Conceptual Plan

Pilot Projects to Address Chronic Flooding in the Stoney Creek Watershed

Wayne County, North Carolina

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Prepared for:

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1. Stoney Creek Pilot Study Overview

This Conceptual Plan presents project goals and objectives, stakeholder engagement, and proposed methods for the current conditions watershed modeling and evaluation of potential flood mitigation sites. Formal design plans and detailed modeling results (both existing and proposed) will be presented in the Mitigation Plan Document that will be prepared later in 2023. **Figure 1** depicts the boundary of the Stoney Creek Watershed.

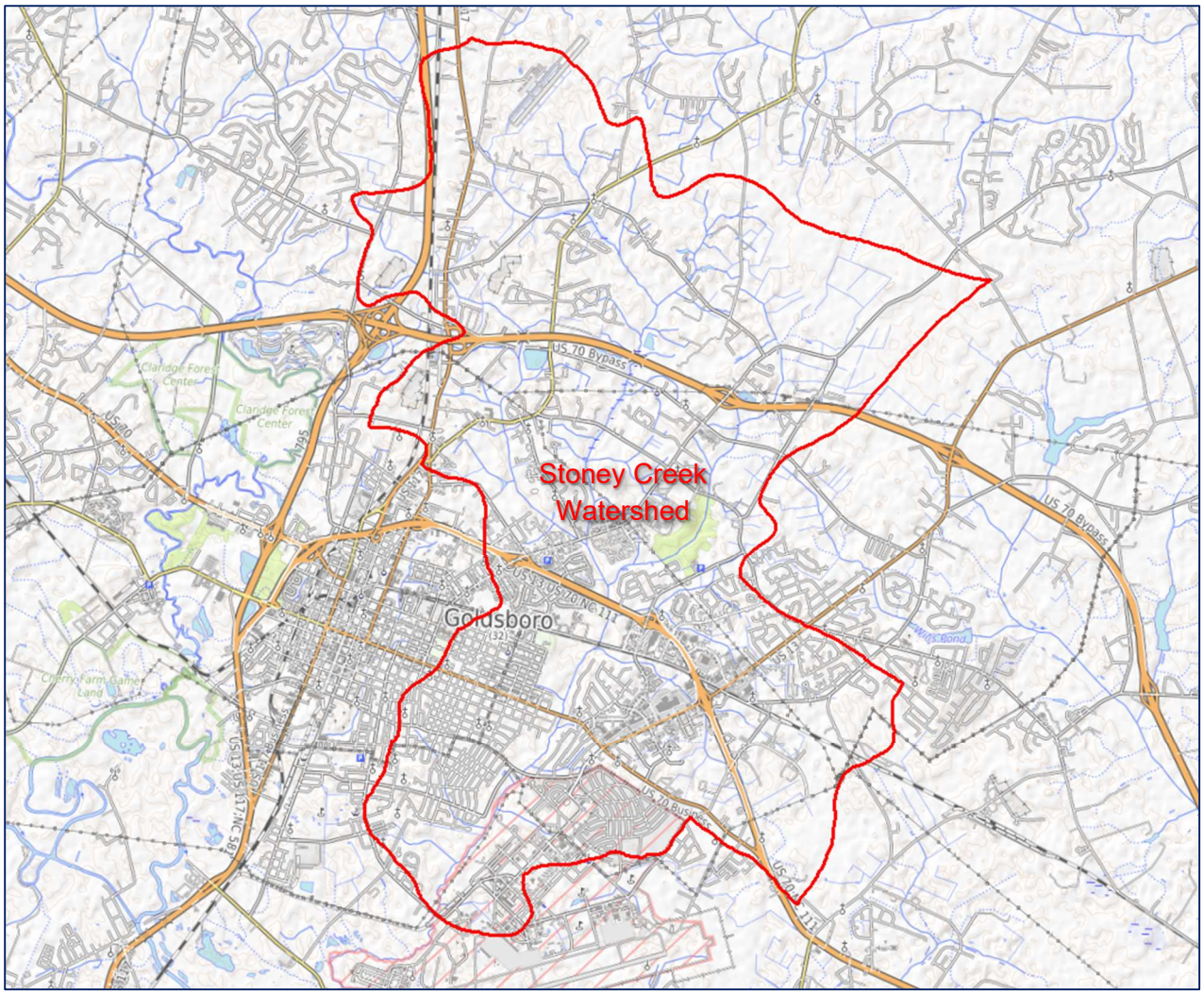

Figure 1. Stoney Creek watershed.

2. Initial Goals and Objectives.

The 2021 Appropriations Act provided funding as well as a set of clear objectives to guide the North Carolina Division of Mitigation Services (DMS) in the implementation of the Stoney Creek Pilot. The legislation was initiated to develop one or more projects to address chronic flooding in the Stoney Creek watershed of Wayne County. This objective has been clearly asserted by DMS through the implementation process.

Utilizing legislative directives identified in the appropriations for the Stoney Creek Pilot Project, the project's goals and objectives are as follows:

Goal: Engage government and community stakeholders within the Stoney Creek watershed to share project information, hear concerns, and receive input regarding potential project sites.

Objectives:

- Coordinate stakeholder meetings for public input to identify concerns and opportunities within the watershed.
- Discuss opportunities and implementation strategies with landowners within the watershed.
- Incorporate stakeholder concerns and values into nature-based solution design and decisions.

Goal: Implement one or more nature-based pilot projects to address chronic flooding in the Stoney Creek watershed impacting businesses, roadways, and access to emergency services in Wayne County and Goldsboro.

Objectives:

- Identify chronic flooding areas within the watershed and determine problem sources utilizing hydrologic and hydraulic modeling.
- Determine suitable nature-based solutions based on identified problems and sources, landscape variables, and land availability.
- Negotiate protection agreements with landowners for viable sites, and implement sites as project funding allows.

Goal: Evaluate project performance to determine effectiveness of flood resilience projects.

Objectives:

- Establish a monitoring plan for each implemented project site to quantify performance and to test model predictions.
- Evaluate lessons learned from this pilot project and provide observations and recommendations for future flood mitigation projects.

3. Community Engagement

There has been considerable past work performed by others regarding flood mitigation and stakeholder involvement in the Stoney Creek Watershed. Stakeholder involvement continues to inform processes for project selection. Ecosystem Planning and Restoration, PLLC (EPR), in conjunction with DMS, conducted a stakeholder meeting with federal, state, and local agencies and nonprofits on February 8, 2023. The feedback received during the meeting provided information concerning existing programs in the Stoney Creek watershed, consequential changes within the watershed, and some of the challenges that exist currently and may in the future.

Additionally, EPR presented an overview of the Stoney Creek Watershed Pilot to the Wayne County Commissioners on March 21, 2023. Comments received during and after the meeting from Commissioners have been supportive of the Pilot Project, and EPR will continue to keep the County Commissioners apprised of progress as the project continues.

EPR anticipates at least one additional stakeholder meeting with landowners and local business interests in the Stoney Creek Watershed, specifically focused upon the Wayne Memorial Drive area. The purpose will be to gain local perspective for the implementation of practices for the Pilot.

EPR will also provide periodic information to DMS on project progress, so that DMS can update their Stoney Creek Pilot Project website. The website will be used as a resource to keep local stakeholders and interested parties up to date with project progress.

4. Modeling Analyses

Current Conditions Model

EPR will develop a HEC-HMS model for the entire Stoney Creek watershed that can be used to assess watershed hydrologic conditions. The model will be developed first to simulate current watershed conditions, including existing land use, soils, crossing and constraints, hydrologic, and climatic conditions for storm flows ranging from the 1- to 500-year return period storm events.

In addition, existing HEC-RAS models for FEMA-mapped streams in the watershed will be acquired and used to simulate hydraulic conditions for watershed streams, particularly at road crossings. By combining the results of the HEC-HMS and HEC-RAS modeling of the watershed, EPR will simulate current watershed conditions and provide a baseline condition by against which proposed improvements to flooding conditions can be assessed and quantified.

Proposed Conditions Modeling – General Practices

EPR will perform a hydrologic and hydraulic modeling study to evaluate and predict the water quantity impacts (changes to runoff volume, peak flow attenuation; etc.) from a suite of nature-based solutions that may be implemented to provide flood mitigation services within the Stoney Creek watershed. Model scenarios will be developed and run for a variety of project conditions, with the intent of identifying trends that can be used to estimate the benefits of future project sites within the watershed quickly and efficiently.

Due to the number of practices and the wide variety of conditions that could be encountered with such projects, this work will focus on assessing a limited subset of possible conditions to develop initial results that can be evaluated and inform further studies and modeling scenarios.

Three subwatersheds within the Stoney Creek watershed will be selected, with one subwatershed anticipated to be less than 0.5 square miles in size, one watershed approximately 1.0 square mile in size, and one watershed approximately 2 – 3 square miles in size. This will allow modeling of projects applied on a range of stream and watershed sizes to look for overall trends. Modeled subwatersheds will be rural land use (<10 - 15% impervious).

EPR will develop HEC-HMS and HEC-RAS models for the three subwatersheds to estimate the following range of baseline condition flood flows: 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, 100-year. Watershed land-use cover and other model parameters will be determined using best available GIS information and layers.

Table 1 below lists out the anticipated model scenarios that EPR will develop and evaluate as part of this study:

Table 1. Flood mitigation practices to be modeled to evaluate effectiveness.

Scenario Number	Watershed Size	Practice	Variables
P1-S1	Small	Priority 1 Restoration	Narrow floodplain (~5 Wbkf)
P1-S2	Small	Priority 1 Restoration	Wide floodplain (~10 Wbkf)
P1-M1	Medium	Priority 1 Restoration	Narrow floodplain (~5 Wbkf)
P1-M2	Medium	Priority 1 Restoration	Wide floodplain (~10 Wbkf)
P1-L1	Large	Priority 1 Restoration	Narrow floodplain (~5 Wbkf)
P1-L2	Large	Priority 1 Restoration	Wide floodplain (~10 Wbkf)
P2-S1	Small	Priority 2 Restoration	Narrow floodplain bench (~5 Wbkf) – both sides
P2-S2	Small	Priority 2 Restoration	Wide floodplain bench (~8 Wbkf) – both sides
P2-M1	Medium	Priority 2 Restoration	Narrow floodplain bench (~5 Wbkf) – both sides
P2-M2	Medium	Priority 2 Restoration	Wide floodplain bench (~8 Wbkf) – both sides
P2-L1	Large	Priority 2 Restoration	Narrow floodplain bench (~5 Wbkf) – both sides
P2-L2	Large	Priority 2 Restoration	Wide floodplain bench (~8 Wbkf) – both sides
P3-S1	Small	Priority 3 Restoration/Enh.	One-sided floodplain bench (~2 – 3 Wbkf)
P3-M1	Medium	Priority 3 Restoration/Enh.	One-sided floodplain bench (~2 – 3 Wbkf)
P3-L1	Large	Priority 3 Restoration/Enh.	One-sided floodplain bench (~2 – 3 Wbkf)
RW-S1	Small	Riparian Wetland Restoration	Headwaters location
RW-M1	Medium	Riparian Wetland Restoration	1st order stream location
RW-L1	Large	Riparian Wetland Restoration	Main stem location
BR-S1	Small	Buffer Restoration	20 ft buffers converted to 200 ft buffers
BR-M1	Medium	Buffer Restoration	20 ft buffers converted to 200 ft buffers
BR-L1	Large	Buffer Restoration	20 ft buffers converted to 200 ft buffers
DB-S1	Small	Constructed Wetland (detention)	5% of watershed area

Scenario Number	Watershed Size	Practice	Variables
DB-S2	Small	Constructed Wetland (detention)	10% of watershed area
DB-S3	Small	Constructed Wetland (detention)	15% of watershed area
DB-M1	Medium	Constructed Wetland (detention)	5% of watershed area
DB-M2	Medium	Constructed Wetland (detention)	10% of watershed area
DB-M3	Medium	Constructed Wetland (detention)	15% of watershed area
DB-L1	Large	Constructed Wetland (detention)	2% of watershed area
DB-L2	Large	Constructed Wetland (detention)	5% of watershed area
DB-L3	Large	Constructed Wetland (detention)	10% of watershed area

For each model scenario above, EPR will modify the existing condition HEC-HMS hydrology models and develop HEC-RAS hydraulic models, as necessary, to appropriately simulate the practice conditions listed above. Model results will document any calculated changes in total flow volumes, peak flows, and peak timing that occurs.

For each modeled scenario, schematics (such as cross-sections, profiles, and/or plan views concepts) will be developed and provided that illustrate how the practice was applied and modeled. Modeling assumptions and input parameters will be documented so that the work may be duplicated in the future, if necessary.

EPR will summarize the methodologies used in a final report and summarize the model results into an overall impact matrix to document the results of the modeling in comparison with the results of the baseline condition models. This matrix will assist with evaluating the impacts of modeled mitigation practices.

Proposed Conditions Modeling – Specific Sites

Results from the modeling analyses described above will be used to both target potential project sites within the Stoney Creek watershed and evaluate potential sites that have already been identified through other means (see Section 5 of this report).

Once specific project sites have been identified as potential sites for implementation, using the Site Prioritization Approach discussed in Section 6, the existing condition models will be modified appropriately to estimate the effects of implementing the potential project site. This will likely involve modification of the HEC-HMS modeling for the project subwatershed to estimate proposed site hydrology, and potentially modification/creation of HEC-RAS model files to estimate changes in flood levels and elevations. The actual modifications to the models will depend on the practices to be imposed and is anticipated to follow the protocols developed for the *Proposed Conditions Modeling – General Practices,* described above. Model results will document any calculated changes in total flow volumes, peak flows, and peak timing that occurs within the subwatershed and at downstream crossings.

5. Site Identification and Quantification.

The EPR Team identified 12 sites for future evaluation during the proposal development stage of the Stoney Creek project. Evaluation of these sites was limited to desktop applications that focused solely on the following criteria:

- Sites that may have appropriate topography and soils,
- Ownership by one or at most two landowners (to facilitate negotiations),
- Appear to offer marginal farm production value,
- Areas where the EPR Team has previous relationships and believe the landowners would likely be willing to implement the work identify.

This initial and cursory site evaluation provided a starting point for the Team's site evaluation strategy. Since the proposal stage, EPR has further evaluated these initial 12 potential sites and provides the following summary (**Table 2**). Sites are named sequentially in accordance with the stream subwatershed to which they drain. **Figure 2** provides a map with the location of each proposed site.

EPR will secure Memorandums of Agreement (MOA) with landowners that are considered to have viable sites, prior to moving further into site evaluations or detailed landowner negotiations. The MOA documents that EPR has discussed the potential project with the landowner(s) and that landowner(s) are interested in continuing discussions to see if the project can ultimately be implemented. **Tables 2 and 3** provide the status of MOAs secured at the time of this report completion; however, attempts to secure MOAs for viable properties will continue.

Table 2. Summary of twelve (12) initial potential sites identified at the proposal stage.

Site Name	Opportunity	Viability	Status	Executed MOA *
Howell 1	Adjacent to Howell Branch, is an existing pond that could potentially be modified for more flood capacity.	Unlikely	Increasing capacity would be limited due to inflow topography and watershed that drains to the site.	No
Howell 2	Open field with ditches, apparently receiving drainage from upstream development	Maybe	While enhancement of stormwater functions may make this site attractive for further evaluation, the landowner has not been responsive thus far. EPR will continue to attempt to make positive contact with owner.	No
Howell 3	Existing pond that receives drainage from upstream development. Could potentially increase capacity.	Maybe	Further investigation has determined that the site is currently under consideration for residential housing. EPR has been in contact with the owner/developer and has completed an onsite review. While the topography of the site and drainage from the adjacent proposed Goldsboro Business	No

Site Name	Opportunity	Viability	Status	Executed MOA *
			Park continues to make this site an interesting opportunity, there is a utility (water or sewer) line adjacent to the existing ditch, an area of prime opportunity for flood retention. Maintenance requirements of the utility line may complicate this site to be used in this Pilot.	
Stoney 1	Adjacency to the Wayne Executive Jetport. Area appears to receive drainage from the airport.	Unlikely	This site does not appear to be viable due to the adjacent houses and possibilities of hydrologic trespass.	No
Stoney 2	Existing pond at two headwater reaches of Stoney Creek. Capacity could possibly be increased for flood retention.	Maybe	EPR is attempting to contact the landowner(s).	No
Stoney 3	The site is located adjacent to HWY 795 and is a barrow pit pond from the highway construction.	Unlikely	Site appears to have a limited drainage area that could be collected and attenuated.	No
Stoney 4	This site appeared to have several drainage ditches through an existing agricultural field and could be carrying drainage from an adjacent neighborhood.	Maybe	EPR is attempting to contact the landowner(s).	No
Stoney 5	The site is located adjacent to a mall shopping area and appears to receive a lot of impervious surface runoff.	Likely	EPR is attempting to contact the landowner(s) for detailed discussions. Preliminary site visits have already been conducted.	No
Reedy 1 and 2	The topography and the confluence of multiple headwater channels of Reedy Branch create the opportunity for significant flood retention.	Maybe	EPR has had initial discussions with the landowner(s) and is continuing these discussions to determine interest.	No
Reedy 3 and 4	These sites are located behind the college along an existing greenway. The opportunity to attenuate stormwater from the college may impact Reedy Branch peak flow.	Likely	EPR has had initial discussions with the college and is continuing these discussions to determine interest.	No

** Indicates status of executed MOA at publication of this report. For those that do not have an executed MOA, landowner discussions are ongoing.*

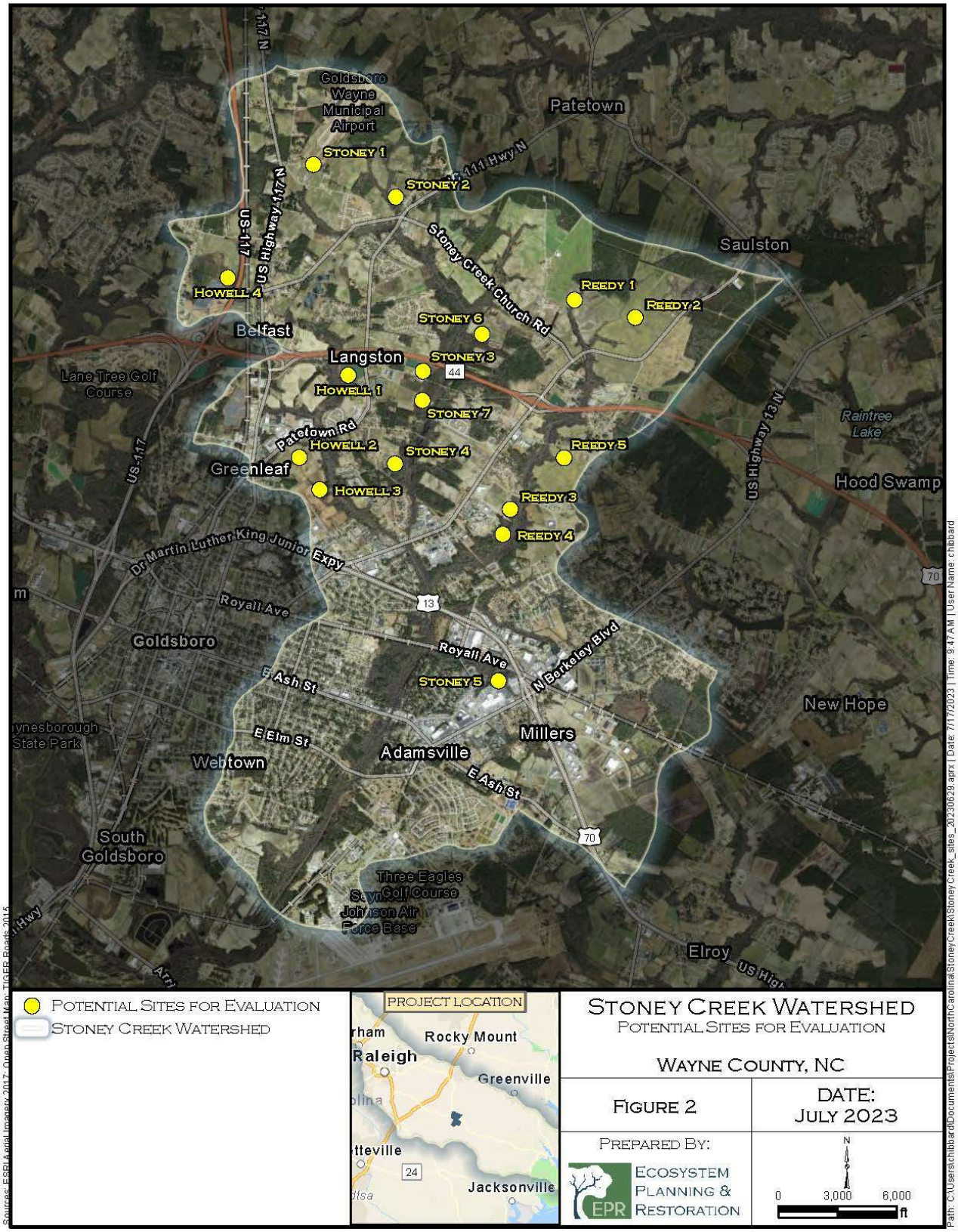

Figure 2. Potential sites identified in the Stoney Creek watershed for evaluation.

Since the proposal stage of the Stoney Creek work, EPR has continued to identify and evaluate additional potential sites, through a combination of landowner contacts, stakeholder involvement, and increasing knowledge of the watershed. **Table 3** lists additional potential sites that have been identified since EPR was contracted to perform the Stoney Creek watershed work with NCDMS, and these sites are identified on **Figure 2**.

Table 3. Additional potential flood mitigation sites that have been identified since the proposal stage.

Site	Opportunity	Viability	Status	Executed MOA
Howell 4	EPR has a longstanding relationship with the landowner and is evaluated the possibility of flood retention on the property.	Maybe	EPR has done preliminary site visits. There are questions about the cost-benefit of the project, as it is at the top of the watershed.	Yes
Stoney 6	EPR identified this site through contact with landowners in the Stoney Creek watershed. Opportunity for flood retention from farm and developed land.	Likely	EPR has done preliminary analyses of this site and it appears feasible. Landowner discussions have also been positive.	No
Stoney 7	EPR identified this site through contact with landowners in the Stoney Creek watershed. Opportunity for riparian wetland restoration.	Maybe	EPR has talked with the landowners and they would likely agree to a project, but effectiveness of the site needs to be evaluated.	Yes
Reedy 5	EPR identified this site through contact with landowners in the Stoney Creek watershed. Opportunity for flood retention from agricultural lands	Likely	EPR has conducted preliminary site visits and had preliminary discussions with the landowner(s).	Yes

** Indicates status of executed MOA at publication of this report. For those that do not have an executed MOA, landowner discussions are ongoing.*

6. Site Prioritization Approach and Project Planning

The work described in this Conceptual Plan Document presents the methodologies that EPR proposes to use to identify problem areas (i.e., road bridge/culvert crossings) in the Stoney Creek watershed, evaluate the potential effectiveness of selected practices to provide flood mitigation, and evaluate and predict the potential effectiveness of specific flood mitigation project sites. EPR has already identified approximately 15 potential projects sites that are in various stages of vetting, and it is anticipated that additional potential sites will be identified. This section presents the methodology that EPR proposes to use to evaluate and prioritize potential project sites, seek NCDMS approval on selected sites, and identify additional sites (if necessary) in the later phases of the project work.

EPR proposed to use the following methodology to both identify and prioritize potential sites for inclusion in the overall Stoney Creek Watershed effort:

1. Use existing conditions models to identify problem road bridge/culvert crossings in the watershed. The results of this analysis will be compared with the work previously done by others, that was completed at a coarser resolution.

2. Prioritize road bridge/culvert crossings where EPR/DMS will focus improvements:
    - Initially anticipate selecting two (2) problem road bridge/culvert crossings, with one of those crossings to be Wayne Memorial Drive (as specified in the project RFP).

3. Use results of the *General Practices* modeling efforts (see Section 4) to inform which types of practices will likely have the best cost-benefit ratio.

4. Evaluate the potential sites (see Section 5) to determine which of the sites are 1) upstream of the identified problem areas to be prioritized (Step #2 above), and 2) would allow for implementation of flood mitigation practices that are likely to provide flood mitigation benefits. It is anticipated that this step will yield three (3) to five (5) potential sites to be further evaluated in the steps below. If at least three (3) sites are not identified, then efforts will be made to identify additional potential sites that meet the criteria of this step, through a combination of GIS/desktop assessments, contact with stakeholders, and contacts with landowners.

5. Develop Mitigation Plan Document. At this step, several potential sites will have been identified and initially evaluated through preliminary modeling efforts. The Mitigation Plan Document will summarize the work done to date and provide an analysis of each of the proposed sites, regarding expected effectiveness and costs. The Mitigation Plan Document will include the following information:
    - Summary of existing watershed assessment, with identification of problem areas,
    - Methods used to date to identify potential sites,
    - Model analysis results for general practice scenarios,
    - Summary of identified viable sites that would benefit the pilot project (expected to be 3 to 5 sites),
    - A prioritization of the identified viable sites,

- Detailed evaluations for each identified viable site,
- Preliminary design plans for each site, indicating the practices that would be implemented,
- Proposed protective easement mechanism and long-term protections, and
- General monitoring requirements and performance standards expected to be.

6. Submit the Mitigation Plan Document to NCDMS for review and approval.

7. Begin landowner negotiations for sites identified and evaluated in the Mitigation Plan. Work in order of identified priority provided in the Mitigation Plan.

8. As landowner agreements are secured, EPR will prepare detailed assessments and design plans for each site that will be submitted to DMS as supplements to the Mitigation Plan Document. These supplements will document the detailed information for each project site to be implemented.

9. EPR will work through the steps of securing easements, implementation, and monitoring identified in the Mitigation Plan and associated project supplements. EPR will work to secure and implement sites as project funds allow.

10. It is possible that additional project sites may need to be identified, if landowner interest is low and/or reaching landowner agreements is difficult. If EPR exhausts all the sites initially identified in the Mitigation Plan Document, and still has project funds available, then new sites will be identified for evaluation. It is anticipated that the site identification process will be slightly modified from the steps presented above:
    - EPR will attempt to identify additional potential sites that would benefit the prioritized crossings identified in Step 2 above.
    - Identified sites will be evaluated preliminarily with model analyses to estimate overall effectiveness.
    - If effectiveness is considered appropriate, EPR will attempt to reach a verbal agreement with the landowner to secure a protective easement.
    - If successful with landowner negotiations, EPR will provide preliminary information to NCDMS regarding the identified site and seek approval to secure a formal landowner agreement and begin formal site evaluations.
    - Upon achieving a formal landowner agreement for the site, EPR will prepare a Mitigation Plan Supplemental Information Packet that provides the site-specific information for the project, as stated above in Step 5. This information will be appended to the Approve Mitigation Plan Document.
    - EPR will then move to formal site design, implementation, and monitoring stages for the project.

7. Project Performance Evaluation

A key component of the Stoney Creek Pilot is the evaluation of project performance for each practice and project site implemented. It will be important to develop a suite of metrics ensuring site stability after construction, measurement of stage/capacity/discharge, and provide data for model verification. Monitoring efforts will continue from the date of construction and extend for five (5) years.

Performance monitoring will vary depending upon the practice implemented. Site stability evaluations will include at least biannual (twice per year) inspections with photo documentation of any outfalls, embankments, and any other structures installed to maintain the slope, dimension, and stability at or near conditions post construction. Inspections will also be conducted after major storm events (25-year return period storm and larger).

Stage/capacity verification will be provided with as-built surveys conducted after construction completion. Data loggers may be utilized within the constructed area to provide a comparison of actual project retention and attenuation values with modeled, pre-project values. EPR anticipates monitoring equipment will be downloaded and maintained at least quarterly.

The monitoring data collected are expected to better inform future projects and accurately document the benefits of practices installed within the Stoney Creek Pilot. Based upon findings, EPR will provide recommendations to DMS that will inform programmatic decisions for similar future flood attenuation projects.