



Town of Chapel Hill
Stormwater Management Program
Lower Booker Creek Subwatershed Study UPDATE

Summary of Draft Report Comments

1. Comment Received: 9/23/16
June Dunnick, 2556 Booker Creek Road

- Comment

Dear Booker Creek Report Authors:

Regarding this recommendation in the 9/23/16 lower Booker Creek Report:

"Less than 200 feet downstream of Honeysuckle Road a culvert crossing conveys water across Booker Creek Road to the east side and draining south. The conveyance system transitions to an open channel with **six driveway culverts** before crossing back to the west side of Booker Creek Road near the Booker Creek Apartments. Flooding has been reported along Booker Creek Road and erosion was identified in the open channel portion. The proposed solution includes replacing..."

Crossing the six driveway culverts mentioned about are all utilities, water, sewer, electrical etc.

If you plan on replacing the culverts how would all these utilities be handled??

- WK Dickson Response via email on 10/24/16

Ms. Dunnick

We received your comment regarding the Lower Booker Creek Subwatershed Study. Thank you very much for providing that information.

You are correct that utilities will need to be addressed during the design and construction of this project, which is typical for most stormwater retrofit projects. We did include a line item in our cost estimate for utility relocations and during design, those costs will be developed in more detail. Typically, private utility companies such as electric, gas, and telecom will move their lines out of the way before construction begins. For public water and sewer, the Town and the design team will coordinate with OWASA regarding how they would like the utilities handled

and it will vary for each project. Any impacts to homeowners during construction would be communicated by the Town and the contractor.

Please let me know if this does not address your comment.

- Ms. Dunnick follow up on 10/25/16 via email

Tom, Thanks for the reply about all the utilities over the culvert - not sure there is a real solution to this. Thus, your best bet to control the water along Honeysuckle and Booker Creek is to control the runoff from the Chesley neighborhood and install adequate storm water runoff retention for these upstream neighborhoods. Thus, please have the town address this issue before disrupting all the utilities along Booker Creek Road.

- Ms. Dunnick follow up on 10/27/16 via email

Dear Tom,

The Booker Creek Study shows that water rushes in at the Honeysuckle Rd from upstream neighborhoods, roads etc. that the Town of Chapel Hill approved without taking adequate storm water retention policies. Many of these upstream areas (e.g. Chesley neighborhood) have lawns and impervious surfaces.

Thus, we recommend that the Town retain the water upstream via retention ponds on town land or land or in the neighborhoods that are creating the flooding problem.

Please update you Booker Creek plan to hold water in the upstream neighborhoods that are creating the problem.

Most of the houses in Lake Forest have many trees and natural retention areas.

Please update your plan to address how to retain the upstream problem that has been created over a period of time by the Town of Chapel Hill.

- WK Dickson Response via email on 10/28/16

Ms. Dunnick

Thanks for your response. We actually have a proposed project upstream of Honeysuckle Road between Red Bud Lane and Chesley Lane that would increase the size of the existing detention area located on Town property. This proposed project would decrease the peak flow upstream of Honeysuckle Road by approximately 50% in the 25-year storm. This project is ranked as the

#2 project in the prioritization list. If you have downloaded the report, more details on the project can be found on Page 4-7.

- Ms. Dunnick follow up on 10/31/16 via email

Hi Tom,

One of my neighbors pointed out that the Weaver Dairy road expansion projects created more stormwater. I went up to look at this this weekend, and noted that there were many drains along the Weaver Dairy expansion road on the south side - the side that drains towards Booker Creek. For example, at the bottom of a Weaver Dairy hill, near the new traffic circle, there were several storm drains. Lots of water from the road and the hill would go into these drains.

Is there a retention basin for these drains?? Where does this water go? Please address this in your reports/meetings. thanks. june

- WK Dickson Response via email on 11/2/16

June

Thank you for bringing that to our attention. I believe the inlets at the traffic circle at Weaver Dairy actually drain to the east away from our watershed, but I will confirm that before finalizing the report.

- Ms. Dunnick follow up on 11/3/16 via email

Tom, Thanks for looking into this. The road slopes toward the Booker Creek area and the drains are on the side of the Booker creek side of the road. So at the very least this side of the road would drain toward Booker Creek. june

2. Comment Received: 10/8/16

Tracy Kelly
105 Oxford Hills Place

- Comment

I live in the watershed area and have tried to have my house identified as a flooded house. Please find video evidence. I live at 105 Oxford Hills Place
What are the next steps?? I know December 31, 2015 was a huge storm in Chapel Hill and Booker Creek walkway was flooded, so was my crawl space.

Today again my back yard is completely flood. I do not have the land space to accommodate the surface water of my higher grounded next door neighbors especially when they keep cutting down their large Pines trees.

I am out of the country when you present to at the library. Can I speak directly with someone?? Please feel free to come by my house at your convenience.

- WK Dickson Response via email on 10/24/16

Tracy

We received your comment through our website with regards to the Lower Booker Creek Subwatershed Study. We actually have identified your area as a project area in the draft report. I believe you also submitted a survey early in the project, so thank you for that feedback as well.

If you were able to download the report, please reference pages 4-28 and 4-31 (Figure 4-13) for the project in your area. We are proposing adding additional infrastructure along Old Oxford Road to help capture drainage from the roadway as well as the homes higher up on the hill along Ridgecrest Drive and Markham Drive. That infrastructure should significantly reduce the amount of runoff that drains down towards your property.

If you would like to speak with me directly, let me know and we can set up a time. Also, I encourage you to contact the Town each time you have flooding issues as the frequency of flooding and associated damages can have an impact on project prioritization.

- Ms. Kelly follow up on 10/24/16 via email

Tom

This is a very helpful email to receive. Thank you. I think the work on Old Oxford and Markham will help tremendously as that is where 80% of the water comes from. When you say "contact the town" each flood, who do you mean?? Storm Water management ?? I have had them at my house after last December 31st rain when my entire crawl space flooded, but I haven't call them again. We have had several more flooding in the crawl space since (and likely a whole lot of moisture fungus) especially this Spring and last week with Mathew.

Thank you again and I might call to meet with you soon. I leave for Africa this week for a couple of weeks. I would like to call you when i return

- WK Dickson Response via email on 10/24/16

Tracy

Yes, I would contact Sue Burke in Stormwater Management to report flooding when it occurs. It's good to know how much rain is causing the flooding, so the more information the better.

I will be happy to talk to you when you return. Have a safe trip.

3. Comment Received: 10/25/16

Julie McClintock and Fred Lampe

1. **Future Conditions.** From the summary is this sentence.

"The conveyance system within flood prone areas was evaluated to determine the existing level of service, the future level of service based on land use in the watershed, and the potential capital improvements that would required to reduce the risk of flooding."

- The only reference to "future conditions" in the Exec Summary is the proposed Red Bud Storage pond. Do any of the recommendations include "future conditions"?
- There is no basis upon which a reviewer of the study and the associated appendices can determine if the acceptable "future conditions" reduction amount is accurate and accounts fully for the additional in impervious surface areas associated with approved growth plans. See Executive Summary Recommendations listed in Table ES-1 on Page ES-12.
- Since the table for existing conditions, starting in the Appendices on Page 199 and future conditions, starting on Page 221 are not combined, it is impossible to do a 'reasonability' review of this information without using consultants the computer model which is not provided.
- Note that this was a primary request from citizens at the public outreach sessions. This could be remedied by the consultant providing the list of the approved projects with square footage that were included in the calculations.

- WK Dickson Response via email on 1/16/17

-On page ES-1 and ES-2 the report states that "As part of this study, the conveyance system within floodprone areas was evaluated to determine, the future level of service based on built out land use in the watershed, and the potential capital improvements that would be required to reduce the risk of flooding." All projects were sized based on the future land use conditions. We will add a statement on Page ES-3 under Project Recommendations that explicitly states that the proposed projects are based on the future land use condition.

-Appendix A includes several tables that provide information on the future conditions assumptions. Tables A-6 and A-7 show the types of land use anticipated for existing and future conditions. Table A-8 shows the future curve number and directly connected percent impervious for each subbasin. To provide additional information we will add the estimated

percent impervious for each subbasin in addition to the directly connected amount. In addition, we will provide a zoomed in map for each subwatershed for Figure C-1, so that it will be easier to equate a specific subwatershed to a known location. We will also include the aerial photography for the zoomed in subwatershed maps. We will also add a table showing the total estimated impervious percentages for existing and future land use conditions for each subwatershed.

-Beginning on page B-10 (page 27), there is a comparison of existing and future water surface elevations for each storm event. The tables referenced in the comment for pages 199 and 221 are the actual HEC-RAS output files. Please use the tables starting on page B-10 for the reasonability review.

2. Significant conclusions. The report concludes that the existing infrastructure does not provide the desired level of service and cites several areas that have repetitive flooding during large storm events. (cite) . In addition this key recommendation from Page ES-11 needs to be highlighted: Based on the existing flooding in the watershed, it is highly recommended the Town strongly review any rezoning requests that will increase the impervious area and determine if additional stormwater measures are required.

- WK Dickson Response via email on 1/16/17

-In some instances the proposed projects do not meet the desired level of service as retrofits cannot always meet new development requirements due to current constraints due to available land, utilities, existing development, topography and other constraints. The recommendation to review rezoning requests is very important, which is why it was included in the Executive Summary. Highlighting the recommendation would indicate priority of this recommendation over the other recommendations in the Study. Typically for watershed studies we do not prioritize qualitative recommendations as these recommendations can be incorporated simultaneously without significant expenditure of funds that would be required for capital projects.

3. More information.

- It would be helpful if the consultant would provide a list of all the properties that regularly flood. Does that number exceed the removal of 6 existing structures that are recommended to be removed?
- Most of study deals with detention and rate. Do we have enough information on volumes?

- Projected reductions in flood water depth, in general 2 feet, are based on implementing ALL recommendations — \$24 million cost. What is the flood period assumption — 25 years?
 - All of the proposed solution elements appear to be based on mitigating historical 25 year flood events. Is this a reasonable basis to use looking 50 years into the future given Climate Change?
 - Perhaps highlight that this \$23 million, is not the end of the consultant recommendations — as additional water quality and stream stabilization actions are estimated to cost about another \$6 million.
- WK Dickson Response via email on 1/16/17

-Table 3-4 shows a list of properties that are at-risk of flooding. The proposed improvements will reduce the severity, frequency, and duration of flooding for many of these structures although the individual level of service for a structure may or may not improve. Will add a table in section 4 that is similar to Table 3-4 to show the reductions as a result of the implementation of the projects.

-The flow rate provided is a volumetric flow rate. Level of service for stormwater infrastructure is typically related to flow rate and water surface elevation. A static volume does not account for the movement of flow through a detention facility before, during, and after a storm event.

-Water surface reductions are provided in Tables 4-4, 4-5, and 4-6 for the 2-, 10-, 25-, 50-, and 100-year storm events. Individual benefits for the primary system projects will be included in the Final Report.

-Where feasible, the proposed projects provide the Town required level of service based on future built out land use conditions. Furthermore, the calculated flows don't account for detention as required by Town ordinances with the exception of Carolina North where 50-year detention is required as part of the development agreement. Many unknowns exist regarding climate change including how climate change specifically impacts a given region. The precipitation values included in the report are based on updated NOAA values. During the design phase of each project, it is recommended that the Town revisit the desired level of service and design storm events.

-We will include language in the Executive Summary noting the totals for stream stabilization and water quality projects would add approximately \$6 million to the total costs.

4. **Competing priorities.** If the Town only can spend, for example, \$5 (?) million per the recently passed Stormwater Bond Issue, what is the resultant flood reduction impact? \$10 million? What remediation investment amount provides the biggest value in flooding prevention? Correspondingly, if 100 year floods become regular events, what is the cost to address these?

- WK Dickson Response via email on 1/16/17

-The final report will include individual benefits for each project to better show the incremental benefits.

5. Technical errors, definitions, and missing appendices

- From the Appendix I, page I-4, note the following statement: *Following an initial scoring and weighting analysis, WK Dickson met with Town staff to adjust the weighting and scoring based on specific system needs and level of importance.* Question to staff and consultant: what specific scoring adjustments were made?
- The very key Appendix L “Prioritization Matrix” is not included in the Appendices included on the web site. Without this item, it becomes a “trust me” situation to consider the recommendations in the Exec Summary in Tables ES-1 and ES-2, which total a bit over \$23 million for the 19 prioritized recommendations.
- It is clear that there are a number of either data entry or calculation errors throughout the report and appendices. A very simple example is in Appendix A on Page A-15 Hydrologic Analysis Table where the 100 year flow rate is shown to be exactly the same as the 2 year flow rate for Dobbins Drive, Summerfield Crossing and Foxcroft Drive. Such data anomalies occur throughout the document and are too numerous to list. It is not known how seriously do these errors impact the study results.
- Since the table for existing conditions, starting in the Appendices on Page 199 and future conditions, starting on Page 221 are not totaled and then combined, it is impossible to do a 'reasonability' review of this information without using consultants the computer model, which is not provided.
- Please provide a “List of Abbreviations and Acronyms” provided in the document. Thus a lot of material cannot be adequately deciphered by anyone without a civil engineering degree.
- A couple of terms keep popping up which sound like drainage ponds or settlement ponds: Storage Area, Passive Green Space, Stabilization Load Reduction, etc. Could a list of definitions be provided? The 'storage area' behind the Chapel Hill Library is full of cattails and is wet most of the time - which breeds mosquitoes. Settlement ponds rapidly fill up with sediment - check the one at the corner of Lakeshore and Curtis. These type of 'solutions' do require continued maintenance.

- WK Dickson Response via email on 1/16/17

- No adjustments were made to the prioritization matrix by Town staff. This statement will be revised. Per the request of the Stormwater Advisory Board, the Town will consider the request to move Piney Mountain to the third ranked project.
- The prioritization matrix will be included in the final report.
- The Draft report is in the process of being thoroughly reviewed for any errors as a result of manually transferring data output to tables.
- See comment above regarding the reasonability review for the tables on pages 199 and 221.
- A list of abbreviations will be included.
- We agree that maintenance is required for all stormwater infrastructure.

4. Comment Received: 10/28/16
David Schwartz

- Comment

Greetings. The Booker Creek draft report notes that the proposed Willow Drive project (page ES-7) would entail removing "3 structures from the 25-year floodplain and 3 structures from the 100-year floodplain." Please provide the addresses of the six structures that would need be removed in order to implement the Willow Drive project.

Thank you,

- WK Dickson Response via email on 11/2/16

David

Thank you for the comment you sent on the Lower Booker Creek Study on October 28th regarding structures at Willow Drive. Upon reading your comment I realized the text was not clear. We are not proposing to remove any structures.

What we meant to convey was that 3 structures currently in the 25-year floodplain would no longer be in the 25-year floodplain and 3 structures that are currently in the 100-year floodplain would no longer be in the 100-year floodplain as a result of the project. While the project will improve conditions for the majority of houses along the stream, those six houses would no longer be located within the designated floodplains. Please note these are estimates based off of digital data and actual survey data would be required for a structure to no longer be designated in a floodplain. Additionally, final design will be required to finalize the proposed water surface elevations.

The 3 structures that would no longer be in the 25-year floodplain are 1102 Willow, 1106 Willow, and 407 Walnut.

The 3 structures that would no longer be in the 100-year floodplain are 1104 Willow, 1114 Willow, and 405 Walnut.

- Mr. Schwartz follow up on 11/2/16 via email

Thanks Tom. Can you explain in layman's terms the mitigation that you have proposed for the area south of Willow Drive? It sounds like you are proposing excavating the stream bank to create benches that would lower the peak water level during heavy rainfall. What would the area look like if that were done? Would there be room for a greenway or footpath?

- WK Dickson Response via email on 11/3/16

David

The project would involve clearing and excavation, so that the ground in the floodplain area would be approximately 2 feet lower than it is now. The area already has some wetland features, so it would continue to be wet, however the Town could add a greenway that would likely have at least sections of boardwalk in the wetland area. The Town's greenway plan does involve a future section in that area, so we are certainly recommending that if they move forward with the stormwater project, that they also construct the greenway at the same time, but that plan would be based on funding. Details on what the area would ultimately look like would be completed during the design process that would likely include a landscape architecture component. There are usually additional opportunities during the design process for public review and comment of the project specifics. Please feel free to ask any additional questions. Thanks,

5. Comment Received: 11/4/16
Ann Loftin

- Comment

Hi, I skimmed the draft report on the lower Booker Creek watershed and was surprised that Emory Drive was excluded from the study. My property routinely floods and as a result I cannot sell my house, nor will the county lower my taxes. I need a FEMA buyout. Please contact me at xxxxxx. I have photos from the recent flood in which sewage also came up from the shower drain.

- WK Dickson Response via email on 11/10/16

Ms. Loftin

We received your comment on the Lower Booker Creek Study regarding the exclusion of Emory Drive from the report. Unfortunately our project limits only included the area that drains to Booker Creek upstream of the confluence with Bolin Creek. While Emory Drive is in close proximity to Booker Creek, runoff from this area actually drains to Little Creek just downstream of Booker Creek, which is outside of our study limits. Please let me know if you have any additional questions.

6. Comment Received: 11/7/16
Paul Clark - DWR

- Comment

As stated in the WS Study document, Lower Booker Creek receives drainage from Booker Headwaters, Crow Branch, Eastwood Lake, and Cedar Fork subwatersheds. Is it your intent to study those subwatersheds and then begin implementation? As you know, what is done in the upper watersheds could reduce (or eliminate) the need to do work downstream. I saw that in the study there were recommendations for work done 'upwatershed' of Lower Booker. Thx.

- WK Dickson Response via email on 12/12/16

Paul

We've been working on compiling all the comments on the report, so my apologies for the delayed response. The Town's stormwater advisory board met last week to discuss the report and make recommendations to council. Based on what we are hearing from the board and the staff, the Town appears to be interested in implementing several of the higher priority projects while continuing the studies of the other subwatersheds. At this time, it is the Town's intent to present the recommendations to council on January 9th.

Unfortunately, the flooding is significant enough downstream that the upstream improvements will not eliminate the need for downstream improvements as we are trying to maximize the amount of flood reduction, but since there are numerous structures within the floodplain, we will not be able to eliminate flooding or meet the desired level of service if these areas were developed today. Since all of the projects work together, there will be incremental benefits as various projects are implemented. The projects are prioritized in a way to try to realize the most significant benefits first.

- Mr. Clark follow up on 12/2/16 via email

Thx for the update and explanation.

7. Comment Received: 11/9/16
Scott Parker – Lake Ellen HOA

- Comment

Ken Hurst, Bob Loomis and I, all representing the Lake Ellen Homeowners' Association, attended the November 3, Lower Booker Creek Subwatershed Study meeting at the Chapel Hill Library.

An important part of the Lake Ellen Homeowners' organizational responsibilities is to maintain and protect Lake Ellen itself, which, as you know, is a privately owned lake in Chapel Hill.

We listened with interest to the excellent presentation on proposed flood prevention strategies, project proposals, costs and benefits. One interesting part of the presentation and discussion was that meeting the estimated flood prevention targets would require implementation of all the proposed projects - certainly a long-range and expensive undertaking.

In that regard, since not mentioned in either the report or briefing, we wonder if the two run-off catch basins located on the west side of MLK Blvd. are 1) already included in the coordinated flood prevention strategy; 2) have been overlooked; or 3) have been considered and are not suitable for inclusion in the strategy?

Neither catch basin has been maintained since construction of the MLK widening project some 15 years ago; but, even so, seem to be functioning in an impaired fashion.

Basin #1 is located close to where Booker Creek crosses under MLK, and Basin #2 is located ¼ mile south of Weaver Dairy road. These basins seem to be tied in with the MLK drainage grates and were designed to catch and filter the considerable runoff from the MLK Blvd. before it reaches Booker Creek and in turn, Lake Ellen.

Thanks for the presentation, the opportunity to respond, and your attention to our question.

Scott Parker, president

Lake Ellen Homeowners' Association

- WK Dickson Response via email on 12/12/16

Scott

Thank you for your comments on the Lower Booker Creek Study as well as your attendance at the public meeting.

I'm sure you have a lot going on with the recent damage to Lake Ellen, but I wanted to respond to your email below.

First, the focus of this study was predominantly on the Lower Booker Creek subwatershed study. While opportunities were investigated and ultimately recommended upstream in the larger watershed, those opportunities were focused on areas where significant floodplain storage could be implemented that would provide some benefits downstream in Lower Booker Creek. Both the New Parkside project and MLK project summarized in the Lower Booker Creek report would provide flood reductions and water quality treatment upstream of Lake Ellen, although again the ultimate goal of those projects is to provide some flood reduction downstream in Lower Booker Creek.

Recommendations that are specific to the Booker Headwaters subwatershed that may more directly impact Lake Ellen can be found in the Booker Headwaters report which can be found on the Town's website linked below. That study was completed by a different firm. Please contact the Town with any questions directly related to the Booker Headwaters Study.

<http://www.townofchapelhill.org/home/showdocument?id=25507>

Regarding the basins you noted below, we did account for storage upstream of MLK along Booker Creek in our models. There appears to be little room to expand storage in that area, which is why we looked a little further upstream in the New Parkside Drive area. We did not specifically evaluate Basin 2 noted below as there did not appear to be enough storage to significantly impact Lower Booker Creek. Regarding maintenance of those facilities, I would assume DOT is responsible for the maintenance of facilities required as part of the MLK expansion, but I would recommend contacting the Town to confirm.

8. Comment Received: 11/15/16
Christine Berndt

- Comment

Dear Consultants,

I have the following additional comments/questions after looking at the draft report and attending your public presentation:

1. How does the technique of creating detention area promote the stated goal of protecting and restoring natural stream corridors?

2. The use of detention areas appears to require extensive excavation and removal of trees and vegetation. What will this look like in practice? It would be beneficial to visualize with illustrations the completed result for citizens.
 3. Is the use of detention areas of this type permitted in floodways, floodplains, and associated wetlands? How difficult would it be to get the required permits?
 4. What effect will the proposed detention areas have on Town-owned properties, parkland, and existing greenway paths?
 5. Please expand your consideration of daylighting Booker Creek at Eastgate. Your analysis assumed continuation of existing commercial development. While this is likely in the short term, the report should also consider the potential for complete redevelopment at some point in the future, with a daylighted creek as a community amenity. Explain what potential benefits could be, not just why it cannot be done now.
 6. I could not find mention in your report of the water quality status of Booker Creek as an impaired stream, and what this means. I think this information should be added, and explain how your proposals might affect existing water quality.
 7. The report findings make it difficult to understand how significant are the projected magnitude of the impacts of the potential improvements in relation to costs.
 8. Illustrations of water quality techniques for neighborhood opportunities would be helpful.
 9. A follow-up report discussing public and private financing options would be a useful next step. Such a report should also include the costs of making the detention areas into attractive, useable parks and greenways.
- WK Dickson Response via email on 12/12/16

Christine

Thank you for your thoughtful comments on the Lower Booker Creek subwatershed study. We certainly appreciate your time reviewing the study. Our responses to each of your comments/questions are below.

Dear Consultants,

I have the following additional comments/questions after looking at the draft report and attending your public presentation:

1. How does the technique of creating detention area promote the stated goal of protecting and restoring natural stream corridors?

Response: We assume the referenced detention areas in your question are the proposed floodplain storage areas. The floodplain storage areas will allow water to spread out into the floodplain which will reduce water surface elevations, slow the water down, and promote infiltration. While there will be temporary ponding in these areas, there will be no permanent detention areas or ponds created. For instance, water is already ponding behind New Parkside Drive and Piney Mountain Road temporarily during storm events. The proposed projects increase the available storage area behind these road crossings as an example. The existing stream is currently incised and in some instances the floodplain can be quite narrow due to the urbanization of the watershed. Creating floodplain storage areas will help contribute to a more natural stream as storm water can reconnect to the floodplain rather than be conveyed completely within the stream.

2. The use of detention areas appears to require extensive excavation and removal of trees and vegetation. What will this look like in practice? It would be beneficial to visualize with illustrations the completed result for citizens.

Response: The proposed floodplain storage areas will require temporary removal of trees and vegetation as well as excavation. The areas will then be revegetated. The specific types of vegetation and trees proposed will be determined during final design of the project. It is likely that the design process for each of the floodplain storage areas would include a conceptual planning phase to determine a more detailed plan for what the proposed storage area would look like. At this time the various stakeholders of the project would be engaged which may include other Town departments, OWASA, property owners, and the public at large. Many times renderings are provided for these types of projects during the conceptual planning phase to better illustrate the proposed project although the specific methods for visualization would be determined during scoping for any proposed projects.

3. Is the use of detention areas of this type permitted in floodways, floodplains, and associated wetlands? How difficult would it be to get the required permits?

Response: Permitting is an important part of the design process and the types of permits would be identified early in the conceptual planning phase. Typically, we would meet with permitting agencies early in the design project to clarify the permitting required. FEMA permits are

required for excavation and fill within the floodway, however since the purpose of the project is to excavate material from the floodplain, it is likely the FEMA permitting would be fairly straightforward and result in reductions in water surface elevations. Stream impacts are not anticipated with these types of projects since the excavation will be above the ordinary high water mark, however 401/404 permits will likely be required as temporary stream impacts are typically unavoidable. 401/404 permits will also be required if the floodplain area includes jurisdictional wetlands.

4. What effect will the proposed detention areas have on Town-owned properties, parkland, and existing greenway paths?

Response: Our recommendations include merging stormwater projects with parks and greenway projects to the extent possible. These details would be determined in the conceptual planning process. We are not recommending removal of any park or greenway features.

5. Please expand your consideration of daylighting Booker Creek at Eastgate. Your analysis assumed continuation of existing commercial development. While this is likely in the short term, the report should also consider the potential for complete redevelopment at some point in the future, with a daylighted creek as a community amenity. Explain what potential benefits could be, not just why it cannot be done now.

Response: Regarding the potential benefits, the study notes that daylighting Booker Creek at Eastgate can provide some environmental benefits by creating an open stream, however due to the urbanization of the watershed, the stream would not be restored to a natural condition. The study also notes that daylighting the stream would not have a significant impact on water surface elevations. Water surface elevations would be reduced through the floodplain storage areas both upstream and downstream of Eastgate. As noted in the report the areas adjacent to a daylighted stream at Eastgate would still be floodprone and located within the FEMA floodplain. Given the topography and the location of this area within the watershed, significantly reducing the width of the 100-year floodplain at this location is unlikely.

If the Town and the property owner determines that redeveloping the Eastgate shopping area is something they want to move forward with then we would certainly recommend considering daylighting Booker Creek as one of the alternatives evaluated. We don't disagree that daylighting the creek could be a community amenity, but it really needs to be part of a larger redevelopment project and not a stand-alone stormwater retrofit for reducing the severity, duration, and frequency of flooding.

- I could not find mention in your report of the water quality status of Booker Creek as an impaired stream, and what this means. I think this information should be added, and explain how your proposals might affect existing water quality.

Response: Section 6.3 discusses the Jordan Lake Rules and some potential strategies for meeting the potential retrofit requires from the rules, however I agree that more discussion is warranted regarding the benthic impairment. We will add some discussion on this item.

- The report findings make it difficult to understand how significant are the projected magnitude of the impacts of the potential improvements in relation to costs.

Response: The benefits of the projects are presented as a cumulative benefit. We will be adding individual benefits (water surface reductions) for each project to more clearly project the magnitude of the benefits.

- Illustrations of water quality techniques for neighborhood opportunities would be helpful.

Response: Section 6.2.2 discusses the potential water quality neighborhood retrofit opportunities. Photographs of different water quality techniques are available in the powerpoint presentations at the last 2 public meetings and are linked on the project web site.

- A follow-up report discussing public and private financing options would be a useful next step. Such a report should also include the costs of making the detention areas into attractive, useable parks and greenways.

Response: The Town is currently evaluating financing options. Based on the Council's direction, Town staff will determine if a more detailed funding analysis is warranted at this time.

- Comment Received: 11/15/16
Rich Guerin

- Comment

Tom and Sue,

First, thanks for all the hard work, it appears to be very helpful to use a well defined model for these types of challenges. Following up on our discussion, I had 3 things I would suggest we

consider to help with investment reduction and and further information that I thought might help clarify impacts and prioritization of the various proposed investments:

1) Given the large majority of residents in Chapel Hill are greatly concerned about the growing issues of climate change and expected more violent storm events- recognizing our recent experiences with two "25 year storms" in 2 years.., AND projected 30% growth impacts on an already overburdened stormwater system, I would propose for all environmentally sensitive areas in town (to be defined) that we change the building codes to be able to handle a 50 year storm in those specific areas. It will do three important things: a) have the property owners that exacerbate the existing problems bear responsibility to pay for development costs rather than shifting this cost to all property owners in Chapel Hill. b) discourage expansion in environmentally sensitive areas and thereby incentivize expansion where the areas are more appropriate for development. c) It would minimize the risk to life, private and town property damage, and further town investment and tax increases when we see storms exceeding the "25" year levels which-given scientific projections for additional violent climate events- will occur here in Chapel Hill.

2) Interested in exploring impact of lowering Eastwood Lake to offset large projected investments downstream. It was discussed informally by members since the last stormwater study meeting earlier this year and under the right circumstances if benefits significant it is plausible there could be willingness by the association to a mutually beneficial arrangement. As a point of clarification on possible obstacles, I was told by the current LFA Chairman that changing the lake levels would not require a unanimous agreement by members or subset of members of the association. Eastwood Lake is the largest possible retention area upstream of many sensitive areas- the lake surface is approximately 44 acres. I was informed the Dam has at least 2 or maybe 3 valves (on surface would need to create permanent extension of valve handles to more easily open lower valves simultaneously with upper valve) to rapidly drop lake if we had a short e.g. one day notice... Could you conduct a scenario of dropping lake level prior to storm and impact on projected investments :

-1 foot drop (likely no investment required) in summer and up to 2.5 foot drop out of recreational season. Based on agreed storm risk parameters dropping the lake up to 1 foot lower in advance of storm.. with some cost sharing by town and lake forest association on lake maintenance.

- up to 2 foot level drop in summer with high probability of violent storm event to refill lake and 2.5 foot in winter. This would be a more expensive option and would likely involve dredging the bottom of the lake 2 feet lower to start (or dredging in the defined recreational portion with some cost sharing of on-going dredging of lake by town and lake forest association. Based on

agreed storm risk parameters dropping the lake up to 2 feet lower in advance of storm.. with some cost sharing by town and lake forest association.

These two options don't require buying property, clear cutting, tree removal and might be less risky from a mosquito borne disease perspective like Zika than adding additional wetlands like spaces through the town.

3) Understand potential impact of community initiatives like rain gardens or other non-traditional stormwater management approaches to help private property owners to retain water upstream of flooding. What have best practices yielded in benefits to other communities that could help with Chapel Hill's flooding problem. What is the investment and support required to put those in place?

If you could identify how much excess water volume we think we need to handle in a 10 and 25 year storm at various major flooding points e.g. Honeysuckle rd, Franklin street, Fordham blvd etc.. (current baseline capacity, 30% growth forecast), and how much of the excess water volume each of the proposed projects addresses it would be very helpful rather than just water heights for the overall system. Tom thought he had the information in his model for the overall system that he could share with me (and would be helpful for others to see how the picture comes together).

As an aside, I think the growing Zika issue might also bear a separate investment consideration for Chapel Hill based on existing mosquito population, CDC predictions and impact on highest risk pregnant women.

- WK Dickson Response via email on 12/12/16

Rich

Thank you for your comments on the Lower Booker Creek Study as well as your attendance at the public meetings.

I apologize for the delay in responding to your email. Our responses to your comments are as follows:

- 1) Regarding design storm and climate change, each community determines the most appropriate level of service that balances flood risk and infrastructure costs.

For the purposes of this study, the Town has decided to use current design standards based on future build-out land use conditions. However, the design scenarios do not incorporate the required detention for the 25-year storm, so the flows would actually be lower than those included in the report. Additionally it would be many years before the future build-out scenario occurred if ever as it is a very conservative assumption. The future build-out scenario assumes all undeveloped land that is not otherwise protected would be developed according to zoning, land use plans, or surrounding land use.

Many times in retrofit situations the desired level of service cannot be cost effectively achieved however significant improvement can be made. We did evaluate the 2-, 10-, 25-, 50-, and 100-year events so that the Town could see the impacts of the proposed improvements for various events. During the design of any of the proposed projects, it is likely the Town would revisit the design storm and the cost benefit of increasing the size of the infrastructure to accommodate larger events.

- 2) We have evaluated modifying Eastwood Lake to compare what improvements would be required if the New Parkside Drive, MLK, and Piney Mountain Road projects were not constructed. Raising the dam significantly as Eastwood Lake would not be feasible as it would cause upstream flooding to residential properties and roadways, so the normal water surface would need to be lowered to increase the flood storage. To approximately equal the storage provided by the New Parkside Drive, MLK, and Piney Mountain Road projects, the normal water surface would need to be reduced approximately 1.8 feet. There are approximately 50 private properties around the perimeter of the lake including the recreational area that would be significantly impacted by a water surface reduction. We will include this information in the final report.

While a temporary drop in water surface elevation during the winter months could certainly help for that period of time, improvements throughout the watershed would not be able to depend on the additional storage since the lake would be at normal elevation for the remainder of the year.

For any modifications to the dam or lake, the Town would need to enter into some type of easement agreement with the owners of the lake.

- 3) Section 6.2.2 discusses the potential water quality neighborhood retrofit opportunities. Photographs of different water quality techniques are available in the powerpoint presentations at the last 2 public meetings and are linked on the project web site. Typically rain gardens and other green infrastructure are designed for the first inch or runoff from a storm event with the intention of filtering pollutants before they enter the

conveyance system. While these features will somewhat reduce the volume of runoff, they typically don't have a significant impact on the larger storm events such as the 10-year and 25-year events.

Durham actually has a rain catcher program that you might find interesting. See the link below for more details.

<http://durhamnc.gov/949/Rain-Catchers>

- 4) We will include the capacity of the existing infrastructure as well as the proposed infrastructure in the final report.

10. Comment Received: 11/15/16

Paul Jansen, Vice President of The Parkside HOA and founding member of the Booker Creek Alliance

- Comment

The following are comments to the recent WK Dickson Lower Booker Creek Sub Watershed Study. The comments and suggestions focus on of the water shed in the headwaters portion of Booker Creek and the proposed storm water storage areas with the following issues and suggestions:

- **Water Quality:** The heavily wooded and shaded canopy will be clear cut to create the detention areas. Booker Creek (Creek) will be exposed to more sunlight raising water temperatures and reducing dissolved oxygen content destroying aquatic life in the upper portion where the ecosystem is currently in balance. The impact of reducing water quality in the upper watershed would have a cumulative effect moving downstream and transform the Creek from a thriving ecosystem to an urban ditch.
- **Control of Stormwater (SW) Inputs:** There are other better opportunities to capture the storm water and mitigate flooding downstream. The headwaters plan has no consideration for detaining SW before it reaches the Creek particularly from Parkside and Tremont Circle/ Northwoods neighborhoods. The plan has missed several opportunities where stormwater can be captured before the creek and released slower over time using the natural topography.
- **Erosion:** The stream meanders in a natural meandering or sinusoidal pattern in the New Parkside proposed 7.5 acre detention area. The stream flattens out, spreads out and spills out naturally during rain events creating water storage in this bottomland hardwood forest with its network of channels in its current state. Clear cutting of trees in addition to construction and excavation will compact the soil and expose these silty / clay soils to erosion. Stabilizing the soils with post construction plantings after construction is very difficult to implement and maintain.

- **Restoration and Maintenance:** From experience, the construction is easy compared to the restoration and maintenance required to keep these detention basins functional. Plantings have to be timed in very tight planting windows and then irrigated to make sure they take. Once the protective canopy and forest root system is removed storms will wash away soil and plants before they root and take. Invasive plants and weeds need to be removed on a regular basis and replacements made for plants that don't survive. These public detention areas are routinely neglected. By contrast, the natural wetland system that currently exists appears to be working in the New Parkside and ML King areas.

We are proposing several suggestions for further evaluation:

- **Pre- creek detention** can be created along Lonebrook and the unnamed tributary running parallel to Kenilworth Road capturing stormwater from Northwoods/Tremont Circle and Parkside neighborhoods intercepting and storing stormwater before it reaches the Creek. There are at least four places along the system that could capture the neighborhood flows. Primarily shallow impoundments east of the sanitary sewer within the existing cleared easement can be created with meandering shallow spillover channels to reduce impacts to the underground utility pipe. By reducing the upland stormwater inputs to Booker Creek and changing the overall hydraulic curve and time of concentration to the Creek will reduce the amount of storage from the primary Creek channel. This remedy can be strategically reproduced along the entire watershed.
- **Tiered wetlands:** Use a tiered wetland approach that works with the natural topography. Instead of one large multi acre polygon, recreate a natural meandering approach utilizing topography in a chain of interconnected wetlands. This work is as much art as it is science and the current plan lacks imagination and creativity and ignores the existing opportunities for a lower impact more sustainable approach to stormwater detention. Tiered wetlands would look like a series of golf sand traps with many shallow interconnected depressions that captures most of the stormwater before it gets to the Creek. Tiered wetlands are more attractive to the community and effective at dropping out pollutants, sediment and reducing stormwater time of concentration. Invasive plants and weeds would be eradicated at the edge and work inward over time so that the desirable plants will take-over.
- **Restoration:** Include desirable plantings particularly at the forest edge in the restoration plan. Consider willows, dogwoods, elderberry, alder, cypress, river birch, and other wetland plants and grasses that offer habitat and food for wildlife. Strategic excavation and harvesting of the native hydric soils to create or enhance naturally occurring depressions from the Creek can be used as earthen weirs to control the water and reduce the cost of transporting and disposing of excavated soil that would be required for the consultant's plan. The soils and vegetation removed can be chipped and mulched and re-used in the restoration as it proceeds. Soils and mulch could also be used to create a meandering pathway following the natural pattern of the Creek. Maintenance, invasive removal and replacement planting could be done by Town employees with some initial training and oversight.

- **Phasing and Sequencing:** Implement the pre-creek detention basins in a phased approach with consideration of pilot projects and sequencing to see what works best and then reproduce down the watershed. A phased approach could be done with smaller equipment that has a lower impact on the forest with less compaction of the root system. Smaller equipment and phasing of smaller projects following a thoughtful and flexible design will have less impact to the adjacent homeowners and the neighborhoods. Material balances are always an issue during construction. The Town would utilize its material yard for temporary storage and beneficially re-use boulders, stone, crushed concrete, mulch and other materials during construction.
- **Augmentation of existing resources:** Evaluate raising the dam at Eastwood Lake to increase storage capacity in a public private partnership to gain stormwater capacity at a critical link in the watershed storage chain.
- **Local expertise:** Chapel Hill has many smart people with a broad range of experience and skills that range from engineers, landscape architects, biologists, environmental scientists etc. We can tap into UNC expertise and public grants and funding and utilize students for data collection opportunities for additional studies by UNC Environmental Science students.

We welcome an open dialog and exchange of ideas with the Town and its consultant to better preserve what is working and fix what is not.

- WK Dickson Response via email on 1/6/17
Mr. Jansen

Thank you for your thoughtful comments on the Lower Booker Creek Sub Watershed Study. Due to the high level of development within the Booker Creek watershed, it is very challenging to develop feasible alternatives for substantial reductions in the duration, frequency, and severity of flooding. It became apparent during the Study that substantial flood reduction along Lower Booker Creek in the Franklin Street area and downstream would require upstream reductions in peak flow and an increase in downstream floodplain storage to reduce tailwater elevations. The approximate volume provided by the three (3) proposed floodplain storage areas upstream of Eastwood Lake is in excess of 65 acre-feet. Given the topography and the extensive existing development, there were very few areas available for significant storage in the watershed limited predominantly to the existing floodplain and existing impoundment areas. See your specific comment below for our response regarding modifying Eastwood Lake.

Many of the questions you raised are items that would be addressed in the design phase of a project, including the identification and location of significant mature tree stands. Where possible, disturbance to these tree areas would be avoided or minimized.

Individual responses to your comments are attached.

Response (Water Quality): The areas shown in the plan are planning level conceptual areas intended to show the relative size of a potential floodplain storage area. During a detailed conceptual planning and final design effort, the specifics of the project will be defined including the limits of tree removal and the vegetation to be replanted. The floodplain storage areas will have elements of a stream restoration project where the stream is reconnected to the floodplain and habitat is provided for macroinvertebrates and other organisms.

Additionally, the Booker Creek Headwaters Report completed in 2014 notes that the reach from Weaver Dairy Road to New Parkside Drive “is unstable and is likely to experience continuing erosion until a new stream equilibrium is established.” The proposed New Parkside project could include measures to stabilize the headcuts and reduce the active erosion that is currently occurring.

Response (Control of Stormwater (SW) Inputs): The report notes the importance of infiltrating stormwater at the source through its Neighborhood Retrofit Opportunities described in Section 6.2.2. For this portion of the study our scope was limited to the Lower Booker Creek Subwatershed, but obviously many of these measures could be implemented throughout the Town. These types of measures are critical for improving water quality in the watershed, but would not provide substantive water quantity benefits.

Response (Erosion): As noted above, previous reports have identified portions of the stream in the New Parkside area as already having erosion issues. Certainly construction of the floodplain storage areas would need to be implemented correctly to avoid over compacting the soil to allow new vegetation to take hold. Again this process is very similar to stream restoration projects that are occurring throughout the State. Ongoing maintenance and monitoring will be required to ensure the success of the project.

Response (Restoration and Maintenance): We agree that the maintenance of all stormwater infrastructure is critical to its success.

Response (Pre-creek detention): The Pre-creek detention areas could potentially be implemented for additional water quality treatment, but incorporating water quality treatment facilities in this subwatershed was outside the scope of this study. As noted above, it does not

appear these pre-creek detention areas would provide the volume for meaningful peak flow reductions in large storm events. It also appears for the tributary parallel to Kenilworth that a significant number of private easements would be required to implement these detention areas for very little water quantity benefit.

Response (Tiered wetlands): The specific design elements of the floodplain storage areas are yet to be determined and it's possible that tiered wetlands could be incorporated. The imagination and creativity would likely occur in the design phase once more information is available such as survey, stream and wetland boundaries, geotechnical information, utility locations, tree surveys, and other elements typically associated with a design project.

Response (Restoration): The planting plan would be developed during the design phase of the project.

Response (Phasing and Sequencing): Phasing and sequencing of construction would occur during the design phase. The selected contractor will have significant input in the methods and means of construction.

Response (Augmentation of existing resources): We have evaluated modifying Eastwood Lake to compare what improvements would be required if the New Parkside Drive, MLK, and Piney Mountain Road projects were not constructed. Raising the dam significantly as Eastwood Lake would not be feasible as it would cause upstream flooding to residential properties and roadways, so the normal water surface would need to be lowered to increase the flood storage. To approximately equal the storage provided by the New Parkside Drive, MLK, and Piney Mountain Road projects, the normal water surface would need to be reduced approximately 1.8 feet. There are approximately 50 private properties around the perimeter of the lake including the recreational area that would be significantly impacted by a water surface reduction. We will include this information in the final report.

Response (Local expertise): We agree, which is why we have reached out to the public at large throughout the planning process including hosting 6 public meetings, attending HOA meetings, meeting individually with interested residents, sending out survey questionnaires and hosting a project website. Additionally, we have presented to the Stormwater Advisory Board 3 times. The Town is committed to an inclusive process in its stormwater management planning efforts and will continue to engage the public in future planning studies.