3 GREEN INFRASTRUCTURE CONCEPTUAL PLANS FOR ‘CATCHMENT 2’

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Introduction/Abstract/Executive Summary

The purpose of this report is to outline three Conceptual Plans to engage AUC campuses in mitigating storm water challenges in the Proctor Creek Watershed in Atlanta, Georgia.

Though this report outlines possible methods of storm water management, the planning process must be continued by communicating with the academic, governmental, and nongovernmental property owners to collaborate in resolving the flooding and public health issues connected with flooding. Much of the area in Catchment 2 is high elevation and currently flows downhill to the stadium. We propose a series of cisterns and recreational floodplains to mitigate this problem. We have tried to keep most of the water off of the Clark Atlanta University (CAU) Stadium, but it will be seen that some rain from major rain events, 25-year to 100-year, will eventually end up at one of the lowest elevations in the area, the CAU stadium area.

Implementation of these Conceptual Plans will require that someone nurture collaboration and cooperation among the public and private stakeholders. Once they agree to consider moving forward, more complex hydrological analysis will be necessary along with cost/benefit analyses.

This report encompasses Conceptual Plans for the Interdenominational Theological Center (ITC), parts of the Morris Brown College campus, parts of the Clark Atlanta University campus north of Parsons Street and other properties uphill and east of ITC. It conceptualizes how to capture 4 million gallons of storm water runoff – 2.3 million gallons in cisterns and 1.7 million gallons in greenways.

Background

The institutions included in the AUC (Atlanta University Center) in the West End neighborhood of Atlanta, GA were built in the higher elevated areas of West Atlanta. Unfortunately, during heavy rainfall, massive flooding occurs as the rain drains through a combined sewer system into downstream lower elevation residential areas such as Vine City and English Avenue. The storm water carries pollutants and trash with it that eventually pollutes the downstream communities. Furthermore, the combined sewer system is overpowered by the rain which causes water and sewage back-up in many of the lower elevation residential areas in West Atlanta.

Sewage overflows exert physical, chemical and biological effects on the receiving environment. This may result in human health, environmental and aesthetic impacts, which can be both acute and cumulative (American Rivers). Such impacts are dependent on the characteristics of the discharge and receiving environment.

Because sewer overflows contain raw sewage, they carry pathogens, which are disease causing organisms. These include bacteria, viruses, protozoa, helminths (intestinal worms), and inhaled molds and fungi. The diseases they may cause range in severity from mild gastroenteritis (causing stomach cramps and diarrhea) to potentially life-threatening ailments such as cholera, dysentery, infectious hepatitis, and severe gastroenteritis. Human health impacts can be dependent on the duration of exposure to, and the levels of pollutants in the overflow. Humans can be exposed to pathogens through direct contact with overflows into homes and businesses and into public areas such as parks, streets, streams, and tributaries. Historically, downstream Proctor Creek residents have used the streams for baptisms, fishing, swimming, and other communing with nature.

Many health problems are associated with back-up sewer systems. Potential human exposure to the pollutants found in sewer overflows can occur through several pathways. According to EPA, the most common pathways include direct contact with waters receiving CSO or SSO discharges, drinking water contaminated by sewer discharges, and consuming or handling contaminated fish or shellfish. However, humans are also at risk of direct exposure to sewer overflows, including sewer backups into residential buildings, city streets, and sidewalks.

The Proctor Creek Community Collaborative Health Survey conducted in English Avenue and Vine City revealed observable mold in 53% of the residences compared with 15% of the homes included in the American Healthy Homes Survey; 32% of the people with current asthma live in a home with observable mold, and 82% of homes had ERMI (Environmental Relative Moldiness Index, a measure of water damage related mold in the home) values greater than 5. In the American Healthy Homes Survey, 25% of homes had ERMI values greater than 5 compared with 82% for the Proctor Creek Survey. Emory University and four community organizations along with other local, state and federal partners conducted the survey supported by Emory's HERCULES Center, funded by the National Institute of Environmental Health Sciences (P30ES019776).

The cost of eliminating CSOs and SSOs throughout the nation is staggering. The wastewater systems of the United States are aging and require significant investment in traditional infrastructure and innovative, non-structural infrastructure to prevent the occurrence of sewer overflows. In its most recent Clean Water Needs Survey (2000), EPA estimated the future capital needs to address existing CSOs at $50.6 billion. In addition, EPA estimated that it would require an additional $88.5 billion in capital improvements to reduce the frequency of SSOs caused by wet weather and other conditions (e.g., blockages, line breaks, and mechanical/power failures).

Literature Review and Field Work

In the beginning stages, aerial maps were collected for the study area (ITC, Morris Brown College, Clark Atlanta University, and the local areas) that depicted elevation, combined sewer lines, and electrical conduits. Furthermore, multiple meetings were scheduled every week to conduct field work by walking around the area with the maps and taking notes on areas where potential green infrastructure can be constructed. Based on literature review and initial field work, we concluded that floodplains will cost less than cisterns per gallon of storm water detained. We chose to retain 2.3 million gallons in cisterns and to detain 1.7 million gallons of rainwater in floodplains and greenspaces.

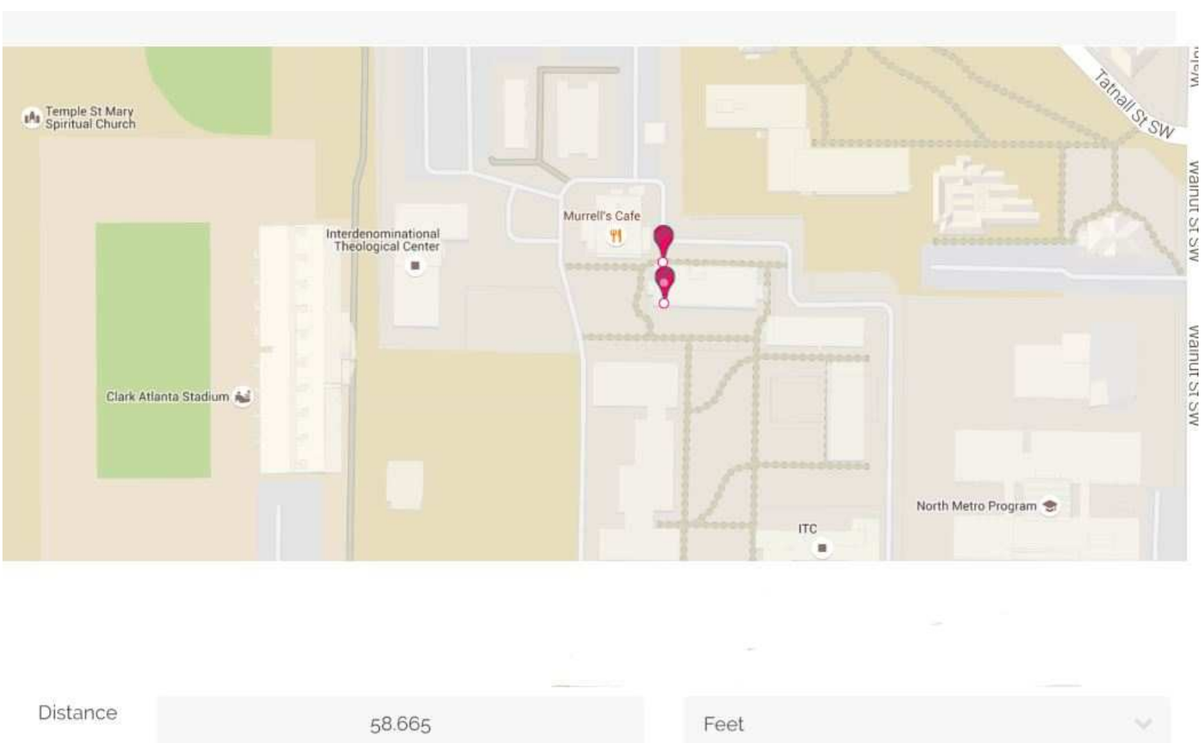
Storm water can be retained in cisterns located throughout the study area. The cisterns all vary in size, appropriate to the calculated run-off from corresponding impervious surfaces. We realized that the cisterns must be located in the lowest elevations within each localized area. Furthermore, because each cistern has a limited capacity, any excess storm water may flow in ephemeral streams that will eventually flow into reclaimed floodplains.

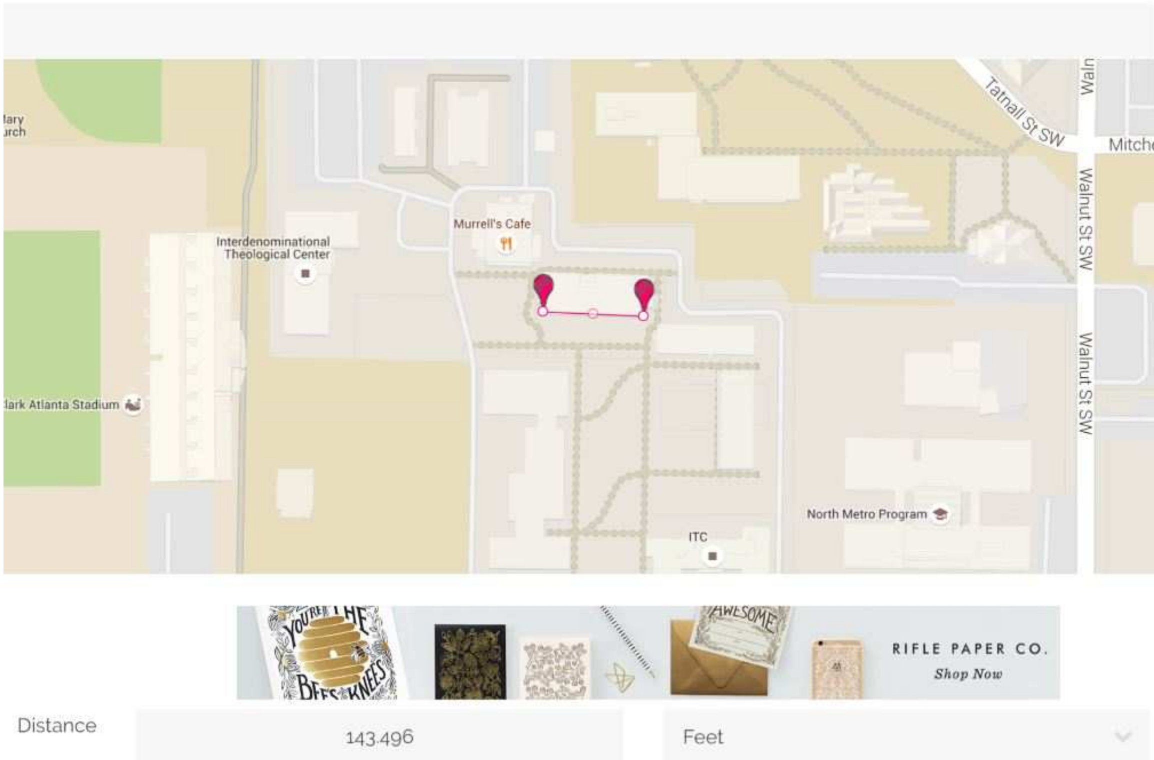
For detaining major rain events, at this stage we considered the following ideas: capturing storm water in a pond in the front of ITC north of Beckwith Street; locating a large greenspace in the quadrangle area of the campus (it was noted that significant flooding already occurs in this area, because it is lower than the surrounding area); and detaining storm water in the smaller green area between Gammon Theological Seminary(4) and Baptist School (Bennett Hall)(5). Moreover, we concluded the large green area west of GNETS could also capture a large amount of rain water. Being almost the same length as the green space located within ITC, this GNETS greenspace could also provide storm water mitigation from its surrounding higher elevations. Finally, we saw that the long, area between the main ITC parking lot and the CAU football stadium as a viable solution to capture the rain water coming from the northern half of ITC campus and the contiguous high elevation area of the Morris Brown campus at Martin Luther King, Jr. Drive.

Methodology

The methodology of this project was directed at capturing storm water. To determine the amount of storm water we wanted to capture, we calculated the surface area of each building and some select ground spaces. Using DaftLogic.com, we were able to pull up the study area on Google Maps and place "pins" to find the lengths and widths of each space. Then, we created a table of each space, noting the dimensions, calculating the surface areas, and figuring the volume of runoff for each rain-event (2, 5, 10, 25, 50, and 100- year).

To illustrate, DaftLogic.com was used to find the dimensions of each building and greenspace on campus. The following images display how Daft Logic can be used:





Once we had surface area calculations and reviewed topography, campus restraints, historical land use, and aesthetics, we were able to identify the type of green infrastructure we wanted to implement at specific locations relative to the amount of water that needed to be captured. We tabulated the dimensions and area of each building along with the dimensions of some parking lots, tennis courts, and green spaces.

Calculations

The following calculations were used to find the surface areas of each space: (length x width) = area in square feet. To calculate the gallons for each area, we converted the area of square feet to acres to use the following equation:

$$\frac{calculated\ sq\ ft}{43{,}560\frac{sq\ ft}{acre}} = acres$$

$$\left(\frac{acres\ x\ rain\ water\ event(inches)}{12\frac{inches}{ft}}\right) = acre\ feet\ (1\ foot\ deep\ with\ stormwater\ runoff)$$

$$acre\ feet\ x\ 325{,}000\frac{gals}{acre\ ft} = gallons$$

To determine the amount of rainfall that occurs for each rain event, we spoke with Dr. Nirajan Dhakal, Assistant Professor of the Environmental and Health Sciences Program at Spelman College. The rain gauge that records local rainfall data has been located in Newnan, Georgia since 1891. Dr. Dhakal gave us the following data for each rain event:

Rain Event (years)	Precipitation (inches)
2	3.15
5	4.15
10	4.81
25	5.65
50	6.26
100	6.87

Source: USHCN (United States Historical Climatological Network)

From there, we calculated capacities by distinguishing which buildings' run-off would go to each cistern and then computing the necessary storage for each cistern.

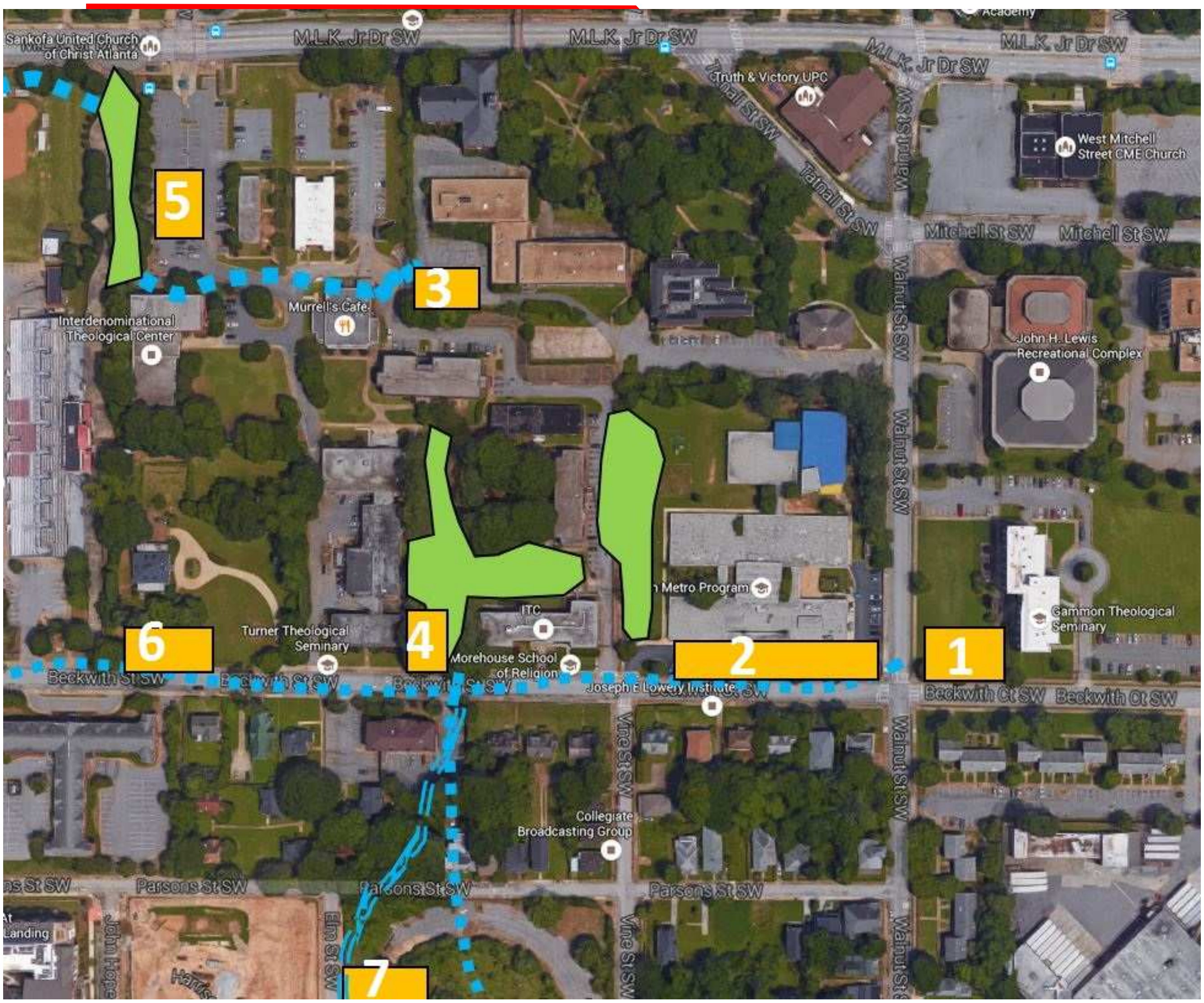
Green Infrastructure Conceptual Plan

It is essential to construct retention cisterns to capture the 25-year rain event from the zones in Catchment 2. Further, green spaces will be utilized to detain storm water in excess of the 25-year rain event. See overall plan on the next page.

Beginning at the top of the watershed, the flooding mitigation infrastructure will be described moving downstream and separated into the following zones:

- *New Friendship Baptist Church,* on the former site of Gammon Theological Residence Towers.
- *North Metro Georgia Network for Educational and Therapeutic Supports (GNETS),* school under the ownership of Atlanta School Board
- *Morris Brown College,* off of Martin Luther King, Jr. (MLK) Drive
- *Interdenominational Theological Center (ITC),* between MLK Drive and Beckwith Street
- *Clark Atlanta University (CAU) President's Home Lot,* off of Beckwith Street beside the CAU football stadium
- South side of Beckwith Street running to Parsons Street

Map of Green Infrastructure Conceptual Plan



Legend	
Greenspace	
Cistern	
Ephemeral Stream	
Culvert	

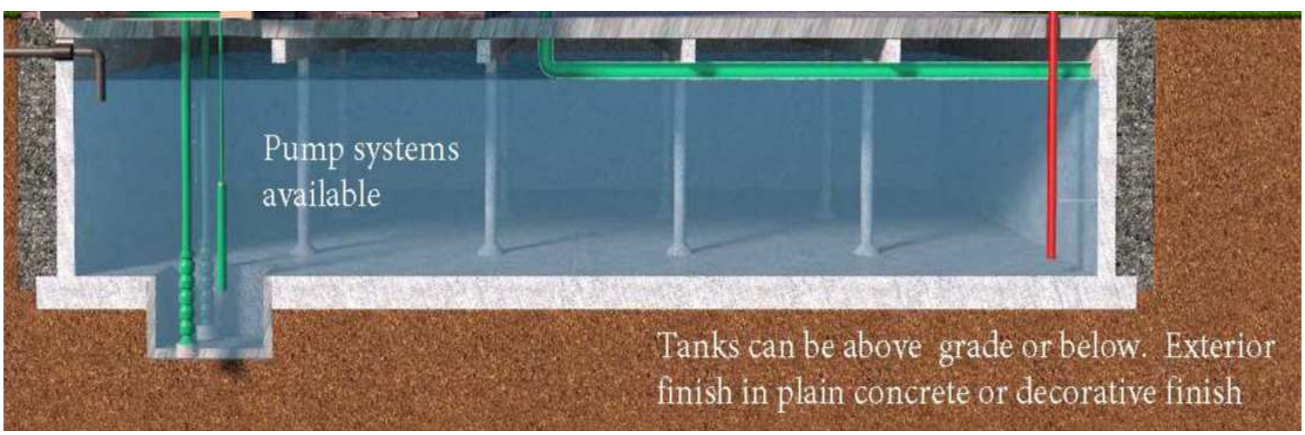
Cisterns	#
Friendship	1
North Metro GNETS	2
Morris Brown College	3
Beckwith	4
MLK, Jr.	5
President's House	6
Bird Cage	7

Summary of Results

Cisterns	
Friendship	374,000
North Metro GNET	361,000
Morris Brown	299,000
ITC Beckwith Quad	310,000
ITC MLK Drive	361,000
CAU President's House	440,000
Bird Cage	167,000
Total	**2,312,000**

Greenways	
King Meadow plus east extension	350,000
ITC Rain Garden	561,000
GNETS Greenway	796,000
TOTAL	**1,707,000**

A **cistern** is an underground storage tank used to capture storm water run-off from impervious surfaces. Cisterns come in various shapes and sizes. Below is an image of the type of cistern we propose in our conceptual plan:



A **greenway** is a recreation area that does double duty as a floodplain to capture and temporarily detain storm water runoff only during major rain events such as the 25-year to 100-year rain events. See pages 21 through 23.

<u>CISTERNS</u>

Friendship Cistern, #1

At the highest elevation in Catchment 2, the storm water run-off from the new, Friendship Baptist Church, which is under construction on the north side of Beckwith Street, and a small portion of the future redeveloped Friendship Center on the south side of Beckwith will require the construction of a retention cistern for the 25-year rain event. Storm water from the Friendship Baptist Church site, much of the John Lewis Gym, and western end of Friendship Center Apartments will go to cistern at the uphill elevation east of Walnut Street, under the parking lot for the new church. This is another case where collaboration and cooperation of all stakeholders will be necessary. Much of the affected area is privately owned; property owners must be urged to understand the necessity to reduce the need for flooding the stadium and lower elevation residential neighborhoods.

Friendship Baptist Church Cistern		
Impervious Surfaces	sq ft	25-year rain event in Gallons
John Lewis Gym	20,000	70,257
Friendship Center Apartments	14,000	49,180
Future Friendship Baptist Church	72,325	254,069
TOTAL	106,325	373,506

Possible dimensions:

100 ft x 50 ft x 10 ft deep

(For a possible alternative, if North Metro GNETS cooperates, see the next page).

North Metro GNETS Cistern, #2

Storm water run-off from the North Metro GNETS school building and parking lot will flow into a cistern under the school parking lot. To be considered: the need to solve flooding in the Vine City and English Avenues area and the CAU stadium area, Friendship Baptist Church and its neighbor, the Atlanta School Board, may be able to collaborate to have a larger cistern under the school parking lot, thus eliminating or reducing the size of Friendship Cistern #1.

North Metro GNETS Cistern		
Impervious Surfaces	sq ft	25-year rain event in Gallons
North Metro GNETS	71,782	252,161
Parking Lot at School	30,975	108,811
TOTAL	**102,757**	**360,972**

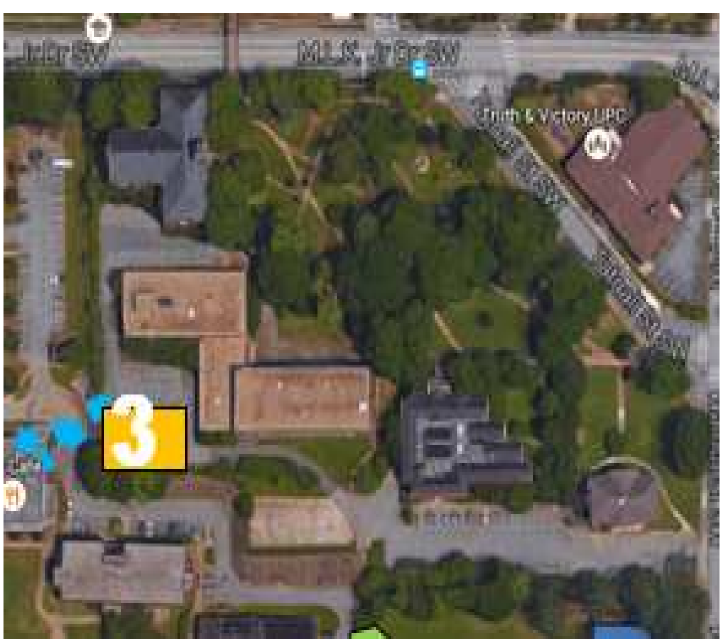
Possible Dimensions:

150 ft x 40 ft x 8 ft deep

Morris Brown Retention Cistern, #3

Storm water run-off from the 25-year rain event will be captured from Fountain Hall, Griffin Hightower building, Administration building, and Oglethorpe Hall, and the parking spaces on the high elevation overlooking ITC. Note that to prevent destabilization of the surrounding earth, this cistern must be located well away from the edge of the property, because of the steep drop in elevation at the boundary between Morris Brown College and ITC. Run-off from larger storm water rain events will overflow this cistern and flow via a constructed waterfall down to and across the ITC property via an ephemeral stream into the ITC Rain Garden, which will be located west of the main parking lot of ITC and east of the CAU stadium. Again, this development is an example of the need for cooperation and collaboration among stakeholders.

Morris Brown Cistern		
Impervious Surfaces	sq ft	25-year rain event in Gallons
Fountain Hall	10,104	35,494
Griffin Hightower	23,862	83,824
Administration	11,256	39,541
Ogelthorpe Hall	4,800	16,862
Parking Lots	35,118	123,365
TOTAL	85,140	299,086

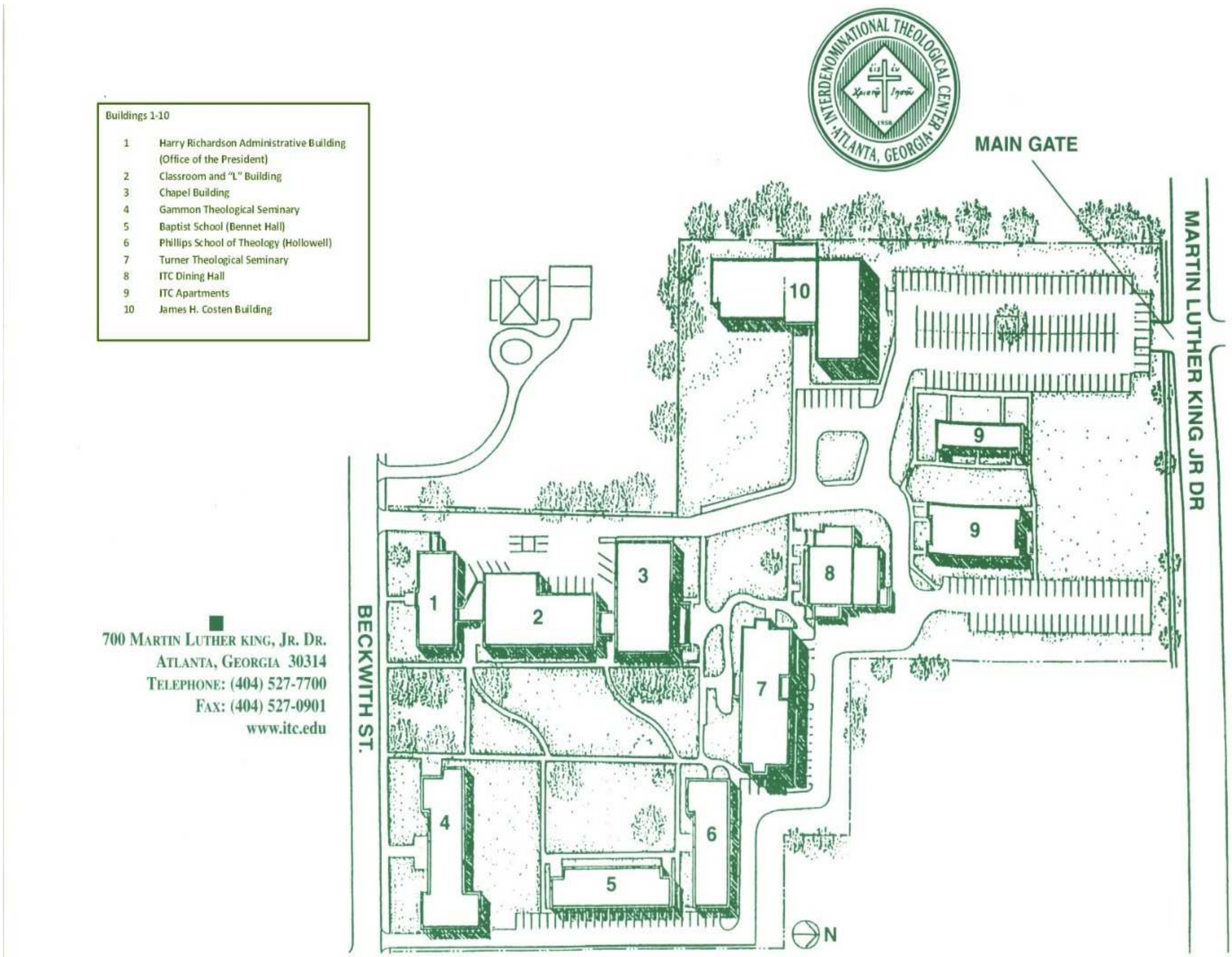


Possible Dimensions:

80 ft x 50 ft x 8 ft deep

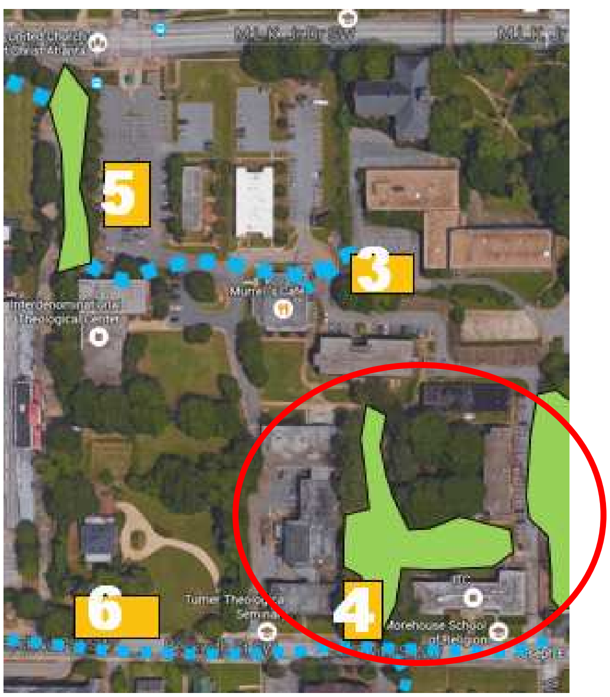
Interdenominational Theological Center

Campus Plan



Beckwith Quad Cistern, #4

This cistern will be located beneath the main quadrangle on the Beckwith Street side of the ITC campus below the current drain in front of the Classroom and 'L' Building (2). It will capture runoff from the Harry Richardson Administrative Building (Office of the President)(1), Classroom and 'L' Building(2) and the Chapel Building(3), as well as Gammon Theological Seminary(4) and Baptist School (Bennett Hall)(5), and Phillips School of Theology (6).



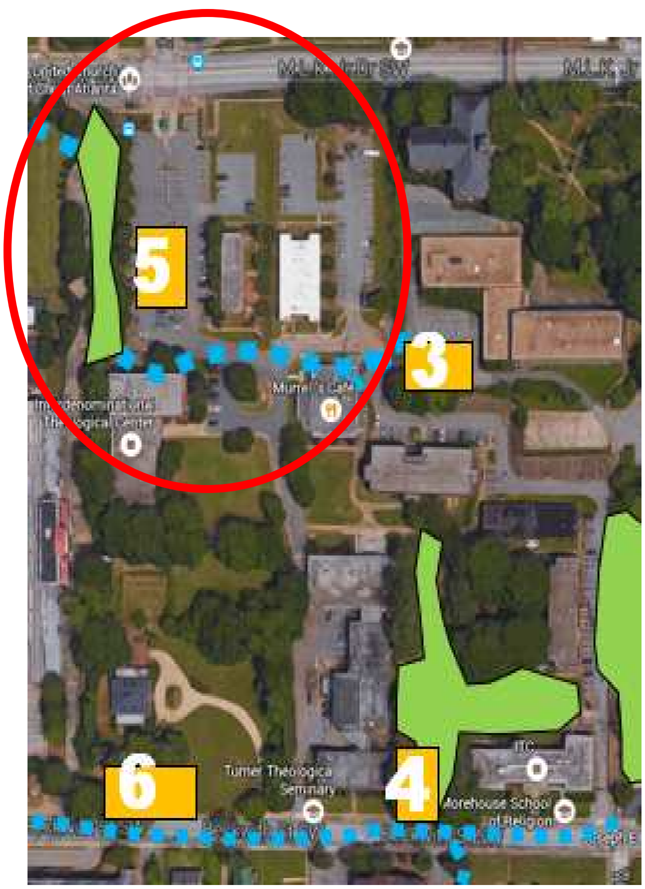
Beckwith Quad Cistern	sq ft	25-year rain event in Gallons
Chapel	7,686	27,000
Classroom	8,240	28,946
Administration	4,312	15,148
Bennet	5,520	19,391
Turner	8,520	29,930
Phillips	5,440	19,110
Gammon	4,390	15,422
Other Impervious Surfaces	44,108	154,946
TOTAL	**88,216**	**309,892**

Possible Dimensions:

70 ft x 70 ft x 8 ft deep

MLK Drive Cistern, #5

The MLK, Jr. Drive Cistern will be located halfway along the western side of the main ITC parking lot at its lowest point. Storm water run-off from the following buildings will be captured in the cistern: Turner Theological Seminary (7), ITC Dining Hall (8), ITC Apartments (9), James H. Coston Building, the parking lot, and a “ghost” building, or a potential building to be constructed in the greenspace between James H. Coston and the Chapel Building.



MLK Cistern	sq ft	25-year rain event in Gallons
Costen Center	11,868	41,691
One bedrooms	2,820	9,906
Efficiencies	6,048	21,246
Dining Hall	6,665	23,413
Potential Bldg.	4,312	15,148
Main Parking Lot	33,120	116,346
Costen Proper	9,384	32,965
Lot North of One Bdrs.	4,235	14,877
Lot North of Eff.	5,100	17,916
Lot with Dumpsters	9,752	34,258
Road toward Chapel	3,519	12,362
Behind Turner	6,080	21,358
TOTAL	**102,903**	**361,485**

Possible Dimensions:

80 ft x 82 ft x 8 ft deep

CAU President's House Cistern, #6

A cistern will be buried under the front lawn of the CAU President's house at the edge of Beckwith Street, well away from the President's house. Water coming from the western half of block bounded by Beckwith Street, Parsons Street and Vine Street, and downhill from Knowles Building. Furthermore, the water run-off from the Knowles Building and parking lot, as well as the CAU Beckwith dorm and corresponding parking lot will be captured in this cistern. This will be the minimum requirement, as the cistern should be made as large possible to mitigate the flow from the ephemeral stream running down Beckwith into the stadium area. The bigger the cistern, the smaller the stadium problem.

CAU President's House Cistern		
Impervious Surfaces	sq ft	25-year rain event in Gallons
CAU President's House	3,300	11,592
Knowles Building	6188	21,738
Knowles Parking Lot	20165	70,837
Homes off Beckwith	14,850	51,236
Beckwith Dorm and parking lot	80,920	284,262
TOTAL	**125,423**	**439,665**

Possible Dimensions:

150 ft x 50 ft x 8 ft deep

Bird Cage Cistern, #7

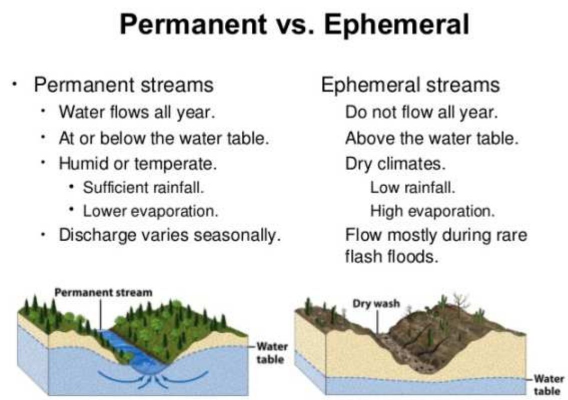
Storm water run-off from the homes surrounded by Beckwith, Vine, Parsons, and Walnut Streets will flow into a storm-water drain under Parsons Street into Cistern #7.

Bird Cage Cistern		
Impervious Surfaces	sq ft	25-year rain event in Gallons
Homes - Beckwith/ Vine/ Walnut/ Parsons	25,800	90,632
Home - Beckwith/ Vine/ Elm	21,738	76,362
TOTAL	**47,538**	**166,994**

Possible Dimensions:

56 ft x 50 ft x 8 ft deep

<u>**EPHEMERAL STREAMS**</u>



By capturing and controlling excess stormwater flow from Catchment 2, ephemeral streams will help mitigate storm water flooding. The first ephemeral stream will direct and control the excess flow coming from the Morris Brown Cistern #3 Waterfall and will run north of the Turner Theological Seminary and the ITC Dining Hall eventually emptying into the ITC Rain Garden. (See **Greenways/Floodplains** on next page).

A second ephemeral stream will help the water from the homes located in the Beckwith/ Vine/ Parsons and Walnut area run to the Bird Cage Cistern #7 located in the AHA/ CAU Planning Area 6 near the eastern edge of Elm Street, previously the site of the CAU Bird Cage. A third ephemeral stream will run along the parking lot to the left (east) of the Knowles building, part of CAU, and finally cross through the greenspace end of the 'Bird Cage' site near Parsons and Elm. The topography is challenging, so it will probably be preferable to utilize trenchless technology to insert a storm water culvert under the area. Overflow water will go into the E.J. Simon Park Recreational Greenway located at the southern end of the greenspace bordering on Atlanta Student Movement Blvd/ Fair Street.

Greenways/Floodplains

King Meadow Plus East Extension

Because of the trees located on both sides of the Beckwith Quadrangle, further research and input from land use planners, architects, and arborists should be sought to better determine how to accommodate the King meadow; it must be sloped down and around the trees for maximum storm water capture. It will be an organically shaped meadow holding 260,000 gallons during the 100-year rain event. Because of the need to protect existing trees, the King Meadow will vary in width from 10 to 62 feet, with a length of 319 feet running under the fence to Beckwith Street. It will have a peak depth of 4 feet during a 100-year rain event.

To encourage multiple usage of existing green spaces on ITC campus, the King Meadow should extend east beyond the "Quad" and into the greenspace between Gammon Theological Seminary(4) and Baptist School (Bennett Hall)(5). A stone bridge can be created to allow for a walkway to the west side of the "Quad." The King Meadow extension will have the following dimensions and capacity: 100 ft x 30 ft x 4ft deep = 12,000 cubic ft = 90,000 gallons. King Meadow plus the east extension will have **a total capacity of 350,000 gallons.**

ITC Rain Garden

The Rain Garden will be located between the main parking lot of ITC and the CAU football stadium. It will be 250 feet long by 50 feet wide with a peek depth of 6 feet during a 100-year rain event. **Capacity will be 561,000 gallons**. Any overflow will pass over a waterfall, run via an ephemeral stream at the north end of the CAU stadium area just below field elevation between the players' box and MLK Drive, and finally run via an ephemeral stream around the north side of the baseball field and via a storm water culvert under MLK Drive to the Sunset Avenue Greenway for detention and infiltration. (See Sunset Avenue Greenway Conceptual Plan.)

GNETS Greenway

The GNETS greenspace will be positioned 20 feet west of the current ITC fence-line to 10 feet west of the sidewalk at western side of the GNETS property and south from Morris Brown College to Beckwith Street.

The long, narrow parking lot behind Gammon Theological Seminary(4) and Baptist School (Bennett Hall)(5), and Phillips School of Theology (6) parking lots floods often because it is at the lower elevation of the GNETS school. We propose that the 28 parking spaces in this area be eliminated and the impervious surface in this area be halved by narrowing it from 40 feet to 20 feet in width to allow service vehicles to access the buildings. If necessary, the eliminated parking spaces can be replaced by acquiring the small jut-out from the Morris Brown campus. This area could then be excavated and leveled for replacement parking.

The objective is to reduce flooding at the "Quadrangle" between the Harry Richardson Administration Building (1), Classroom and 'L' Building (2), Chapel Building (3) and Gammon Theological Seminary(4) and Baptist School (Bennett Hall)(5), Phillips School of Theology (6). Currently, the sidewalk from Gammon Theological Seminary(4) to Turner Theological Seminary(7) experiences frequent flooding. We also acknowledge that the Quadrangle floods as well. The greenway will have the following dimensions 380ft x 70ft = 26,600 sq ft with either possible depth listed below:

4 ft deep = 106,400 ft cubed = **795,872 gallons**

6 ft deep = 159,600 ft cubed = **1,193,808 gallons**

Benefits and Experiences

The purpose of this research is to develop capacity relief for the combined sewer systems in order to mitigate the negative health impacts associated with flooding. Some long-term benefits include sewer system capacity enhancement, improved community health and livability, cleaner air and water, retained storm water for reuse and for resiliency to drought, and lessened impact of climate change.

We recommend these conceptual plans will be considered over time not only to improve the community livability in the AUC, but also to ensure improved living conditions for all affected downstream communities. It is our moral responsibility to take action that will help to prevent and reduce impact of flooding on public health. We urge that each of these conceptual plans be taken into consideration in order to provide a long-lasting, renewable, and community beneficial method of mitigating storm water and combined sewage flooding with its related health issues.

As a student who has been engaged with this project, I have gained an increased understanding of GI and its application in capturing storm water, engineering concepts, design processes, and the importance of moral responsibility.

References

Katherine Baer. “Health Risks of Sewage.” American Rivers, Washington D.C.