standardization.
Todd – Do we need to provide for not installing gutters, period? What if you don’t?
Annette – My own feeling is a house that doesn’t have gutters will become a house that has gutters. Future owners will install gutters.
Boyd – Are we thinking about having this option something that can be used at near low-density situation, or something designed by engineer and put on plans?
Annette – We haven’t talked about allowing folks to be low density if disconnect. It’s been more about being part of a treatment train to allow smaller treatment device.
Boyd – So it’s involved with developments with engineered plans drawn.
Annette - It’s a little more challenging with public education. These disconnected impervious areas will be owned by individual homeowners.
Rob – I agree an algorithm would help. But in small storms, you can achieve 100% impervious – can you use it as incentive to encourage it? It’s too complicated. Can we use it as incentive to decrease size of other stormwater devices?
Annette – If you put in small DIS on site that needs a wet pond, your pond can be 30% smaller, for example
Rob – Does it matter if it’s got 6 by 12 or 12 by 24? If you overload the 300 SF area, does that still work?
Annette – If overload it, you can damage it, eroded gullies, then it wouldn’t work even in small storms.
Eban – In coastal areas, make sure these aren’t being discharged over septic fields.
Natalie – In coastal, you’d almost need a minimum slope to keep water moving.
Eban – If you overload in coastal area, you’ll have wet spot over septic drain field.
Rob W – How do you make it an incentive that really works?
Annette – I think intent is that it would apply everywhere. No one is going to be required to disconnect downspouts.
Eban – What will stop homeowner from moving end of pipe from grassed area to driveway?
Annette – It would have to be in a drainage easement like other practices.
Robert – You would envision a drainage easement for each of these?
Linda – That would be tough. You wouldn’t know where the disconnected areas are until the house is built. You’d have to have an assumed easement.
Eban – Would this be like septic permit?
Joe H – This is not a permit. Septic fields don’t have to be recorded.
Annette – We’re open to your thoughts. This chapter is on draft.
JD – In an area like Falls Lake -- with regulations in place -- you’ll force people to do this. But if you’re talking easements, nobody’s going to do this voluntarily.
Annette – I’ve always said, you’re welcome not to like something. Better idea?
Robert – There’s going to be an O&M requirement, but I don’t ever see an easement getting recorded. Plans get recorded kind of on front end, then lots get handed over to builders. Then year or two from now, house gets built. They’re not going to re-record the plats. Just have to rely on O&M agreement.
Joe H – Have you looked at effect on wells? You can’t put it in back because of septic; can you put it in front with well?
Natalie – In general, roof runoff is pretty clean, so contamination not a major concern.
Joe H – Until it runs across fertilized and limed area of yard. Biggest problem we’ve had with wells is shallow wells. If you sheet flow it to the well site, will that have effect on well quality down the road?
Peter – Isn’t that more of a design flaw of the well not being deep enough?
Joe H – This has an urbanized area application.
Peter – I see this being used more for retrofit. Big builders have their designs. No matter what we put in this, they will use that design.
Annette – Our friends in DWR will use this chapter for credits on existing development in Falls and Jordan watersheds.
Todd – For most part, we’re talking about standard for issuing stormwater permits. Houses on wells and septic probably meet low-density criteria anyway.
Joe H – Used to say you can have an acre lot to get this on there, but now I can get well and septic on 0.4 acre with all setbacks with reduction system.
Robert – Most rural lots have disconnected downspouts because there’s nothing to connect to.
Todd – I wouldn’t discount the appeal of this for reducing size of systems. 300 SF of roof area shall drain to a minimum drainage area. Or just put gutters on portion of house where you need them.
Annette – We do have to propose some language on MDC to the ERC February 1, 2015, then going through rulemaking -- that will take some time. We do have flexibility during rulemaking process to make tweaks as needed. If we get additional date from Wilmington study, maybe we can increase roof drainage area then.
Natalie – I see these as initial estimates that will be improved with more data.
Annette – This is a brand new practice for us. Having an algorithm would imply to the public that we know more than we know.
Rob W – Remind me again where 300 SF and 500 SF came from?
Annette – Natalie’s research says when you go over 300 SF, it becomes overwhelmed by water and doesn’t function.
Rob W – So everything else we’ve done in this group, we’ve looked at algorithm, soil types, other issues which she controlled for in her study, but we’re not letting someone with bigger area, bigger roof, adjust. What we’re doing is creating rule for using a device that is very limited. I’m having tough time figuring out if we limit it to such a small area of roof. If we’re making it so selected, it’ll never be used.
Boyd – I envision having one gutter at one end of house and having fork or splitter device to go into areas. Doesn’t have to be divided on roof; can be provided on ground.
JD – I think this is important topic. I can’t tell if we’re being conservative or not conservative. We would like people to disconnect gutters. So to roll out something that’s not right may have counterbalancing effect. It takes a long time to change a rule. I’d like to see us take it back and talk to niche developers and bring back a revised approach to consider again. I don’t think I’ll be comfortable with anything at this point. We need to ask about 300-500 SF – applicable to every geography in the state?
Rob W – Only rule we’ve talked about that talks about what generates the water. So do we work backwards and say that “X” amount of SF works width to length and work backwards to what roof size should be.
JD – What are other people doing? It sounds like we’re one of a handful of people that have a rule in place. Then where’s the process for engineer solutions? Redesign roof system as alternative to 300 SF?
Linda – In infiltration chapter, formula talks about effective infiltration area. Maybe that can be adapted for slope? Might be able to show that 300 and 500 SF is sufficient to account for volume? Gives you amount of area you need based on how quickly you can infiltrate and how fast you want it to infiltrate.
Natalie – Compared to other states and muni’s -- 300 and 500 SF are more conservative, but our other factors are less conservative. If can control roof area, and have two simple lawn conditions, makes it easy to implement. Cost is low, but cost of oversight is much higher, so that’s a big issue to wrestle with.
Peter – Not much science on this practice. But if we’re trying to give credits for it -- this might be the best we’ve got right now.
Derek – A lot of the decisions we’ve made on other practices is based on what does science say. Now we have some science, we’re trying to say wait for more science? Can’t go both ways.
JD – I would argue that where we’re at is not science -- not a big dataset.
Natalie – We have a substantial dataset.
JD – I’m just saying there’s not a body of knowledge.
Derek – Those other muni’s that are less conservative. What are their credits?
Natalie – Don’t have them memorized.
Derek – Maybe we offer less of a credit if we allow larger roof size?
Peter – Do we have enough data to create that algorithm? I don’t think so.
Eban – I think this is fairly conservative. If you compare to bioretention which is 10:1 -- this is about half of that. We want this area to dry out in between storms. If you go higher than 300 SF, it’s probably going to be too wet, more like bioretention. I think this is a good start. Ties dimensions of your areas to some workable areas, without letting it get too big where you’ll have problems with channelization. Slope and infiltration rates -- being able to expand those ratios -- is valid. It can only go up from here.
Rob W – Instead of hard and fast SF of roof, can you create loading rate and base this on loading rate? Can it be established as where we’re going?
Eban – I expect that when you start at beginning of your area, that will infiltrate most, stay the wettest -- is that right? You won’t have uniform wetness across it. If your focus is all in one area, you’ll probably want to break it up, trying to overinfiltrate one area, staying too wet, management issue.
Joe H – This is similar to spray irrigation system. We size those based on infiltration rate of top 12 or 18 inches. Can we do that here? Look at soil types. If engineer can prove that can load it at 0.3 vs 0.1, let them do it. Then size of area will be dictated by that. Loading rate would tell you how much water you could take off coming off of that roof.
Natalie – That would be more thorough and ideal, but an infiltration test would be done at every downspout.
Joe H – You would do it in the yard, not at every downspout.
Natalie – I see high variability even in same yard.
Joe H – You can have a variety of soils suitable – you look at lowest denominator in yard. There are smaller devices that can be used, like used on golf courses. They do work. They’re easier than bringing in small water truck.
Rob W – Is it possible to construct rule to say 300 or 500 SF unless infiltration rate is used, which gives us different soil types. And as science gets better, not having to open rule to tweak it?
Todd – We’re working on minimum design criteria. Other practices, we’ve allowed folks to come forward with other designs, just not under fast track.
Boyd – You could say “or something that provides equivalent infiltration or protection . . .”
Robert – Goal was to keep this simple.
Boyd – But to have the option – why not put it down there?
Todd – Can we also consider the design storm size in the DIS design?
Annette – The way we have it now is a one size fits all, which is not congruent with how we’re doing other practices. I’d like to sit down with NC State and brainstorm about how to do what we want to do and still be respectful of the data we do have on this. Let’s table Item 1 and 2 for now.
*Group agreed to table Item 1.*
[This is how Item 1 was left: For disconnected roofs, a maximum of 300 square feet of roof shall drain to each vegetated receiving area. If there is a device to spread the flow evenly across the entire width of the vegetated receiving area, then the roof drainage area may be increased to 500 square feet.]

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**Item 2**
Annette - For disconnected roofs, the receiving vegetated area shall be a rectangle of either 6 by 12 feet or 12 by 24 feet (width of vegetated area by length of run in direction of flow). The entire rectangle shall not include any impervious surface to ensure that water released from the roof does not run onto another impervious surface.
Todd – Should it be a *minimum* receiving vegetated area?
Derek – No benefit, you wouldn’t get additional treatment? I think it’s implied that those are the minimum sizes.
JD – Is it permissible to have one easement on property, not 8 or 10 little ones throughout yard? Doesn’t say ”independent.”
Robert – You’re not going to get someone to record an easement for disconnected downspout.
Derek – Recorded easement needs to be publicly-owned piece of property to get access to it. If easements drain to sides of house, it doesn’t apply. We vetted this with developers in Wilmington. They all said it’s a great thing, but for niche developments that specifically hone in on low-impact development.
Annette – How about: For disconnected roofs, the minimum sizes of the receiving vegetated area shall be a rectangle of either 6 by 12 feet or 12 by 24 feet (width of vegetated area by length of run in direction of flow). The entire rectangle shall not include any impervious surface to ensure that water released from the roof does not run onto another impervious surface.
*Group agreed to table Item 2.*

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**Item 3** [Move to general MDC]Annette – How about: The vegetated areas of disconnected roofs are not required to be in an easement, but shall be required to have an operation and maintenance agreement.
Linda – Seems like difficult to get easements on residential development after that fact.
JD – With a convention center, strip shopping center, those easements could get dicey too.
Robert – If somebody did LID, and they had a rain garden at every lot, are we requiring easements for each?
Annette – I think we are.
Robert – But you don’t know where they’ll be until they’re built. You don’t go back and re-record a plat. That’s expensive.
Rob W – Let me throw some oil on this fire. In Cary, I asked about permeable pavement. How do you do easement without knowing exactly where it’ll be. I think this issue will carry on for swales and pervious concrete.
Annette – Has Morrisville figured out what to do about this?
Robert – If a swale is serving a single lot, then it’s not being put in an easement. But if it’s part of a major design system, it is. But those are major swales that go in with overall design, not individual – when individual builders, they put in lot line swales, and those don’t go into easement.
Todd – Good thing is it’s easy to spot disconnected downspouts. If it’s put in property to start with --
Annette – Nice thing about having it on plat is that you see it when you buy the property. Otherwise, you might not know not to take out bioretention cell, for example.
Todd – But it is part of an enforceable permit. But people aren’t reading all details of their closing papers.
Robert – I could see text being added saying individual lots --
Todd – Challenge we see is that gutters go in last when there’s not any communication between builders and gutter folks. How do you let contractors know what requirements are? As-built drawings are done before that stage.
Annette – What about O&M agreements?
Robert – Those should be recorded. I think there’s going to be enforceable documentation that’s not going to be in the form of recorded easement on plat.
Derek – Linda and I run into that all the time. One thing you can do is when you record O&M is attach plan as exhibit to O&M.
Robert – There would be a typical detail showing how the lot --
Annette – How about: On residential lots, the plat shall have a note that disconnected impervious surfaces will be used on the property. Disconnected impervious surfaces on residential lots are not required to be in an easement. O&M agreements shall be recorded. The applicant shall attach a typical detail as an exhibit to the O&M.
Todd – Are we requiring easements for everything else?
Annette – We are, but we have an issue with device installed by developer/builder --
Todd – We say residential, but for other land uses?
Annette – We have general MDC that says practices shall be in an easement. We’re making an exception that practices on individual residential lots don’t have an easement, but those would be handled in this manner.
Annette – How about: On residential lots, the plat shall have a note that an SCM will be used on the property. SCMs on residential lots are not required to be in an easement. O&M agreements shall be recorded. The applicant shall attach a typical detail as an exhibit to the O&M. [Move to general MDC.]
Group agreed.

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**Item 4** [Move to general MDC]
Annette - The vegetated receiving area shall not include a septic drainfield.
Joe H – Will you include all areas – mountains, piedmont? We have found that downspouts that run over any septic field can short circuit that system.
Rob W – Would that be a general rule for all practices?
Todd – Does that include designated repair area?
Joe H – If you want to be more specific say designated repair area.
Annette – How about: SCMS shall not be sited in the initial septic drainfield or in the designated repair area [move to general MDC].
*Group agreed.*

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**Item 5 [Tabled]**
Annette – How about: For disconnected pavement, the receiving vegetated area shall be either 10 or 15 feet long. The maximum width of pavement run that may discharge to the vegetated area is 100 feet and the maximum slope of the pavement shall be 7 percent.
Robert – We tried to implement this in a park. We struggled in areas where it was a little steeper. But there would be 100 or 200 foot run that would never be developed; no mechanism to take advantage of that. That wouldn’t be typical in residential, but could see that in commercial. We had a grass verge for 10 or 15 feet, but we couldn’t in some areas get down to 7%. But we had that vegetated area we couldn’t take advantage of. Park site is 6% BUA, but we couldn’t get it to his LID on Storm E-Z. We had permeable pavement, disconnection. If that can’t hit LID, how would you ever -- I think this is good for most cases.
Annette - How about we table Items 5 and 6?
*Group agreed.*

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**Item 6 [tabled]**

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**Item 7**
Annette – How about: If the vegetated area is established on fill soils with a different permeability than in-situ soils, then the credit will be based on the soil with the lowest infiltration rate unless it can be shown that the fill is at an adequate depth to infiltrate the design storm.
*Group agreed.*

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**Item 8**
Annette – How about: The vegetated receiving area shall not contain any impervious surface.
JD – That would include power poles, transformer pads? What about *de minimus* impervious?
Eban – If there’s a pad, you have to extend it a little more.
Boyd – Percentage will be reduced by any impervious in the drainage area.
Linda – Doesn’t the word vegetated connote there wouldn’t be any impervious?
Mike M – When we’re talking 72 SF, that’s big.
Peter – Do we want to exclude those things from the area, or expand the area?
Andrew - If it’s just a square footage issue – what about the minimum width?
JD – Pervious pavement -- the shoulder -- bothers me more than residential.
Annette – Along roadside, there’s going to be a telephone pole, driveway --
Rob W – Is this just a wording change?
JD – Take into account minor –
Peter – Can we combine this with Item 1?
Annette – Combine this with disconnected roads and roofs?
JD – I think he’s saying Item 6.
Annette – 6 is just for disconnected roadways. My opinion is for residential area, there shouldn’t be any impervious surface. But other types, it’s unavoidable.
Joe H – Can we say “Vegetated area shall be modified/adjusted if it contains any impervious surface.”
Annette – Are you saying that you would add extra width elsewhere to make up for it?
Joe H – Yes.
Boyd – Shall be “expanded”? It’ll always be expanded.
Robert – This is a long ribbon pavement, sidewalk, it’s not roof disconnection.
Boyd – Say size of vegetated receiving area shall be increased.
Robert – Strip of pavement, you’ve got 4x4 transformer, that’s negligible. You don’t need to add 4 SF just adjacent. Doesn’t make sense. It would just be a gap in your credit area.
JD – I think we agree. Just says “shall not” right now.
Annette – How about: BUA within the vegetated receiving area shall be minimized. Allowances can be made for incidental, unavoidable --
Mike M – Credited, vegetated receiving area shall not contain any impervious surface.
Robert – Does this apply to rooftop as well?
JD – Both. But applies more to roads.
Mike M – If it contains impervious surface, then that portion just doesn’t receive credit.
Annette – But can they increase impervious elsewhere to make up for that?
Mike M – I think that says that, would allow it. If you have a vegetated receiving area that’s going to get credit, it should not contain any impervious surface. Now you can add that second sentence to add --
Robert – But if it’s just a manhole, it’s not important.
Mike G – When I do a set of plans for subdivision, I don’t know where they put transformers in. Hard for me to design plan and increase that area when I don’t know if it’s going to be there. I have no control over that.
Annette – Phasing issue --
Mike G – So does that mean I won’t be able to certify a project later?
Robert – I don’t think you need to move it around for incidental BUA.
Mike M – We’re talking about 72 SF in some cases; that’s not incidental. We need 72 SF of vegetated receiving area for residential -- bare minimum.
Annette – So 6 x 12 is for disconnected rooftop, not pavement.
JD – May want to say it’s different for residential than for pavement.
Annette – For rooftop disconnection, shouldn’t be any impervious surface. But for roadway, there could be some impervious.
Robert – You shouldn’t have to make up for it. If there’s a power pole, manhole, you’re not losing anything.
Todd – What about underground utilities – disturbing that area.
Mike G – Sometimes those lines can drain a site if it’s wrapped in rock. I don’t know that you can account for that in the scope of a design like this.
Annette – I think it’s confusing to use the word “credited.” How about: The vegetated receiving area shall not contain any impervious surface except for incidental, unavoidable BUA along disconnected pavement.
Brian L – Get rid of “avoidable.”
Annette – How about: The vegetated receiving area shall not contain any impervious surface except for incidental BUA along disconnected pavement.
*Group agreed.*

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**Item 9**
Annette – How about: The vegetated cover shall be a non-clumping, deep-rooted grass species. For disconnected downspouts, the vegetated area shall be kept off-line until vegetation has been established. For disconnected pavement, soils shall be stabilized with temporary means such as straw or matting until the permanent vegetative cover has taken root. Seeding is preferred but sod may also be used.
Rob W- Are you saying that downspouts have to be connected? How do you keep it offline?
Annette – You temporarily direct the flow to another area.
Brian L – That works for roof, but not parking lots.
Annette – Right. That’s not what it says for parking lots.
Rob W- A 2-foot pipe would have to be 12 or 15 foot. I’m probably missing something here. The whole vegetated area – you’re piping all the way around it?
Robert – Could they stabilize it with temporary matting?
Annette – Maybe with both types, you can make it offline if possible, or providing matting.
Natalie – All of my sites were put offline. But in other areas, they weren’t and didn’t seem to have problems. That’s just observational.
Mike G – Is there deed restriction language about this?
Annette – We talked about that earlier. See notes on earlier items.
Annette – How about: The vegetated cover shall be a non-clumping, deep-rooted grass species. Soils shall be stabilized with temporary means such as straw or matting until the permanent vegetative cover has taken root or if possible, the runoff could be directed elsewhere until vegetation has established. Seeding is preferred but sod may also be used.
*Group agreed.*

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**Item 10**
Annette – How about: The vegetated area shall be uniformly graded with no gullies, low spots or lateral slopes.
Robert – For parking lot, you’re going to have lateral slope.
Rob W – How about graded to minimize or avoid concentration.
Mike G – To avoid channelization – a lot of this seems purview of erosion permit.
Annette – My issue is it’s not clear what we’re asking people to do.
Bradley – I think it’s better to say to avoid concentrating flow. Isn’t that was Mike said?
Annette – How about: The vegetated area shall be graded to avoid concentrated flow.
*Group agreed.*

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**Item 11**
All sites built within the past fifty years shall be tilled to eight inches prior to vegetation establishment.
Rob W – What’s significance of fifty years?
Natalie – There have been studies on agricultural sites on permeability of no till systems, land that hasn’t been tilled. After 10 years, there is comparable infiltration with till vs. no till. The 50 year is conservative because I don’t have any research on sites built more recently.
Mike G – I think change to say all sites shall be tilled. This will confuse people and apply to almost every site.
Peter – This will also be used for retrofit.
Rob W – Would it apply to 100-year-old house? It’s been compacted by years of kids running around.
Eban – We looked at 4 inches of tilling, could do it with hand tiller. At 8 inches, till top, move it.
Annette – You would recommend changing from 8 to 4?
Eban – That was in sandier soils. Throwing it out there for discussion.
Bill H – 50 years is about trying to capture when development changes – fingerprinting homes vs. nuking. That’s what that was about.
Todd – What do we mean by “all sites”?
Annette – We mean the vegetated area.
Andrew – Wouldn’t it mean the parcel?
Bill H – You could also just test -- if it’s above a threshold, you till or don’t till. Or make everyone till and be done with it.
Annette – We could say vegetated area shall be tilled to 8 inches prior to vegetation establishment unless the site is on a retrofit that is more than 50 years old.
Brian L – We’re doing some research on tillage. Sites that were tilled and sites that were not. Initially, there infiltration rates were better, but after a year, they were the same. If site built 10 years ago and has good infiltration on it, benefit of tilling it, reseeding it vs just disconnecting downspout to it?
Annette – So both or all retrofit sites don’t need tilling?
Brian L – Don’t know if there’s long-term benefit to it. Don’t have all results on it yet.
Annette – Someone suggested giving this to the subcommittee on infiltration?
Bill H – Who’s on the subcommittee?
Annette – You. You’re heading it. I don’t know. Anyone who wants to be on it can be on it. Subcommittee will deal with sizing of the system, site characteristics and look at that for disconnected roof and pavement, and reevaluate issue of tillage, mostly looking at retrofit sites.
*Group agreed to give this item to subcommittee*.

Annette - There are a number of recommendations:
Recommended: A minimum separation of five feet should be provided between the disconnected downspout and the foundation. [Group agreed to eliminate this.]
Recommended: Do not use wooded areas as vegetated receiving areas because uneven micro-topography often causes channelization, which reduces surface area exposed to stormwater.
Recommended: Use caution when placing DIS in the vicinity of water supply wells.
*Group agreed to all 3 recommendations, but subsequently eliminated recommendation on 5 feet separation.*
Mike G – Anything about grading away from the foundation?
Brian L – I don’t think we should have the five feet here.
Linda – It’s really a structural issue vs a stormwater issue.
Annette – Maybe make it even more vague.
Linda – Where you leave these practices should be dictated by --
Annette – Consider the effects of seepage on structures and move it to general MDC.
Rob W – Building code covers effects on structures.
Annette – Are you suggesting we delete this all together?
Rob W – Yes, but I’m not a regulator.
*Group agreed to get rid of recommendation about 5-foot separation.*

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**Swales**

Andrew – What if you can get a customized TSS removal credit based on your design? Modeling efforts of Bill, Ryan, and myself. Trying to predict performance of filter strip and swale TSS reduction as function of common design parameters. Looked at 43 collected storm events across 12 sites in North Carolina. Result: *Triangular* swales did not meet flow depth requirement; most *trapezoidal* swales met the flow depth requirement.

Hydraulic Residence Time (HRT)– The longer water stays in swale, the higher the rate of pollutant removal. Result: As swale length gets up to 300-500 feet, you get residence times of one hour. On order of 25-50 feet, HRT won’t get higher than 15 or 20 minutes and 0-50% sediment removal.

Can clays be trapped in swales? No, they’re not going to be settled out in a short amount of time. Not high enough HRTs for clays.

You can pick your target, and find out what minimum HRT will get you there. For example, if 40% TSS removal is baseline performance goal, HRT is greater than or equal to 4 minutes. Saw up to 80% removal for really long swales with tall grass height. As you increase watershed area, you cap your upper limit of performance. Fewer options in larger watershed area below flow depth requirements not met. Note – 85% TSS was not possible in our model with just swales.

Conclusion: TSS removal most sensitive to trapezoidal vs triangular; TSS removal least sensitive to side slope.

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Annette – With Andrew’s help, we pretty much threw out what we currently have in BMP Manual. Here’s what we came up with:

**Item 1 DESIGN STORM INTENSITY**
Annette – How about: The design storm intensity shall be 0.75 inch/hour.
Annette – Have higher intensity storms on coast. Would be more restrictive in Piedmont, but helps compensate for poorer soils.
*Group agreed.*

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**Item 2 HYDRAULIC RESIDENCE TIME**
Todd – Since legislation says we are protecting our water quality standard, do we need more info on other parameters, other than TSS?
Bill H - We can extrapolate to TP, but no good data for TN. For pathogens – pathogens often associated with soil particles – don’t know what percent of pathogen removal would be. But we would be capturing sediment with its associated pathogens.
Bill H – Eventually, this can be used for maintenance prediction.
Bill H – Not every grass species is going to work. Important to have grass species – clumping species not very good. Grasses that are somewhat rigid are going to be preferable. Grass suppliers can serve you up the grass you want.
Rob W – Does it match DOT’s swale grasses? Common roadway grasses?
Bill H – DOT’s grasses will work, yeah. Particularly the ones at the bottoms of ditches.
Annette – [Spreadsheet] We are varying bottom width of trapezoid 2-6 inches; flow height is 6 inches; varying slope – tells you swale length using Manning’s equation to get HRT. On low end, with shallow slope, you need 50 feet of swale length; steeper slope goes up to 130 feet. If you have impervious drainage area, you can use swales for conveyance but not for improving water quality.
Bill H – Manning’s number is 0.35. Water does not overtop grass. As soon as water overtops grass, retention time decreases and you don’t get performance. But swale can still convey big storms; it’s just not providing water quality benefit.
Annette – Some states have 10 minute HRT. Look how long your swales get when you spec that. That seems unreasonable. We were relieved that modeling data verified that 4 minutes was good retention to get 40% TSS removal, which is reasonable to expect from a swale.
Mike G – Looking at chart, wider the bottom width, the longer your swale.
Annette – True, but notice your “Q” is going up as well so your depth doesn’t go above 6”. I don’t see a lot of swales being used for pollutant removal, sometimes at airport projects. Side slopes in Manual say 5:1. But as Andrew said, it’s not very sensitive to changing side slope; slightly decreases length. So someone could go more shallow than 3:1, but makes footprint take up a lot more space.
Mike G – Can you go steeper than 5:1, but armor sides?
Andrew – Didn’t look at anything steeper.
Mike G – Wouldn’t get pollutant removal credit for side slopes, but as long as flow depth is below height of grass --
Bill H – I think it would be minor. I don’t think that’s a common situation.
Mike G – We wouldn’t be looking to get credit from it.
Linda – We ask for a factor of safety in the flow depth -- that’s about it.
Annette – How about: Minimum Hydraulic Residence Time shall be 4 minutes. [Table with TSS Removal Target and Minimum HRT]
*Group agreed.*

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**Item 3 FLOW DEPTH**Annette – How about: Flow depth for the design storm intensity may not exceed 6 inches.
Bill H – Most of the time, you should have 6 inches be maximum height because not all grass species are rigid.
Todd – Can you maintain 6 inches in non growing season?
Bill H – I think key is when the last mow occurs and what the grasses are. Todd’s point is good.
Annette – Do you think we need to add anything?
Bill H – I think grass selection part should have Todd’s point in there.
Annette – How about: Flow depth for the design storm intensity may not exceed 6 inches.
*Group agreed.*

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**Item 4 CROSS-SECTIONAL SIDE SLOPES**Annette- How about: Cross-sectional swale side slopes shall be no steeper than 3:1.
Brian L – I prefer 2:1
Annette – Harder to maintain, mow 2:1.
Rob W – Whole thing is getting hand mowed anyway.
Bill H – Bottom width and depth is based on storm size you’re trying to convey –
Robert – Still have to meet 10-year storm requirements per DEMLR erosion control.
Annette- How about: Cross-sectional swale side slopes shall be no steeper than 3:1 if they are vegetated. Steeper slopes are allowed if permanent stabilization measures are provided.
Rob W – I would say there are a lot of 2:1 slopes where vegetation works. I don’t see that this allows it.
Annette – So this swale is also conveying larger storm events at a deeper depth.
Rob W – 2:1 vegetation works in a lot of cases; depends more on sun. I’m reading it that if you do 2:1, you have to use something that’s not alive.
Annette – Intent is not to say permanent stabilization measures have to be hardened surface; it could be vegetated, but thought would have to go into it. A way to clarify that?
Robert – We already address this in general MDCs as 3:1 for vegetated cover.
Peter – If it’s in general MDC, do we need to repeat it here?
Annette – I would suggest doing it here also because it’s a little clearer since we’re talking about slopes in the device, not around it. Okay to cut/paste language from general MDC?
*Group agreed.*

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**Item 5 SHAPE**
Brian L – If make it too wide, then in low flows, have smaller meandering channel rather than flow through.
Bill H – I remember two feet being used as minimum for mowing purposes.
Mike G – You don’t want the bottom mowed, do you?
Brian L – I prefer to remove the lower number.
Rob W – If 3:1 side slopes, can push a professional mower across and get 6 inch grass.
Annette – How about: Swales shall be trapezoidal with a maximum bottom width of six feet.
*Group agreed.*

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**Item 6 SWALE LENGTH**Rob W – If it’s part of a treatment train, is it okay to use three minutes, for example? Is there a reason to put a lower – advantage to give flexibility?
Annette – We could put together tables. Right now the way our program is there isn’t incentive to get 20% TSS removal. Either you got 85% or you didn’t. The practices that get you to 85% are in 40-50% range. But we could share that information in the BMP Manual, so as our program evolves over time to more tailored removal rates.
Rob W – Should be general MDC that can lower whatever for treatment train.
Andrew – Particle size distribution is different going into and out of practices in treatment train.
Mike G – If you reduce particle size going into wet basin – if reducing it to point – not going to be effective either.
Annette – Bigger particles will be easier to get. BMP will pass smaller particles to next practice. Once we move past MDCs, we will have to discuss crediting for these practices.
Annette – How about: Swale length shall be determined based on a minimum hydraulic retention time of four minutes.
*Group agreed.*

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**Item 7 SHWT**
Andrew – Would this encompass bioswales?
Annette – At bottom, I have an item that says swales designed as other SCMS . . .may be accredited in accordance with the appropriate device.
How about: Swales shall not be excavated below the SHWT.
*Group agreed.*

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**Item 8 GRASS SPECIFICATION**Rob W – Can’t we just have someone come up with a list of acceptable grasses?
Bill H – There’s a lot. Depends on shade, recipe. There are experts out there.
Annette – So I should go out and ask grass experts which species are sufficiently stiff?
Bill H – For example, tall fescue mix.
Annette – How about: The grass species in the swale shall be non-clumping, deep-rooted and rigid.
*Group agreed.*

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**Item 9 GRASS HEIGHT**Rob W – Unless you’re mowing weekly or monthly -
Bill H – Expected minimum grass height. Okay to be five inches for a little while. For people that are worried that they can hit 4 inches, that is within the realm of you can do that except there’s – number of design configurations does reduce. That’s what Andrew’s graphs showed. To be safe, you can mow to 6 inches.
Rob W – More questioning verbiage. You end up with 6 inches most of the time. If it’s 9 inches, it starts to fall over, not what you want. Really how it’s addressed in O&M guidelines.
Boyd – Is it maintained at 6? Or cut at 4 and average at 6?
Bill H – Depends on what degree of caution you want.
Mike M – DOT specs for cutting?
Brian L – 4 inches; gets cut 2x per year on average.
Bill H – That’s great. In areas more frequently maintained than DOT, you’ll want to mow at higher height, as high as possible. If it’s cut 2 or 3 times a year, it will be at or over 6 inches.
Linda – This is more maintenance than design.
Annette – MDCs have to address maintenance as well.
Bill H – I think four inch minimum is key.
Annette – How about: Grass height shall be managed at an average of 6 inches. The grass shall never be cut lower than 4 inches.
*Group agreed.*

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**Item 10 CONVEYANCE OF LARGER STORMS**
Annette – How about: Swales shall non-erosively pass the 10-year storm.
Group agreed.

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**Item 11 FREEBOARD**
Swales shall provide a minimum freeboard of 6 inches for the 10-year storm.
Rob W – Do you give it a percentage of volume? Just want freeboard so it doesn’t wash out?
Annette – I think that’s the idea.
Linda – Do we have it more for flooding?
Mike G – Probably so don’t overtop it.
Annette – Brian L suggested making it a recommendation.
Rob W – Are we worried about freeboard or stability?
Annette – It’s possible we don’t need this item.
Brian L – Doesn’t seem to do anything for water quality.
Mike G – I’ve looked at it from design perspective. Swales should have 6-inch freeboard to protect yourself from liability. Good engineering practice. It’s not 2 feet; it’s 6 inches.
Annette – May be situations where SHWT is close to surface and won’t be able to do it. Consensus is to keep as is and move to recommendation?
*Group agreed.*

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**Item 12 SWALES DESIGNED AS OTHER SCMS**
Mike M – Would an RSC fit in this?
Annette – An RSC could. I’d eventually like to have this as an item in the Manual.
Annette – How about: Any swale may be designed in accordance with the MDC for bioretention cells, infiltration systems or stormwater wetlands, and the treatment volume may be credited in accordance with the appropriate device.
*Group agreed.*

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**CONVEYANCE-ONLY SWALES**Annette – This would apply to all types of development -- low- or high-density -- that has conveyance swales. These won’t be covered under general MDCs. They are not a SCM.
Brian L – What types of swale are we talking about? Lot line swales? Wouldn’t be included in a plan.
Annette – I guess swales that we review on the plans – those that drain parking lots, for example.
Mike G – Right now we don’t limit low density. We don’t say anything about SHWT because basically you’d have to have someone go out and shoot SHWT for every curb outlet.
Annette – I worry about excavating swales below SHWT even for conveyance.
Linda – I don’t review conveyance-only swales for flow. Nothing in low-density requirements that swale has to be designed for flooding. Just says they have to have 3:1 side slopes and be vegetated.
Todd – Can you do vegetation below SHWT?
Linda – Just says vegetation on side slopes.
Boyd – Where do you get 3:1, Linda?
Linda – That’s in stormwater rule.
Robert – Don’t existing rules already cover this in low-density requirements?
Annette – Could still have conveyance swale in high-density, LID. Not for water quality, but we don’t want them to negatively impact water quality.
Robert – How is this difference than piped conveyances? We don’t review those.
Mike G – You have to do that for erosion control permit.
Annette – What is difference in design between curb outlet swale and conveyance-only swale? Why would we make those different?
Robert – Curb outlet swale is a treatment device.
Todd – I’ve seen on low-density projects where they’ve dug below SHWT. I think we need some standard.
Rob W – In piedmont, it will still carry water, seasonal water – it’s a different animal as far as conveyance.
Mike G – Would probably get more curb outlet systems if didn’t have SHWT stipulation. Do you have to have separation?
Linda- In the Manual? I can’t remember.
Mike G – There’s a minimum separation in the Manual.
Annette – When I was thinking about this, I didn’t see huge differentiation between designing conveyance swales and curb outlet swales. Calcs show 5:1 vs 3:1 don’t make a big difference. You may need a bigger footprint for curb outlet swale if you have a parking lot going to it, but let the calcs speak for themselves.
Linda – If set flow depth at 6 inches, not much variation in slope, but curb outlet swales are allowed to be triangular which makes a difference for flow depth. We just limit it by velocity.
Mike G – A lot of developers would like to do curb and gutter. If near SHWT, they do collection catch basins which throws them into a high-density permit, which is something you don’t want them to do. If get rid of separation, would encourage low density. Something to think about.
Todd – So low-density rule says you can convey water with vegetated conveyances. My question is how do you maintain vegetation when you go too deep?
Mike G – Another issue I have with SHWT – driveway pipes.
Annette –What is reasonable to have people do for conveyance-only swales?
Mike G – Separation from SHWT hard for me because you have to have a guy go out and check for every lot. This increases cost of project tremendously, with not much benefit.
Linda – When you design swales that are going to have water in them, it encourages people next door to swales want to pipe them. They’re tired of mosquitoes, whatever, and they want to pipe it. You need the swale to convey the water, but around here on the coast, it’s flat. There are millions of ditches that never drain. I get the calls from people talking about standing water in drain, ditch. I have nothing to go to in rule except for curb outlet swales that I can have them designed on particular basis.
Annette – What would make your job easier?
Linda – To have the separation to SHWT.
Todd – Are we asking for separation, or just not to go deeper? I still contend if you go too deep, you won’t have vegetation.
Mike G – If you can encourage people to do low-density plan, you’re better off than pushing them to high density.
Robert – Conveyance-only swales are not about water quality.
Annette – But you’re trying not to add pollutants.
Rob W – Can we address this issue by saying it’s not by charter of MDC so we remain silent?
Annette – You can do that. We might ask for your input later on the rule readoption process.

>All swales shall be in a recorded drainage easement with access to a public right of way.
>[Language on cross-sectional slopes from above]
>~~Swales shall not be excavated below the SHWT.~~
[More recommendations we didn’t get to]

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**Action Items**Annette –Send Team additional homework in 2 weeks.
Team – Review chapters and additional homework as assigned.

**Upcoming Meetings
January 12, 2015 – 9:30 to 3:00 Topic: Rainwater harvesting and green roofs *[Attendance is optional.]* January 26, 2014 – 9:30 to 3:00 Topic: Permeable pavement and road map for fast track permitting** ***[Regular monthly meeting]***