**Minimum Design Criteria (MDC) Team  
1/12/2015  
Triangle J COG, Durham**

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| --- | --- | --- | --- | --- | --- | --- |
| **Attendees** | | | | | |  |
| ***Team Members*** | |  | | |  | ***Others*** |  |
| Eban Bean  Bradley Bennett  Jonathan Bivens Tim Clinkscales Tracy Davis Boyd Devane Hunter Freeman Mike Gallant Joe Hinton  Marc Houle Ron Horvath Bill Hunt  Linda Lewis |  | | Brian Lipscomb Annette Lucas  Mike MacIntyre Todd Miller  Cameron Moore Tom Murray Robert Patterson Derek Pielech Peter Raabe Larry Ragland  JD Solomon Virginia Spillman Toby Vinson Rob Weintraub |  | | Julie Ventaloro, NC DEMLR  Nathan Brinkley, NCDOT Ben Brown, City of Raleigh  Sally Hoyt, UNC-CH |

**Rainwater Harvesting Systems  
  
Item 1 – BUILDING CODE COMPLIANCE**  
Annette – Does Team want to keep this in MDCs or eliminate it?  
Rob W – To be consistent, eliminate it.  
Annette – Yes, DENR doesn’t have authority over this.

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**Item 2** **MINIMUM CAPTURE VOLUME** [*later became Item 1*]  
Sally Hoyt – 86% that’s in here is tied to research of Dr. Hunt’s student. If you’re getting 86%, that’s equivalent to what you would get with another device, like a wet pond.  
Hunter – Equivalent to one inch?  
Sally Hoyt – Yes. And basically it’s saying this water has to go somewhere; can’t keep it in cistern.   
Hunter – May require two standards. One is if cistern is designed for 86% and another when it’s not.  
Sally Hoyt – That’s basically what this is saying.  
Hunter – May need to be clarified. First sentence says cistern shall be sized for 86%, not clear there’s that option.  
Sally Hoyt – You only want it going through your system if there’s a reason to go through the system. If it’s always going to be treated downstream, then convey it another way that’s less complicated. Sometimes you’re putting overflow through your cistern, so that amount is included in the 86%.  
Hunter – At Chapel Hill, you have some large cisterns. I don’t want 10,000 gallons to be minimum entry size for cistern to count as storage. I think there should be a benefit to having a 2,000 gallon system that might overflow more frequently, but can still have smaller BMP downstream. 86% means it stands on its own and doesn’t need anything else downstream.  
Robert P – For full credit, as standalone BMP, you have to do this --  
Hunter – That’s what I’m trying to say.   
Sally Hoyt – That’s true for any BMP. I think that’s one thing that came out as we were working on draft chapter is because we’re allowing to do disconnected impervious area, something that’s less rigorous than downstream BMP, then you have to meet criteria. If put a flow splitter in upstream, then a portion of it’s not going to the BMP, then you’re calculating that however you’re calculating that.  
Hunter – If I were splitting flow, how do I justify 86%? 50% is already bypassing. What I did divert to it met the 86%. Just a matter of rephrasing. I don’t like minimum capture volume. Just want to reword the statement.  
Brian L. – On other BMPs we’ve taken out minimum so you can do these in series.  
Rob W – We talked about having a general rule about how to create a treatment train, certain minimums wouldn’t apply. We’re one meeting away from being done here, and I’ve never seen anything about how a treatment train would work. I think we need to create a treatment train set of rules, then certain BMPs will be bypassable, diversionable. We need a matrix for that and it needs to be simple enough for someone like me to understand.  
Sally Hoyt – Where other things are based on water quality volume, it’s harder to compare this to that -- Have you looked at other BMPs – for example, when you design bioretention you’re looking for storage and water quality volume, others for infiltration – have you looked at that?  
Annette – Yes, we’ve looked at “treatment volume” where volume might not be whole amount of runoff from the design storm. You could pick a treatment volume that is less than the design storm.  
Jonathan – I think change from minimum capture volume to sizing or something like that -- then you can have a phrase for total use, then secondary that it can also be sized and used in conjunction with other devices.  
Hunter – If cistern is designed for 86%, then no other BMP is needed. If it’s not designed for 86%, shouldn’t be any minimum.   
Robert P – Minimum is there for full credit.  
Hunter – I know. I don’t want people to be discouraged from doing this measure if it’s not 86%.  
Mike M. – We do that all the time. In Charlotte, you can send some of your treatment this way, some that way.  
Annette – How about: SIZING. If the system is sized for 86% of the total annual runoff volume as demonstrated through water balance calculations, then no additional stormwater treatment is required. If the cistern is sized for less than 86% total annual runoff volume, then the stormwater shall be routed to another SCM sized per another chapter of this manual. The captured runoff in the cistern shall be either (a) used to meet a non-potable water demand or (b) discharge via a passive drawdown device to a vegetated infiltration area or another SCM.  
Bill H – If discharge into a sand filter, that’s good too. Sand filter is so low flow with small footprint --   
Robert P – Like a micro BMP.  
Jonathan – Why don’t you change ‘b’ to any other device and not specify?  
Bill H – Water that is discharged through passive drawdown – counting it towards 86% -- we’re making sure it gets treatment.  
Sally Hoyt – It’s a detention device until you do something to it.  
Boyd – Rooftop water is clean; why does it need treatment? Just slow it down.  
Sally Hoyt – This doesn’t specify is only rooftop runoff. We are letting you spread it out. It’s saying you can’t have a cistern and pipe it directly to storm drain system.  
Boyd – I think you should. Why does it need other treatment if it’s rooftop runoff? I’m saying detention is a type of treatment.   
Robert P – Isn’t that just a lump it and dump it?  
Boyd – I don’t want to encourage that. I see rooftops taking water, and instead of being able to slow that clean water down and release it slowly. Say a building at airport. We say their rooftop runoff goes to a pond, and we say it’s getting 85% TSS removal, but we know it’s not. It was below the standard anyway when it was coming in from rooftop. I’m saying if it’s already clean, I don’t want to mix it in with the pond. They do it all the time.  
Bill H – Rooftop runoff can have a lot of bacteria.  
Rob W – We’re not allowed to talk about bacteria in this forum.  
Jonathan – Are we saying we can capture runoff from anywhere or just rooftops?  
Annette – Anywhere.  
Boyd – Let’s take a Walmart with rooftop water and street runoff. They take street runoff and put it into a pond, then dilute it with roof runoff. Isn’t there something we can do with the roof runoff?  
Rob W – Is there ever a time when you would do rainwater harvesting for anything other than a rooftop?  
Sally Hoyt – We’ve done it off of a parking garage. We’ve also done some that are just rooftop runoff.  
Bill H – In the end, you can see ponds being used for rainwater harvesting, like golf courses.  
Sally Hoyt – Unless the state is going to say we don’t have to treat rooftop runoff, this still allows you to discharge rooftop runoff and direct it to the landscape.  
Annette – If Walmart is going to use that thing, they’ll use the rooftop water for non-potable uses hopefully.  
Robert P – Rule says all impervious surfaces must be treated.Annette – Back to Item 1. How about SIZING. If the system is sized for 86% of the total annual runoff volume as demonstrated through water balance calculations, then no additional stormwater treatment is required. Smaller systems may be used in conjunction with other SCMs to reduce the treatment volume of the downstream device.  
Hunter – I don’t want to open a loophole here where someone can put a dry pond in, but we’ve suddenly given is 85% TSS just because we renamed it rainwater harvesting.   
Sally Hoyt – I have the same concern. Maybe it’s to keep original language and say that for full credit – if you do less – it’s part of a treatment train.  
Boyd – If it’s in an NSW watershed, then I am concerned about nitrogen and phosphorus. If not in an NSW --   
Sally Hoyt – Another thing that came up -- should there be a minimum requirement for it to be used for something else? By adding the second requirement that says what has to happen to it downstream, you’re making it that if you can’t document demand, then you have to size your downstream BMP for all of it. If there’s criteria in other areas that look at rate-based sizing, you can size your sand filter based on rate water is reaching it. Then you can downsize it.  
Annette – Bioretention is sized for volume, but you can route it and turn it into rate-based.  
Bill H – This is geared for rooftop management – to have filter for infiltration be sized on flowrate. That’s what’s included in it.  
Annette – Do you all want to add component under major components of a rainwater harvesting system?  
Sally Hoyt – That might be a way to get around where these things go together. Rainwater harvesting consists of cistern, the runoff captured in cistern and list the two options.  
Brian L – Can we use “means to detain water” instead of “cistern”?  
Sally Hoyt – Or a “storage component.”  
Rob W – So it’s easy to translate pure gallons here to peak flow problems of other devices?  
Sally Hoyt – I would say it’s not necessarily the case. This one is being sized through a simulation instead of just saying this is my water quality volume.  
Annette – What if someone said we have a one-inch design storm and 10,000 SF of roof. What’s one inch times 10,000 SF -- is that acceptable way to size it?  
Eban – No. More about timing of water coming in, water going out.  
Hunter- Is there a way to take any volume of cistern to translate that to equivalent depth of runoff treatment? Like 86% is translated to one inch? May not be linear --  
Eban – Will depend on use or release rate.  
Hunter – More variables, but the ones that I’m using in my head are volume of cistern. If I changed cistern to 4,000 gallons, that might not be 3,000 more credit, but can we --   
Sally Hoyt – There is a relationship, but not one to one.  
Jonathan – Based on one inch storm, your 86% of annual runoff, that’s captuinge most one-inch storms. It’s all based on one inch. But what’s the frequency of one-inch storms? That gets back to how quickly the device is discharged. Not linear.  
Bill H – We looked at what would happen to wet pond sized appropriately. We looked at Raleigh rainfall records over past decade. 86% of water would be subject to treatment.  
Hunter – Almost like a pump curve, a lot of different factors. Can rainwater harvester act in the same way? 50% of runoff treated equals this many inches. That can be translated to figure how much more volume needed in treatment train.  
Bill H – Could undersize practices then look at how they perform over course of 10-year window. If it’s 50% undersized, how much treatment do you get from that. It’s doable, but she put in a lot of effort to get one number -- 86% -- enough for a journal article.   
Hunter – Let me ask the group – I want credit for anything, even if it’s undersized. But is that what the rest of the group wants? Do we want to say only get credit if design it for 86%?  
Robert P – The other practices – that’s because treatment volume is standard for those, different for this. You can still undersize it.  
Hunter – All the other devices have passive drawdown devices. We’re not really worried about the next storm.  
Sally Hoyt – I would say that if you wanted, you keep using example of 55-gallon rain barrel – there’s evidence that doesn’t do much. Let’s set that aside. Partly about sizing. What size roof area or drainage area do you put to the system?  
Bill H – I have an idea. What if we take ratio of 86%. Say we treat 43% and we allow that fraction to remove offline for downstream, sort of like treating it like permeable pavement, reduce the BUA by that fraction of surface. That provides a good incentive to use it.  
Annette – Complicated.   
Bill H – Shouldn’t our design community be able to figure that out?  
Annette – More of a policy question – is it high density or low density? Messes with our policy more than our engineering.  
Robert P – Engineers will have a typical set of home plans for subdivision.  
Rob W – But if you have to hit a certain number – it can float – if give minimal number, every house can get 20% or whatever, but there may be a house that can’t get 43% and another one can get 86? How do you deal with that in subdivision?  
Jonathan – Average per house.  
Hunter – If you know that every house has 5,000 gallon cistern, what’s that equivalent impervious area that equals 86%, then can reduce downstream BMP.  
Jonathan – I think you need to put incentive in here. May not be to capture all of it, but a lot of residential is now doing this. In mountain communities, they’re doing it because they have water shortage. High altitude homesites don’t get that much water out of wells. They have separate gray water systems in the houses. It’s not stormwater runoff. We need to provide any incentive we can that will minimize disturbances.  
Sally Hoyt – I agree. For full credit, you have to meet 85% of runoff volume. If you provide less than that, you get credit --  
Bill H – I like it.  
Annette – I like the verbiage we have “smaller systems. . . .” We’re struggling with exactly how to do that.  
Eban – Any cistern can capture and treat 86% of runoff from some area, so you get full credit for capturing 86% of total runoff volume from --  
Jonathan – Boil this down. You’re just prorating it. Let’s just put that – prorate based on gallons.  
Annette – If you were using rainwater harvesting model, you would design it with 10,000 SF and you only get 50% --   
Bill H – If goal is to get 86% capture --  
Jonathan – You’re trying to calculate sizing for whole site. To get sizing for whole site, have to work up a calc to get to the size tank you need to get 86%. You have to do that regardless of whether you’re doing total or partial.  
Mike M – Will require two sets of calcs -- one for sizing and one for regulatory purposes.  
Jonathan – Will be limited by what size tank or facility you can accommodate.  
Marc – You size it for 86%, then for a portion of that, you want to do half that amount of storage, then you treat half that amount of impervious area. That’s the linear relationship, which is easy to figure.  
Bill H – Let’s say 10,000 SF roof yielded 43% overall use. If you ran a 5000 sf roof, so half that size, that will not get you 86%. It won’t because contributing area changes, a lot of factors. Not a linear relationship.  
Jonathan – But proposal you all had was. We can leave it open ended and let engineers design and prove, provide calcs. Or we can give a rule of thumb that we’re good with.  
Annette – That was how I envision the Manual evolving. Does this proposal allow to put a cistern in only to allow one to reduce size of BMP?  
Sally Hoyt – It does allow that.  
Annette – How about this for Item 1: REQUIRED MAJOR COMPONENTS OF A RAINWATER HARVESTING SYSTEM. Rainwater harvesting consists of a means to store stormwater runoff and the (a) use of the stormwater to meet a non-potable water demand and/or (b) the discharge of the stormwater via a passive drawdown device to a vegetated infiltration area or another SCM or a combination of (a) and (b).  
Group agreed.

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**Item 2 - SIZING**  
Annette – How about this for Item 2. SIZING. If the system is sized for 86% of the total annual runoff volume as demonstrated through water balance calculations, then no additional stormwater treatment is required to achieve full credit.  
Hunter – Most people’s picture in their head is just a cistern.  
Sally Hoyt – I agree. Could take out the “no additional stormwater treatment.”  
Annette – How about this for Item 2. SIZING. If the system is sized for 86% of the total annual runoff volume as demonstrated through water balance calculations, then the system shall receive full credit. Smaller systems may receive pro-rated credit and then may be used in conjunction with other SCMs to reduce the treatment volume of the downstream device.  
Bill H – As long as understanding is that systems can be made smaller --   
Robert P – For this chapter, would be helpful to have multiple examples, configurations instead of trying to put it all into words.  
Sally Hoyt – If you haven’t made a comment about “pro-rated” on each BMP, why put it here?  
Hunter – Warrants providing guidance on pro-rating.  
Mike M – Should we call it water quality credit?  
Annette – How about this for Item 2. SIZING. If the system is sized for 86% of the total annual runoff volume as demonstrated through water balance calculations, then the system shall receive full treatment volume credit. Smaller systems may be used in conjunction with other SCMs to reduce the treatment volume of the downstream device.  
Group agreed.

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Item 3 – NON-POTABLE WATER DEMAND  
Sally Hoyt – I put this in there for a reviewer to know you need to see calculations.  
Hunter – Is that a recommendation? Does it meet criteria as MDC? Calculations are needed for any BMP.  
Eban - If use isn’t going to be recovering that volume, then it’s not functioning as treatment.  
Hunter – I agree. But is this an MDC?  
Rob W – Jumping ahead -- when it comes time for enforcement, if somebody comes along and says it rained 6 days in a row, you were supposed to be watering plants to get drawdown --.  
Bill H – In wet period, your system’s just not being used. It’s critical that a water demand be established.  
Robert P – Must be quantified.  
Sally Hoyt – More about having non-potable water demand, not as much about specific calculations. More about being quantifiable.  
Bill H – We can drop “non-potable” part.  
Annette – How about WATER DEMAND – The water demand shall be quantified.  
Jonathan – As a reviewer, aren’t I going to want to see the calculations? Would you approve it without design calcs? If it’s quantified, has a seal on it, would you approve it?  
Sally Hoyt – Is there a minimum design criteria that says you must show calculations for other practices?  
Hunter – Is this about showing calcs for demand or drawdown?  
Sally Hoyt – Drawdown is the next step.  
Annette – Reviewers always want to see calculations. In fast-track, we’ll talk about what’s required for application, review, compliance. It is odd that we talk about calcs for this one practice. It’s a universal issue. Also have water balance calcs in next item.  
Annette – How about WATER DEMAND – The water demand shall be quantified.  
[See further discussion under Item 4]

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Item 4 WATER BALANCE CALCULATIONS  
Annette – How about WATER BALANCE CALCULATIONS. The water balance shall be calculated using the NCSU Rainwater Harvesting model or another continuous-simulation hydrologic model that calculates the water balance on a daily or more frequent time-step using a minimum of 5 representative years of actual rainfall records. The model shall account for withdrawals from the cistern for usage and for the active or passive drawdown as well as additions to the cistern by rainfall and runoff and by a make-up water source (if applicable).  
Group agreed.  
Hunter – So is Item 3 even needed?  
Bill H – We wanted people to be really sure of their demand.  
Hunter – Can we just beef up Item 4?  
Bill H – I say we eliminate Item 3.  
Mike M – Proof is in the pudding. Releasing it is not using it. I would just like to have a bona fide usage attached to the calcs. That’s what I get out of Item 3.  
Eban – How do you justify or trust that person’s going to use that amount of water?  
Mike M – University in Charlotte did this plan with underground cisterns. But until they provide information about how much they’re actually using and how much they reduced from previous potable water use, no good way to gauge what’s really being done.  
Annette – So does Team want to keep Item 3 now?  
Jonathan – If it had teeth to it, I’d keep it.   
Bill H – What if a reliable water demand has been established?  
Jonathan – What is “reliable”?  
Annette – RRC does not like adverbs or adjectives, of which “reliable” is one.  
Bill H – I use “frequent” and “reliable,” but --   
Annette – Do you need year round?  
Sally Hoyt – You can model it for seasonal demand.  
Rob W – A water demand shall be required.  
Sally Hoyt – How about the usage, volume and timing of water demand shall be established?  
Rob w – Or justified. Don’t want someone to design a bogus system that won’t be needed.   
Jonathan - You want to establish water demand based on a few criteria. So do we really need to describe those criteria? We don’t want people making that stuff up.   
Sally Hoyt - Use, volume of use, frequency of use, is there seasonality.  
Mike M – There used to be guidance --  
Annette – We have a chapter we can open.  
Sally Hoyt – You have to enter in how many gallons, are you using it every day, certain months. . . . You have to figure out what you’re doing with it and enter those into the calculations.  
Marc – Factors you’re talking about Jonathan are all in the model, right? So if you do the model and you put good information in, question is who’s going to say if it’s good information or not? You can put it in model, you can play with it.  
Sally Hoyt – Key word is “justified.”   
Jonathan – I’m not familiar with the model. If those bases are required to plug into the model, I’m okay with doing away with Item 3. Sombody had to calculate those numbers to put them in there. If somebody sees numbers you’ve got, they can question those numbers. If they’re off by a factor of 100, you can’t get by with 55-gallon rain barrel for the site.  
Mike M – How about this: we can punt Item 3 if you change first sentence in Item 4 --  
Sally Hoyt – Case for keeping Item 3.  
Robert P – We can still have no water demand, go to cistern, and go to small sand filter, right?  
Annette – Yes -- if you have passive drawdown.  
Annette – How about: WATER DEMAND. The usage, type, volume, frequency and seasonality of water demand shall be established and justified.  
Group agreed.

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Item 5 MAKE-UP WATER SUPPLY  
Annette – How about: MAKE-UP WATER SUPPLY. If a make-up water supply discharges into the cistern, this water volume shall be accounted for in the design. [Note – need to define “make-up water supply” in rule.]  
Sally Hoyt - Definitions in Page 21-5 in manual do not include “make-up water supply.”  
Jonathan – Different people call things different things.  
Group agreed to Item 5.

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Item 6 DISTRIBUTION SYSTEM  
Annette – How about: RWH systems shall include a functioning distribution system prior to being considered complete. The design of this system shall include testing protocols which shall be executed prior to acceptance of the system at the construction completion.  
Rob W – Why would that be tied in with water demand?  
Sally Hoyt – This is about physically constructing things and testing their performance.  
Hunter – As-built should cover this, and that should be a general MDC.  
Sally Hoyt – This differs from other BMPs in that it requires more active operation.  
Mike M – Should MDC for maintenance and inspection include a flow meter for what comes out?  
Annette – I think it should.  
Sally Hoyt – We talked about that and got rid of it. Who’s going to check it? It’s not really as a reviewer that you care how much you’re using. We recommend you include a meter for owner’s use, but from regulatory standpoint – is local gov’t going to track that?  
Mike M – I am. We have third party inspections.   
Sally Hoyt – Other thing that came up when reading this -- if you’re talking about large-scale systems, that’s different than a homeowner. So if you want to make case that systems over a certain size have those, I’d be okay with that.  
Mike M – It would only be commercial. We initially started required flow meters for facilities using chillers that need make-up water.   
Annette – Anyone have suggestions?  
Sally Hoyt – So there’s not a reason you can’t require them.  
Hunter – I’m not sure it’s a minimum design criteria.  
Mike M – Flow meter will be necessary for anyone needing a fee credit in Charlotte.  
Rob W – Maybe add distribution system to Item 1?  
Jonathan – Easy to put this testing requirement in here for one building on a site. But multi-use sites, neighborhood with 50 houses all using it, the way this is written, developer can’t get acceptance of neighborhood until all built and testing. Is that really what we want to do? Last house could be 10 years out.   
Sally Hoyt – Same thing could be said for DIS.  
Rob W – Developer sells before house are built. If developer can’t get off hook for system until last house --  
Jonathan – This doesn’t seem to handle that.  
Sally Hoyt – I think it’s important to include testing. System at UNC that’s not functioning. Joints are leaking. Apparently, they’ve always leaked, just started leaking more. Built in 2007. Wasn’t a clear standard, so it’s not performing. Another system with pump not installed correctly, wasn’t tested.  
Rob W – So it wasn’t certified once a year by an engineer?  
Sally Hoyt – Distribution systems needs to be here, but maybe move to Item 1. Important to include testing requirements. I can be convinced just need to be in Manual, but it’s unique to rainwater harvesting system.  
Jonathan – We need to incorporate it so it’s not a penalty, tied up until last house. If we only want this for corporate users – might be more opportunities for residential.  
Eban – Can we tie it to certificate of occupancy?  
Annette – Awkward for us. That’s a locally-approved --  
Marc – Parcel is done on a local level. We bond those things. We talked about that before. On this level, I’d think you would do them on a lot-by-lot basis. You wouldn’t close permit until all lots are built. But testing individual houses on a lot-by-lot basis--   
Jonathan – We need to put disconnect here somehow. Anything that’s for the entire development – but if it’s based on individual users that are building lots, theirs should be tied to their acceptance not the whole development’s acceptance.  
Annette – Prior to the approved use of the system -- I’m not sure I like saying ‘testing protocols.’  
Bill H – Can we just say you need to turn this system on?  
Jonathan – Why don’t we just say it’s got to be functional?  
Sally Hoyt – Depends on what size/type/use as to what testing protocol is. Gets back to system operating in perpetuity. BMP isn’t complete until it’s functioning.  
Jonathan – Can we put something in here on parcel-for-parcel basis?  
Boyd – Can we say have to test it now, but show mechanism that future buildings will be -- I think about like we do for HOAs: you get permit, then HOAs will make sure houses are built not over 24% BUA or whatever, some mechanism for future testing will be revised.  
Jonathan – Need to break it out on per parcel, per building, like office parks are broken into separate lots even with same owner.  
Annette – This seems like more of a universal issue with project completion. Could have a different device on each parcel.  
Jonathan – This one is a little different, like Sally said. When you’re talking about subdivisions, commercial or residential, your devices are designed to handle group things. This is an individual device.  
Annette – How about: DISTRIBUTION SYSTEM. The distribution system shall be tested for functionality prior to the approved use of the RWH system. The design shall include a protocol for testing the functionality of the distribution system upon completion of the initial system and upon additions to the existing system.  
Group agreed.

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Item 7 PRE-TREATMENT [ incorporated into Item 1]  
Sally Hoyt – Propose to change Item 1 that would include this. Rainwater harvesting system shall include the following components: A collection system, pre-cistern filtration, a cistern or other storage device, an overflow, and a distribution system. The captured runoff in the cistern shall be either (a) or (b). . . .  
Annette - How about this to replace Item 1 (formerly Item 2) and incorporate Item 7: MAJOR COMPONENTS OF A RAINWATER HARVESTING SYSTEM. Rainwater harvesting systems shall include the following components:  
a. A collection system  
b. A pre-treatment device to minimize gross and course solids collection in the tank  
c. A cistern or other storage device  
d. An overflow  
e. A distribution system  
Use or discharge of the captured water by either (a) the use of the stormater to meet a water demand and/or (b) the discharge of the stormater via a passive drawdown device to a vegetated infiltration area or another SCM.  
Group agreed.

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Item 8 PROTECTION FROM LIGHT.  
Bill H – That’s about not having algae growing in them.  
Rob w – So that’s the rule that keeps it from being a pond?  
Annette – Anyone have any comments about this item?  
Bill H – That is how you keep algae from being a problem.  
Jonathan – Protecting only “cisterns,” not other storage devices?  
Annette – So you could use a pond and not possible to protect a pond from light.  
Mike M – Algae’s not a big a problem in the pond, right?  
Bill H – Not if the water’s constantly moving.  
Sally Hoyt – Does this need to be an MDC?  
Annette – Can algae gum it up so it doesn’t work?  
Bill H – Maybe the protection is from “algae.”  
Jonathan – Should that just be in the chapter, not an MDC?  
Rob W – It’s an operational thing.  
Bill H – In the end, it’s all about appropriate operation.  
Annette – We have O&M in our general MDC.  
Bill H – I can see this being taken out.  
Jonathan – Might be something else coming up for cisterns later that will kill the algae. They’re making all kinds of things now.  
Group agreed to make this a recommendation: Protection from Algal Growth. Cisterns should be constructed to prevent algae growth.

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Item 9 SAFETY  
Annette – I was wondering if this was really an MDC or not.   
Mike M – I think that’s every BMP.  
Annette - Move to general MDC?  
Brian L – No.  
Annette – Or purpose of DENR’s rules isn’t to remind people of all other rules that are out there.  
Rob W – You can design a sewer manhole and design guidelines don’t say anything about safety.  
Annette – Is Team in favor of deleting Item 9?  
Group agreed.

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Item 10  
Annette – Manufacturer requirements – We’ve deleted this item for other MDCS.   
Group agreed to delete this item.

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Item 11 SIGNAGE REQUIREMENTS  
Sally Hoyt – Building code does not cover this because it’s not in the building. Also important that passive drawdown device be marked because people will close it.  
Jonathan – If I just have roof drainage, I don’t have a sign. I don’t think we need this.  
Sally Hoyt – Required by NC to label things “Caution, reclaimed water, not potable.” When we installed irrigation systems to use reclaimed water, had to put on special spray nozzles with labels.   
Bill H – If there is a spigot that someone can turn on, needs to be a sign to say “non potable.”  
Mike M – I would say leave it in.  
Bill H – I know what the pathogen concentrations are coming off of roofs. The pathogen counts increase in the cistern. If someone drinks it, they are exposing themselves to disease.  
Sally Hoyt – Reclaimed water requirements require that any spigot be in locked, below-grade vault or require special tool to turn it on.  
Mike M – You’re saying reclaimed water is better?  
Sally Hoyt -- Reclaimed water requires continuous testing of water quality. It’s been disinfected. It’s a wastewater product. If we include those things for rainwater harvesting, we would be more stringent.  
Brian L – Can we take out storage facilities part, so we don’t have to put signs up around all ponds that say this is non-potable water? So it’ll be on the distribution systems.  
Annette – How about: All harvested rainwater outlets (e.g., spigots, hose bibs) and appurtenances shall be labeled as “Non-Potable Water” to warn the public and others that the water is not intended for drinking . . . .  
Group agreed.

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Item 12. PASSIVE DRAWDOWN DEVICES  
Bill H – It’s a given. We’re going to talk about this in our workshops.  
Hunter – Keep it. Important for functioning in perpetuity.  
Rob W – Maybe we should put this in general rule.  
Hunter – I like putting it in general MDC.  
Rob W – Use word “minimize” instead of “prevent.”  
Bill H – You’re *designing* it to prevent clogging. This is different than saying it shall not clog.  
Group agreed to move this to general MDC: All drawdown devices, when employed, shall be designed to prevent clogging.

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Item 13 Recommendation – An indicator of water level should be visible to users and maintenance personnel.  
Group agreed.

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Item 14 Recommendation  
Sally Hoyt – It’s not required. But from risk perspective, since this is untested, unregulated, potential for pathogens, would like to be told would be better if put on special spigot and has special tool to turn on.  
Jonathan – Why don’t we make this a recommendation for commercial uses.  
Mike M – I like that. That’s a good recommendation for them to protect their assets.  
Jonathan – They’ll have staff to operate it, whereas homeowner --  
Annette – How about: For commercial or institutional uses, all spigots, hose bibs or other outlets for the harvested rainwater should be of a type or secured in a manner that permits operation only by authorized personnel.  
Group agreed.

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Item 15 Recommendation  
Sally Hoyt – If you’re putting pipe in the ground, you should know if it’s non potable to avoid tapping into the wrong thing. You can buy pre-stamped pipes for little cost.  
Rob W – Purple pipe for reclaimed water; white pipe for potable water; another color for this?  
Sally Hoyt – Indoors, rainwater harvesting water is in purple pipe like reclaimed water; outdoors, there’s no standard so it’s ambiguous. But if you’re buying irrigation equipment, you can buy purple everything.  
Group agreed to: For commercial or institutional uses, exterior distribution piping for the harvested rainwater should be color-coded, taped, or otherwise marked to identify the source of the water as non-potable.

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**Green Roofs**Item 1 SLOPE. The green roof shall have a slope (or pitch) of no greater than 15 percent.  
Bill H – You can put in a higher-pitched roof, but it’s not cost effective. Recommend striking it.  
Hunter – Would it be worthy of credit?  
Bill H – It’s a geometrical thing. If you cross that 15% threshold, would do it in containerized systems that allow capture of water. Remember Elizabeth Fassman talking about this. Her point was economically, this is what people will operate under. Data she collected was based on 15% or less.  
Sally Hoyt – It’s about how much water it’s capturing. You wouldn’t need thing about slope if there’s an item about capturing rainwater.  
Bill H – Make it a recommendation.  
Annette – How about: The green roof should have a slope or pitch no greater than 15 percent.  
Group agreed to make this a recommendation.

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Item 2 MEDIA SPECIFICATION   
Annette – How do we credit intensive green roofs as compared to extensive?  
Bill H – Same credits as max extensive roof. Weight load is much higher.  
Annette – How to organize this? Don’t need different chapters for intensive and extensive.  
Bill H – Not a lot of intensive green roofs in North Carolina.  
Sally Hoyt – Bring focus back to water quality MDC, not what do you need to do to design a green roof.  
Jonathan – You are using volume to quantify these materials. That cannot be measured. At what density are you measuring this volume? These materials should be measured by weight. Do you have any idea 10% by volume on organics == that could be like no weight. No spec for lightweight aggregate. Lightweight aggregate is for making concrete – measured by weight, not volume. Need to put something here that’s constructable, doable.  
Sally Hoyt – Manual references German standard which is 65 g/liter.  
Mike M – Is there still only one major supplier of lightweight aggregate in North Carolina?  
Bill H – Yes. Recommend table this item so can see UNC-CH specs.  
Jonathan – Where did 10% by volume come from? Need to do it by weight, not volume.  
Bill H – Let’s table it.  
Sally Hoyt – I’ll talk to Elizabeth about the specs.  
Bill H – There is a reason lightweight aggregate is affixed to extensive green roofs.  
Jonathan – What about Styrofoam pellets, peanuts, mixing organic in with that?   
Bill H – Aggregate that is used is good for plants. Styrofoam would be neutral at best.  
Mike M – Lava rock?  
Bill H – Used it oversees where they have it abundantly. Still game to table it. Organic matter really is the thing that cuts across no matter what type of roof. For extensive green roof, you’re going to use lightweight aggregate (I think).  
Sally Hoyt – The terms “intensive” and “extensive” might need to be defined, but it really doesn’t matter from a stormwater perspective.  
Group agreed to table Item 2.

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Item 3. MINIMUM MEDIA DEPTH  
Sally Hoyt – Don’t need to specify extensive or intensive. Plants don’t survive well in less-deep roof.  
Annette – What’s minimum depth?  
Bill H – I think 2.5-3 inches is minimum. It’s hard to get things established in North Carolina.  
Annette – Do you want to just say 3 inches?  
Sally Hoyt – This goes to something that’s more about purpose of MDCs. Could be that in future other research will reveal another technique, but gets back to having the plants live.   
Rob W – Do we just say like in other MDCs, shallower media can be used if plant performance is --  
Bill H – If someone wants to guarantee that plants 2 years in that they’re all alive, 90% are alive, they can do less. From retrofitting standpoint, I’m fine to let them take that chance.  
Rob W – Is depth related to slope?  
Bill H – I’m going to say no.  
Jonathan – Should this be recommendation or requirement?  
Bill H – For retrofitting, could be recommendation.  
Jonathan – Newer methods could allow plants survive in less media.  
Bill H – When you irrigate, you lose runoff reduction benefits. So you want to have non-irrigated 4” or more green roof for runoff reduction.  
Jonathan – Too wet plants just from rain. But if irrigate just when it’s dry, would there be any benefit to that?  
Bill H – You can do that to get plants to take, but runoff reduction studies don’t show those systems to work as well. Maybe that’s the driver. Some people put them in because they look nice.  
Sally Hoyt – There are a lot of green roofs just for aesthetics, but we don’t care about those. Because pollutant removal is tied to runoff reduction. To get full credit, needs to be 4” deep. But do we give someone half credit if it’s 2” deep? So is this really a recommendation?  
Annette – Plants surviving is essential to function for runoff reduction and pollutant removal.  
Sally Hoyt – Minimum depth of green roof should be 4” unless it is actively managed to sustain plant cover.  
Jonathan – Still saying it doesn’t get the same benefit for runoff.  
Bill H – Benefit is having drier media which makes it harder on the plants.  
Jonathan – On flat tar roof covered in 2 inches of normal weight stone, you can replace with lightweight stone. Supposed to put enough stone up on flat roof to protect it since those don’t have UV rating.  
Sally Hoyt – I think we need to have longer conversation about what required design calculations are for green roof credit. That relates to media depth. I don’t know if we’re ready for that today. Can we table minimum depth for time being?  
Rob W – Should say “support plant health.”  
Group agreed to table this item for now.

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Item 4 VEGETATION SPECIFICATION.   
Rob W – We say a professional who is familiar with green roof vegetation -- does that mean they’ve taken a class? Is this a requirement or recommendation? If roof falls in or they die, that hasn’t met criteria. But how do you meet this if there’ve been only a few built in the state?  
Annette- Good to just say follow ASTM standard?  
Rob W – I don’t know that this can be more than a recommendation.  
Bill H – Few people in eastern U.S. know about green roof plants. Contractor reaches out to these people, get recommendations on palette of plants. People who provide those palettes of plants know what they’re doing. I don’t know if they are licensed professionals or not. There is a green roof industry that has its own certification process. I suspect they are certified under that umbrella. That’s how green roofs tend to be done right now. Go to person who knows about the plants.  
Rob W – If I’m an engineer and I’m spec’ing this membrane and it has this list of acceptable plants, is there anything else needed?  
Sally Hoyt – How did you handle plants in bioretention chapter?  
Annette – We didn’t get into specifics on plants.  
Bill H – Green roofs aren’t cheap. People putting these in will hunt down the people who know about the right plants.  
Mike M – Green roof across street from my office put in 12 types of plants. 5 died, 7 are starting to spread to empty squares.   
Rob W – Going back to Item 4 -- is that because person spec’d the plants weren’t familiar, or were they familiar and it’s just hit and miss?  
Bill H – They didn’t have 4” of media on their roof. Probably the reason for mortality. This is a hard state to have green roofs work.  
Sally Hoyt – Aren’t you guys taking out licensed professional requirements elsewhere and just having it as general MDC?  
Jonathan – Don’t have any standard for green roof professional.  
Annette – Probably well intentioned but fairly meaningless.  
Jonathan – Design of planting, media that kind of thing, but structural engineer needs to verify that structure will support it. Somebody needs hydrology for what kind of water they’re going to have on that roof.  
Bill H – Now it captures first flush of water quality volume. Could pick different storms – right now designed to capture either 1” or 1.5” storms in media. That’s what drives media depth. More or less, for every 1” of media, capture 0.25” of rain. You get evaporation and evapotranspiration loss. Rains, some drains, some remains, bit of inter-event dry period, restore capacity for next rain event.  
Jonathan – Plants also need to get rid of nutrients.  
Bill H – Systems not getting a lot of nutrient benefit. Concentration going out almost always higher than going in.  
Hunter – If you’re going to put something in there, say “shall” meet ASTM.  
Bill H – If only put one plant per 6 SF, there’s not enough coverage.  
Sally Hoyt – From Elizabeth’s text, says 75% cover within 24 months.   
Rob W – Given that someone competent is designing these roofs, how do you give them credit? Is this so different or cost intensive that you have to think differently?  
Mike M – You can’t get 100% green on these roofs.   
Bill H – Hunt Library has two strips of green roof. They are treating water falling on it. Balance of roof drains down to bioretention areas. This was designed close to what we are proposing.  
Annette – How about: The vegetation plans for extensive green roofs shall meet ASTM E2400-06 Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems. The green roof shall achieve a 75 percent cover within 2 years.  
Group agreed.

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Item 5 MAXIMUM WATER STORAGE.  
Bill H – Elizabeth sees tapering off at about 40 mm (1.5 inches).   
Hunter – Saying what maximum credit is -- is that an MDC?  
Sally Hoyt – How about if this gets put into what we’re going to revisit, calculating what credit you get?  
Mike M – If designing to remove one-inch storm, and they build it so you can do 1.5”, can you have additional impervious from roof allowed to drain onto roof?  
Bill H – Chapter says no. In reality, if that water is dispersed across green roof rather than just on dripline, then yeah. We don’t have a lot of examples on the ground of this practice.  
Annette – Which is an argument for keeping these MDCS outcome oriented rather than nitpicky-design oriented.  
Hunter – I don’t have a problem with credit, but is a statement about credit an MDC?  
Sally Hoyt – I think should be an MDC about how you calculate how much credit you get.  
Annette – We haven’t discussed credit in any of the MDCs. We’ll discuss that during the fast-track process.  
Hunter – So let’s explain it in the Manual. Not an MDC.  
Group agreed to eliminate this item as MDC, but explain credit elsewhere.

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Item 6 PROTECTION OF ROOF DRAINAGE  
Bill H – Protect vegetated blocking of water conveyance. We do not want green roofs to actively pond water. Weight issues, blue roof.  
Mike M – A blue roof is a detention system on a roof.  
Jonathan – Is this a maintenance item or a recommendation? Not really part of the function. You have to maintain it, everything about a green roof you have to maintain to function.   
Bill H – It’s the one that has a genuine structural issue with it.  
Jonathan – Likewise, that’s true of any roof, period.  
Annette – But other roofs aren’t a BMP.  
Marc – Is all vegetation shallow rooted?  
Sally Hoyt – Yes. Really, you have to put in layers, root barrier.  
Jonathan – When you’re designing it, do you put a rim around roof drains that keep 4” of media?  
Sally Hoyt – Yes.  
Jonathan – So we block the water on the 15% slope that may never go away unless you have dry spell and it evaporates?  
Sally Hoyt – Perforated collar around roof drains.  
Bill H – Plants on green roofs are the plants you find in the “Stans” like Uzbekistan, Turkmenistan. They try to grow natives, feeble attempts.   
Sally Hoyt – Climate on roof not the same as on the ground.  
Mike M – Finding good luck with turf grass, irrigated.  
Bill H – Everything I’ve told you is based on no irrigation.  
Annette – Do people want to keep, eliminate,turn it into recommendation?  
Bill H – Where does it fall into other chapters?  
Jonathan – I’m good with recommendation.  
Group agreed to make this a recommendation, change “shall” to “should.”

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Item 7 CONSTRUCTION PHASING  
Group agreed to make this a recommendation.

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Item 8 SAFETY  
Sally Hoyt – It is much easier to maintain these if they have access other than going up an extension ladder. Still okay keeping this a recommendation, but address access issue.  
Jonathan – Consider access when locating green roofs. Get rid of safety part.  
Annette – How about: RECOMMENDATION: ACCESS. Consider construction and maintenance access when locating green roofs.   
Group agreed.

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Item 9   
Green roofs may be designed to receive some runoff from adjoining elevated roof surfaces.  
Jonathan – Is this an MDC? There’s thousands of things we can do with designing these.  
Hunter – If it is an MDC, needs to be like permeable pavement with a maximum.  
Mike M – If combine it with former Item 5, could be 50%.  
Jonathan – As this item is written currently, there’s nothing there.  
Hunter – Right. We need to come up with a requirement.  
Group agreed to table this and consult with Elizabeth.

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Item 10  
Recommendation. A waterproof membrane should be installed between the building structure and the drainage layer of a green roof to protect the building structure from leaks.  
Rob W – What about a parking deck? Do we care if it leaks?  
Jonathan – Building you’re putting it on should already be designed for whatever purpose. Take it out.  
Group agreed to eliminate this item.

**Action Items**Annette –Send Team additional homework in 2 weeks.  
Team – Review chapters and additional homework as assigned.  
Sally, Bill H and Annette follow up with Elizabeth about media spec, media depth, coverage, runoff from adjoining roof surfaces

**Next Meeting January 26, 2015 9:30 to 3:00 Topic: Permeable Pavement**