Appendix :

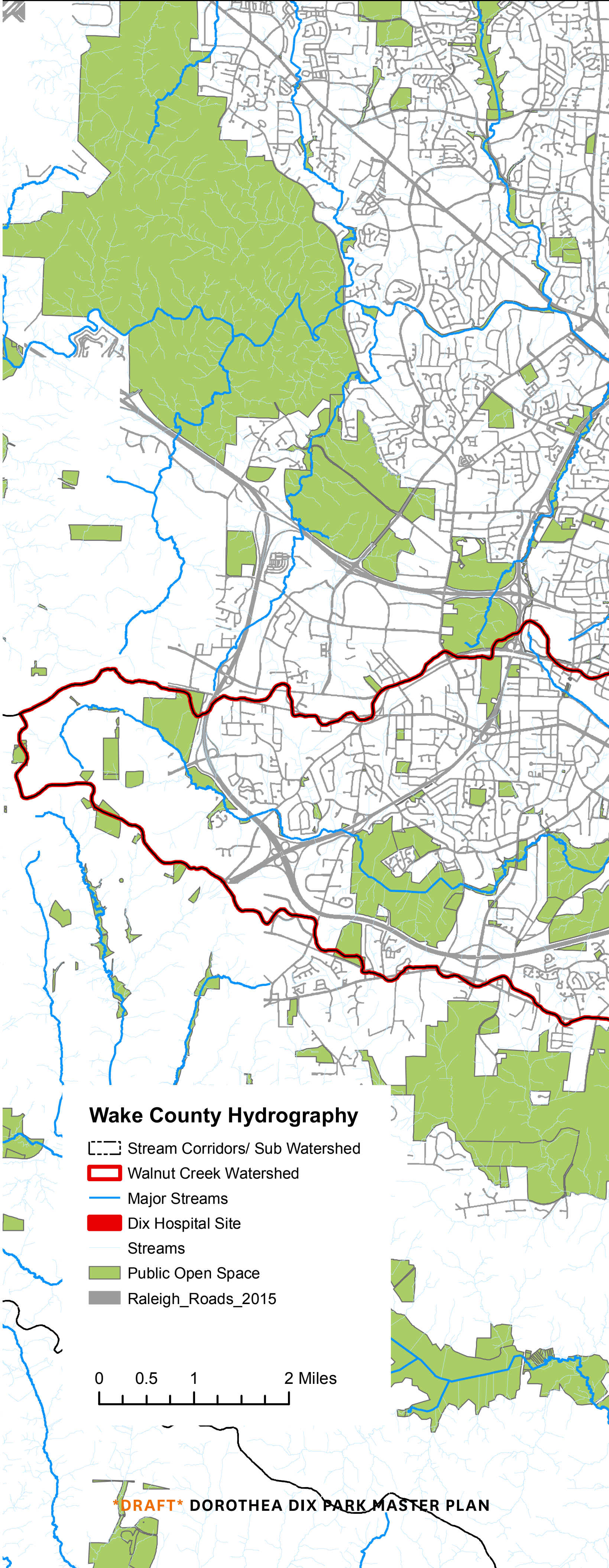
Hydrology

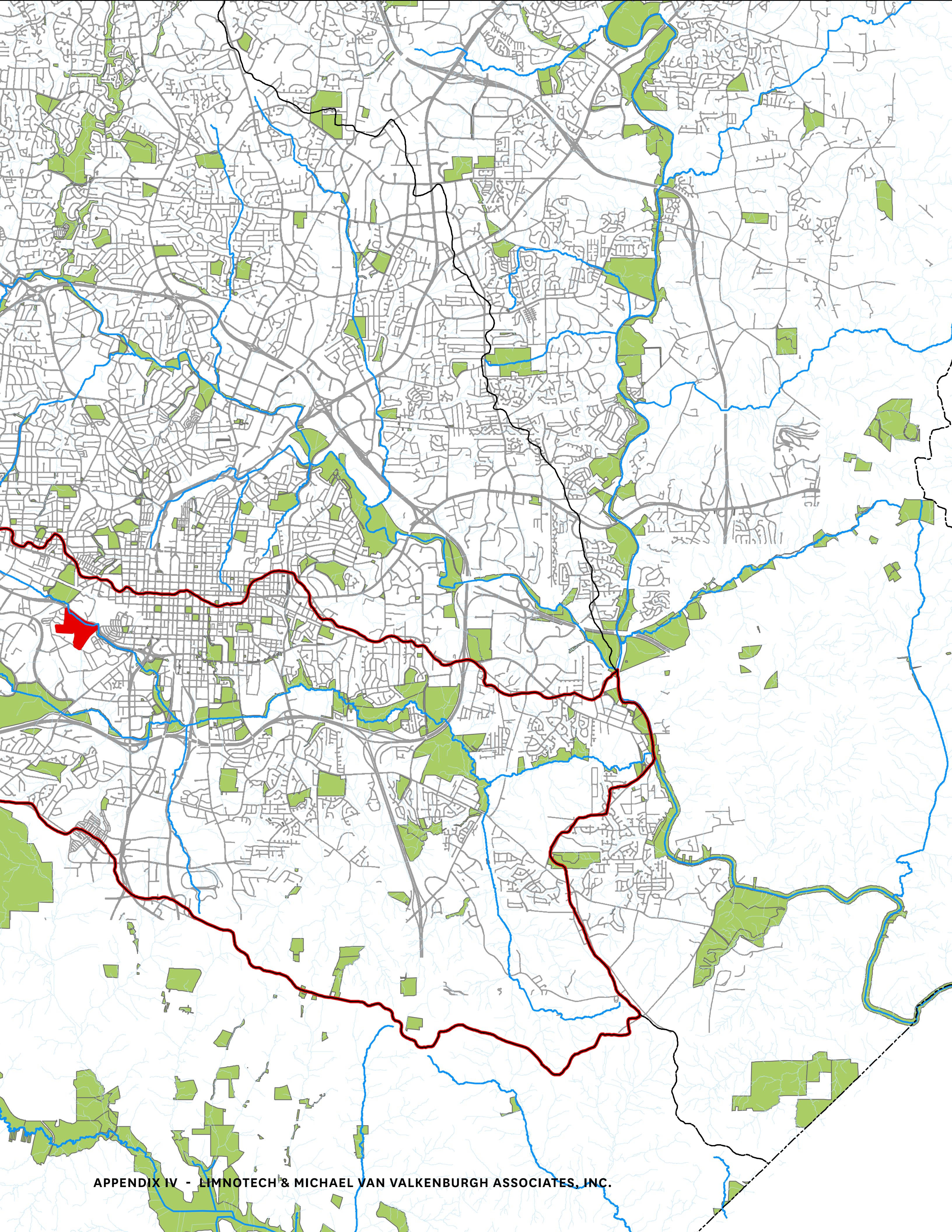
Source:

LimnoTech

Michael Van Valkenburgh Associates, Inc.

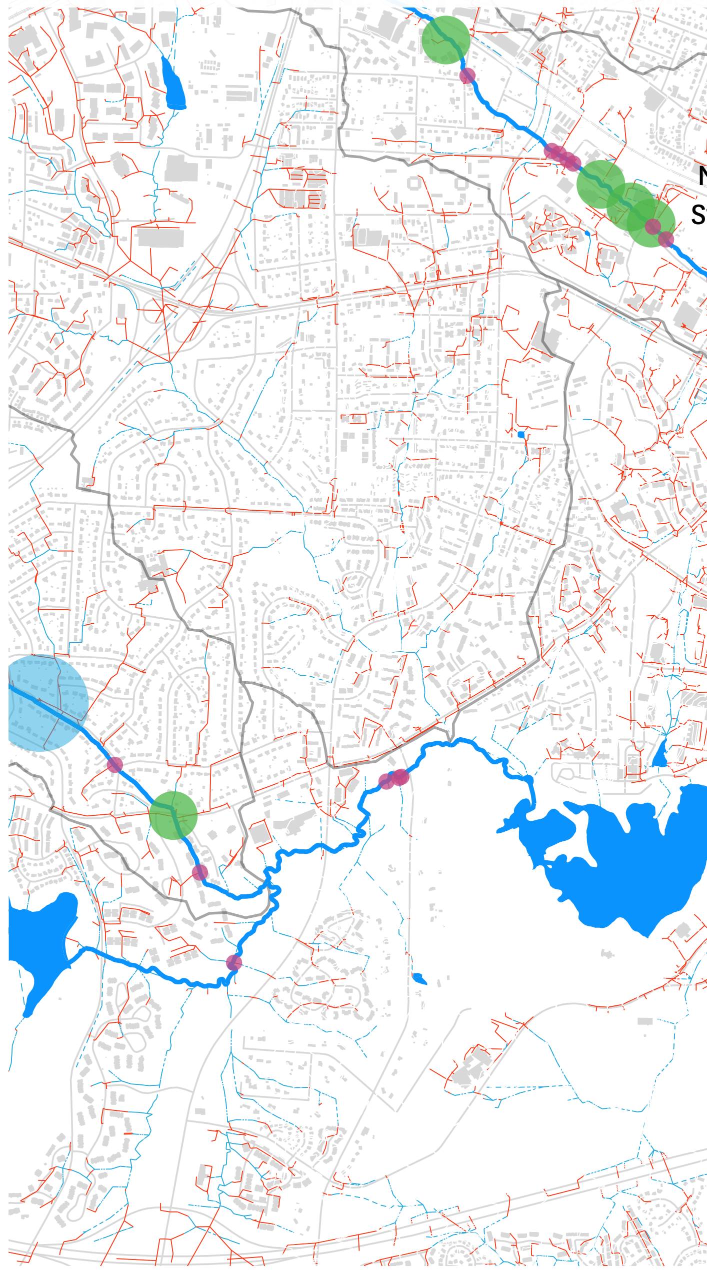
Context

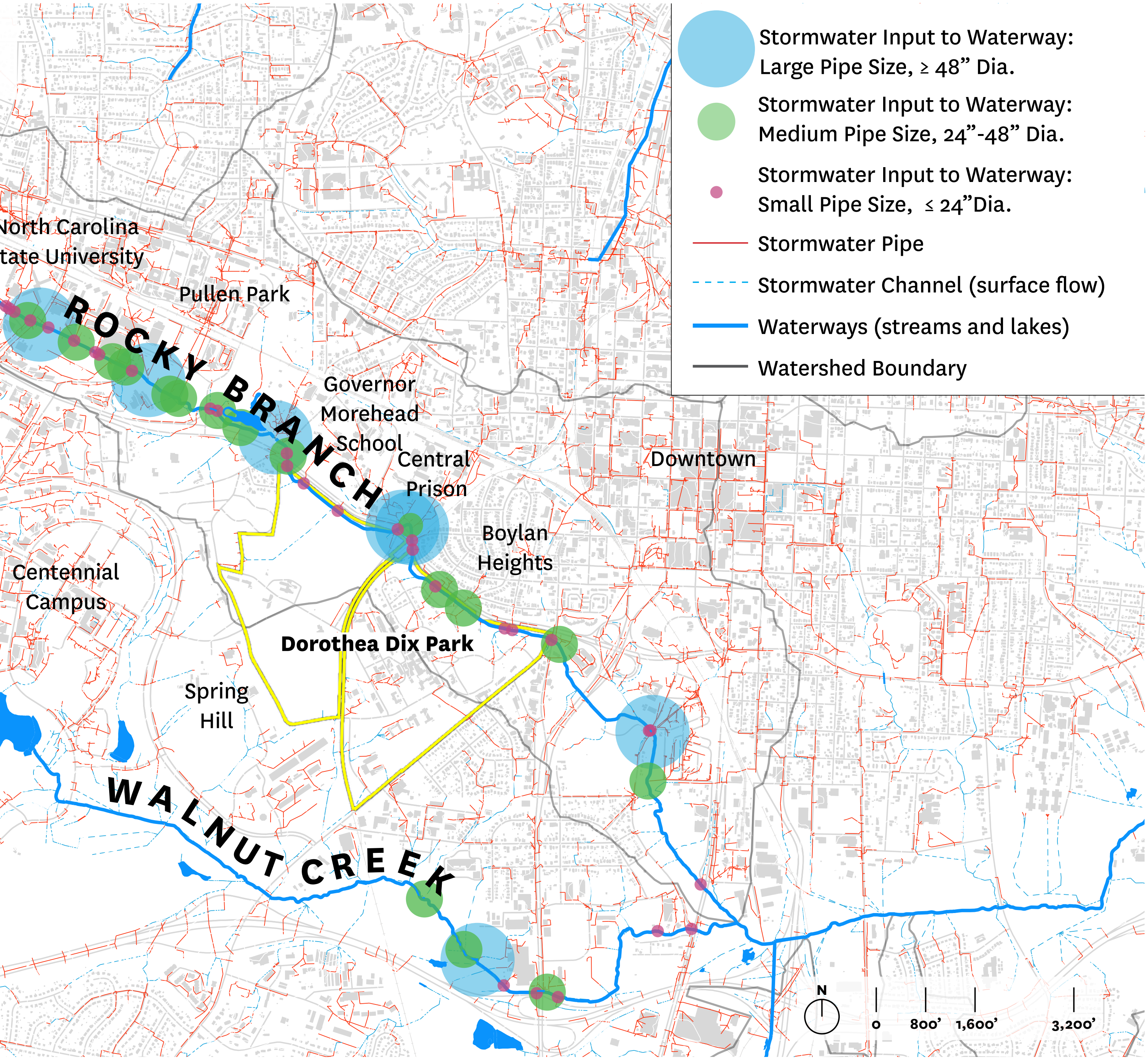

Wake County Hydrography
Stream Corridors/ Sub Watershed
Walnut Creek Watershed
Major Streams
Dix Hospital Site
Streams
Public Open Space
Raleigh_Roads_2015
0 0.5 1 2 Miles



Existing System

GEOMORPHOLOGY, VEGETATION, HYDROLOGY
Regional Watersheds
References: Raleigh IMAPS, Raleigh Open Data




Stormwater Input to Waterway:
Large Pipe Size, ≥ 48" Dia.
Stormwater Input to Waterway:
Medium Pipe Size, 24"-48" Dia.
Stormwater Input to Waterway:
Small Pipe Size, ≤ 24"Dia.
Stormwater Pipe
Stormwater Channel (surface flow)
Waterways (streams and lakes)
Watershed Boundary
North Carolina
State University
Pullen Park
ROCKY BRANCH
Governor
Morehead
School
Central
Prison
Downtown
Boylan
Heights
Centennial
Campus
Dorothea Dix Park
Spring
Hill
WALNUT CREEK
N
0
800'
1,600'
3,200'

Proposed

1. Perched Wetland to Seep System:
Perched Wetlands sized based on 4’ depth and monthly average run-off from catchment area. From perched wetland water flows to constructed seeps then to Rocky Branch. 3 wetlands total.

2. Rocky Branch Channel
Creek bed widened to 100’ - 150’ to accommodate 100 - 500 year storms.

3. Grotto Garden Basin
The grotto garden basin is designed to be a point of prospect and transition. Possibly used for swimming and play, it could reach a depth of over 6’ for swimming and could incorporate treated stormwater with a separate basin. To allow swimming, the basin would need to be a closed system.

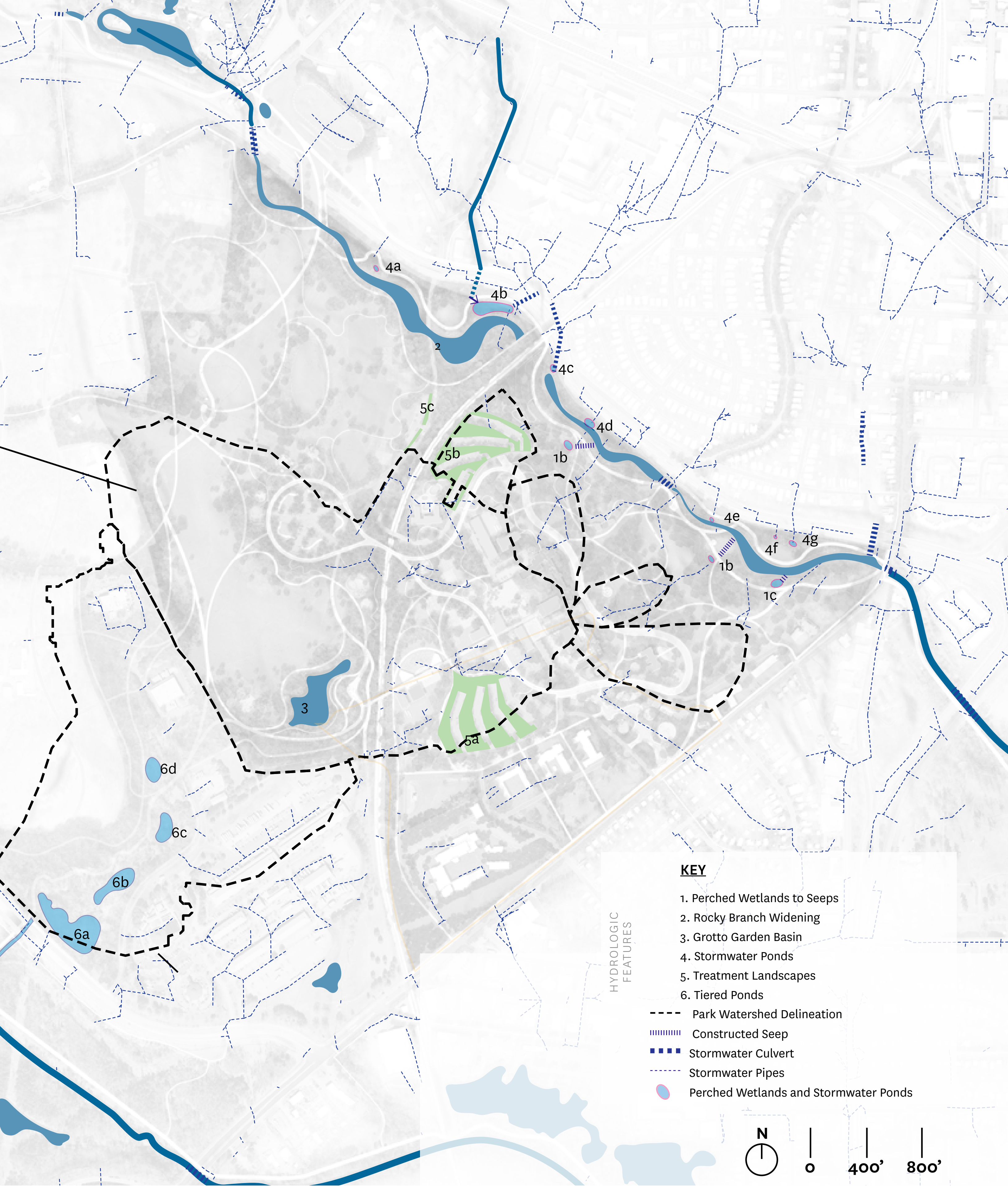
4. Stormwater Ponds
Stormwater ponds act as small catch basins for culverts that carry run-off from adjacent neighborhoods. They are sized based on 4’ depth except 4b which is a deeper pool. The ponds hold water before releasing into Rocky Branch. 7 ponds total.

5. Treatment Landscapes
The treatment landscapes treat localized run-off from impervious park surfaces. They have the capacity to temporarily hold and infiltrate the water slowly during storm events.

6. Tiered Ponds
The ponds lead visitors into the park and will be supplemented by the city’s re-use water if desired. The ponds will maintain water flow and capture run off from the park and the adjacent developments of NCSU. 4 ponds total.

NEXT STEPS

- Establish Groundwater Level at Critical Locations
- Borings to Assess Ground Permeability
- Further Assessment of Culvert Capacity S. Saunders Street

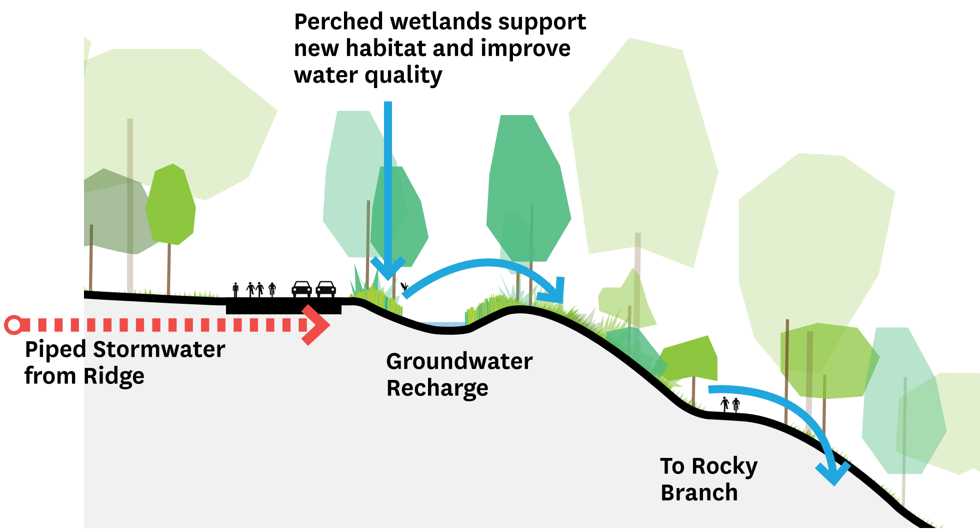


4a
4b
2
4c
5c
5b
4d
1b
4e
4f
4g
1b
1c
3
5a
6d
6c
6b
6a
HYDROLOGIC FEATURES
KEY
1. Perched Wetlands to Seeps
2. Rocky Branch Widening
3. Grotto Garden Basin
4. Stormwater Ponds
5. Treatment Landscapes
6. Tiered Ponds
Park Watershed Delineation
Constructed Seep
Stormwater Culvert
Stormwater Pipes
Perched Wetlands and Stormwater Ponds
N
0
400'
800'

Storm Water Systems

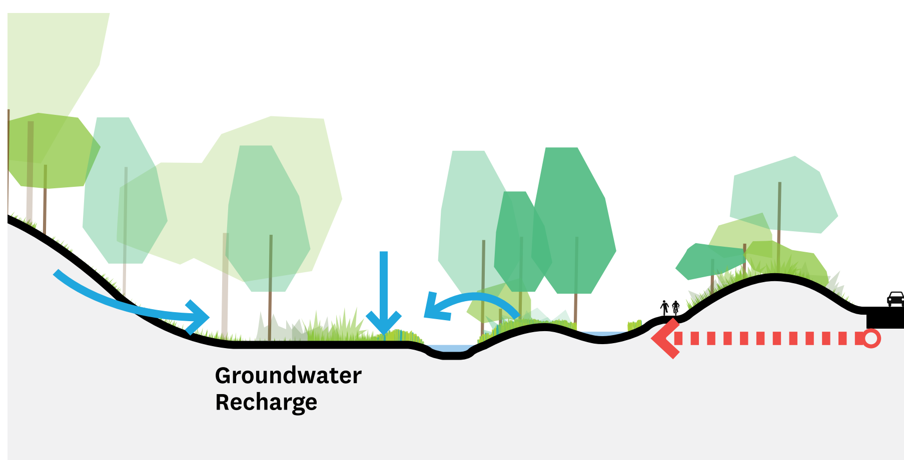
1. PERCHED WETLANDS TO SEEPS

Stormwater is collected in Perched Wetlands from sub-watersheds within Dix Park. This water travels through a constructed seep on its way toward Rocky Branch. The seeps act as opportunities for groundwater recharge while also directing and slowing down water during large storm events.



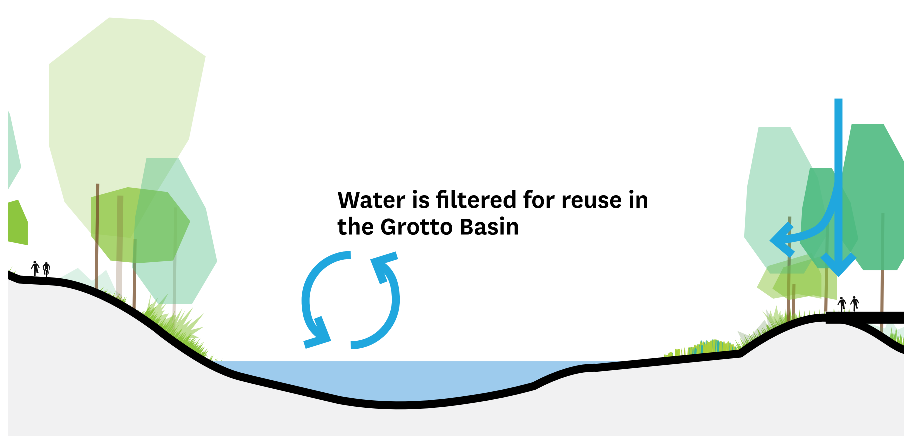
2. ROCKY BRANCH CREEK IMPROVEMENTS

The Rocky Branch Creek bed is widened to 100’ - 150’ to accommodate 100 - 500 year storms. The widened bed helps mitigate erosion during storm events and provides a diverse and rich habitat for wildlife.



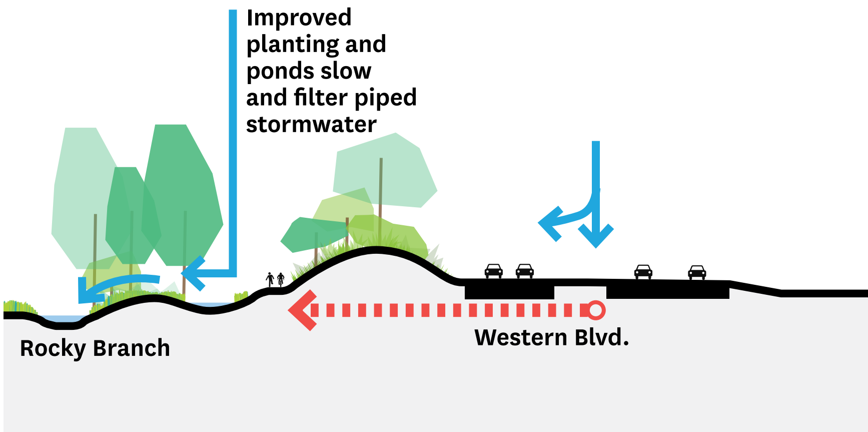
4. GROTTO GARDEN BASIN

The grotto garden basin is designed to be a point of prospect and transition between the park and the State Farmers Market’s loading docks. Possibly used for swimming and play, it could reach a depth of over 6’ for swimming and could incorporate treated stormwater with a separate basin. To allow swimming, the basin would need to be a closed system. It could be a plant or filter system.



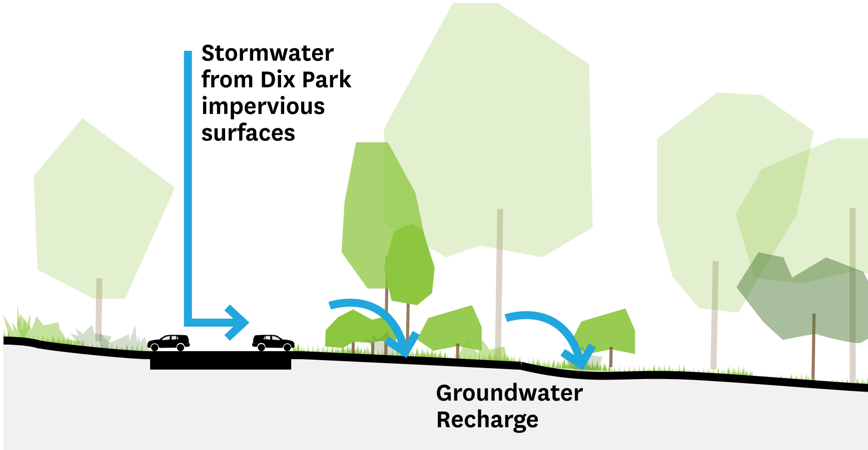
3. STORM WATER PONDS

Stormwater ponds act as small catch basins for culverts carrying run-off from Western Blvd. and neighborhoods north of Dix Park before flowing into the Rocky Branch. Holding water in the pond allows for particulates to settle and improves water quality in the creek.



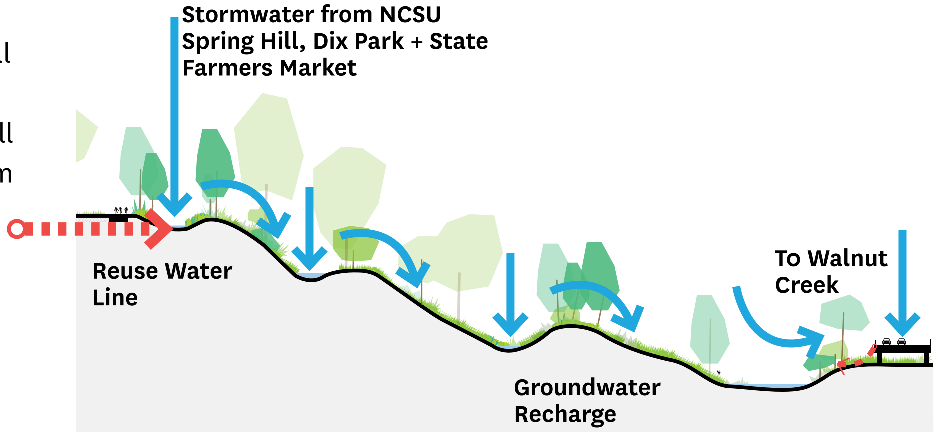
5. TREATMENT LANDSCAPES

The treatment landscapes collect localized run-off from impervious surfaces within the park. In areas like parking spaces, water is collected in adjacent plant beds. Providing lush rain gardens helps to increase infiltration and slow down stormwater.



6. TIERED PONDS

The ponds lead visitors into the park and will be supplemented by the city's re-use water if water year round is desired. The ponds will maintain water flow and capture run off from the park and the adjacent developments of NCSU and the State Farmers Market. the ponds lead to Walnut Creek.



Program Opportunities

NATURAL POOL

The the heard enthusiasm from the public meeting participants regarding expanding water experience at Dix Park, the Design Team investigated best practices in natural pools today.

PRECEDENT STUDY: WEBBER POOL MINNEAPOLIS, MN

PRECEDENT STUDY: BARTON SPRINGS AUSTIN, TX

PRECEDENT STUDY: PARC DES BUTTES CHAUMONT

MVVA

October 10, 2018

White Paper on Natural Swimming Pools

Abstract: The following paper outlines the options and considerations for the use of a natural swimming pool in MVVA's design applications. This documentation was compiled in support f the Dix Park Master Plan. The site offers an opportunity to consider a more natural swimming hole. The following research looks at three case studies. The first is Webber Natural Pool it is a natural swimming pool which uses plant regeneration to clean the water. The second precedent study is an emerging technology called a bio-film system. A industry leader, Bio-Nova recently completed the first residential application in Princeton NJ. This precedent which uses a bio-film system to cleanse the water of contamination. Finally, Barton Springs in Austin, TX provides an example of a natural swimming destination that is not considered a pool.

The design benefits of considering natural swimming pools is twofold. The use of chemicals is detrimental to the human body and the natural environment. Choosing naturally filtered alternatives to the typical chlorine swimming pools helps to reduce the impact these chemicals have on the local water resource. The human body is also 90% microbial cells. Microbes help the body's immune system. Beneficial microbes are the agents in keeping natural swimming pools clean. However, a natural swimming pool can take two forms. The first is the use of a regeneration basin for cleaning the pool's water. The second is the use of a mechanical system to remove bacteria from the water. The first is the method that retains the healthy microbes. The mechanical method devoid the water of life, but does not put in chemical cleaning agents like in a typical public swimming pool. The following case study research also considers a natural swimming destination as a form of natural swimming pool. The natural environment offers opportunities to swim in untreated water all across the country. Understanding the rights of access and liability for such an example helps to put these constructed swimming opportunities in context.

The first case study is Webber Natural Pool in Minneapolis MN. The pool was constructed in July 2015 it was the United State's first public natural swimming pool. The pool is 21,000-square-foot overall. It cost $7 million to build and has a wading area and a deeper swimming area. Both areas have zero-depth entry (ie. slopes that do not exceed 1:12). The other amenities include four lanes for lap swimming and a faux-wood diving platform. The pool uses no chemicals, instead every 12 hours water is pumped through the regeneration basin or wetland. The regeneration basin uses plants, rocks and filter fabrics to clean the water. There is also a skimmer surface cleaner for the swimming area. The pool's carrying capacity is 500 people. The pool does not charge for entry but does charge for lap swim. The site of the pool was actually a historic swimming hole which had been replaced by a modern pool in 1979. When that pool reached the end of its useful life the city wanted to revisit the historic precedent. Constructing the pool required an exemption from the city and state health departments because the use of chemicals for pool cleaning is a Minnesota state law. The pool took 10 years to realize from planning to opening. The pool offers free swimming lessons to lesson the risk of drawing. Landform was the landscape architect on the projects.

Pool Stats (https://www.landform.net/projects/webber-park-natural-swimming-pool/):

- 16,800 square foot Swimming Area and Lap Pool.
- 4,500 square foot Wading Pool.
- 16,250 square foot Regeneration Basin for natural filtration with plants and microbes providing biological cleaning of the water. There are over 7,600 plants and 36 different species of plants within the regeneration basin.
- 2,950 square foot multi-purpose, temperature controlled "Bathhouse" with common spaces, restrooms, sand beach play areas, grassy lounge areas and outdoor pool-side showers.

Benefits of this method: The regeneration basin is a part of the larger site aesthetic. The installation of the regeneration basin is generally less expensive than the installation of a mechanically cleaned natural pool. It is also a habitat area for wildlife. It eliminates the need for chemical cleaners.

Negatives of this method: The pool is in a delicate balance and the regeneration basin takes a long time to remove high levels of bacteria. Therefore, this pool can be closed for long amounts of time while the system rebalances. The regeneration basin requires maintenance and upkeep like any constructed wetland area.

The second case study is the biofilm reactor technology from Bio-Nova. The first residential pool to be built with this system, BioFlow4™, was in Princeton, NJ and was completed summer 2018. This 2000 sf swimming pool is 12' deep. This system is more economical, compact and efficient at controlling water quality. A newer more advanced system is scheduled for release for use in Summer 2019 by Bio-Nova. This technology is anticipated to evolve in the coming years with improved efficiency and larger applications. The system is compact enough that it does not requires any type of remediation basin, unless coupled with a storm water treatment area or an untreated, natural pond adjacent to it for aesthetic interest.

The third case study is Barton Springs in Austin, Tx. The Barton Spring Pool is fed from the Edwards Aquifer located in Austin's Zilker Park which is a city-owned park. It is a spring fed swimming hole used for over 200 years. The Edward springs historically sprung from the ground like fountains. Today at Barton Spring Pool, over 27 million gallons of fresh water a day emerge from the active spring. The pool itself is 900 feet long and dammed on either end. The water flows into Ladybird lake. Although the swimming pool is loved by residents, the pool has been an important point of discussion in the environmental debate of protecting water resources in Texas. The swimming hole is often closed due to high levels of harmful bacteria. These episodes of contamination have been traced to urbanization around the springs and the variable, often very fast recharge of the Edward Aquifer.

Pool Stats:

- 3 acres or 130,680 SQFT
- Average Temp 68 – 70 degrees F
- Depth 0 – 18'
- Fed from Underground Springs

For the application in Dix Park, both the first and second system could be explored. Although the site had a history of active springs, the ground water level is no longer at the point where it could sustain any large-scale pool like at Barton Springs. In considering the first case study, which includes the plant regeneration zone, Dix park has the acreage necessary to remediate and offer a large swimming pool. However, this system is more sensitive to imbalances such as the introduction of fecal matter from visitors or wildlife. The pool may have to be closed for long amounts of time to allow the water to rebalance via the regeneration basin. If this system were to be used with stormwater, a stormwater treatment pond would be needed in addition to the plant regeneration zone. This means 2/3 of the ponds would not be swimmable and could require restricted access with fencing and signage. The manufacturer of these systems recommends a depth of at least 6' for a "good fraction" of the pool's surface area.

The second system, the biofilm, could have useful application at Dix Park. This system is more versatile, affordable (per the manufacturer) and less susceptible to exterior factors offsetting the balance of the water's purity because it is filtered more readily. These pools can take any shape but have the capacity to look like a traditional swimming pool or natural pond. Garnishing with plant material and additional, non-swimming pools is common. In both applications, the amount of phosphate in the water is the critical indicator of water purity. When further site analysis is conducted for the construction of the pool, the stormwater or city water source must be assessed to determine its level of phosphate.

Good Sources:

HCMA Architecture and Design. http://hcma.ca/wp-content/uploads/2016/04/Natural-Swimming-Pools-Report_HCMA.pdf

"How the Chemical-Free Public Pool Came to the U.S." Nov. 5, 2015. City-Lab. https://www.citylab.com/environment/2015/11/how-the-chemical-free-public-pool-came-to-the-us/413386/

Eckhardt, Gregg. The Edwards Aquifer Website. https://www.edwardsaquifer.net/barton.html

Auston parks and Recreation. Parton Springs Pool. http://www.austintexas.gov/department/barton-springs-pool

November 30, 2017

Observations from our site visit are listed below. We'll include these in our Discovery tech memo as well. Site photos have been uploaded to the link you provided – these should be georeferenced fairly well, but let us know if that's not the case.

Notes and observations:

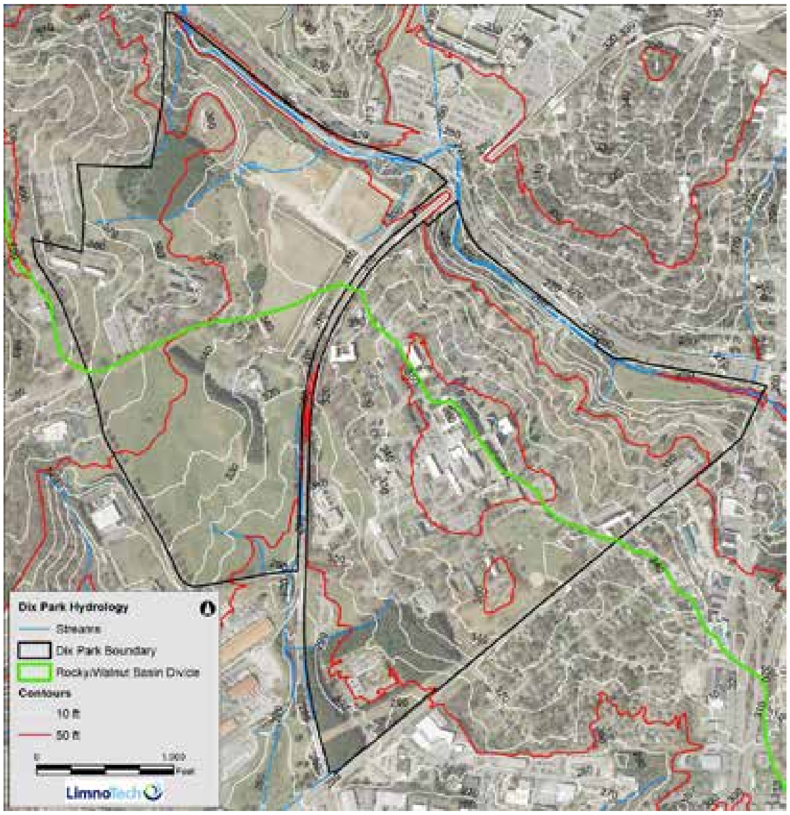
- Rocky Branch creek West of Hunt Drive: Cross section is highly constrained, deeply incised as channel is responding to urbanization and a high energy flow hydrograph. Highly armored channel base, steep banks and toe erosion, bank and vegetation undercutting. Evidence of extremely high velocities of flow and transport of debris in channel, and significant debris flows outside of the channel. Channel bench and floodplain are also constrained, by Western Blvd to the north and soccer fields/landfill to the south. Under low flow conditions some riffles but also stagnant pools with long residence time, surface foams and odors associated with low DO. Floodplain has a dense understory with notable mature trees.
- Rocky Branch Creek East of Hunt Drive: similarly constrained, evidence of high energy flows and debris transport, incised channel, constrained by Western Blvd and the Rocky Branch Trail, with extensive engineered armoring used to shore up the banks adjacent to the Rocky Branch Trail. High floodplain bench, evidence of high velocity floodwaters and debris accumulation in floodplain. Diagonally-configured grade control structure upstream of Boylan Ave.
- Rocky Branch Creek east of Boylan Ave: Creek opens up, still evidence of high velocities and debris movement, much more accessible floodplain and potential to create open water/wetlands on the south side of the creek.
- Rocky Branch opportunities: throughout, opportunities to:
    a. open up the creek cross-section to reduce energy of flow under high flow conditions, create diversity of flow pathways and more varied vegetation than current dense understory scrub/shrub mix, remedy bank erosion and channel instability, and
    b. modify the low-flow channel, possible inset channel to increase velocity of flow under low-flow conditions, add aeration, minimize stagnation, increase diversity of channel substrate types.
    c. Consider creating a channel meander that occupies part of the current soccer park/landfill area, mix of open water, emergent vegetation, scrub/shrub that complements the existing channel. Existing channel should probably remain in some form (probably modified as described above) to handle extreme high flow events.
    d. East of Hunt Drive, consider lowering the trail, opening up the floodplain section, remove invasives and improve access and visibility to the creek. Coordinate with up-slope stormwater management (described below).

- Walnut Creek: Doug, Dendy and I walked Walnut Creek from the Farmers Market to Lake Raleigh. Walnut Creek downstream of Lake Raleigh is a much more open channel with a broad channel cross-section and much more open access to the floodplain bench. Channel banks vary from sloped to steeper and eroding in some locations. Floodplain is wooded with less-dense understory than the Rocky Branch and a more open section for conveyance of floodwaters. Channel has areas of pools and riffles, with sufficient low-flow to maintain relatively high water quality. Some evidence of stream silting and bank erosion in the more downstream locations we surveyed.

- Walnut Creek Tributaries: We traced two locations where Dix Park site drainage makes its way to Walnut Creek. Low dry weather flows, but sizing of flow conveyance under the Walnut Creek Trail gives an indication of high stormwater flows, notable armoring, erosion and sediment deposition near culverts.

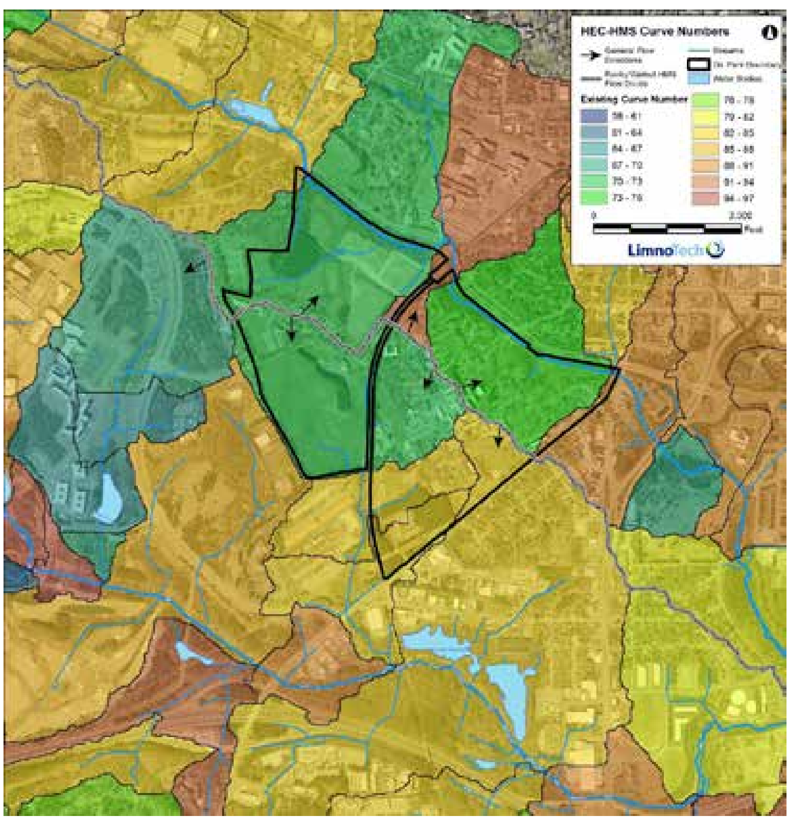
- Lake Raleigh: The Lake Raleigh Dam is in good condition and is architecturally interesting - this is a fascinating spot, channel improvements downstream of the dam could increase value as a destination. See photos.

- Dix Park site stormwater drainage:
    - Major drainage pathway observable along the rail line
    - Some indications (topographic depressions) in the great field area suggestive of historic site drainage
    - Visible site drainage fields adjacent to Hunt Drive
    - In areas around the hospital and to the NE, stormwater drainage infrastructure is apparent, some failing (sinkhole, outwash area near Boylan), vegetation mix suggests shallow groundwater seepage upgradient of the Rocky Branch trail. Opportunities throughout to capture stormwater, infiltrate, support reestablishment of native sedges and grasses on the site (per AES).
    - Throughout the site, soils are tight clays with very shallow vegetation, surficial tree roots, thin grasses (see photos of rail cut soils and surface soils)
    - Other broken/failing stormwater outlets: buried outlet near Hunt Drive and Western, "spring" near Blair Drive is buried parking lot runoff outfall.



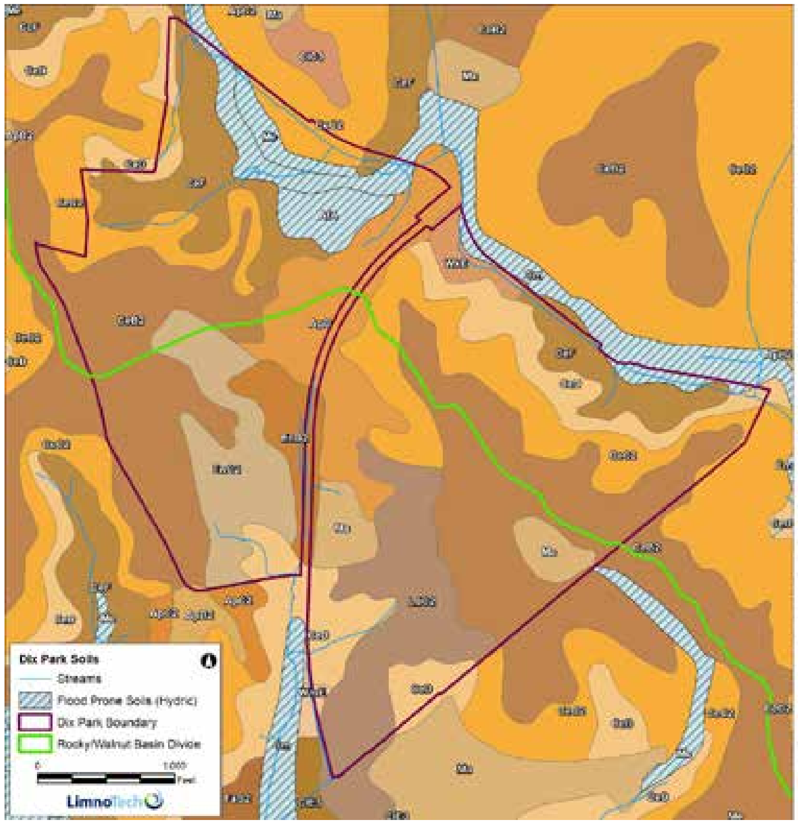
Limnotech, 01/17/2018
10' & 50' Contours

1



Limnotech, 01/17/2018
Curve Numbers -
Stormwater Runoff
Potential

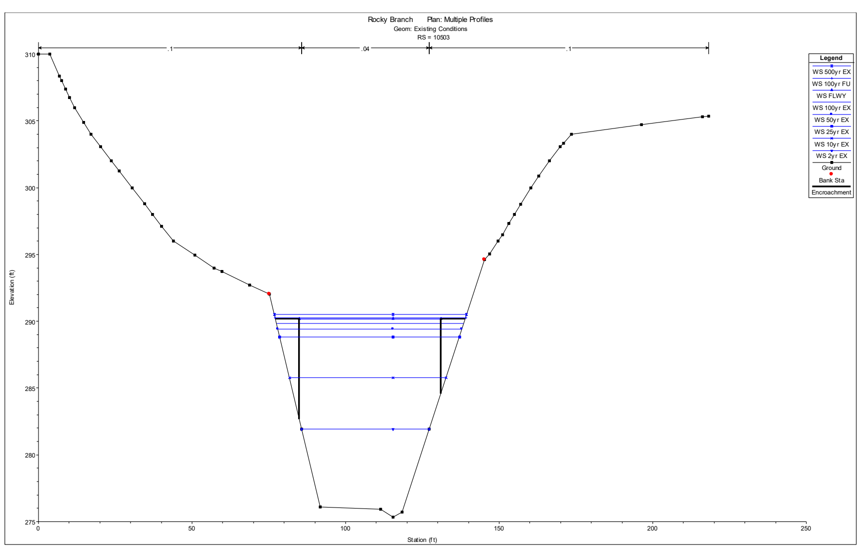
2



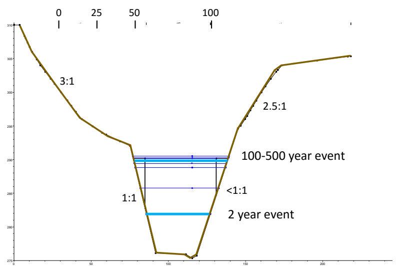
Limnotech, 01/17/2018
Soils Map

Soil Label	Description
AfA	Altavista fine sandy loam, 0 to 4 percent slopes
ApB2	Appling sandy loam, 2 to 6 percent slopes, eroded
ApC2	Appling sandy loam, 6 to 10 percent slopes, eroded
ApD	Appling sandy loam, 10 to 15 percent slopes
CeB2	Cecil sandy loam, 2 to 6 percent slopes, eroded
CeC2	Cecil sandy loam, 6 to 10 percent slopes, eroded
CeD	Cecil sandy loam, 10 to 15 percent slopes
CeF	Cecil sandy loam, 15 to 45 percent slopes
ClC3	Cecil clay loam, 6 to 10 percent slopes, severely eroded
ClE3	Cecil clay loam, 10 to 20 percent slopes, severely eroded
Cm	Chewacla soil, usually found in low-lying areas
EnC2	Enon fine sandy loam, 6 to 10 percent slopes, eroded
EnD2	Enon fine sandy loam, 10 to 15 percent slopes
FaB2	Faceville sandy loam, 2 to 6 percent slopes, eroded
LdC2	Lloyd loam, 6 to 10 percent slopes, eroded
Ma	Made land
Me	Mantachie soil, usually found in low-lying areas
WkE	Wake soil, 10 to 25 percent slopes
WmE	Wedowee sandy loam, 15 to 25 percent slopes

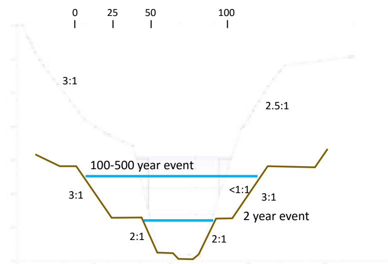
Limnotech, 01/18/2018
Rocky Branch - Existing Conditions



Limnotech, 01/18/2018
Rocky Branch -
Symmetrical Modified
Condition



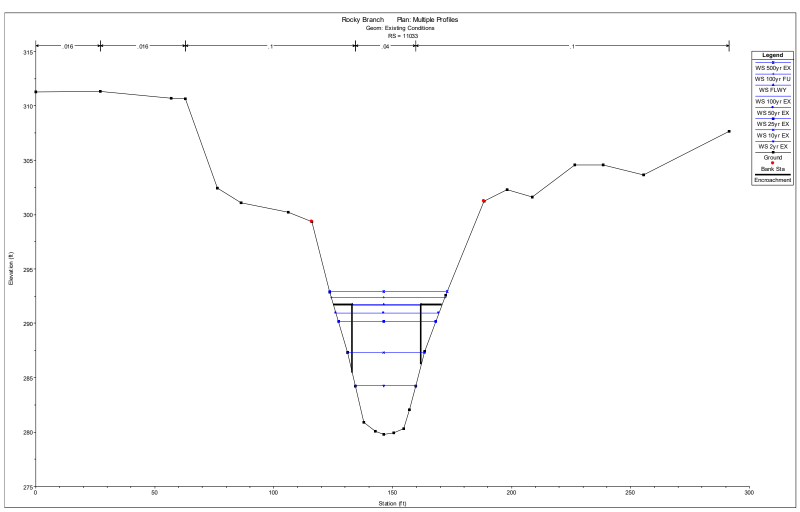
Existing condition: Section 10503



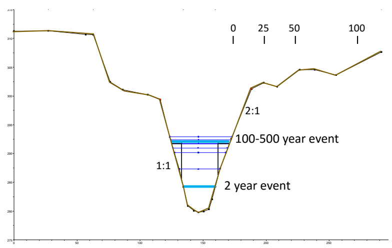
Modified condition: symmetrical expansion of channel section, create floodplain bench, inset channel

5

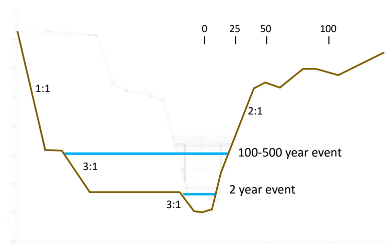
Limnotech, 01/18/2018
Rocky Branch - Existing
Conditions



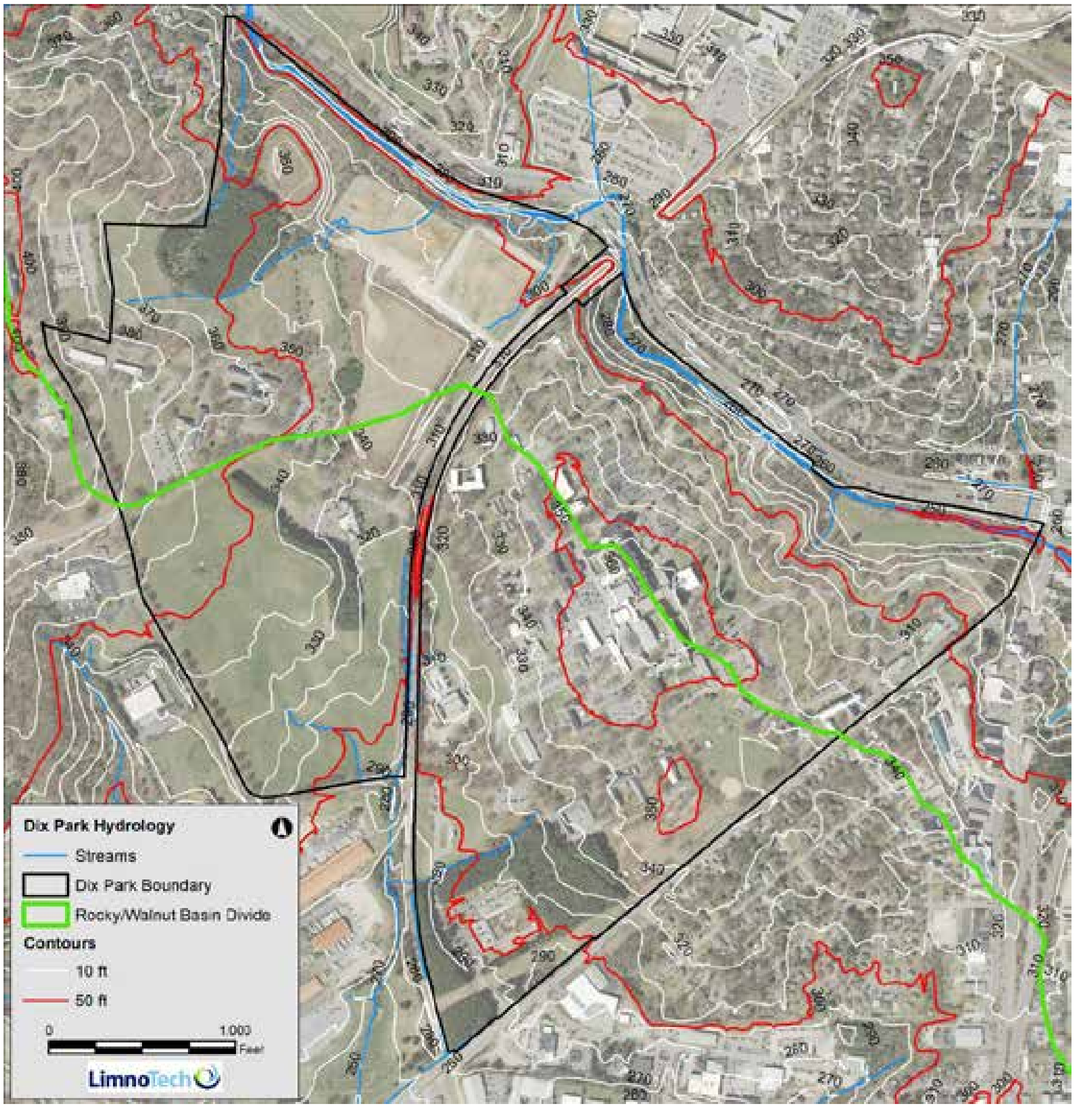
6



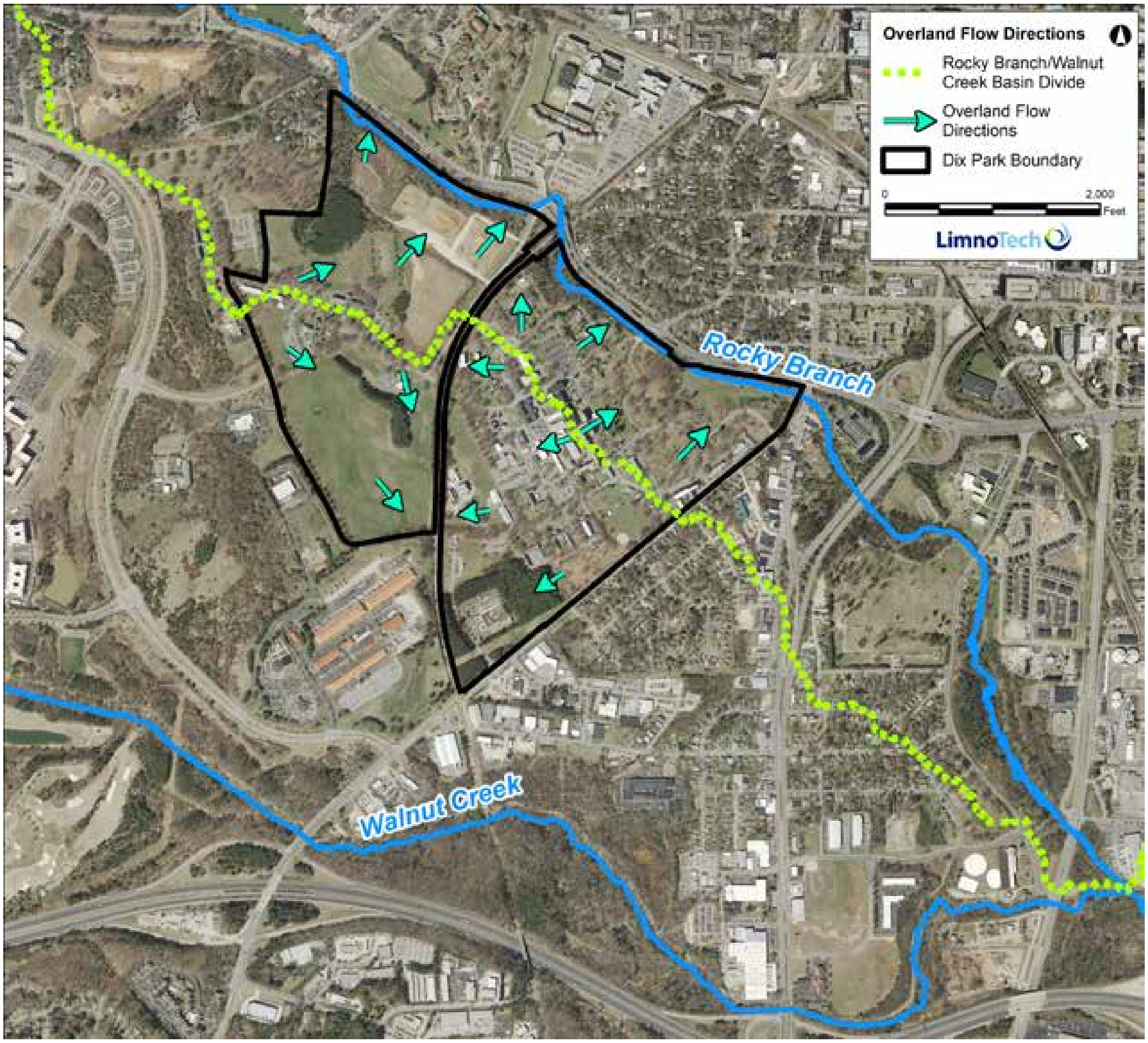
Existing condition: Section 10503

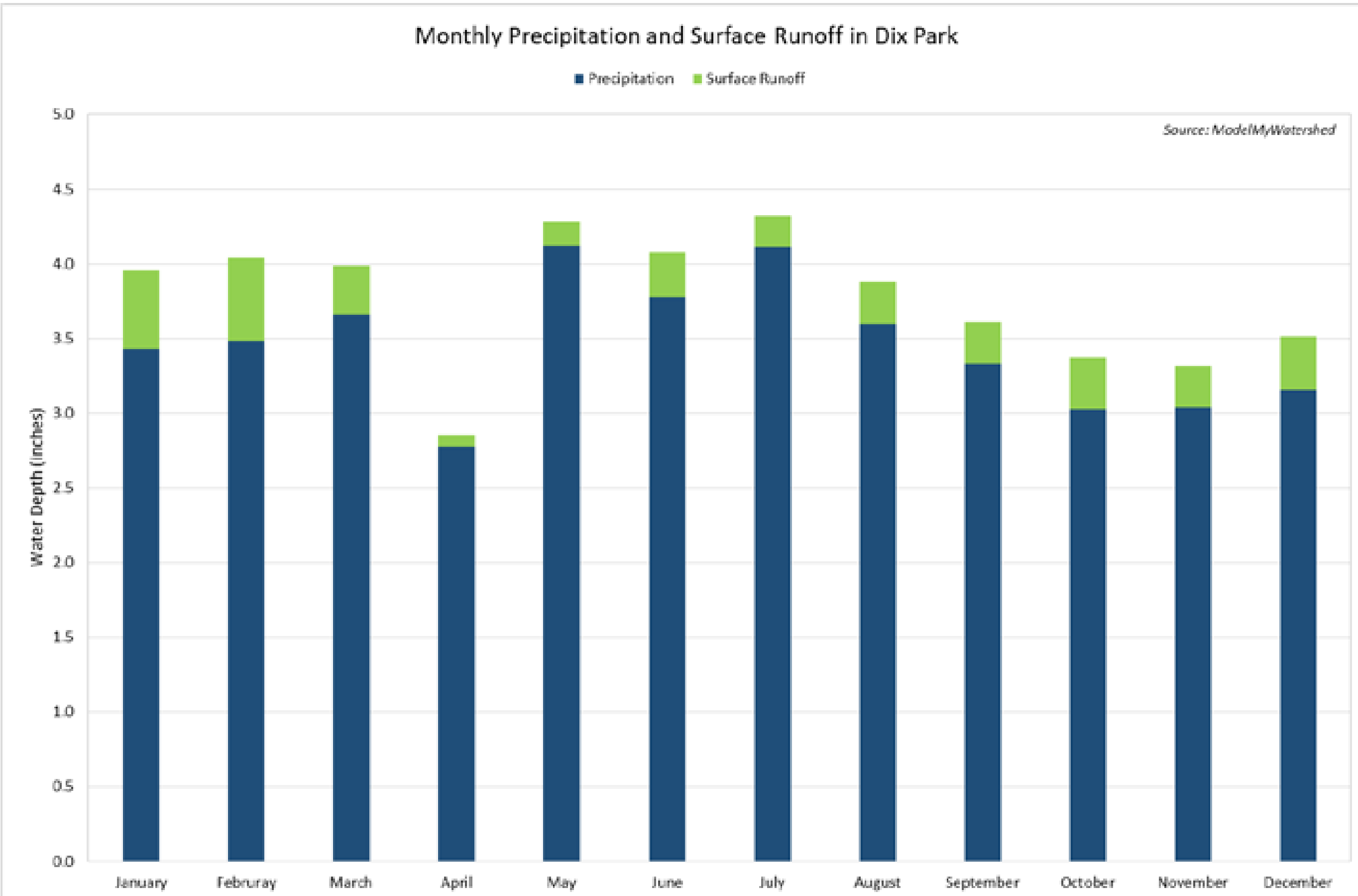


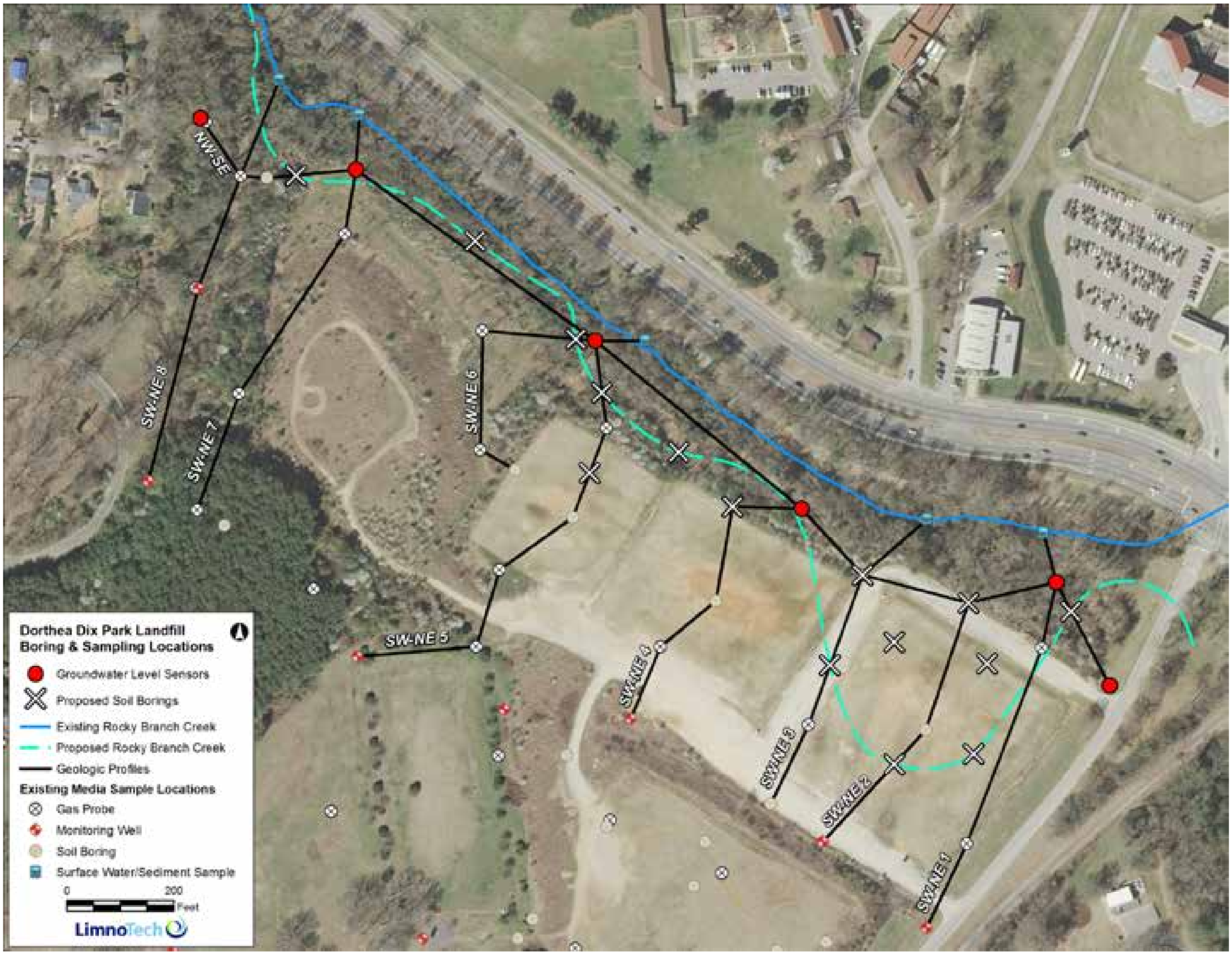
Modified condition: asymmetrical expansion of channel section, create floodplain bench, inset channel



Limnotech, 01/17/2018
10' & 50' Contours


Overland Flow Directions
Rocky Branch/Walnut Creek Basin Divide
Overland Flow Directions
Dix Park Boundary
0
2,000
Feet
LimnoTech
Rocky Branch
Walnut Creek


Monthly Precipitation and Surface Runoff in Dix Park
Precipitation
Surface Runoff
Source: ModelMyWatershed
Water Depth (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
January
Februray
March
April
May
June
July
August
September
October
November
December


Dorthea Dix Park Landfill
Boring & Sampling Locations
Groundwater Level Sensors
Proposed Soil Borings
Existing Rocky Branch Creek
Proposed Rocky Branch Creek
Geologic Profiles
Existing Media Sample Locations
Gas Probe
Monitoring Well
Soil Boring
Surface Water/Sediment Sample
0
200
Feet
LimnoTech
NW-SE
SW-NE 1
SW-NE 2
SW-NE 3
SW-NE 4
SW-NE 5
SW-NE 6
SW-NE 7
SW-NE 8

July 2, 2018

SAMPLING STRATEGY TO CHARACTERIZE GROUNDWATER & SURFACE WATER INTERACTIONS IN THE LANDFILL AREA OF DIX PARK

1. Monitor Groundwater Level

   The interaction between the groundwater and the Rocky Branch will be important to the project, so it will be critical to characterize depth to water table at locations both adjacent to and upgradient from the stream. The locations and spacing of several of the existing monitoring wells were judged to be sufficient to provide this characterization. The water level in approximately six of the existing monitoring wells will be measured continuously using a level sensor, such as an In-Situ Level Troll. The proposed monitoring well locations are shown on the attached map. Measurements will be recorded every 15 minutes over a period of time long enough to determine seasonal fluctuations. A level sensor will also be installed in the stream to determine seasonal fluctuations in surface water elevation.

2. Stream Investigation

   Determine the static groundwater elevation in the stream and stream bank, using a portable Henry sampler to determine if the stream in its present location is gaining or losing. Analysis of discrete groundwater samples collected with the Henry sampler will assist with determining the potential impact of groundwater on the stream. Data collection will include site specific evaluations of groundwater elevations immediately below the stream bed relative to surface water level at a minimum of ten locations to identify gaining and losing portions of the stream. If possible, a sample will be collected from the stream bank at each stream sampling location. Screening level pore water samples also will be collected at each location (as feasible) and will be analyzed for volatile organic compounds (VOCs) and metals.

3. Geophysical Survey

   If possible and feasible, a geophysical survey could be beneficial in determining depth to bedrock across the site. One potential method that may be applicable and cost effective at this site is Horizontal-to-Vertical Spectral Ratio (HVSR) passive seismic. This geophysical method allows one to determine glacial drift/overburden thickness if there is a strong enough acoustic impedance contrast between the drift/overburden and underlying bedrock. The HVSR method uses naturally occurring and man-made seismic noise which is detected using a single station, three-component seismometer to record the ambient seismic noise. HVSR results would need to be calibrated to at least one bedrock boring/well location. If appropriate at this site, the HVSR method has many advantages, including low cost, ease of use, one-man operation, single station, portability, noninvasive, quick, minimal data processing, its specificity to a single interface (bedrock surface) and its ability to be used in culturally noisy areas. Other potential methods for conducting the survey could be electrical resistivity, ground penetrating radar and frequency domain electromagnetic methods, but these would need to be researched further for applicability and feasibility. A successful survey would provide depth to bedrock information across the project area of the landfill and could potentially reduce the number of soil borings required (see Item 4 below).

4. Soil Borings

   Although numerous soil borings have been installed at the site, many are very shallow and do not extend to the bottom of the waste zone. Also, none of the soil borings were advanced to bedrock. Therefore, soil borings are proposed at approximately 15 locations within the proposed excavation area for the new stream. The borings will be advanced to bedrock, if possible. The soils will be continuously logged for physical characteristics and samples will be collected at appropriate intervals based on visual review and photoionization detector readings. Approximately three samples will be collected from each boring to depth of excavation (which will include the waste zone). The samples will be analyzed for VOCs and metals to provide information on contaminated soils. The zone of waste material will be noted in each soil boring. The proposed boring locations are shown on the attached map. If the presence of fractured bedrock in the subsurface makes boring difficult, an alternate approach could include vertical probing

Perched Wetland/Seep Summary

Item 1: Existing topography and PW Locations

- Based on existing topography, two of the four perched wetlands on north end may not be optimally placed to capture enough runoff to be wet all year round with an ideal water depth:
  - Move PW-B northwest approx. 300 ft to increase drainage area
  - Move PW-D a little further down gradient to increase drainage area
  - In addition to the two listed above, the latest design shows 4 parking lots near PW-A, these lots could increase the runoff volume if piped to PW-A
- Perched wetland in the Big Field can also be moved down gradient
  - Capture surface runoff and stormwater inputs from east of rail road with limited uphill pumping requirements

Item 2: Estimated sizes based on precip only

- Sizes based on average monthly runoff – 4 ft deep wetlands (can be adjusted)
- Sizing based on peak runoff would result in either greater SA or greater depth
  - If designed for peak runoff (occurring in February), additional stormwater inputs will be required to make up water volume difference during the rest of the year for ecological viability

Perched Wetland/Seep Summary

Item 3: Additional stormwater inputs required?

- Size based on average monthly runoff
- April - July = greater ET & less runoff, may need to be augmented with other stormwater sources to keep wetland ecology thriving
- Quantify this by looking at the difference between average monthly runoff and actual runoff by month
- Could install depth monitoring sensors for better system management during critical months

Item 4: PW/Seep design feasibility

- First reaction: I think the PW → Seep is a reasonable and workable idea
- Unknown: Where groundwater level is in this side of the park, no soil borings to assess permeability
  - Soils map shows sandy loam @ 15-45% slopes – higher slopes means less contact time with landscape and less infiltration
- Benefits of a secondary PW or basin downstream of seep for larger events would allow for slow release into the pool area. Ultimately we'll need to design the release for the downstream culvert's capacity at S. Sander's St.

Perched Wetland Location	Drainage Area (ac)	Average Monthly Runoff (ft^3)	Surface Area (ft^2)	Depth (ft)
A	3.4	3,779	945	4
B	6.3	8,506	2,127	4
C	4.1	4,513	1,128	4
D	5.1	8,123	2,031	4
A w/Added Impervious	7.3	12,337	3,084	4
B Moved	7.4	9,922	2,481	4
D Moved	11.4	13,473	3,368	4
Big Field	84.8	98,020	24,505	4
Big Field Moved	112.2	117,811	29,453	4

- Table results from ModelMyWatershed
- Drainage Areas estimated from existing 2 ft contours

ModelMyWatershed Results for Ponds 1-4

*Area includes DA contribution to Ponds 1-4 as well as portion draining The Big Field.
Watershed delineation based on HEC-HMS Subbasin, 2-ft Contours, and stormwater network
Assumes the Big Field wetland is part of the tiered pond system

DA (ac)	185.6
Average Monthly Runoff (ft3)	206,015
Pond Size (1 month residence time)	
Number of Ponds	4
SA (each, ft^2)	12,876
SA (each, ac)	0.30
Depth (each, ft)	4

Assumes same size for each pond, can be adjusted such that Runoff volume is balanced throughout all 4

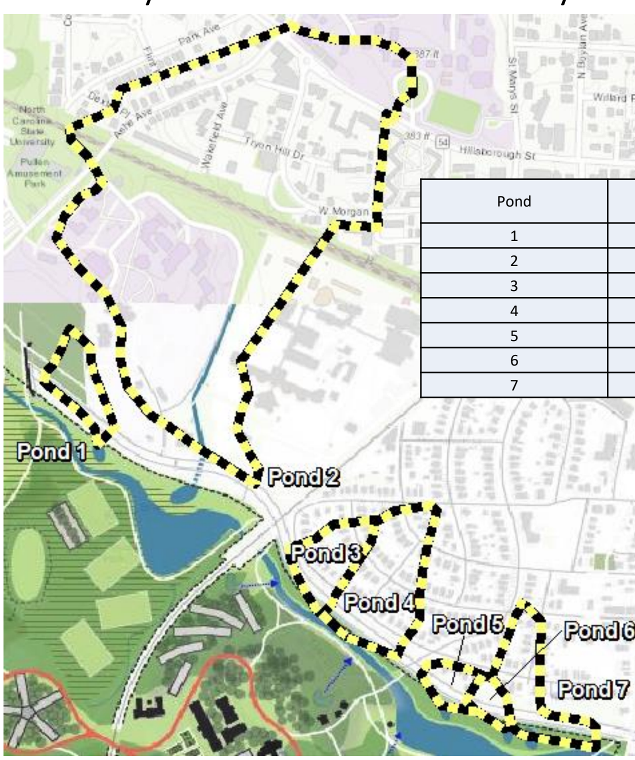
ModelMyWatershed Results for Ponds 1-4

*Area includes only DA contribution to Ponds 1-4.
Watershed delineation based on HEC-HMS Subbasin, 2-ft Contours, and stormwater pipe network
Assumes the Big Field wetland is not part of the tiered pond system

DA (ac)	73.4
Average Monthly Runoff (ft³)	87,910
Pond Size (1 month residence time)	
Number of Ponds	4
SA (each, ft²)	5,494
SA (each, ac)	0.13
Depth (each, ft)	4

Assumes same size for each pond, can be adjusted such that Runoff volume is balanced throughout all 4

ModelMyWatershed Results for Rocky Branch Stormwater outfall ponds



Pond	DA (ac)	Average Monthly Runoff (ft³)	Surface Area (ft²)	Depth (ft)
1	3.5	3,444	861	4
2	88.5	126,293	31,573	4
3	4.4	6,242	1,560	4
4	9.9	11,993	2,998	4
5	1.9	2,330	583	4
6	1.4	1,393	348	4
7	5.9	5,718	1,430	4

*Drainage areas based on 2-ft Contours and stormwater pipe network. Ponds to intercept stormwater inputs into Rocky Branch and slowly release