1. WATERSHED CHARACTERIZATION

The Nancy Creek study area is 6.2 square miles and is located in the southeast corner of the City of Sandy Springs (Figure 1-1). Only 1.7 miles of the main stem of Nancy Creek flows through the southeastern portion of the study area. The majority of the streams in the study area are tributaries that flow in a southeastern direction into the main stem of Nancy Creek. The study area is predominately urban/suburban with highly developed commercial corridors that are surrounded by residential development. This chapter includes an overview of watershed characteristics such as impervious cover, land use, and soils; a description of other model inputs such as the digital elevation model (DEM) and lake surface area; water quality status, and an explanation of the development of the baseline conditions water quality model Watershed Improvement Plan (WIP) Tools for the Nancy Creek study area.

1.1 DEM and Watershed Delineation

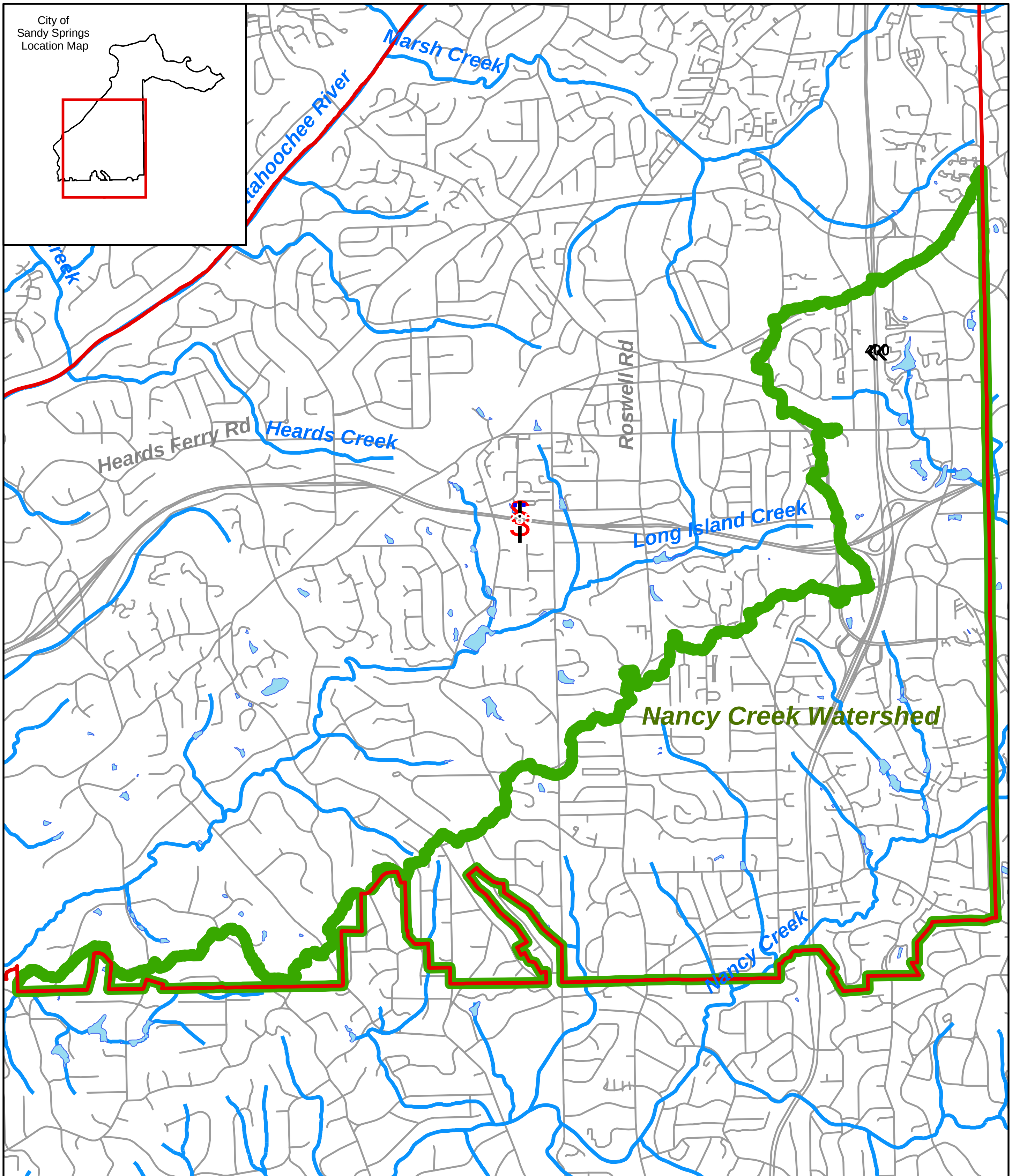
The first step in watershed characterization is to determine the delineation of the area of study. This is accurately completed using DEM information when available. However, the actual drainage area will be impacted by the stormwater pipe network. The watersheds delineated for this study are based on the 16-foot DEM provided by the City of Sandy Springs. Areas outside of the City limits were supplemented with the best available topography data from the National Elevation Dataset (NED), the 1/3 arc second topography, which is a 30-foot DEM. Because so much of the City is urbanized, there is a large proportion of stormwater for smaller storm events that is routed through pipe networks as opposed to overland or open channel flow. In an effort to capture the true movement of stormwater in the study area, burnlines were created using both the USGS streams coverage and the stormwater pipe network provided by the City of Sandy Springs. The DEM was reconditioned using these burnlines. Watersheds boundaries delineated for this study will vary slightly from watersheds delineated for other studies done for Sandy Springs.

The study area watersheds were delineated based on the reconditioned DEM using the ArcHydro program, which is an extension for ArcGIS. This tool automatically delineated smaller watersheds based on a 100-acre drainage area. For this study, the smaller watersheds were then combined into the final watershed to form the Nancy Creek study area as shown in Figure 1-1.

1.2 Impervious Cover

Impervious cover is one of the most important aspects in a watershed study. Impervious area relates to the amount of roads, rooftops, sidewalks and other areas that do not allow rainwater to soak into the ground. Watersheds with high impervious area have high runoff and velocity from stormwater that impair streams.

The impervious cover provided in Figure 1-2 was created from base data provided by the City of Sandy Springs. Street shapes were extracted from the existing zoning coverage provided by the City of Sandy Springs. Any street area shapes outside of the City Limits or not represented accurately in the zoning coverage were digitized by creating a 25-foot buffer around the centerlines of the streets coverage provided by the City. The City provided a building footprint coverage, and all of these shapes were included in the impervious cover file. Impervious cover in commercial areas and residential apartment and townhome complexes was digitized based on a combination of the most recent aerial photography provided by the City and the building footprint coverage.



Legend

- City Limit
- Watershed Boundary
- Lakes/Ponds
- Streams
- Streets

0 1,000 2,000 4,000 6,000 Feet

Figure 1-1. Watershed Delineation
Nancy Creek Watershed Improvement Plan

SANDY SPRINGS GEORGIA

BROWN AND CALDWELL

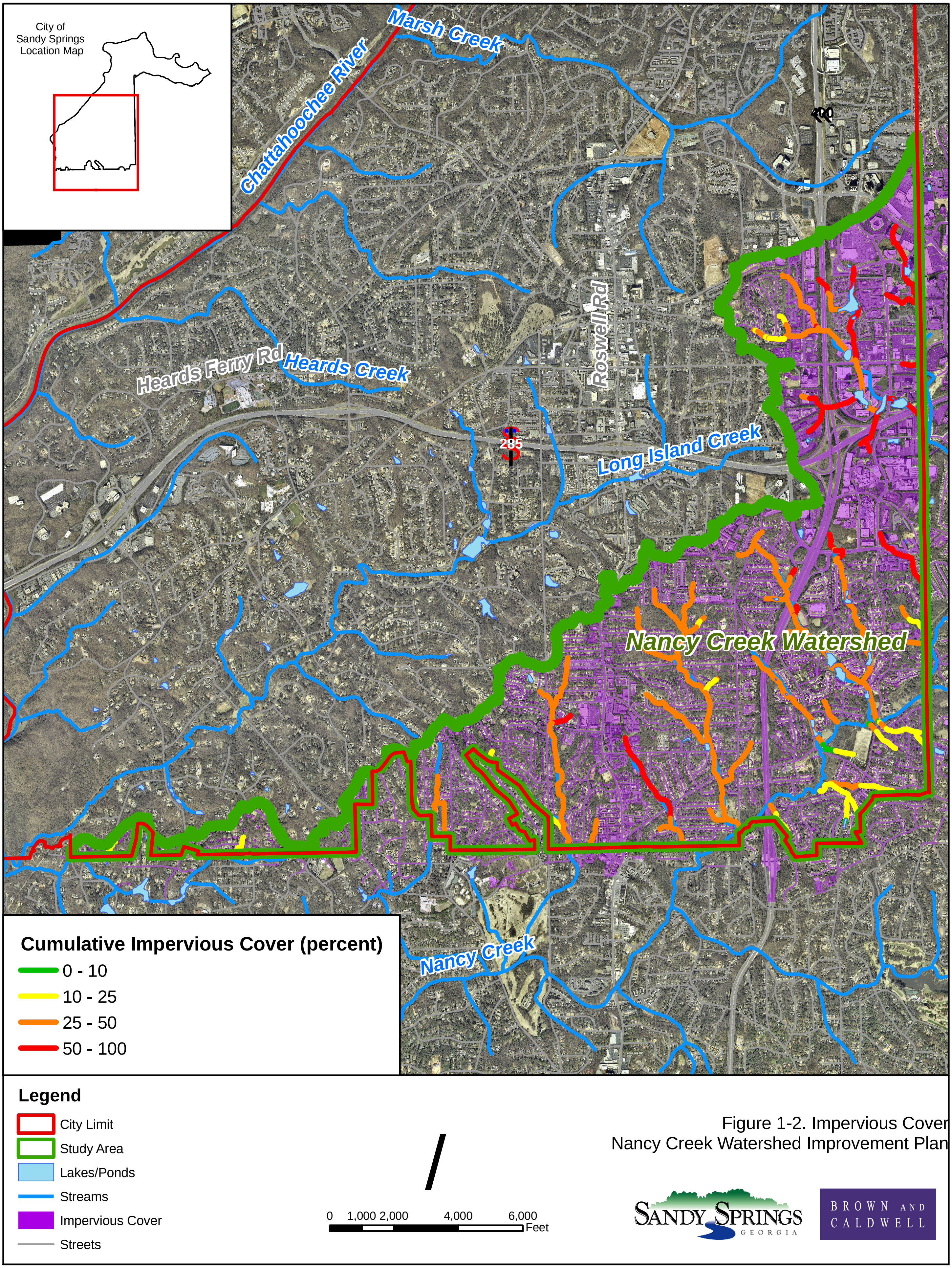


Figure 1-2. Impervious Cover
Nancy Creek Watershed Improvement Plan

Existing footprint shapes for commercial buildings, apartment buildings, and townhomes were included in the impervious cover, and the adjacent parking lots and driveway shapes for these complexes were digitized based on aerial photography. Impervious cover for single-family residential areas was created by buffering the house footprints based on average percents of impervious area per lot based on land use category as follows:

- Land Use Code R12 (2-acre lot size) – Buffered the home footprints by 25 feet. These are typically very large homes with pools, large terraces and very long driveways with ample yard and wooded areas.
- Land Use Code R20 (1-acre lot size) – Buffered the home footprints by 15 feet. These are typically large homes with pools and/or terraces and long driveways with ample yards.
- Land Use Code R25 (1/2-acre lot size) – Buffered the home footprints by 15 feet. These are typically moderate sized homes with medium sized yards, medium length driveways and most have pools or terraces.
- Land Use Code R30 (1/3-acre lot size) – Buffered the home footprints by 6 feet. These are typically medium sized homes with moderate yards, driveways and very few pools or other large paved areas.
- Land Use Code R38 (1/4-acre lot sizes) – Buffered the home footprints by 4 feet. These are typically medium to large homes placed close together and occupying most of the lot with only a short driveway.
- Land Use Code R65 (1/8-acre lot sizes) – Buffered the home footprints by 4 feet. These are typically medium to large homes placed very close together occupying nearly all the lot with only a short driveway.

The impervious cover polygons were used in WIP Tools model (explained in more detail in Section 1.6.2) to generate the cumulative impervious cover for the study area. In Figure 1-2, the watershed streams are color coded based on the model results for cumulative impervious cover.

1.3 Existing Land Use

Existing land use is directly related to water quality in streams and is therefore a necessary input for the baseline conditions WIP Tools model. Table 1-1 provides the codes used to develop this land use coverage. The land use coverage, shown on Figure 1-3, was developed by reviewing the most recent aerial photography in combination with the current zonings codes for each parcel. The zoning codes shown on Table 1-2 were assigned the most applicable land use category based on the most similar use. Aerial photography was used to confirm this land use category assignment. However, in some cases, the aerial photography showed areas of recent development not captured in the zoning coverage. In these cases, the aerial photography was assumed to be the most recent representation of the current conditions in the City of Sandy Springs, so the land use was updated to reflect the current land uses in the aerial photography.

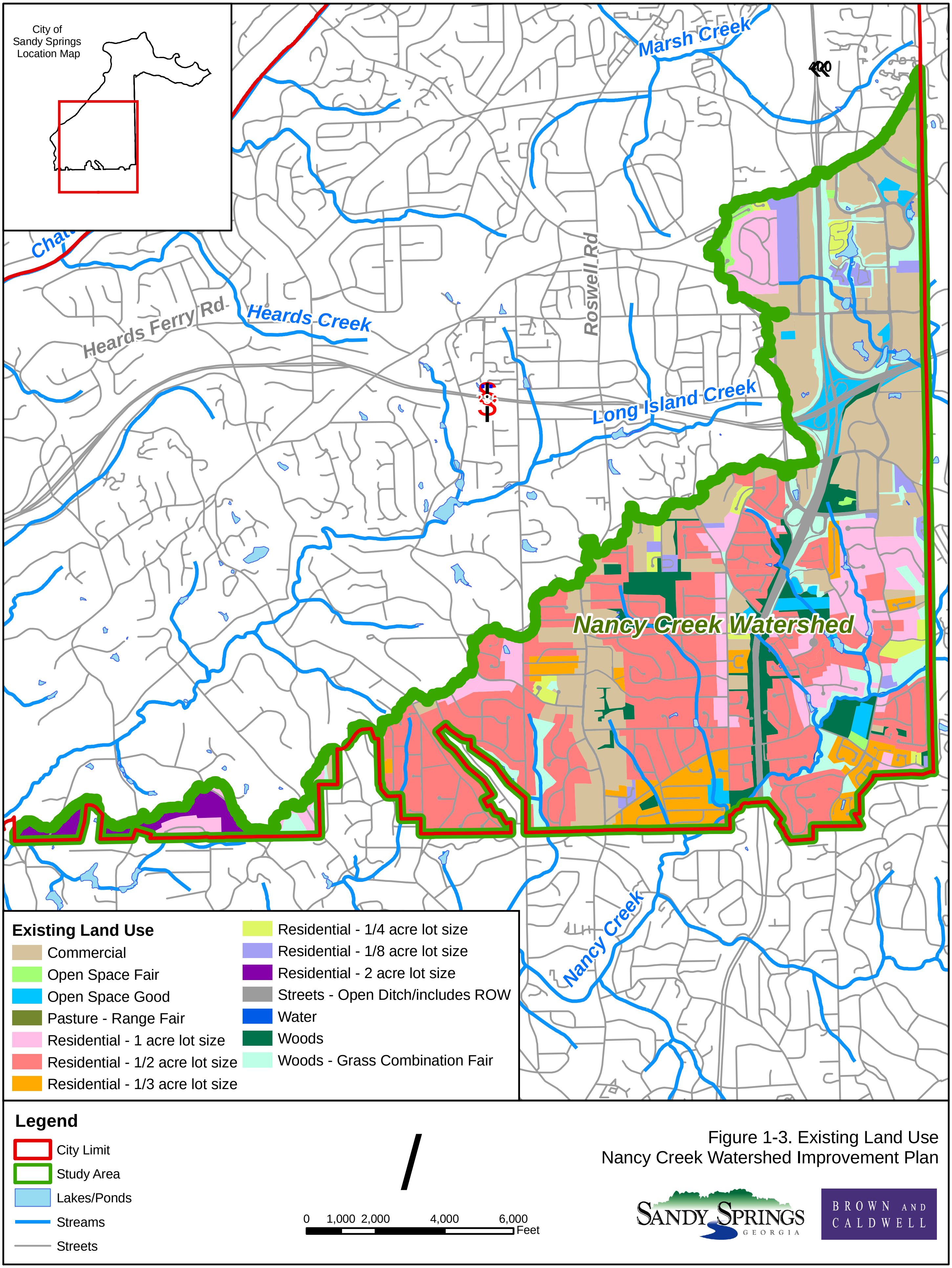


Figure 1-3. Existing Land Use
Nancy Creek Watershed Improvement Plan

Table 1-1. Land Use Categories

Land Use Code	Land Use Description
C	Commercial
I	Industrial
PF	Open Space Fair
PG	Open Space Good
PRF	Pasture - Range Fair
R12	Residential - 2 acre lot size
R20	Residential - 1 acre lot size
R25	Residential - 1/2 acre lot size
R30	Residential - 1/3 acre lot size
R38	Residential - 1/4 acre lot size
R65	Residential - 1/8 acre lot size
SOD	Streets - Open Ditch/includes ROW
POND	Water
WGCF	Woods - Grass Combination Fair
W	Woods

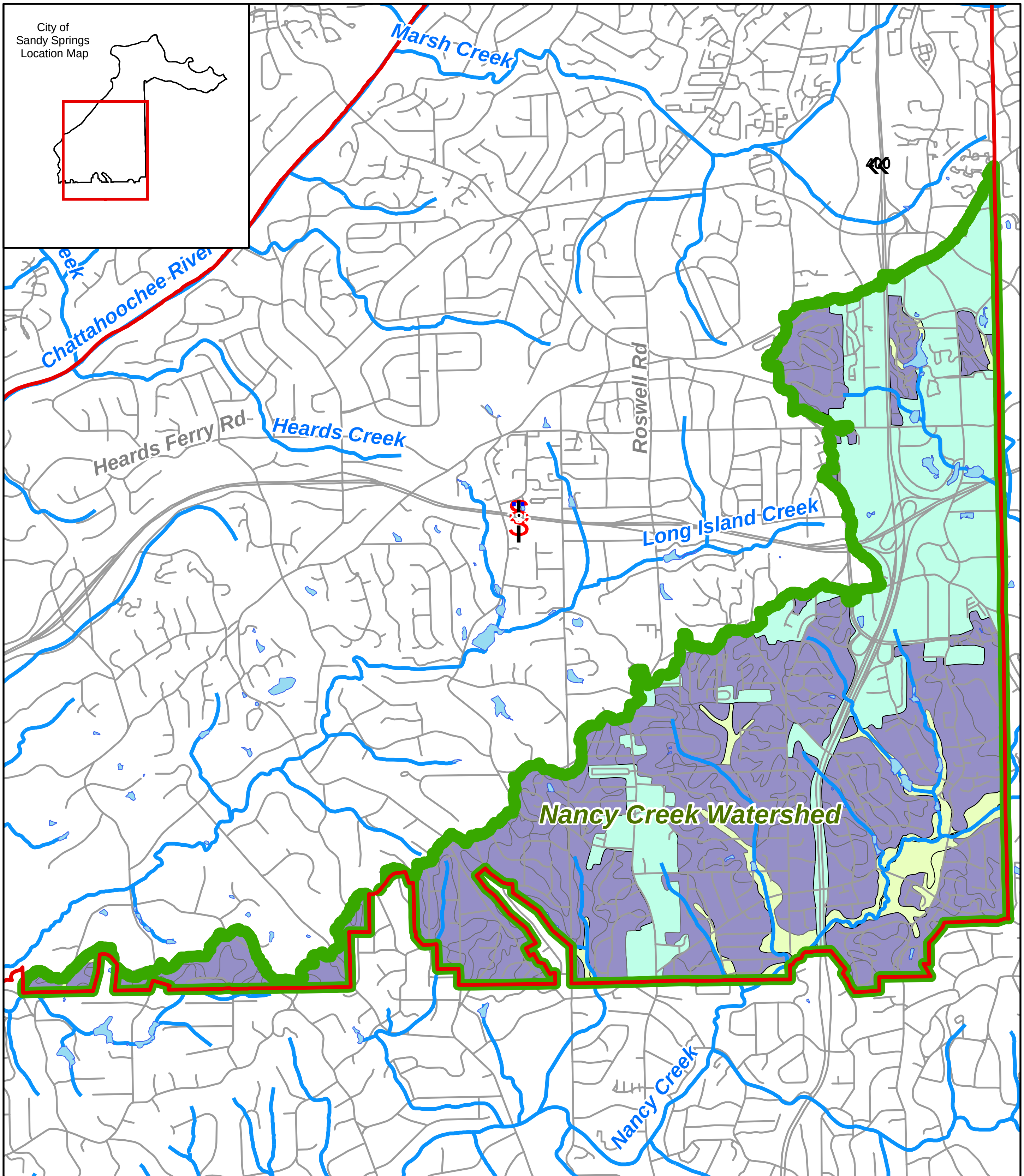
The land use category SOD (Streets – open ditch/includes ROW) was created using a combination of the streets coverage file and the zoning coverage received from the City and the Atlanta Regional Commission (ARC) 2005 streets dataset obtained from Georgia Department of Transportation (GA DOT) records. Any street area shapes outside of the City Limits or not represented accurately in the zoning coverage were digitized by creating a 25-foot buffer around the centerlines of the ARC streets coverage. The land use category POND (Water) was created using a combination of a water bodies file obtained from the United States Geological Survey (USGS) and the aerial photography. All features in the USGS file were verified with the aerial photography, and any additional water bodies seen in the aerials were also included as POND shapes in the land use file. Finally, the open space and wooded land use categories, PF (open space fair), PG (open space good), PRF (pasture – range fair), WGCF (woods – grass combination fair), and W (woods) were digitized directly from the aerial photography provided by the City. Areas outside of the City limits were supplemented with the ARC existing conditions land use coverage. These areas were verified using the aerial topography and assigned the study-specific land use codes given in Table 1-1.

Regions designated as PF (open space fair) were areas of open space, such as grass or dirt that were interspersed with shrubbery, trails or paths, and/or small out parcel buildings, as found at recreation fields or parks. Areas designated as PG (open space good) were regions where open space, such as grass or dirt, occupied more than 85 percent of the area. Comparably, areas designated as W (woods) were regions where trees occupied more than 85 percent of the area. Areas designated as WGCF (woods – grass combination fair) were areas that were an approximate 50/50 mix of open space and woods. Finally, areas designated as PRF (pasture-range fair) were areas with open space that appeared to be fertilized and possibly treated as agricultural areas. There were only four small regions assigned to this land use type in the study area.

Table 1-2. Zoning Code Assignment to Land Use		
Zoning Code and Label	**Corresponding Land Use Code and Description**	**Notes**
R-1 - Single Family	R12 - Residential - 2 acre lot size	
R-2 - Single Family	R20 - Residential - 1 acre lot size	
R-2A - Single Family	R20 - Residential - 1 acre lot size	
R-3 - Single Family	R25 - Residential - 1/2 acre lot size	
R-3A - Single Family	R25 - Residential - 1/2 acre lot size	
R-4 - Single Family	R30 - Residential - 1/3 acre lot size	
R-4A - Single Family	R30 - Residential - 1/3 acre lot size	
R-5 - Single Family	R38 or R64 - Residential - 1/8 or 1/4 acre lot size	Lot size taken from aerials to determine correct Land Use Code designation
R-5A - Single Family	R38 or R65 - Residential - 1/8 or 1/4 acre lot size	Lot size taken from aerials to determine correct Land Use Code designation
R-6 - Two family	R# - Residential	Lot size taken from aerials to determine correct Land Use Code designation
A - Medium Density Apartment	C - Commercial	
A-1 - Apartment Limited Dwelling	C - Commercial	
A-L - Apartment Dwelling	C - Commercial	
A-O - Apartment Office	C - Commercial	
TR - Townhouse Residential	R65 - Residential - 1/8 acre lot size	
O-I - Office and Institutional	C - Commercial	
C-1 - Community Business	C - Commercial	
C-2 – Commercial	C - Commercial	
MIX - Mixed Use	C - Commercial	
CUP - Community Unit Plan	R# - Residential	Lot size taken from aerials to determine correct Land Use Code designation
NUP - Neighborhood Unit Plan	R# - Residential	Lot size taken from aerials to determine correct Land Use Code designation
M-1 - Light Industrial	I - Industrial	
M-2 - Heavy Industrial	I - Industrial	
AG-1 - Agricultural	PRF - Pasture-Range Fair	

1.4 Soils

Determination of soil type is important when considering erosion rates, rainfall infiltration, building suitability, and many other factors. The soils data for this study was obtained directly from the National Resources Conservation Service (NRCS) by Manhard Consulting, Ltd, the floodplain mapping contractor for the City of Sandy Springs. For this study, the soils file was updated to reflect all areas of open water identified during the digitizing of the land use. All areas of open water were assigned MUSYM 'W' and classified as type D, in accordance with NRCS standards. In addition, areas that were classified as urban lands in the NRCS soil survey were classified as type D because of the impervious nature or typically compacted soils common with these land uses. Figure 1-4 shows the soil polygon file color coded by hydrologic soil group.



Legend

- City Limit
- Study Area
- Lakes/Ponds
- Streams
- Streets

Soils

Hydrologic Soil Group

- A
- B
- C
- D

0 1,000 2,000 4,000 6,000 Feet

Figure 1-4. Soils
Nancy Creek Watershed Improvement Plan

SANDY SPRINGS GEORGIA

BROWN AND CALDWELL

1.5 Lakes

The Nancy Creek Study Area has many small to medium size lakes. Lakes can provide water quality benefits and must be included in the development of the WIP Tools model. The surface area at the normal elevation or pool of lakes and ponds is determined by creating a polygon area. The USGS Hydro Area polygon was the starting basis for the lakes. For areas that appeared to have been developed since the USGS file was created or other lakes that were not included in the USGS file, the contours from the City and the aerial photos were used to create the a lake footprint at normal pool. Any polygons that appeared to be delineated in the USGS file due to damp soil and are not actually lakes (based on aerial photograph) were deleted from the model.

1.6 Urban/Rural Discharge Ratio

The urban/rural discharge ratio is used to classify stream segments by the amount of flow increase resulting from urbanization. The ratio is calculated as:

Existing urban 1-year discharge/Undeveloped (rural) 1-year discharge

The 1-year frequency is used because it is often characterized as the channel-forming streamflow. A modification of the formulas found in the *USGS Flood-Frequency Relations for Urban Streams in Georgia – 1994 Update* was used to calculate the urban/rural discharge ratio for all streams in the study area (USGS 1994). For Region 1 which includes the Chattahoochee River and tributaries, the USGS Regression equations for the 2-year event are:

$$Q_2 = 167A^{0.73}\,TIA^{0.31} \text{ (urban)}$$

$$Q_2 = 207A^{0.654} \text{ (rural)}$$

Where Q_2 is the 2 year peak discharge in cubic feet per second, A is the drainage area in square miles, and TIA is the total impervious area in percent. To estimate the 1 year rural condition flood peak, the above equations were reduced by a factor of 0.875 to calculate the 1-year discharge. The urban/rural discharge ratio is used in the erosivity calculation. Retrofitting or modifying BMPs will reduce the 1-year urban discharge, thus reducing the downstream erosivity. The factor of 0.875 is arrived at by dividing the total precipitation depth for a 2-year 24-hour storm event by the depth of the 1-year 24-hour storm event. As a result, the equation used to calculate the Urban-Rural Discharge ratio(Q_{ur}) is:

$$Q_{ur} = Q_u / Q_r$$

$$= 146A^{0.73}\,TIA^{0.31} / 181A^{0.654}$$

Where Q_u is the urban 1-year discharge in cubic feet per second, and Q_r is the rural 1-year discharge in cubic feet per second.

For Nancy Creek, the urban/rural discharge ratio ranges from 1.29 for streams in semi-developed areas to over 2.5 in some stream segments in heavily urbanized areas. The input parameters for the urban discharge are drainage area and percent impervious cover, whereas only drainage area is used to develop the rural discharge. As a result, areas with the highest amounts of impervious surface have the highest urban/rural discharge ratios. Generally, streams with higher urban/rural discharge ratios are expected to be more impacted due to urbanization causing changes in streamflow hydrology (Figure 1-5). However, this is not always the situation. For example, in some locations, bedrock outcrops may prevent stream down-cutting and enlargement even though streamflow has been substantially increased due to urbanization. Conversely, where stream conditions are degraded but a minimal hydrologic alteration is indicated by urban/rural ratios near 1.0, stream changes are likely the result of direct human actions such as bank vegetation removal or

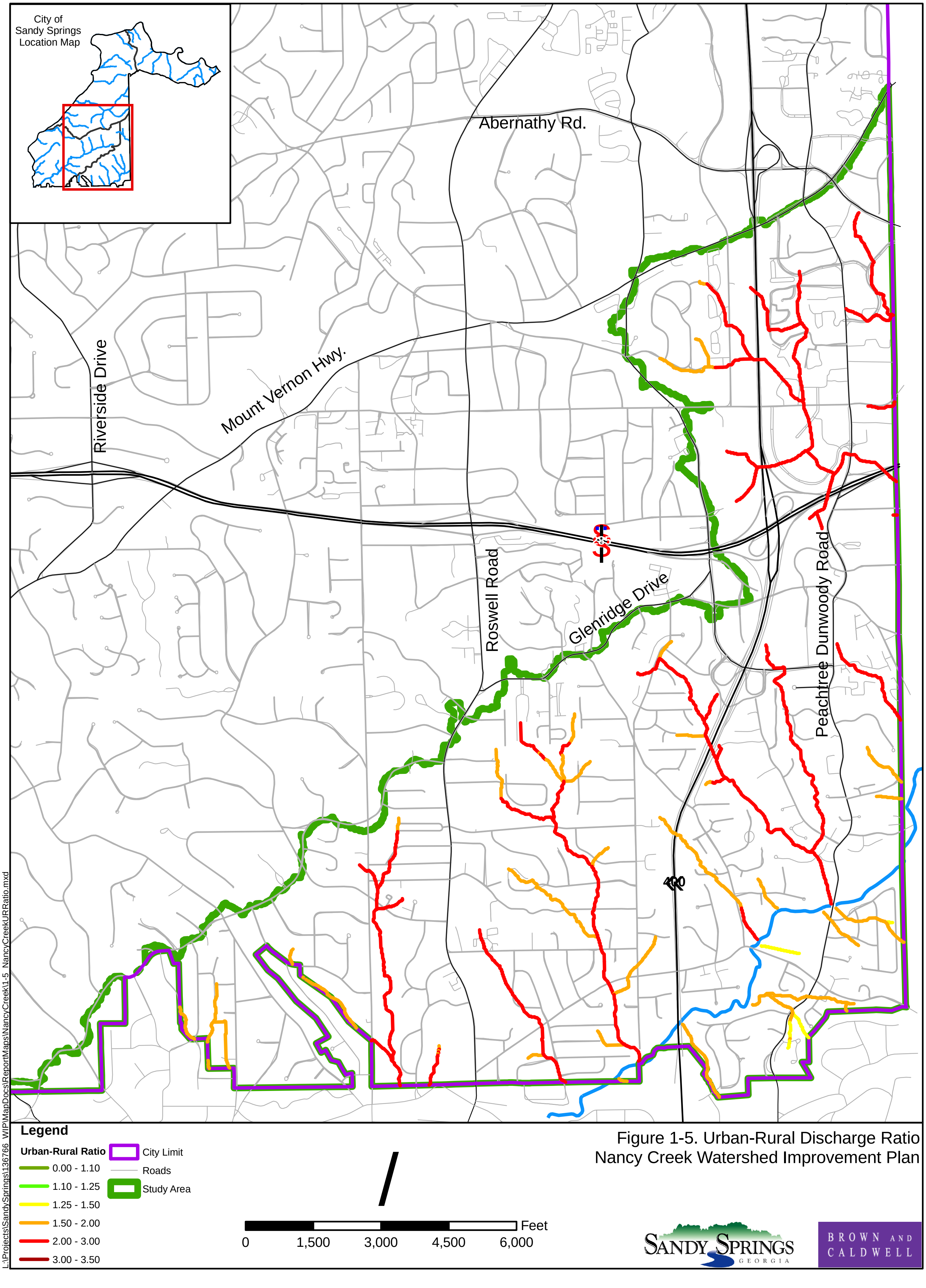


Figure 1-5. Urban-Rural Discharge Ratio
Nancy Creek Watershed Improvement Plan

channel straightening. With these exceptions noted, the urban/rural discharge ratio provides a means to identify locations where hydrologic controls would be most useful at reducing streamflows to more natural channel-forming flows.

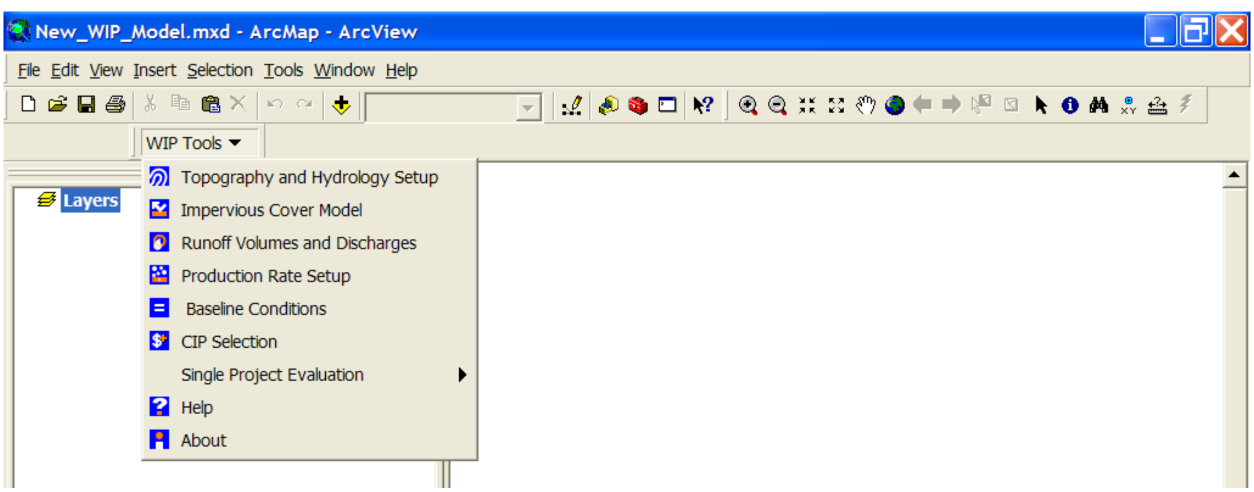
1.7 Impaired Streams

The primary reason for developing the Watershed Improvement Plan for Nancy Creek is to address water quality concerns. Sixteen miles of Nancy Creek from the headwaters to the confluence with Peachtree Creek, of which approximately 1.7 miles are located Sandy Springs, are listed as not meeting the designated use of fishing based on the Georgia Environmental Protection Division (EPD) 2008 305(b)/303(d) list of waters. Nancy Creek is listed as impaired for fecal coliform and biota impacted (fish community) with the potential cause due to urban runoff or urban effects (Figure 1-6).

1.8 WIP Tools – Baseline Conditions Model

The baseline conditions model developed using WIP Tools represents the current or existing conditions within the Nancy Creek Study Area. Land use, soils, existing lakes, and other watershed inputs described above were used to develop the model. The model includes the effects of any existing BMPs that may provide water quality benefits such as stormwater detention ponds. The following section gives an overview of the development of the model and the model results.

WIP Tools is a raster based project evaluation and water quality model deployed as an extension in ArcGIS. It was created by Brown and Caldwell to aid in the development of a Capital Improvement Plan (CIP) for Watershed Improvement Planning. WIP Tools allows for the analysis of multiple 'what-if' scenarios in which a user can 'turn-on' projects, generated results and then try another set of projects. The raster based format allows projects to be placed and evaluated, and results to be extracted anywhere in the study area. The WIP Tools model works in a systematic manner starting at the top menu item and moving downward (see image below). Each of the following sections gives an overview of the key inputs and results by WIP Tools menu item. More details on the equations and methodology in the WIP Tools model may be found in the WIP Tools User's Guide located in Appendix F.



WIP Tools Menu Items

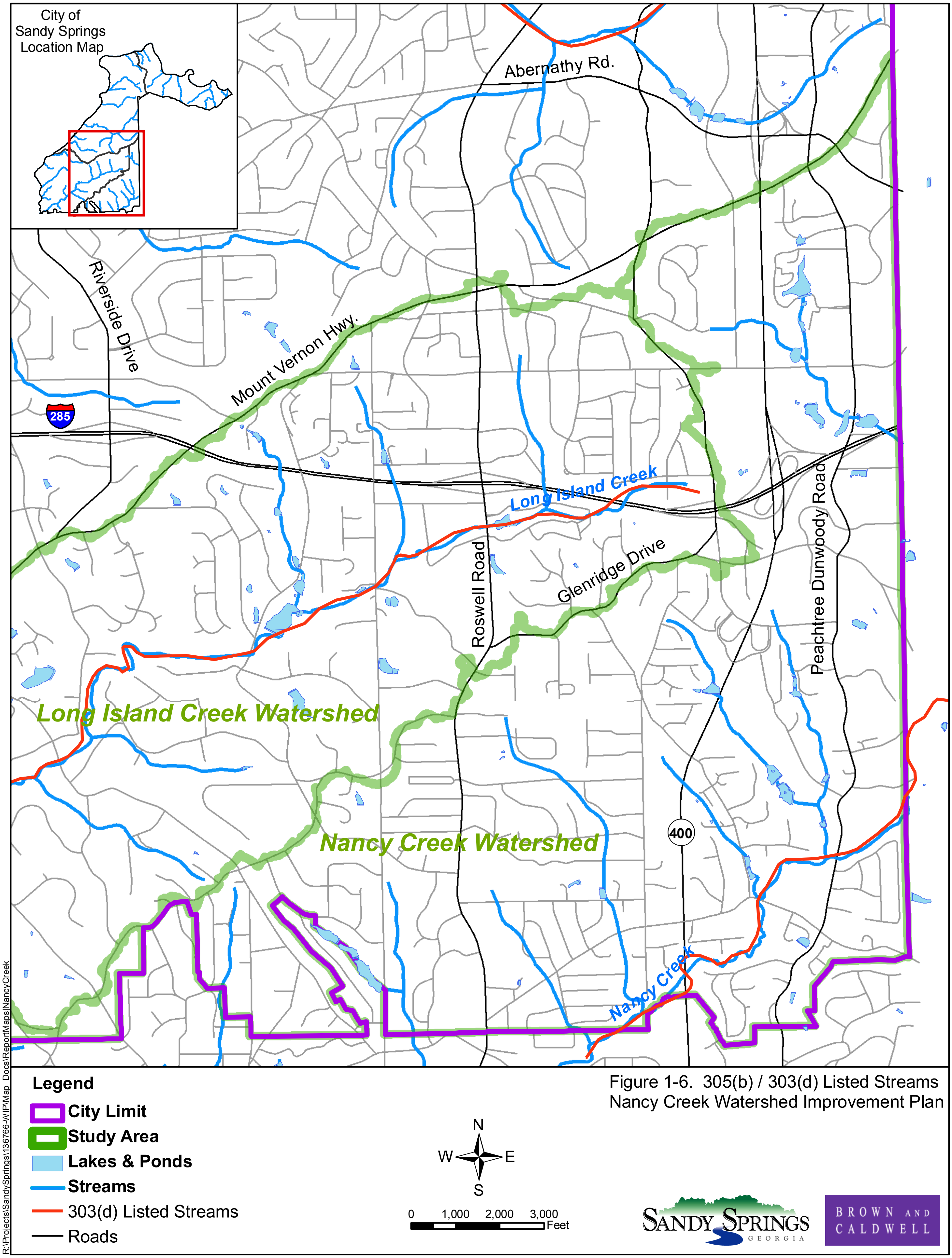


Figure 1-6. 305(b) / 303(d) Listed Streams
Nancy Creek Watershed Improvement Plan

1.8.1.1 Topography and Hydrology Setup

The first menu item was the Topography and Hydrology Setup. The primary inputs for this tool were the watershed DEM and the threshold for stream formation. The development of the DEM was detailed earlier in this chapter. A 25-acre threshold was selected for stream formation. The outputs for this step included a cumulative drainage area raster, a stream raster and a stream vector.

1.8.1.2 Impervious Cover Model

The next step is the development of the impervious cover model. The inputs include the impervious cover polygon file (Section 1.2) and the lakes polygon file (Section 1.5). Output includes an impervious cover raster, a cumulative impervious cover raster and a cumulative impervious cover vector (applied only to the stream segments). The cumulative impervious cover vector is included in Figure 1-2.

1.8.1.3 Runoff Volumes and Discharges

The runoff volumes and discharges tool requires three inputs: hydrologic region, land use and soil data. The hydrologic region specifies the USGS equations to use for calculating discharges. The land use data (Section 1.3) along with the hydrologic soil group (Section 1.4) is used to determine the SCS curve number for each raster cell. The curve numbers used for the WIP Tools model are the same as those used for the floodplain study in order to provide consistency. Table 1-3 lists the curve number by land use and soil group.

Table 1-3. Curve Number by Land Use and Hydrologic Soil Group

	Soil Group			
Land Use	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Open Space Fair	49	69	79	84
Open Space Good	39	61	74	80
Pasture - Range Fair	49	69	79	84
Residential - 2 acre lot size	46	65	77	82
Residential - 1 acre lot size	51	68	79	84
Residential - 1/2 acre lot size	54	70	80	85
Residential - 1/3 acre lot size	57	72	81	86
Residential - 1/4 acre lot size	61	75	83	87
Residential - 1/8 acre lot size	77	85	90	92
Streets - Open Ditch/includes ROW	83	89	92	93
Water	100	100	100	100
Woods - Grass Combination Fair	35	56	70	77
Woods	36	60	73	79

The output for this tool includes the water quality volume, channel protection volume, 25-year flood storage volume, 1-year undeveloped (rural) discharge, 2-year urban discharge, 10-year urban discharge and 25-year urban discharge.

1.8.1.4 Production Rate Setup

This tool develops the production generated by each grid cell for each water quality constituent selected for modeling. The user may model one or many constituents. However, the constituents selected in this tool were the only ones available for analysis in subsequent tools. The production includes both upland production and stream production. The inputs included the stream bank erosion (Section 2.3), land use (Section 1.3), Default in-stream production rate, other default stream parameters, and a die-off raster. For this study area total nitrogen, total phosphorus, total suspended sediment (TSS), fecal coliform and biochemical oxygen demand (BOD) were modeled.

The default in-stream production was assumed to be zero for all parameters except TSS. For TSS the value was set to 8 lb/ft^2. This value was based on stream erosion monitoring performed in the Chattahoochee Tributaries of Gwinnett County, Georgia. The default stream parameters included the hydraulic geometry coefficient, hydraulic geometry exponent, default roughness values and default percent exposed bank. For areas where no bank height information is available a hydraulic geometry relationship was developed. Using the data points collected for both Long Island and Nancy Creek (in order to have a significant number of data points) the hydraulic geometry coefficient is 0.96 and the hydraulic geometry exponent is 0.20. A default roughness value of 0.05 was selected. The default percent exposed bank was determined by calculating the average percent bank exposed of all Nancy Creek stream walk data. The default percent of bank exposed for Nancy Creek was 23 percent.

The die-off raster was only required for parameters that implement the first order decay functionality. The best estimates of effective in-stream "die-off" rates for fecal coliform and similar microbes in fresh water point toward first-order decay rates of between 0.7 to 1.5 per day (Mancini 1978, EPA 1985 and CWP 2000). The overland component was more difficult to determine. The EPA (EPA 1985) argues for an on-surface k rate that is higher than what is used for in-stream. At first glance that seems to make sense in that there is more opportunity for exposure to ultraviolet light, infiltration into the ground, or entrapment. However, more recent studies have produced significantly lower estimates (Meals and Braun, 2006). For the Nancy Creek WIP Study, a K raster was developed for fecal coliform with a value of 1.1/day for streams and 0.7/day for upland areas.

In addition, the user may edit some of the default tables that are installed as a part of the WIP Tools extension. This includes the table export coefficients by land use. This editing is done outside of the WIP Tools model. Table 1-4 list the values used for Nancy Creek.

Table 1-4. Export Coefficient by Land Use

Land Use	Total Nitrogen lb/ac/yr	Total Phosphorus lb/ac/yr	TSS lb/ac/yr	Fecal Coliform cfu 10^9/yr	BOD lb/ac/yr
Commercial	11	1.5	525	9.1	42
Industrial	9.9	1.3	690	2.7	54
Open Space Fair	2.7	0.3	35	7.9	3
Open Space Good	1.8	0.2	23	7.9	2
Pasture - Range Fair	7.5	1.1	200	8.7	15
Residential - 2-acre lot size	2.8	0.3	35	6.9	8
Residential - 1-acre lot size	3.5	0.4	50	6.9	9
Residential - 1/2-acre lot size	4.6	0.6	80	7.6	15
Residential - 1/3-acre lot size	5.8	0.8	110	8.5	20
Residential - 1/4-acre lot size	6.7	0.9	125	9.1	25
Residential - 1/8-acre lot size	10	1.5	525	9.1	42
Streets - Open Ditch/includes ROW	8.2	1.5	590	6.9	67
Water	5.5	0.5	18	10	10
Woods - Grass Combination Fair	2.4	0.3	25	12	13
Woods	2.5	0.3	30	15	15

1.8.1.5 Baseline Conditions

This tool generated the baseline conditions scenario for the study area. This was the current study area conditions prior to the implementation of proposed projects. The water quality benefits provided by existing BMPs may be included in the baseline conditions scenario. The parameter load and yield were developed by accumulating the production developed in the previous step. If an existing BMP is encountered the accumulated load is reduced by the BMP efficiency and then the accumulation continues moving downstream to the next raster cell. In addition, if first order decay was implemented the accumulation is multiplied by the decay at that raster cell and then the accumulation continues downstream. Figures 1-7 through 1-11 show the results of the baseline conditions model for each parameter modeled for the Sandy Springs study area. Note that the main stem of Nancy Creek is not included in the model because the headwaters are located outside of Sandy Springs city limits.

1.8.1.6 Single Project Evaluation – Load Reduction

Once all the efficiencies and discharges were assigned to each BMP, the WIP Tools model was used to evaluate the benefit provided by each project. The Single Project Evaluation – Load Reduction Tool was used to determine TSS reduction and Fecal Coliform reduction provided by each project in isolation. This calculation 'turns on' just the project of interest and any existing BMPs that provided benefit and calculates the load reduction provided by that BMP. The load reduction was added to the attribute table of the project points file and the computation continued on for the next project. Information from project evaluation was used to create the final recommended CIP described in Chapter 4.

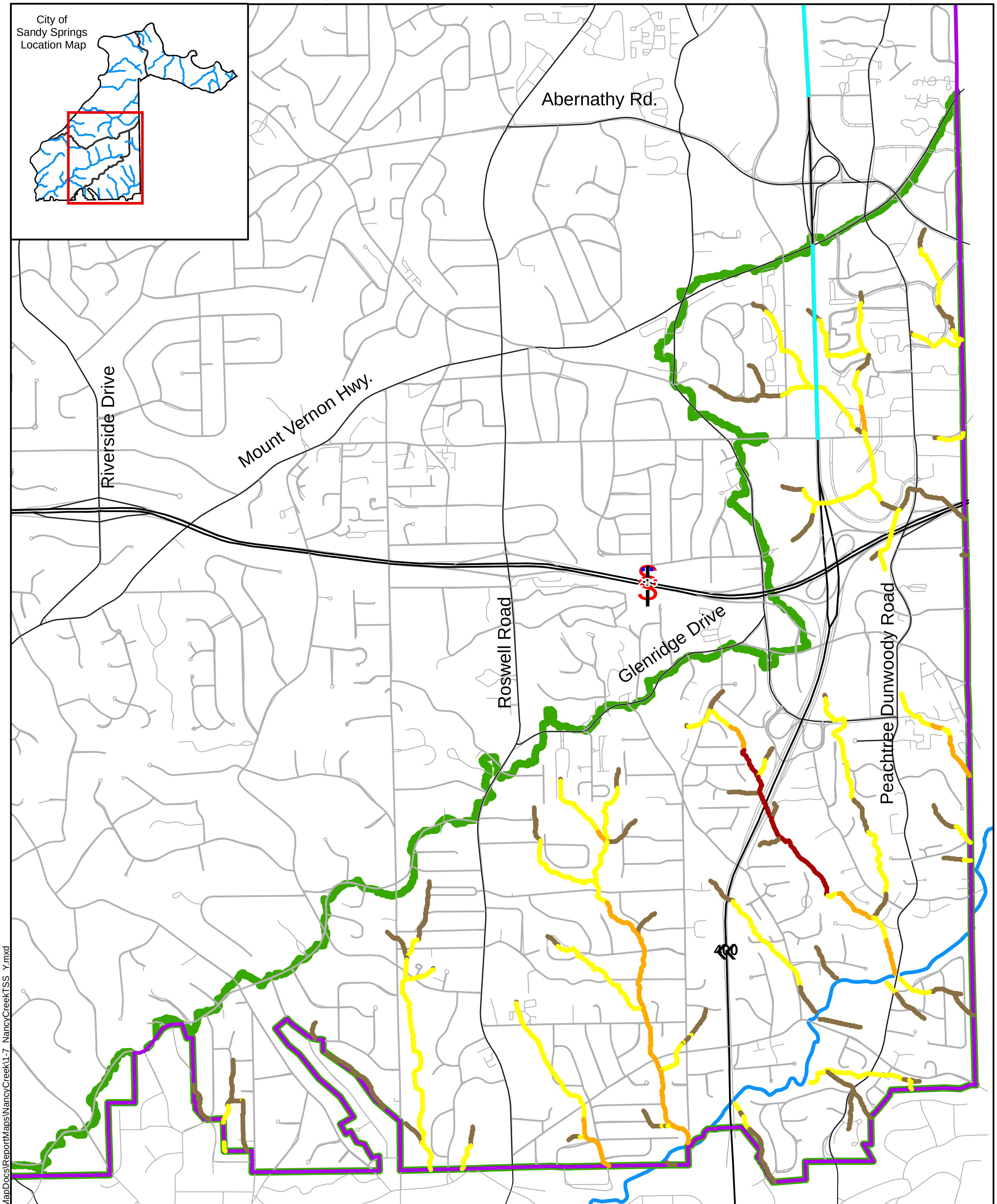


Figure 1-7. Baseline Conditions - TSS Yield
Nancy Creek Watershed Improvement Plan

Legend

Existing TSS Yield
- 0 - 500
- 500 - 1,000
- 1,000 - 1,600
- > 1,600

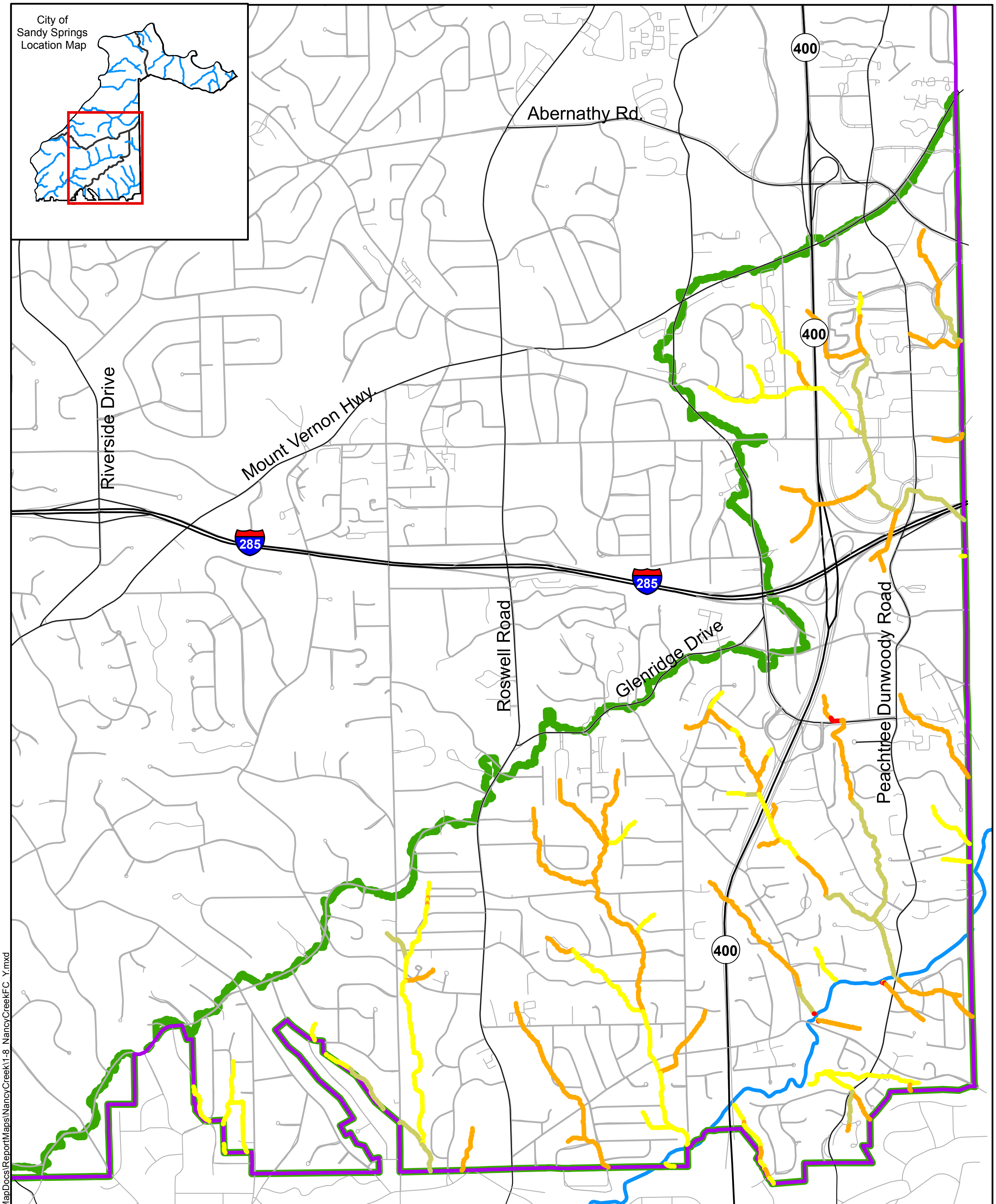
- City Limit
- Roads
- Study Area

0 | 1,500 | 3,000 | 4,500 | 6,000 Feet

SANDY SPRINGS GEORGIA

BROWN AND CALDWELL

L:\Projects\SandySprings\136766 WIP\MapDocs\ReportMaps\NancyCreek\1-7 NancyCreekTSS Y.mxd



Legend

Existing Fecal Yield
- 0 - 6.0
- 6.0 - 8.0
- 8.0 - 10.0
- >10.0

- City Limit
- Roads
- Study Area

N W E S

0 1,500 3,000 4,500 6,000 Feet

Figure 1-8. Baseline Conditions - Fecal Coliform Yield
Nancy Creek Watershed Improvement Plan

SANDY SPRINGS GEORGIA

BROWN AND CALDWELL

L:\Projects\SandySprings\136766 WIP\MapDocs\ReportMaps\NancyCreek1-8 NancyCreekFC Y.mxd

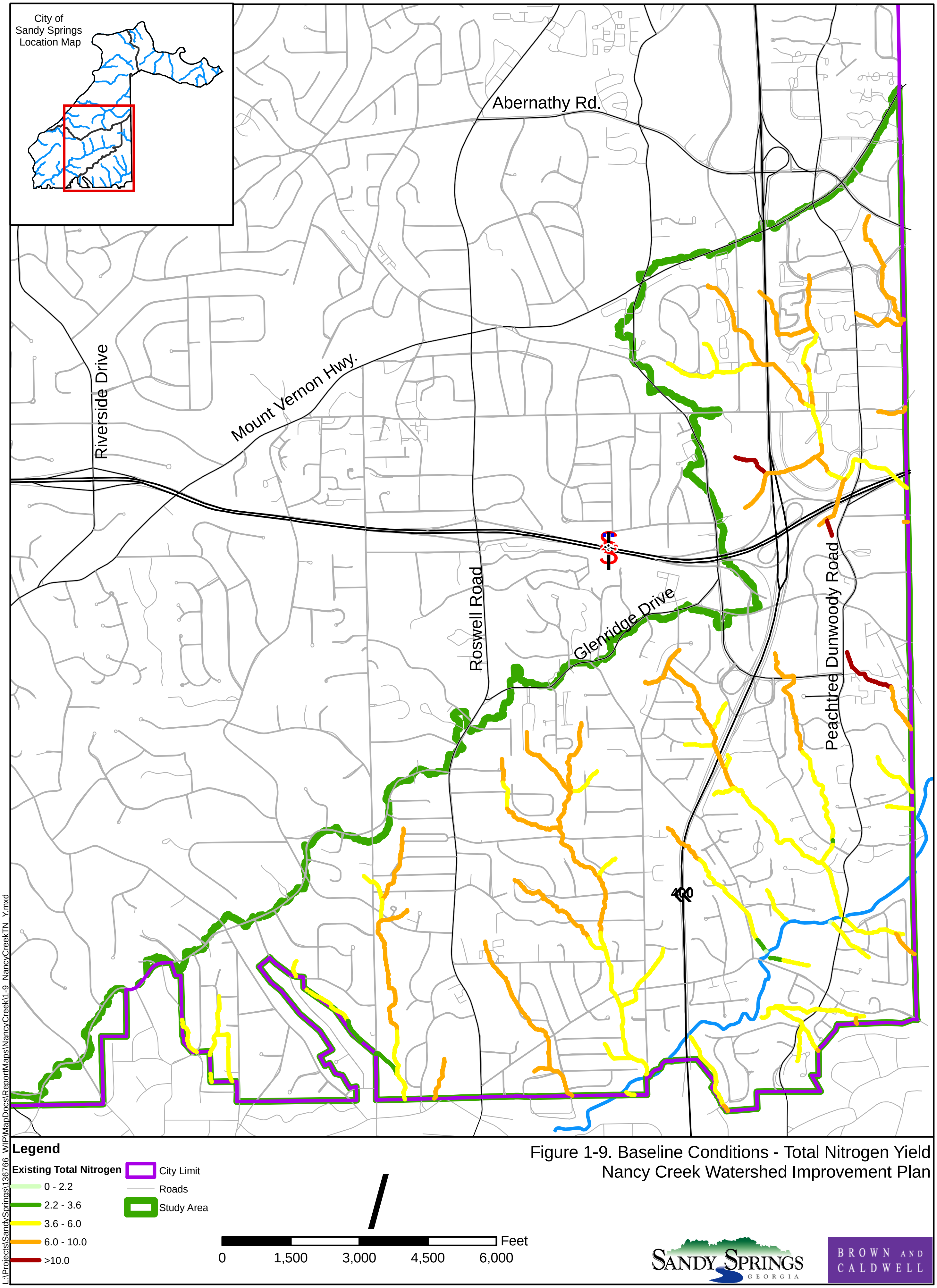


Figure 1-9. Baseline Conditions - Total Nitrogen Yield
Nancy Creek Watershed Improvement Plan

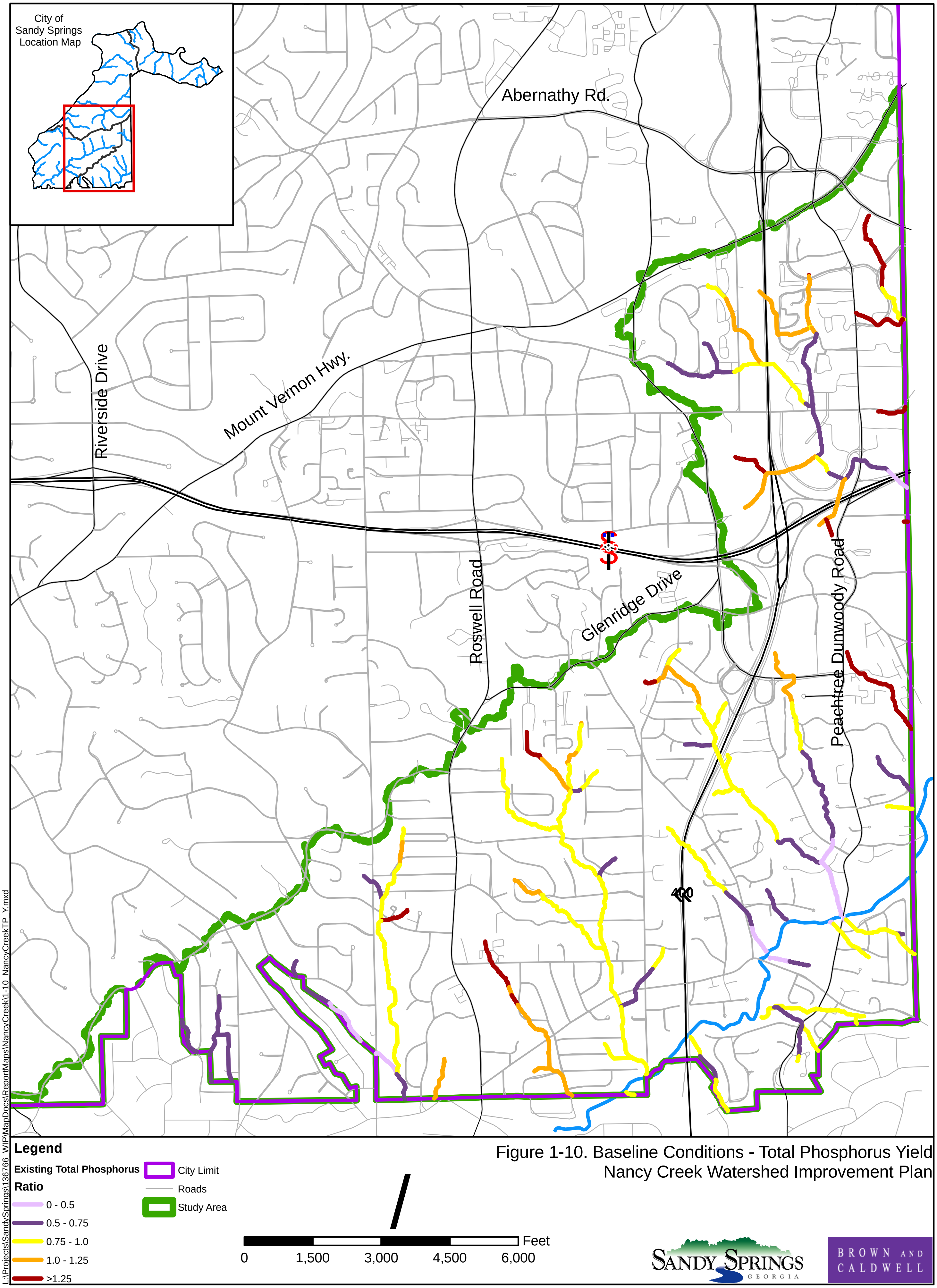


Figure 1-10. Baseline Conditions - Total Phosphorus Yield
Nancy Creek Watershed Improvement Plan

L:\Projects\SandySprings\136766_WIP\MapDocs\ReportMaps\NancyCreek\1-10_NancyCreekTP_Y.mxd

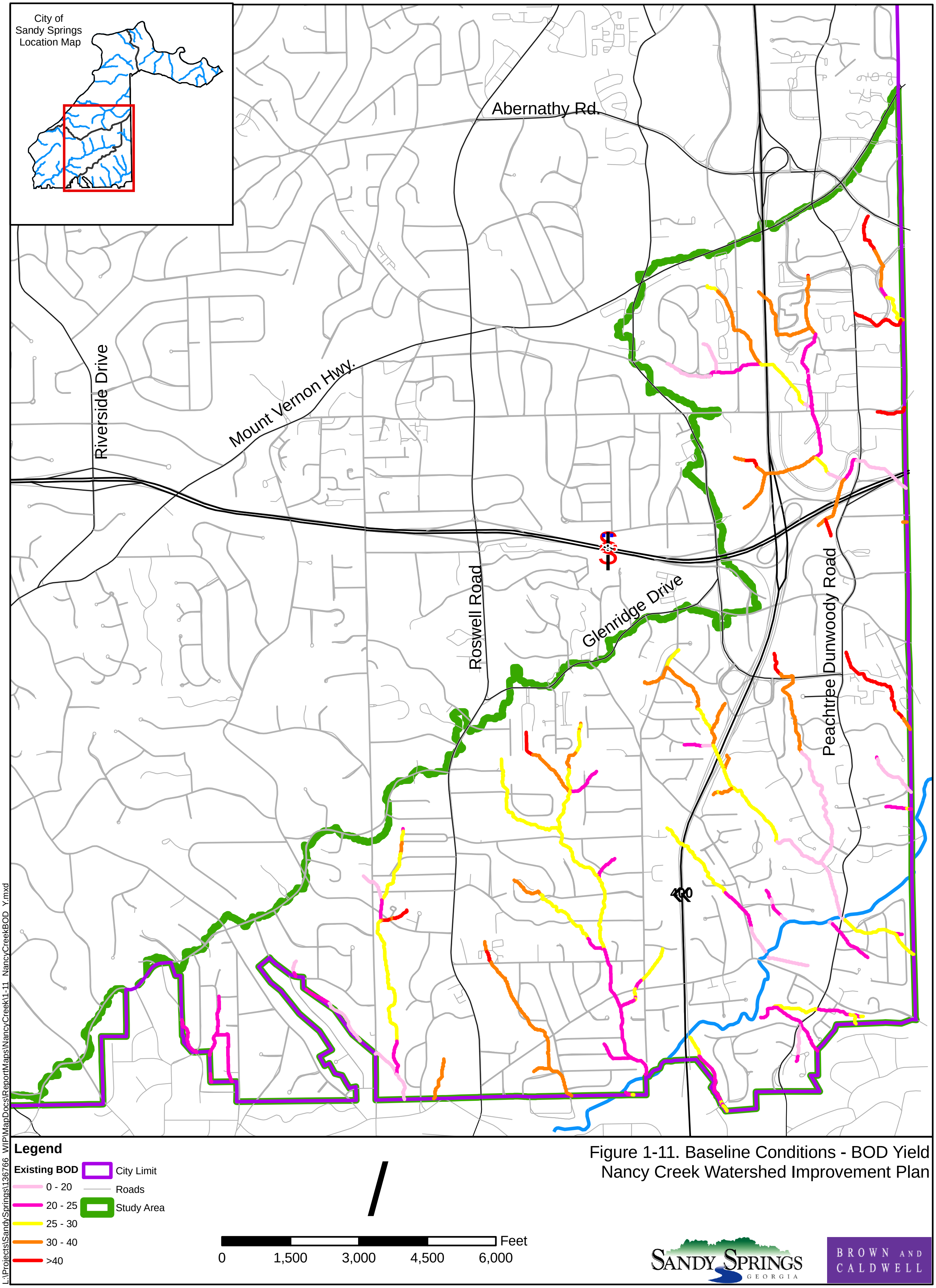


Figure 1-11. Baseline Conditions - BOD Yield
Nancy Creek Watershed Improvement Plan

2. NANCY CREEK STREAM CONDITIONS

2.1 Introduction

Brown and Caldwell assessed 8.98 miles of streams in the Nancy Creek Watershed within the City of Sandy Springs from January 26, 2009 to February 6, 2009 as shown in Figure 2-1. Stream reaches were inventoried along Nancy Creek and Nancy Creek tributaries beginning at the Sandy Springs city limits. Data were collected for man-made and hydrologic channel alterations, streambank erosion, riparian buffer zone encroachment, water quality issues, City maintenance problems, and other miscellaneous observations such as debris dams or braided channels/in-channel wetlands.

Habitat assessment and physical stream cross-section measurements were taken at representative reaches throughout the Nancy Creek Watershed. The cross-section measurements were used to determine the Rosgen Stream Classification, which is a measure of the relative stream stability based on its channel dimension. In addition, potential stream restoration projects were noted during the inventory based on condition of the stream channel, and these data were used to delineate projects evaluated further in the WIP.

Overall, 210 data points were collected by walking stream reaches from downstream to upstream. Data points were taken to represent the portion of the channel at that point and downstream over the length designated with the point. Data were collected using an integrated GPS and PDA loaded with the software *HGIS* that organized the database directly into a geographic information system (GIS) compatible file. Data were merged into a central database for the entire inventory. Some data were used in the WIP tools model (i.e., streambank erosion) and all data were used to evaluate the overall conditions and health of the stream reaches inventoried in the Nancy Creek watershed.

2.2 Channel Alterations

The dominant land uses observed in the Nancy Creek Watershed in Sandy Springs were established residential areas, some areas of new construction, and pockets of commercial areas. These established and changing suburban land uses were the drivers for channel alterations observed throughout the watershed. Channel alterations were divided into two categories – man-made and hydrologic. Man-made alterations can be defined as modifications to the channel that have altered the channel dimension, pattern, or profile and include channelized reaches, piped reaches, rip-rap lined reaches (toe or entire bank), concrete lined channels, or floodplains filled in for development along the channel. Hydrologic alternations can be defined as reaches that are self-adjusting their channel dimension, pattern, or profile due to changes in the impervious area from the watershed which changes the amount and timing of runoff received in the stream channel and include channel incision, channel widening, aggradation, dominant clay streambed substrate, ditch outfalls with direct connection to the stream, stable knickpoints (i.e., a stable vertical drop in the streambed such as a waterfall formed from a large rock outcropping), and unstable headcuts.

The majority of man-made alterations observed were piped reaches and rip-rap lined banks as listed in Table 2-1 and shown in Figure 2-2. Many tributaries were piped under homes, yards, and under roads for more than 500 feet. In addition, channelized reaches and rip-rapped lined banks (both just at the toe and the whole bank) were observed, mostly along residential parcels and adjacent to stormwater culverts. Man-made alterations usually alter the local hydraulics of a stream reach and can cause localized problems, such as scour and bank erosion and can have cumulative effects downstream from the changed reach conditions.

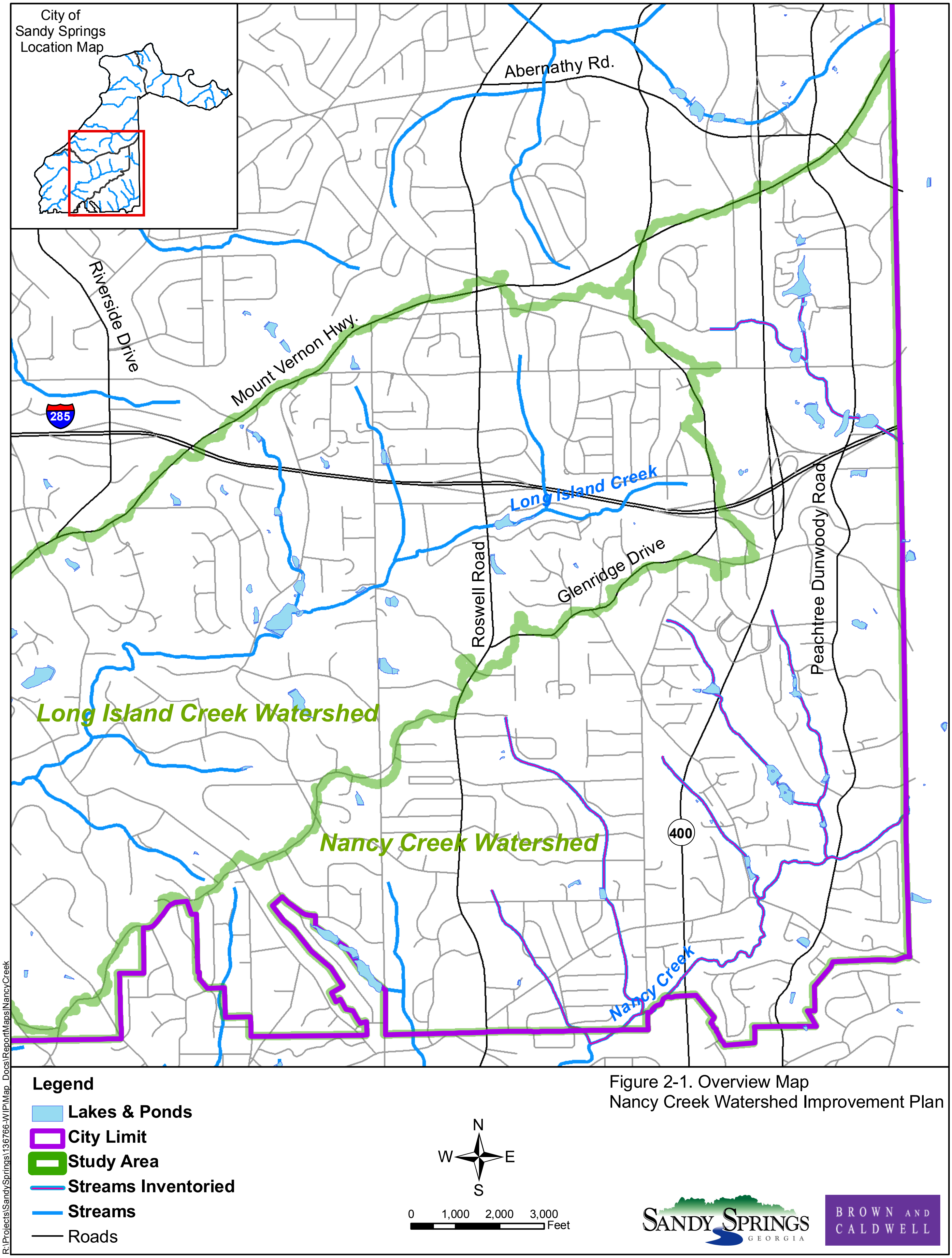


Figure 2-1. Overview Map
Nancy Creek Watershed Improvement Plan

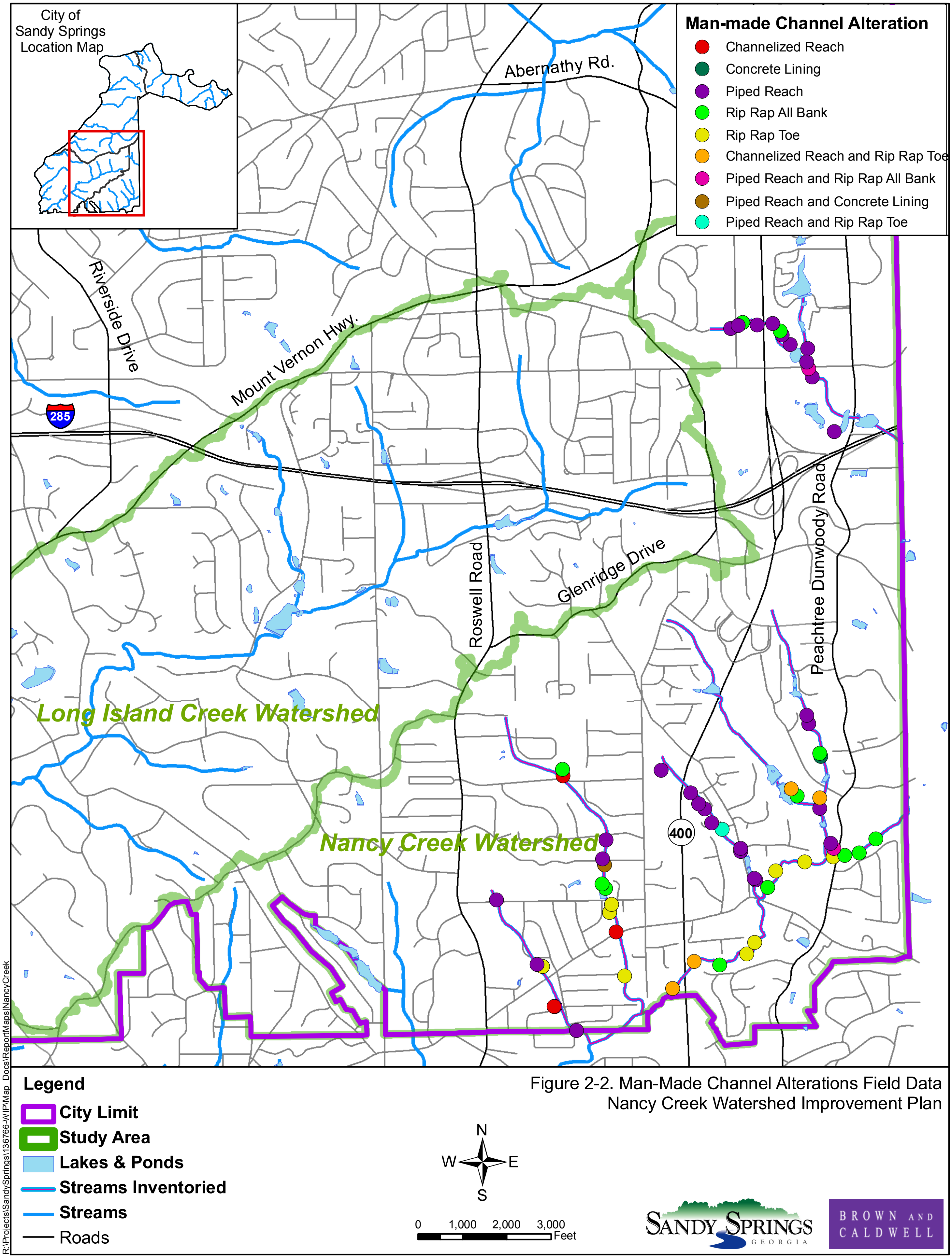


Figure 2-2. Man-Made Channel Alterations Field Data
Nancy Creek Watershed Improvement Plan

Table 2-1. Inventoried Observations of Man-made Alterations for Nancy Creek Watershed

Category	Number of Observations	Total Length (feet)*	Total Length (miles)*
Channelized reach	7	1,500	0.3
Piped reach	18	4,650	0.9
Rip-rap toe	14	2,525	0.5
Rip-rap all bank	16	3,250	0.6
Concrete lined channel	0	0	0
Floodplain build-up	0	0	0

** Estimates of lengths entered in the field – sum of each observation.*

Channel aggradation along Nancy Creek through the formation of large point and lateral sand bars

Example of a channel rip-rap lined along the entire bank

The majority of hydrologic alterations observed in Nancy Creek were channel aggradation (build up of sediment) and some channel incision and/or widening as provided in Table 2-2 and Figure 2-3. In addition, several stream reaches of the tributaries had very steep banks and were encroaching into adjacent properties and yards. Channel aggradation is sign that the stream has a substantially increased sediment supply, either from the banks or the watershed, and the hydraulics of the stream cannot adequately transport the sediment downstream. Therefore, the stream will actively aggrade through increased sand and silt deposition along the channel. Although not observed very frequently, the areas where channel incision and widening were occurring indicated that the watershed hydrology has shifted, and peak flow and total runoff volume have increased and caused the stream to downcut and enlarge its cross-sectional area.

Table 2-2. Inventoried Observations of Hydrologic Alterations for Nancy Creek Watershed

Category	Number of Observations	Total Length (feet)*	Total Length (miles)*
Channel aggraded	13	4,800	0.9
Channel incised	2	500	0.1
Channel widened	5	950	0.2
Channel incised and widened	8	1,550	0.3
Clay-lined channel	0	0	0.0
Knickpoint	9	29	0.0
Head cut	0	0	0.0
Drainage ditch	20	NA	NA

** Estimates of lengths entered in the field – sum of each observation.*

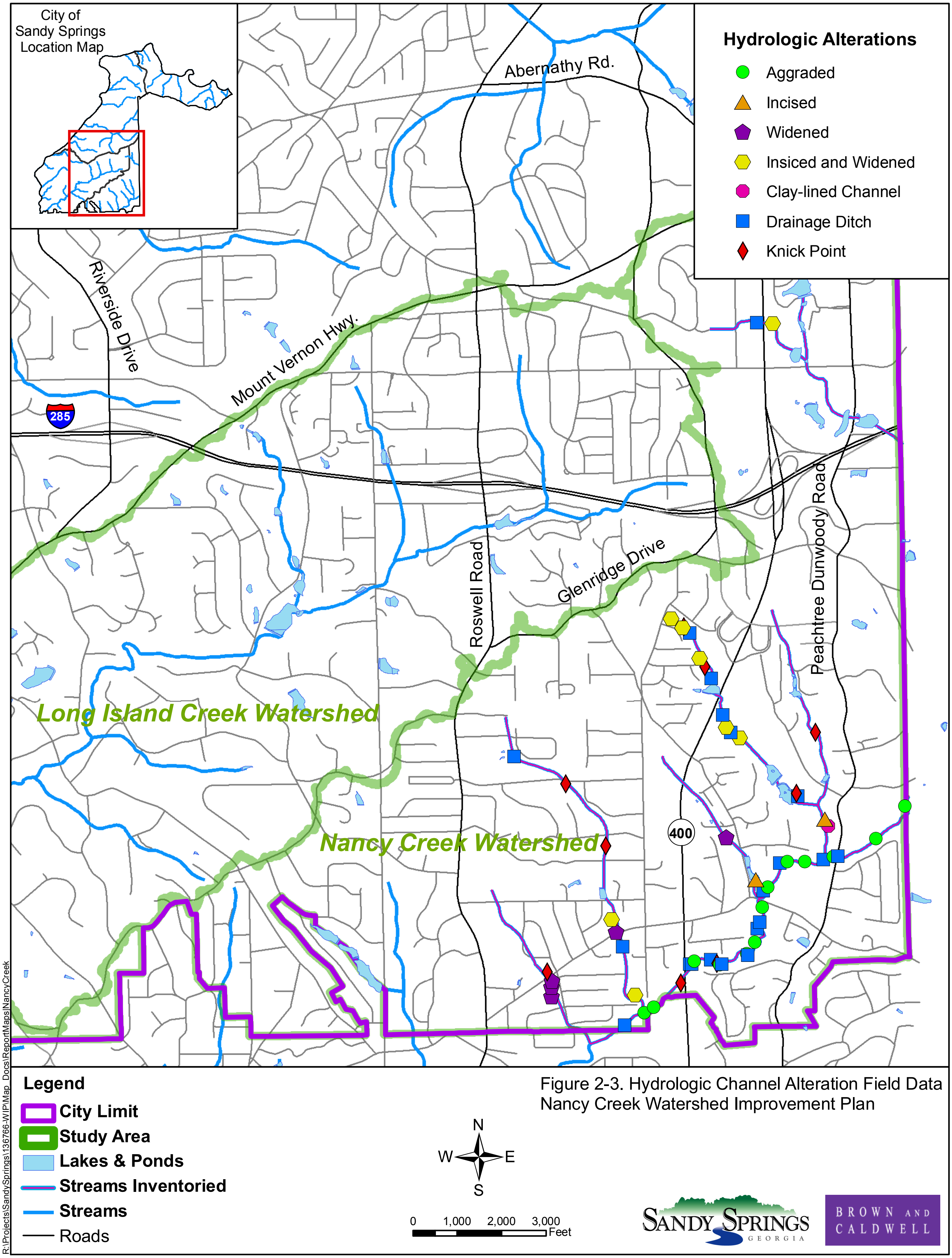


Figure 2-3. Hydrologic Channel Alteration Field Data
Nancy Creek Watershed Improvement Plan

R:\Projects\SandySprings\136766-WIP\Map_Docs\ReportMaps\NancyCreek

2.3 Streambank Erosion

Approximately 29 percent of the stream miles assessed had greater than 25 percent stream bank erosion as provided in Table 2-3 and shown in Figures 2-4 and 2-5. The length and height were recorded with each erosion data point, and these data were used as a primary data set when building the WIP tools model. These data collected were typical of suburban and urban streams in metro Atlanta and correspond with the amount of channel modifications that may be influenced by increased streambank erosion.

Table 2-3. Streambank Erosion by Reach Length and Magnitude for Nancy Creek Watershed*

Percentage of Streambank eroded (%)	Length of Streambank (feet)*	Length of Streambank (miles)*	Percentage of total stream miles**
<25%***	66,844	12.66	71
25-50	8,620	1.6	9
50-75	8,860	1.7	9
>75	10,700	2.0	11

** Estimates of lengths entered in the field – sum of each observation.*

***Includes a summation of both left and right streambank observations. Total streambank mileage is twice the stream miles walked in the Nancy Creek Watershed.*

****Not inventoried in the field. Total erosion lengths for 25 to 100 percent erosion were subtracted from total stream bank miles (8.98 times 2 equals 17.96).*

2.4 Riparian Buffer Zone Encroachment

Approximately 48 percent of the stream miles had riparian zones that were less than 25 feet wide. Riparian buffers are important for water quality treatment, hydrologic improvements, and habitat cover and refuge. The majority of buffer encroachment observations were grassed lawns from residential areas. The northernmost tributary to Nancy Creek near Barfield Road and Hammond Drive had several reaches with impervious surfaces in riparian buffer, including parking lots, office buildings, and tennis courts. In addition, a few perpendicular utility lines were observed with reduced riparian buffers and some horse farms cleared near the streambank and in one case the horses had access directly to the creek. A summary of inadequate stream buffers is provided in Table 2-4 and Figures 2-6 and 2-7.

Example of severe erosion along a streambank that was inventoried as greater than 75% erosion

Example of a poor riparian buffer near a horse farm

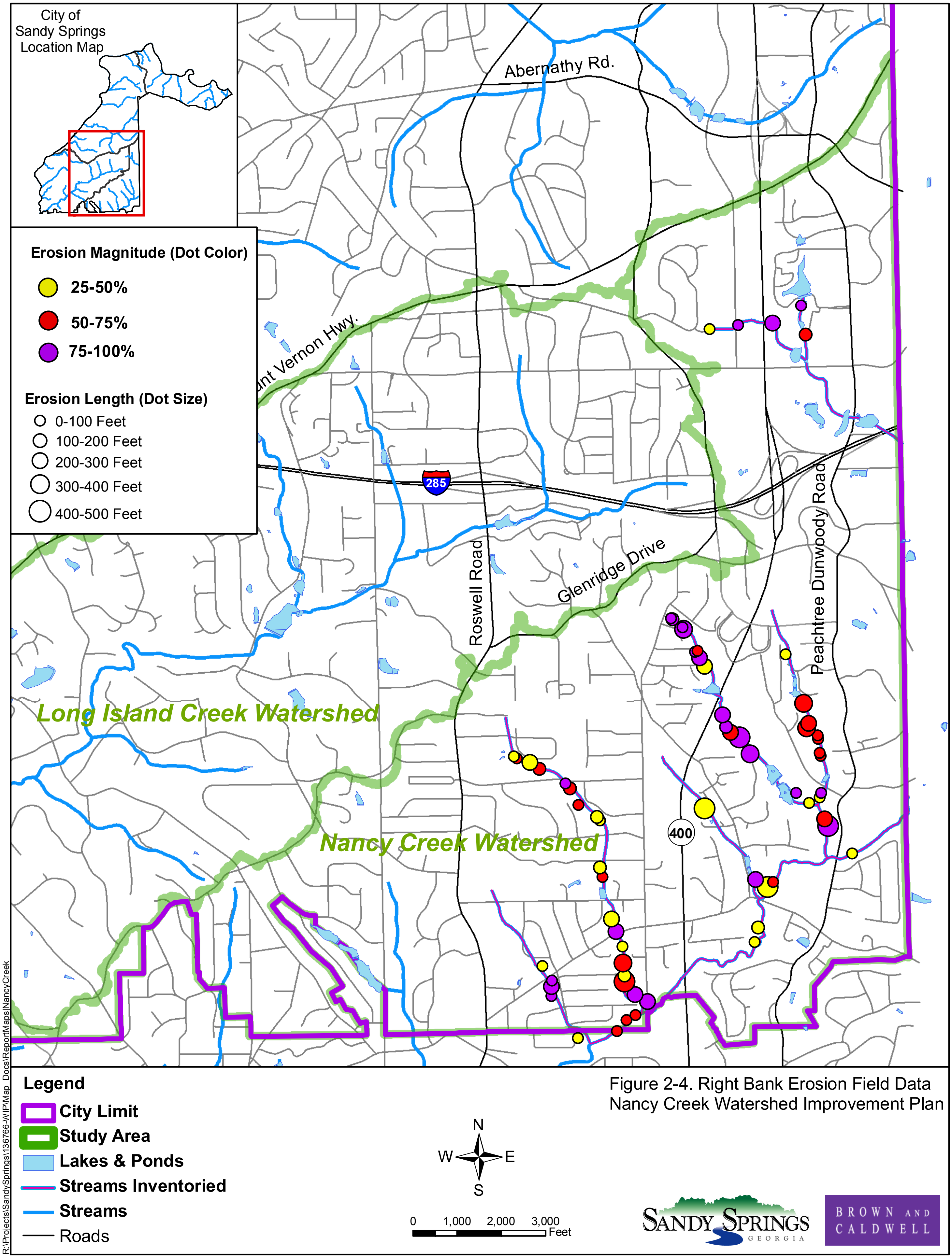


Figure 2-4. Right Bank Erosion Field Data
Nancy Creek Watershed Improvement Plan

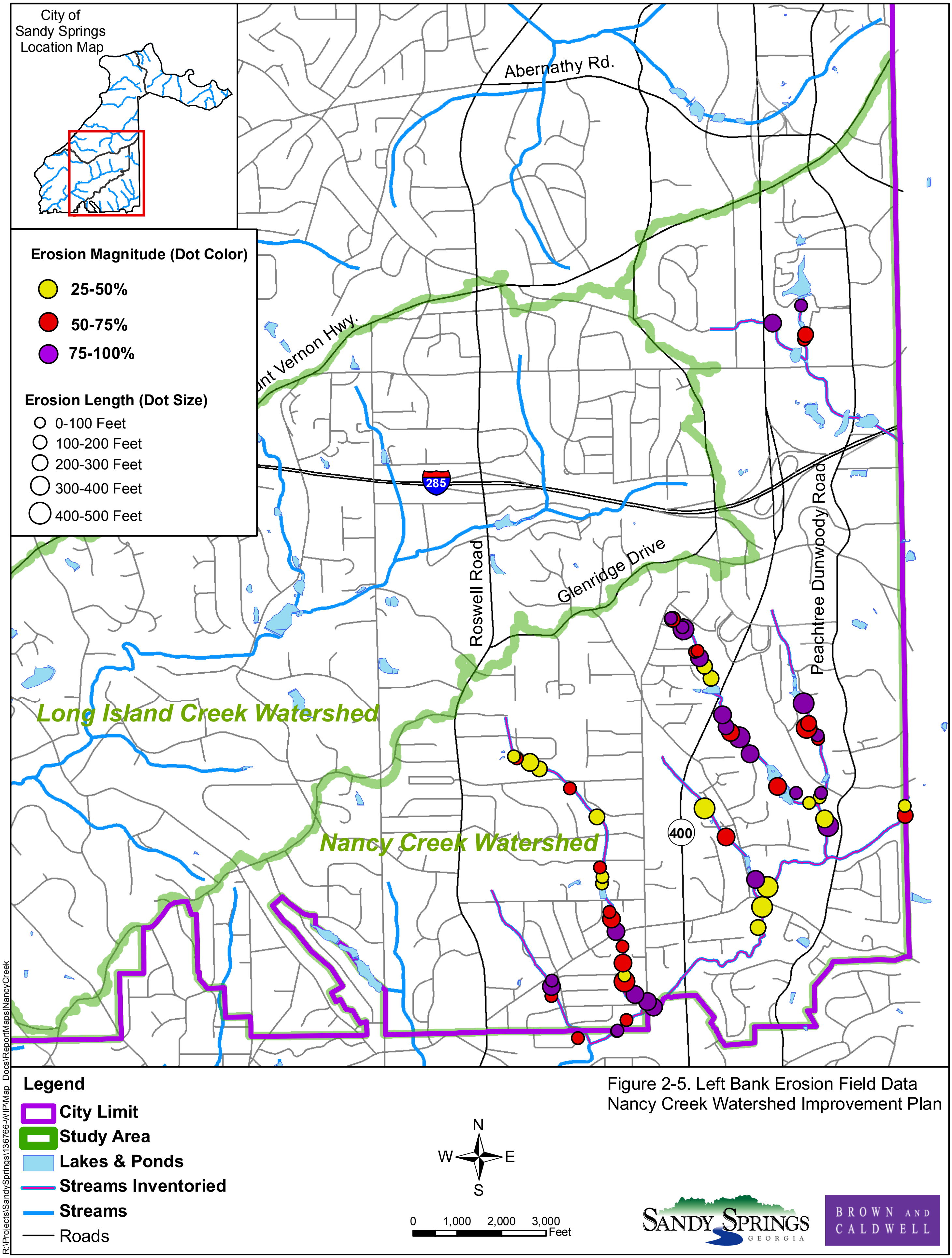


Figure 2-5. Left Bank Erosion Field Data
Nancy Creek Watershed Improvement Plan

R:\Projects\SandySprings\136766-WIP\Map_Docs\ReportMaps\NancyCreek

Table 2-4. Inventoried Observations of Inadequate Riparian Buffers for Nancy Creek Watershed

Encroachment Width (feet)*	Buffer Land Use	RB Total Length (feet)**	LB Total Length (feet)**	Total Length (feet)**	Total Length (miles)**
<10	Crops and Pasture	1,000	800	1,800	0.34
	Cleared and grubbed	NA	NA	NA	NA
	Cleared and maintained parallel or perpendicular utility	350	75	425	0.08
	Impervious or structure	600	600	1,200	0.23
	Landscaped area	200	NA	200	0.04
	Grassed lawn	2,850	4,750	7,600	1.44
	Old Field	400	NA	400	0.08
10-25	Crops and Pasture	400	NA	400	0.08
	Cleared and grubbed	NA	NA	NA	NA
	Cleared and maintained parallel or perpendicular utility	NA	400	400	0.08
	Impervious or structure	600	400	1000	0.19
	Landscaped area	400	475	875	0.17
	Grassed lawn	4,425	4,225	8,650	1.64
	Old Field	NA	NA	NA	NA
>25	Crops and Pasture	NA	NA	NA	NA
	Cleared and grubbed	75	NA	75	0.01
	Cleared and maintained parallel or perpendicular utility	150	75	225	0.04
	Impervious or structure	NA	NA	NA	NA
	Landscaped area	NA	NA	NA	NA
	Grassed lawn	400	1,275	1,675	0.32
	Old Field	NA	NA	NA	NA

** Width of encroachment into the 50-foot riparian buffer (i.e., 10-foot encroachment equals a 40 buffer left intact).*

*** Estimates of lengths entered in the field – sum of each observation.*

2.5 Point and Non-point Source Pollution

Both point and non-point source pollution sources were inventoried as part of the streamwalks. Point sources included septic tank failures or leaks, sewer line leaks or breaks, chemical discharges, and other unknown illicit discharges. Non-point sources included livestock/feedlots, kennels and domestic animals, and urban runoff from stormwater conveyance pipes. Several water quality issues were observed throughout the Nancy Creek Watershed as shown in Table 2-5 and Figure 2-8. Potential non-point source pollution included three greater than 36-inch urban runoff pipes on Nancy Creek Tributaries and a horse farm draining into the creek. Potential point source pollution included a cracked sewer manhole, an abnormal discharge from a sewer manhole pipe crossing, and a manhole missing a cover. The field crew documented a strong sewer smell upstream and downstream of the coverless manhole. These issues observed will be addressed by the City during routine inspections.

Table 2-5. Inventoried Observations of Water Quality Point and Non-point Source Discharges for Nancy Creek Watershed

Category		Number of Observations
Point source	Cracked Sewer Manhole	1
	Abnormal Discharge from Sewer Pipe	1
	Manhole Missing Cover	1
	Sewer Smell	5
Non-point source	Livestock	1
	Urban run-off pipes >36 inches	3

2.6 Miscellaneous Observations

Other data were collected that didn't fit the categories above, which included the following:

- Reference reach – stream reach that exhibits a stable stream and habitat diversity that could be considered a reference for a high quality stream in a suburban setting.
- Invasive species – dense areas of kudzu, privet or bamboo along the stream in the riparian buffer
- Debris dams – debris build up around road culverts or in the stream channel that is substantial enough to cause scour around the debris and potentially cause local flooding due to the dam effect of debris
- Beaver dam – Beaver dams that have caused an impounding effect on the stream
- Water withdrawal – Pipe in the stream that withdraws water from the stream for irrigation or other purposes
- In-channel wetland – Braided stream system that mimics a wetland community more than a defined stream channel
- Off-channel wetland – Wetland system in the floodplain adjacent to the stream channel
- Backwater extent – Signs of backwater effect from a downstream dam structure into the stream channel
- Unusual/Comment – Any unique or unusual observation worth noting and does not fit into any other category.

Debris jams were consistently found on the main branch of Nancy Creek and its tributaries. Most of the debris jams were caused by fallen trees and in some cases were caused by exposed sewer pipe crossings. Invasive species were seen throughout the watershed along the riparian corridor Inventoried observations of miscellaneous features is provided in Table 2-6 and Figure 2-9. Exposed sanitary sewer pipe crossings, inventoried as unusual/comment, were found throughout the watershed, frequently occurring on Nancy Creek's tributaries. Other unusual comments noted high levels of silt, bacteria or algae covering the stream bed, and areas that are not accessible by foot, including deep pools and locked BMPs.

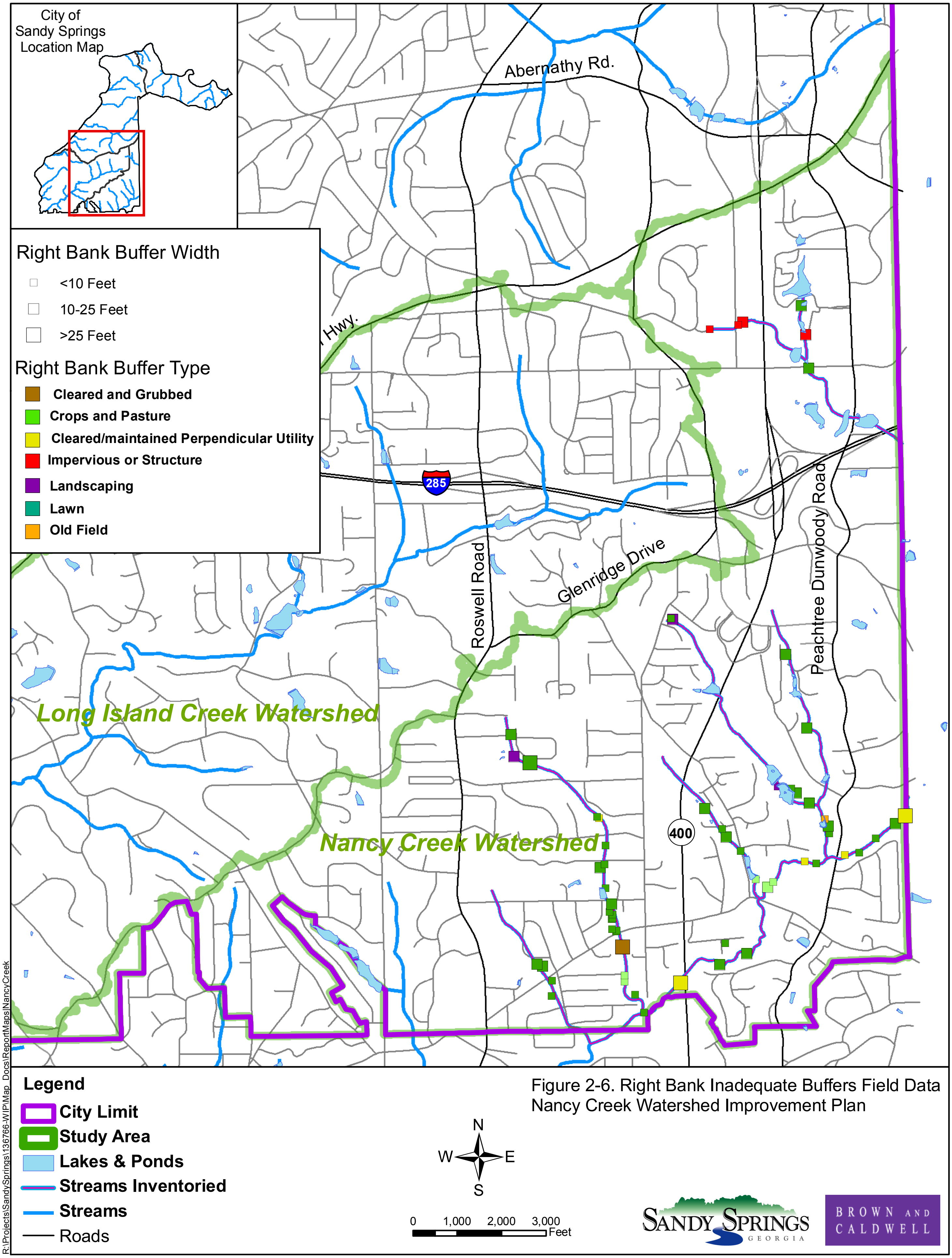


Figure 2-6. Right Bank Inadequate Buffers Field Data
Nancy Creek Watershed Improvement Plan

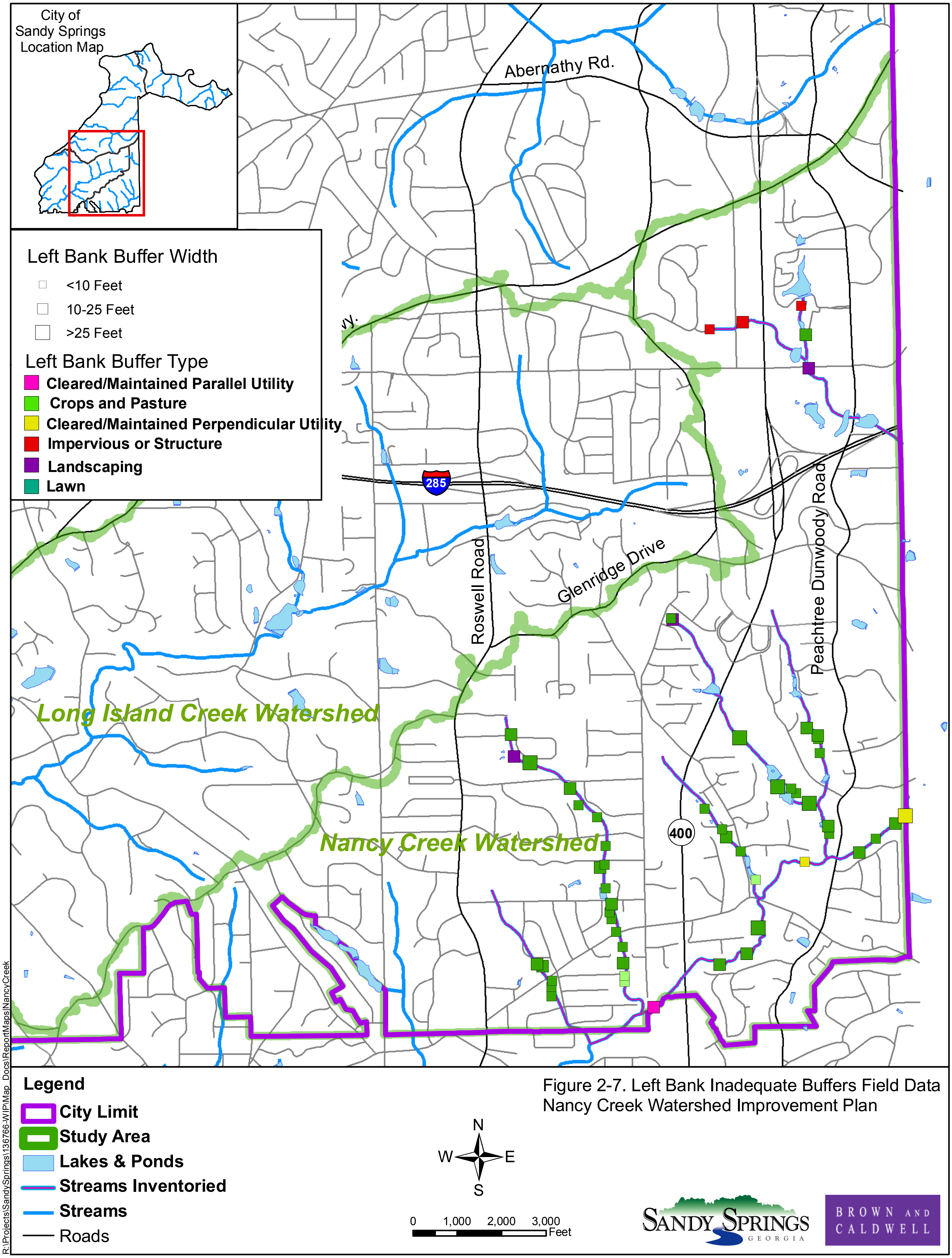


Figure 2-7. Left Bank Inadequate Buffers Field Data
Nancy Creek Watershed Improvement Plan

R:\Projects\SandySprings\136766-WIP\Map_Docs\ReportMaps\NancyCreek

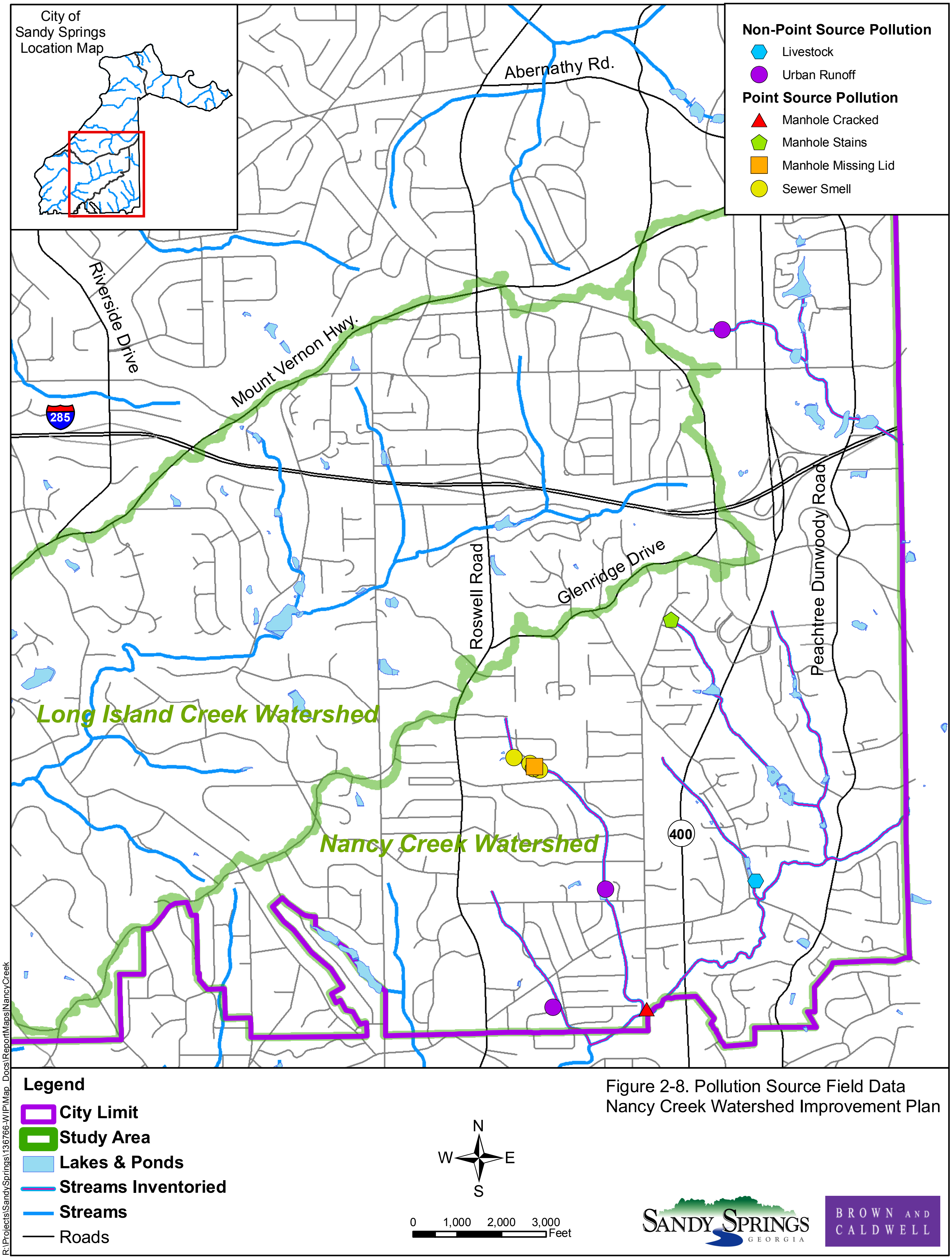


Figure 2-8. Pollution Source Field Data
Nancy Creek Watershed Improvement Plan

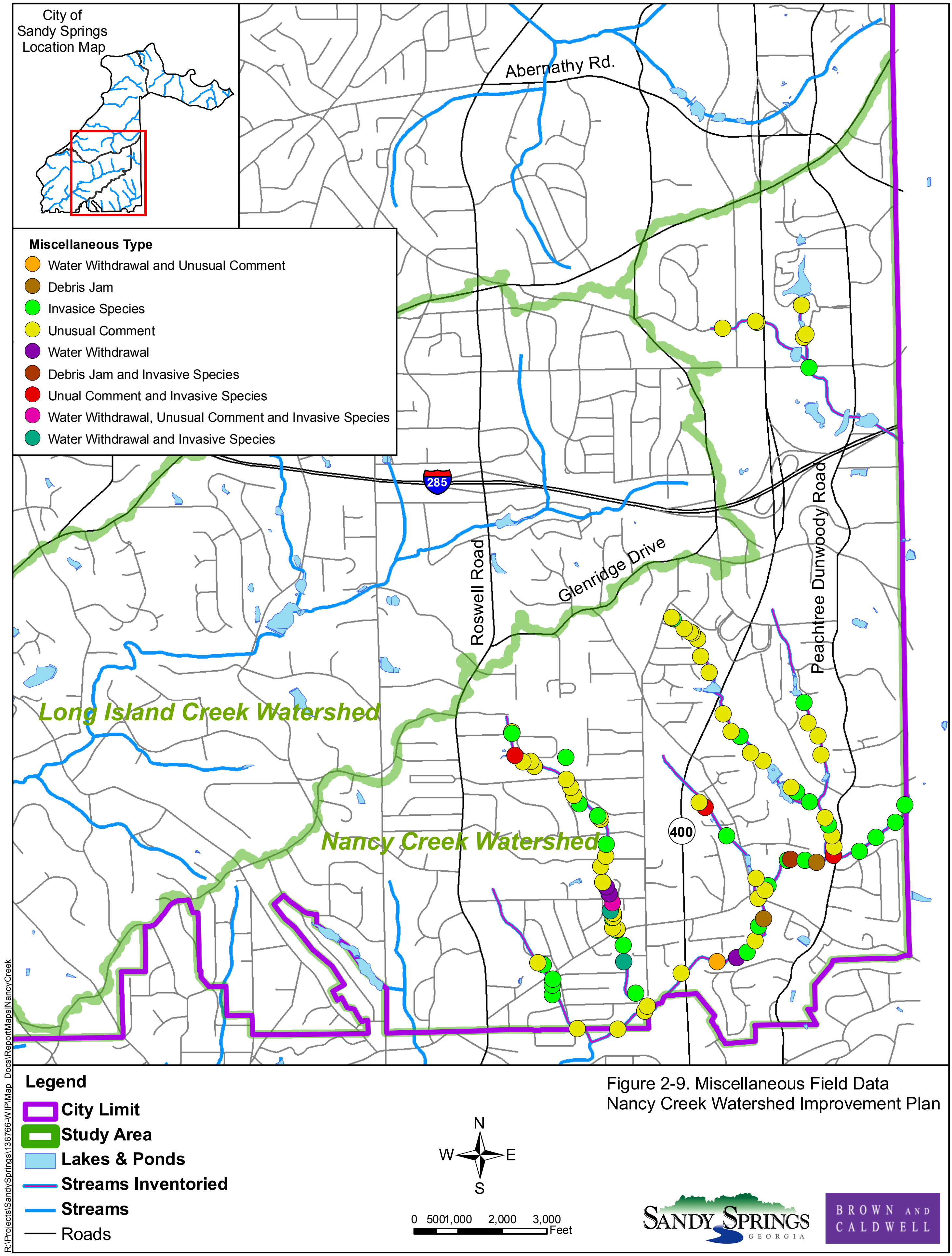


Figure 2-9. Miscellaneous Field Data
Nancy Creek Watershed Improvement Plan

Table 2-6. Inventoried Observations of Miscellaneous Features for Nancy Creek Watershed

Category	Number of Observations
Debris Dam	3
Abundant privet, kudzu, or bamboo	37
Unusual/comment	57
Water withdrawal	7

Example of a debris dam observed throughout

Example of a sanitary sewer crossing a tributary

2.7 Habitat Assessment and Physical Measurements

During the stream inventory, the field crew collected information on the stream physical condition by completing a habitat assessment using the Georgia Department of Natural Resources SOP for Benthic Macroninvertebrates (GaDNR, 2007) and collecting specific width and height measurements along a cross-section which were used to classify a stream reach using the and Rosgen Stream Classification methodology (Rosgen, 1994). The habitat scores were compared to a theoretical score of 150, which is considered a high habitat score for an urban system. No sites were above 134 and 50 percent of the sites inventoried (3 of 6) were below 90 or less than 60 percent of the reference reach. A summary of habitat assessment and physical measurements is given in Table 2-7 and Figure 2-10.

Table 2-7. Habitat Assessment Scores for Nancy Creek Watershed		
Habitat Assessment Score Range	Percent of Reference Reach*	Number of Scores
Less than 90	<60%	3
90 to 112	60-74%	2
113-134	75-89%	1
Greater than 134	>89%	0

** Due to the urban nature of streams in the City of Sandy Springs, a reference score of 150 was used as the reference reach benchmark.*

According to the Rosgen Stream Classification method, three of the reaches were categorized as F or G Rosgen channel types, which are indicative of channel degradation. These channel types are deeply incised and disconnected from the floodplain are considered "degraded" streams. The other three stream reaches were B channel types, which were moderately entrenched with low sinuosity. B channel types are commonly found in headwater areas or transitional zones in confined valleys and can be considered stable stream types in Sandy Springs. A summary of Rosgen channel types for Nancy Creek is provided in Table 2-8 and Figure 2-11.

Table 2-8. Rosgen Channel Types for Nancy Creek Watershed		
Channel Type	Number of Stream Reaches	Channel Type Description*
B1	1	Moderately entrenched channels with a width/depth ratio greater than 12, low sinuosity, and channel slope general between 2 to 4 percent. Usually fond in headwater areas or transitional zones in confined valleys. (Considered a stable reach in Sandy Springs)
B4	1	
B5	1	
F5	1	Entrenched channels with width/depth ratio less than 12. F channels are characterized incised and widened channels that show signs of historic and/or current disturbance. (Degraded channel in Sandy Springs)
G3	1	Entrenched channels with a width/depth ratio of less than 12 and moderate sinuosity. G channels are incised and have limited access to the historical floodplain. The classic "gully" stream. (Degraded channel in Sandy Springs)
G4	1	

** Number connotation on channel type refers to type of substrate – 1= bedrock, 2= boulder, 3 = cobble, 4 = gravel, 5 = sand, 6 = silt/clay.*

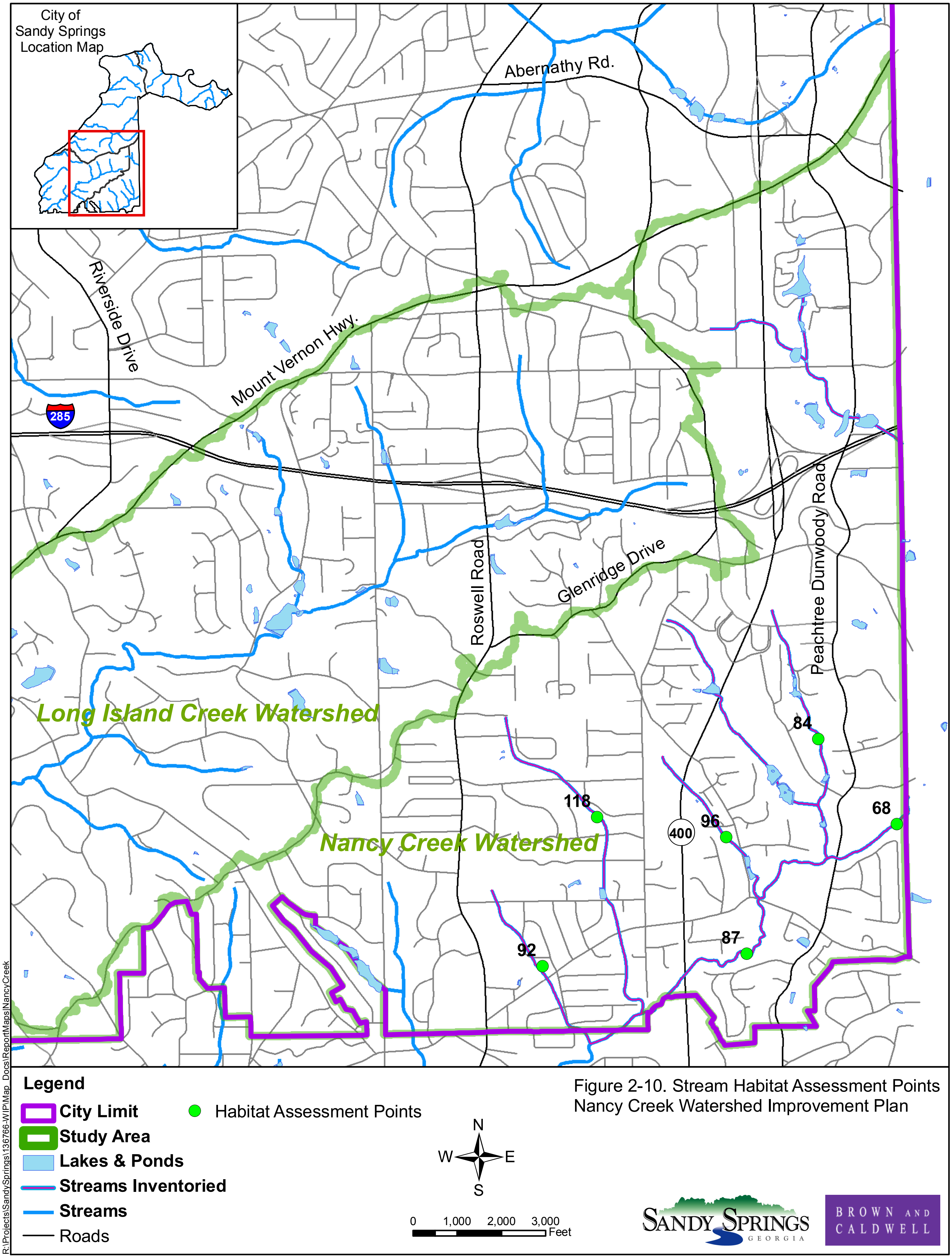


Figure 2-10. Stream Habitat Assessment Points
Nancy Creek Watershed Improvement Plan

R:\Projects\SandySprings\136766-WIP\Map_Docs\ReportMaps\NancyCreek

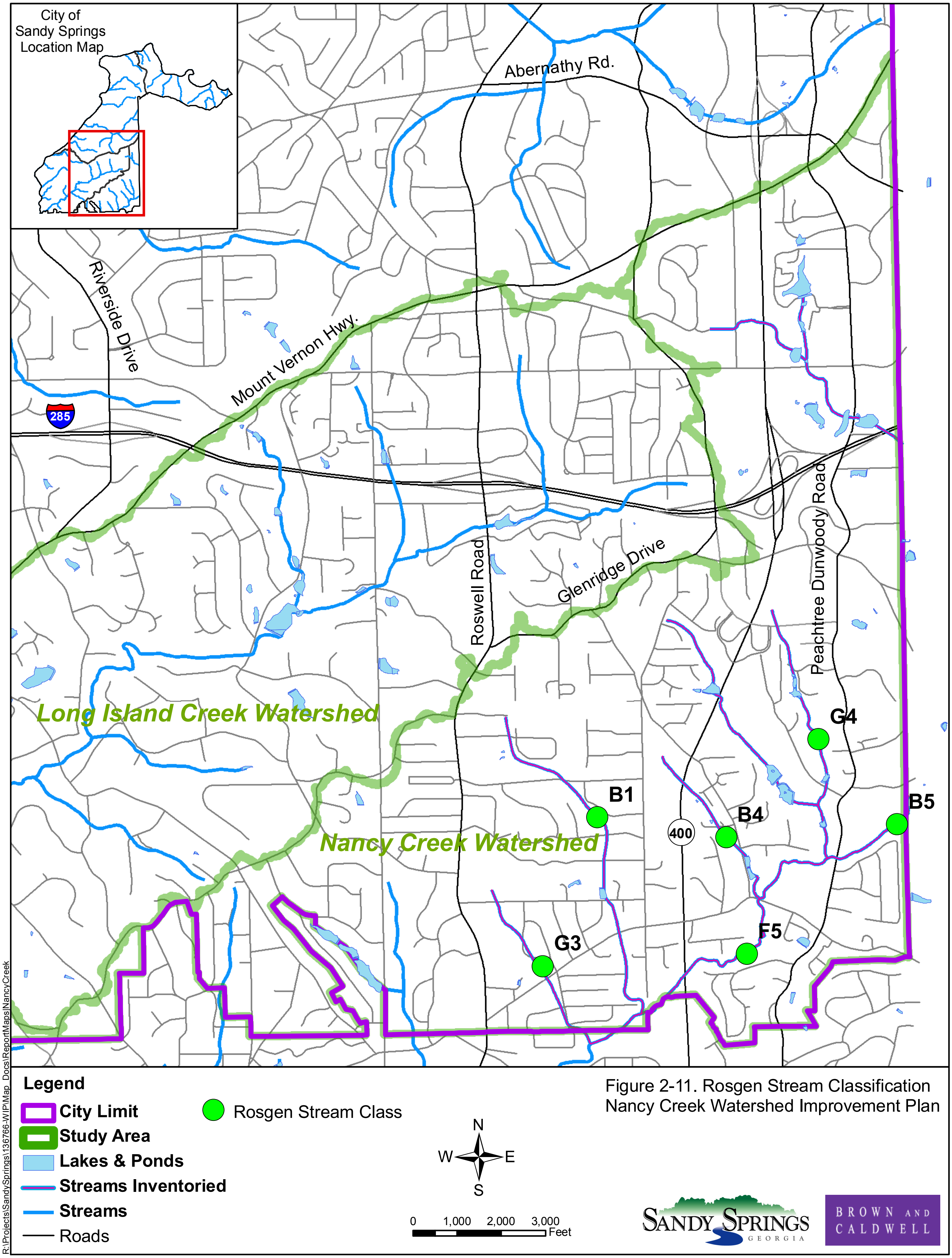


Figure 2-11. Rosgen Stream Classification
Nancy Creek Watershed Improvement Plan

3. WATERSHED PROJECT DEVELOPMENT

3.1 Watershed Project Identification

For this plan, stormwater detention facilities are referred to as best management practices (BMPs). The BMPs evaluated for the Nancy Creek Watershed Improvement Plan come from two primary sources: historical CIP and a desktop review of available GIS data. During the first phase of this project the available historical data including reports, GIS, photos and models were reviewed and cataloged. Appendix A contains a technical memorandum that outlines the available historical data reviewed and used for this project.

Each project has an asset number and project number associated with it. The asset number is a City of Sandy Springs designation based on a numerical value assigned to each asset within the City and named 'AGM_five digit number'. The project number is a combination of the parcel number, what type of project it is, and a numerical designation to represent the project within each parcel. If an asset number did not exist for a particular project, then the nearest asset was assigned to that project. If no asset was in close proximity, the code 'BAC_five digit code' was assigned to that project.

In one case for Project ID 17 0013LL089 BMP 1, the asset was incorrectly assigned a city ownership designation. This project was re-assigned a designation of "9" or "to be determined". An incorrect designation as city ownership would put the project within the City's level of service, so these projects were closely screened.

3.1.1 Historical Data for BMPs and Stream Restoration Projects

In the 2001-03 time frame, Fulton County prepared Water Resource Management Plans (WRMP) that covered all of the then unincorporated areas of the County. The WRMPs included a stormwater infrastructure and stream inventory, watershed modeling and the creation of a CIP. Data included in the WRMP reports include: storm sewer system infrastructure; stream survey cross-sections; SWMM modeling files; stream photos and associated photologs, and prioritized CIP projects with estimated implementation costs. Each of the WRMPs was performed by a different firm, and therefore the criteria for project evaluation were not consistent. Unfortunately, the WRMP report for Nancy Creek was not located in City or County files; however, some GIS files were obtained.

Another source of BMP information is the 2006 CIP Priority Projects List report prepared by Brown and Caldwell for Fulton County (Brown and Caldwell, 2006). This report was prepared to compile recommended CIP projects from all the WRMPs grouped by watershed management district. The area which is now the City of Sandy Springs was included in the Sandy Springs Stormwater Management District (SSSMD) report. CIP projects were aggregated from the various WRMPs. These projects included flood control, BMP, and stream restoration projects. Data from the 2006 report includes a Priority Projects table of the 151 identified CIP projects, a map with the location of all potential projects, and a 2-page project summary for each identified project which included a site map, photographs, and cost estimate. Using the SSSMD report and available GIS data, 17 historical CIP projects were identified for Nancy Creek as given in Table 3-1.

Table 3-1. Historical CIP Projects for Nancy Creek Watershed	
Type	**Number of Projects**
Flood Control	3
Upgrade SW conveyance	1
Pond Retrofit	4
Detention Pond/Wetland	4
Stream Protection/Restoration	5
TOTAL	**17**

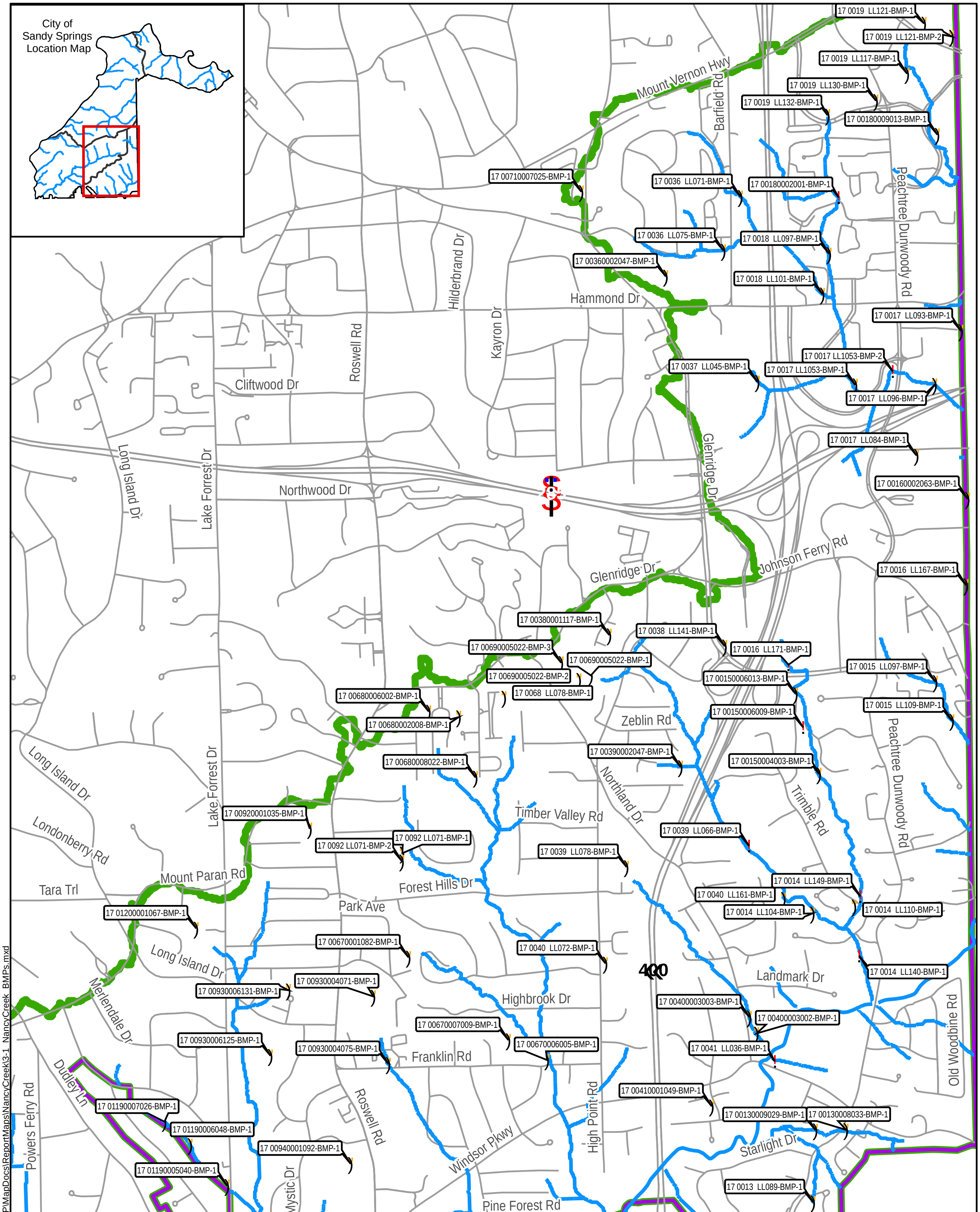
Each of the historical CIP projects was reviewed for use in the current study. Based upon the review, nine projects were removed from the watershed CIP listing or will be evaluated by another study (flood control or infrastructure). The reason for removing each of the projects is listed in Table 3-2.

Table 3-2. Historical CIP Projects Removed from CIP Consideration		
Old Project ID	**Reason**	**Project Type**
NC-AN-BMP-2	New homes constructed, this small reach is piped based on infrastructure data	Stream Restoration
NC-UP-AO	Upgrade Stormwater Conveyance; resize pipes to convey 25-year storm – this is not a watershed improvement project.	Flood Control Project
NC-NC-BMP-1	Bridge replacement	Flood Control Project
NC-AC-BMP-1	Culvert replacement	Flood Control Project
NC-AD-BMP-2	Culvert replacement	Flood Control Project
NC-AC-BMP-3	Merged with AGM_00867, AGM_00899	Stream Restoration
NC-AJ-BMP-7	Merged with AGM_00665, AGM_00568	Stream Restoration
NC-NC-STM-3	Merged with AGM_00685, AGM_00655	Stream Restoration
NC-NC-STM-4	Merged with AGM_00302, AGM_00217	Stream Restoration

3.1.2 Desktop Identified BMP Projects

With such a small number of projects viable from the historic CIP, a desktop GIS inventory was performed to locate additional projects. All of the projects identified are existing BMPs that, based on desktop information, have retrofit potential to provide water quality and perhaps channel protection benefits. Not every BMP in the study area was identified during this process. The focus was to find BMPs with retrofit potential based on available information. Due to the desktop nature of the process and lack of data underground detention was not included in this report.

The desktop inventory was performed in a systematic, grid-like fashion by reviewing GIS data obtained from the City of Sandy Springs. The GIS data used includes the location of rivers and streams, parcel boundaries, topographical contours, aerial photographs and underground storm water conduits. Point and polygon files were developed to inventory the existing BMPs. As a BMP was located a point with a temporary unique four-digit ID was assigned to that particular BMP (the permanent ID was later assigned based on the parcel number). In addition a polygon was developed for the BMP (identified with the same four-digit ID) that delineated the highest ponding elevation of the BMP. A total of 58 additional potential BMPs where identified during the desktop inventory. Figure 3-1 shows the locations of the historic CIP projects and the BMPs identified as a part of the desktop inventory.



Legend

- Desktop Identified BMPs
- Historic CIP BMPs
- Streams
- Roads
- City Limit
- Study Area

0 750 1,500 3,000 4,500 6,000 Feet

Figure 3-1 Historic and Desktop Identified BMPs
Nancy Creek Watershed Improvement Plan

SANDY SPRINGS GEORGIA

BROWN AND CALDWELL

L:\Projects\SandySprings\136766_WIP\MapDocs\ReportMaps\NancyCreek\3-1_NancyCreek_BMPs.mxd

Also, during the desktop inventory each BMP was assigned an existing project type. The project type includes Dry Basin or Wet Pond. The project type was assigned based on aerial photography or previous photography from prior studies. Each existing BMP type is explained below.

- Dry Pond (DP) – denotes a dry facility (no permanent pool) designed to collect and store storm water runoff and release the runoff at a reduced rate. The primary purpose of this facility type typically is flood control; however newer facilities may be designed to provide water quality and channel protection benefits. This designation also includes facilities such as a dry extended detention basin and micropool extended detention.
- Wet Pond (WP) – is a facility with a permanent pool of water. If designed using recent standards, the facility will have a permanent pool to store the water quality volume. In addition, the channel protection volume will be released over a 24-hour period, and the facility may provide additional storage for larger storm events. However, some facilities may have been developed for farm or recreational use without stormwater design considerations. This designation also includes facilities such as wet extended detention and constructed wetlands.

Table 3-3 shows a breakout of the project type for both the historic BMPs and the ones identified during the desktop inventory. It should be noted that this table only includes 63, due to the fact that three of the historic BMPs were determined to not actually be existing BMPs but proposed locations for new BMPs and one of the additional BMPs was also determined not to be an existing BMP, as a result these BMPs are not assigned as existing project type.

Table 3-3. Existing BMP Project Type

	Dry Pond (DP)	Wet Pond (WP)	Total
Historic CIP BMPs	1	4	5
Additional BMPs	36	22	58
Total	37	26	63

3.2 BMP Project Development

In order to evaluate a potential BMP project for inclusion in the updated CIP, specific recommendations for retrofit must be assigned to each project. No details on the proposed recommendations were available for the historic CIP projects. As a result, all of the projects (historic and desktop) were evaluated in this step.

Using the baseline conditions model (described in Section 1.8) the cumulative drainage area, required water quality volume, required channel protection volume are determined for each BMP. The highest ponding elevation polygon file is used to estimate the BMP storage volume (using GIS surface analysis). The following regression equation is used to estimate the wet volume:

$$y = 0.1731x^{1.3437}$$

Where,

x = lake surface area at normal pool (square feet)

y = wet volume (cubic feet)

The lakes file (described is Section 1.5) is used as input into the above equation, which was developed by Brown and Caldwell using data from hundreds of BMPs.

By comparing the existing estimated volumes (both dry storage and wet volume, if applicable) of the BMP to the required volumes and examining site constraints; proposed facility type and retrofit options were assigned.

Table 3-4 lists each type of proposed facility and the number of BMPs for that type. The table includes both new and existing BMPs. Figure 3-1 shows the locations of the historic and additional BMPs listed in Table 3-4. Also, at this point in the review it was determined that some BMPs have design restrictions make the BMP not suitable for retrofit. These BMPs were placed in the Not Recommended category and no further analysis was performed for these BMPs.

Table 3-4. Proposed BMP Project Type

BMP Type	Dry Extended Detention (DED)	Micropool Extended Detention (MED)	Wet Pond Extended Detention (WPED)	Wet Pond (WP)	Shallow Wetland (SW)	Not Recommended	Total
Historic CIP BMPs	0	0	0	5	2	1	8
Additional BMPs	14	15	5	19	0	6	59
Total	14	15	5	24	2	7	67

The retrofit options fall into three categories: outlet control structure retrofits, volume retrofits and additional (add-on) modifications. Each BMP much have at least one structure or volume modification and add-ons are optional (Table 3-5). Every volume modification must also have a corresponding volume increase which notes the amount of volume expansion to be provided by the volume modification. For example, if a 50 percent increase in volume is to be provided then the volume increase is noted by 1.5. All of the retrofit options are recorded in the GIS database.

Table 3-5. Retrofit Options

Code	Description
Outlet Control Structure Modification	
S1	Reduce the lower orifice area
S2	Lower pond level and modify structure
S3	Build/modify structure for wet detention
S4	Build/ modify structure for dry detention
S5	Build/modify structure and change dry to wet
Volume Modifications	
V1	Dredge wet pond within existing footprint
V2	Excavate dry pond within existing footprint
V3	Enlarge pond by building up berms
V4	Enlarge pond by expanding footprint
V5	Increase dam height
V6	Rebuild dam downstream
Additional Modifications	
A1	Build or replace outlet filtering device
A2	Build a sediment forebay
A3	Add baffle to prevent existing short circuiting
A4	Add erosion control measure at outlet
A5	Add erosion control measure at inlet
A6	Bank stabilization
A7	Remove trees from dam embankment

Next, pollutant removal efficiencies and proposed 1-year discharges are assigned to each BMP using a CIP Prioritization Tool. Pollutant removal efficiencies were used to determine the water quality removal benefits, and the one-year discharge reduction calculations were used to determine the channel protection benefits. The CIP Prioritization Tool is a macro-based Excel spreadsheet that performs several functions, including calculating project costs, benefit/cost scores, generated two-page project summary sheets, proposed BMP pollutant removal efficiencies, and proposed channel protection discharges. The CIP Tool will be discussed in more detail in Chapter 4. Both existing and proposed efficiencies are assigned for each parameter to be modeled. Table 3-6 lists the efficiency for each parameter for each type of BMP facility.

Table 3-6. BMP Removal Efficiencies

Project Type	Total Nitrogen	Total Phosphorus	TSS	Fecal Coliform	BOD
Dry Extended Detention	0%	0%	0%	0%	0%
Micropool Extended Detention	15%	30%	80%	70%	30%
Shallow Wetland	30%	40%	80%	70%	40%
Wet Pond	30%	50%	80%	70%	50%
Wet Pond Extended Detention	25%	40%	80%	70%	40%
Dry Detention	0%	0%	0%	0%	0%

For the existing efficiency, the current wet volume of a BMP was compared to the required water quality volume. If this volume is met then the BMP is assigned 75 percent of efficiency listed in Table 3-6. The maximum efficiency is reduced because it is assumed that the BMP is not functioning optimally due to lack of sediment forebay or other design issues that limit the effectiveness of the facility. If the BMP only gets a portion of the water quality volume, then the assigned efficiency is assigned by linearly interpolating between 0 and 75 percent of the efficiency based on the portion of the volume provided. The proposed efficiency is assigned in a similar manner. However, the full efficiency listed in Table 3-6 may be achieved since the BMP will be designed to function effectively. The proposed wet volume (based on volume modifications if applicable) is compared to the required water quality volume. Once again linear interpolation is used to assign an efficiency if the full water quality volume is not obtained.

In addition, BMPs that provide some or all of the channel protection benefit were assigned existing and proposed 1-year discharges. The existing 1-year discharge is extracted from the WIP Tools model for each BMP. The proposed 1-year discharge is assigned using the CIP Tool. If a BMP gets all of the channel protection volume (based on volume modifications if applicable) then the 1-year discharge equals the required channel protection volume divided by 24 hours detention time to get an estimate of the average discharge rate. If a BMP gets a portion of the channel protection, then similar to water quality efficiencies, a linear interpolation between the existing 1-year discharge and the channel protection discharge (channel protection volume/24 hours) was performed based on the portion of the channel protection volume obtained.

These projects moved on to the next step of evaluation, which includes evaluating project benefits using WIP Tools, and estimating project cost and scoring based on the Prioritization Matrix. Details of the WIP Tools evaluation process and the Prioritization Matrix are described in the next chapter.

3.3 Stream Restoration Project Development

As potential stream restoration opportunities were found, they were inventoried into the database and were used as a starting point for project development in later phases. Field crews identified areas where channel morphology was unstable (i.e., channel incising and/or widening) or where bank erosion was severe. Restoration projects inventoried were categorized as Priority 1,2, 3, and 4 Restoration as listed in Table 3-7 and shown in Figure 3-2. For natural channel stream restoration, there are general four levels of restoration. Priority 1 restoration involves re-establishing the stream channel on the previous floodplain using the relic channel (if known) or constructing a new bankfull discharge channel using design criteria for the dimension, pattern, and profile to create a new stable channel to match the watershed conditions (Figure 3-3). Priority 2 restoration involves constructing a new bankfull discharge channel in the bed of the existing channel by cutting a new floodplain bench at the current elevation of the stream channel in order to gain as much floodplain connectivity as space will allow. The pattern and profile are adjusted within the existing channel. This type of restoration is common in incised and widened channels (Figure 3-4). Priority 3 restoration is similar to Priority 2 but the level of grading to create a floodplain bench is minimized due to a variety of constraints (Figure 3-4). Priority 4 restoration involves streambank stabilization measures using a combination of grading, bioengineering, and/or hard structure reinforcement (Figure 3-5). These restoration measures are usually done when budget, space, or other constraints prevent a different restoration approach. The upstream limit of the restoration project was recorded with GPS in the field and this length and location was used as the starting point for developing stream restoration projects considered in the CIP.

Table 3-7. Potential Stream Restoration for Nancy Creek Watershed

Type of Stream Restoration	Number of Observations	Length of Stream (feet)*	Length of Stream (miles)*
Priority 2	5	2,562	0.49
Priority 3	5	4,105	0.78
Priority 4	5	1,804	0.34

** Estimates of lengths entered in the field – sum of each observation.*

A second field visit was made to a number of the identified stream projects for quality control purposes and to collect additional information to refine the recommended restoration project type. Aerial photography was used to determine if surrounding land use and the location of structures in proximity to the stream would affect the feasibility of a stream restoration project. The lengths and locations of potential stream projects were reviewed in the GIS and some projects were combined with others if there was less than 100 feet between identified stream projects. The historic Sandy Springs CIP stream projects were compared with the stream assessment data collected as part of this study. Four of the historic stream projects were merged with the newly identified stream projects and one project was removed from consideration. (Refer to Table 3-2 for more details.)

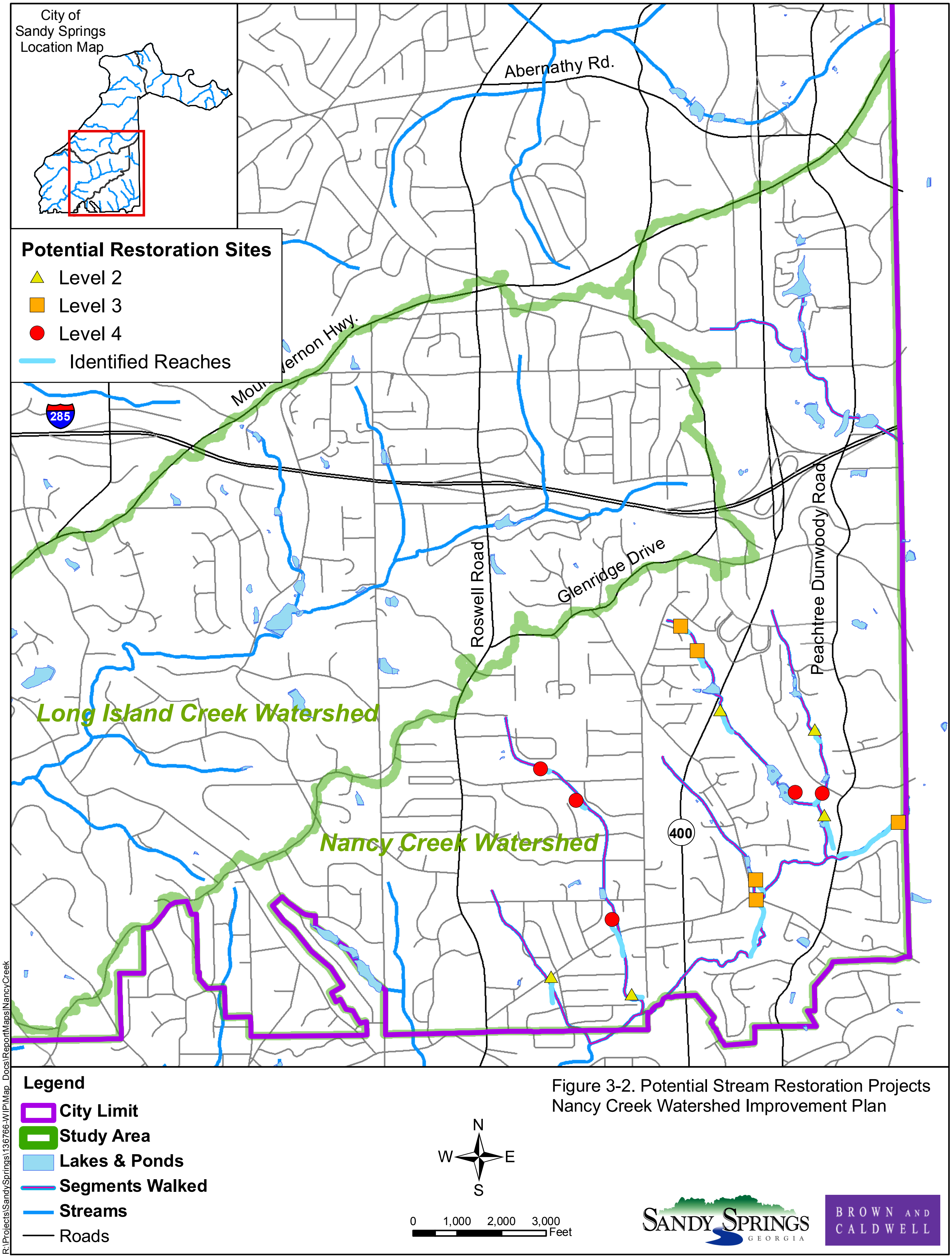
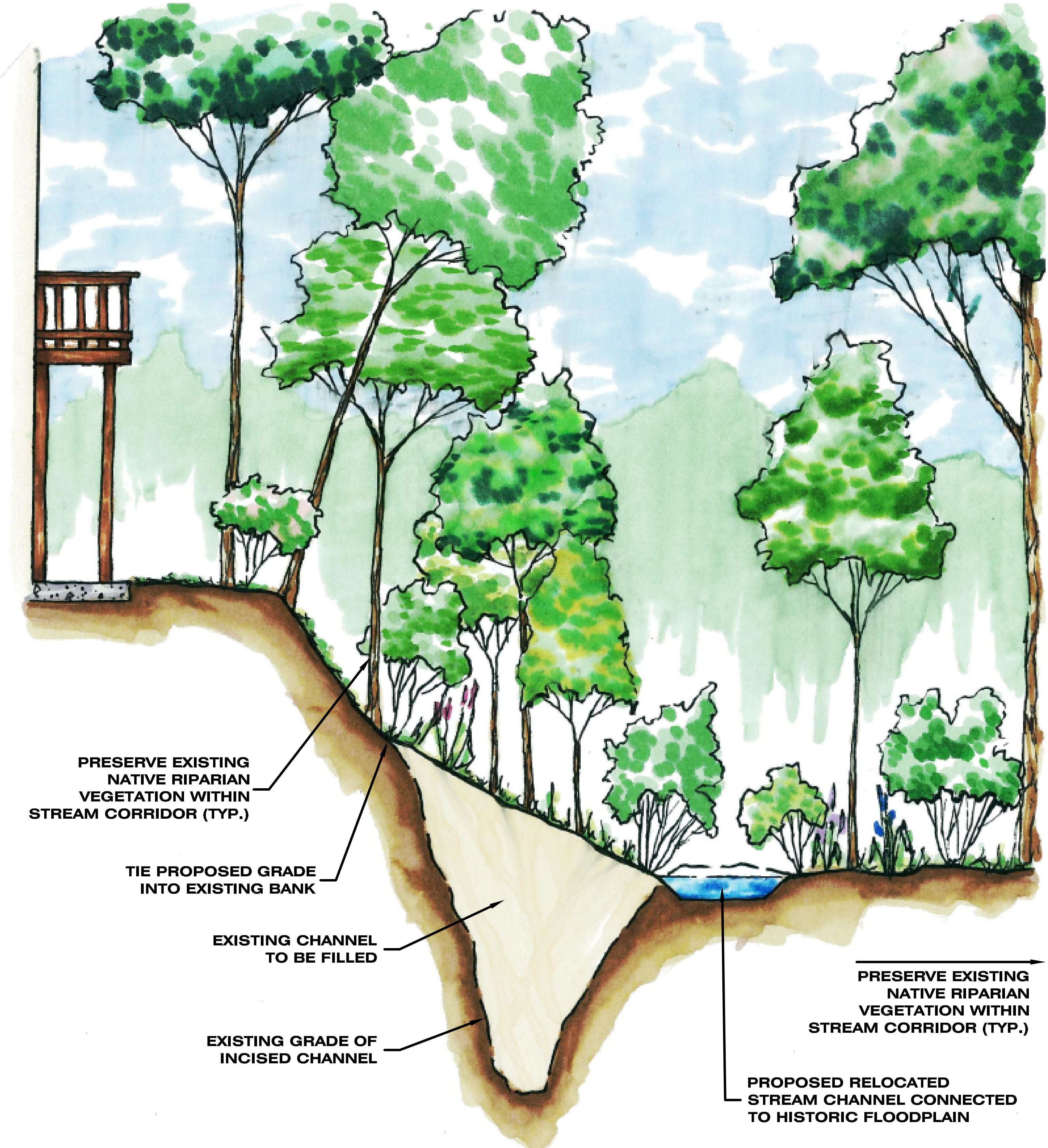


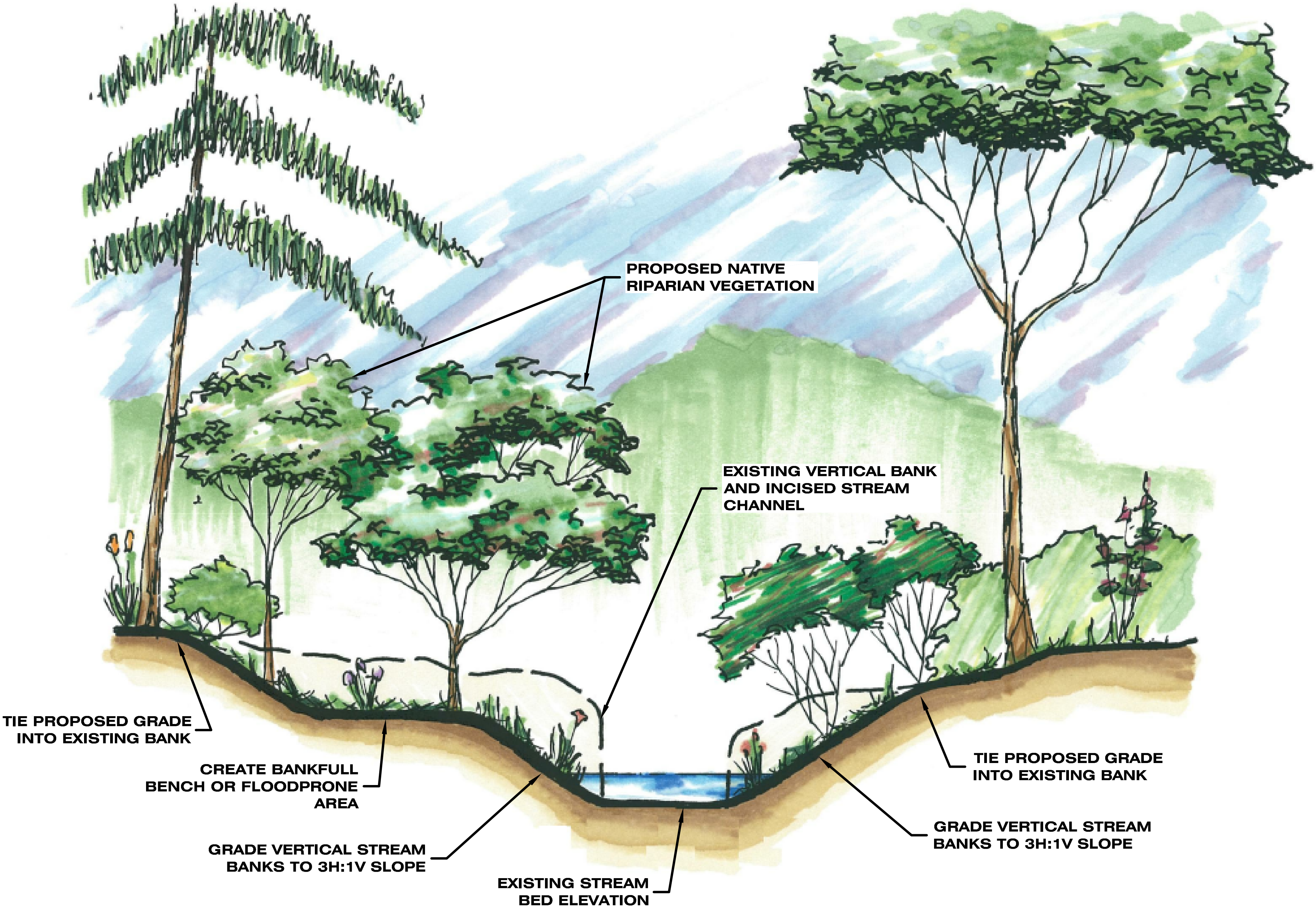
Figure 3-2. Potential Stream Restoration Projects
Nancy Creek Watershed Improvement Plan



BROWN AND CALDWELL
Environmental Engineers & Consultants

FIGURE 3-3
STREAM RESTORATION (PRIORITY 1)

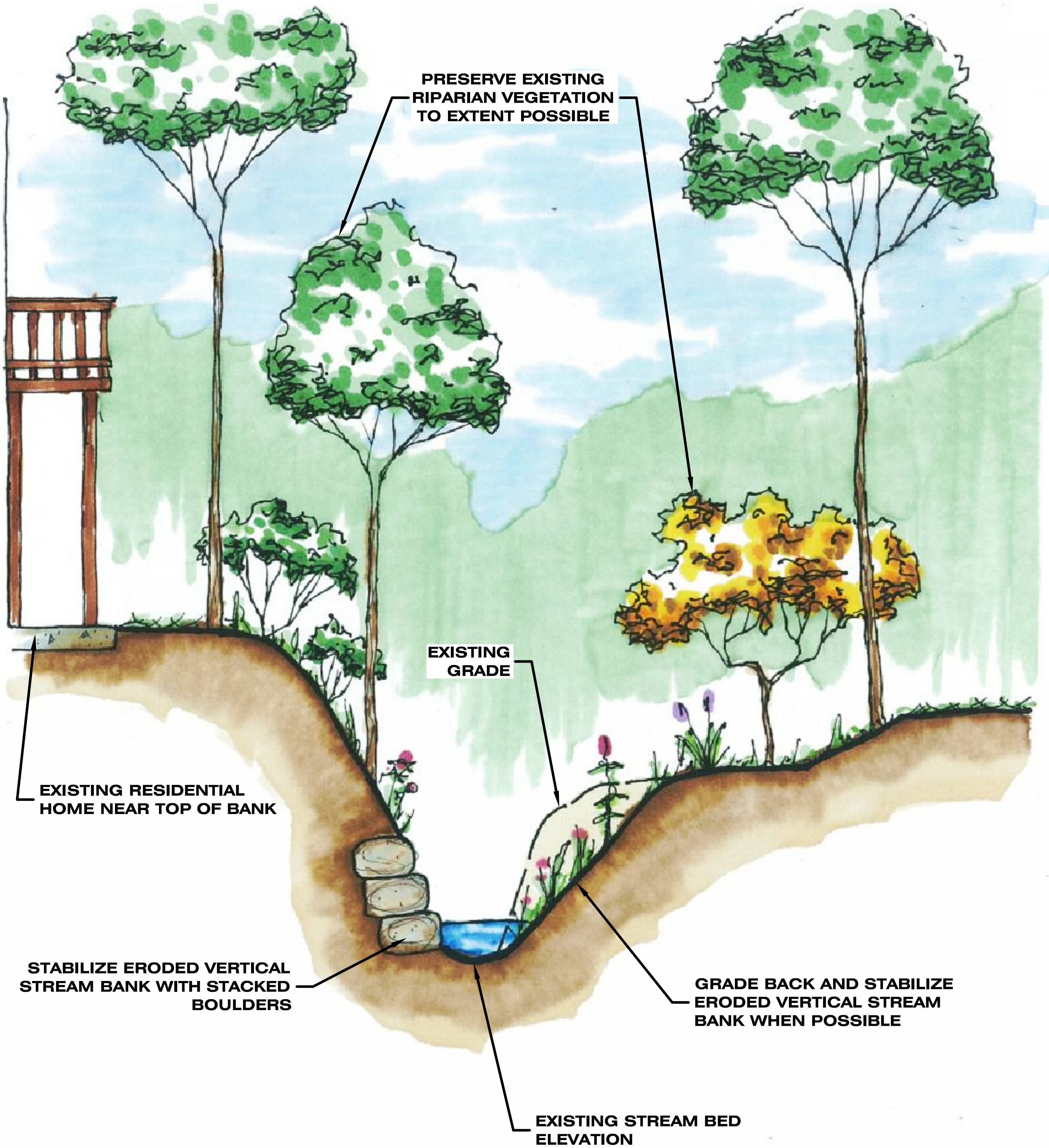
TYPICAL CROSS-SECTION



BROWN AND CALDWELL
Environmental Engineers & Consultants

FIGURE 3-4
STREAM ENHANCEMENT (PRIORITY 2 &3)

TYPICAL CROSS-SECTION



BROWN AND CALDWELL
Environmental Engineers & Consultants

FIGURE 3-5
STREAM STABILIZATION (PRIORITY 4)

TYPICAL CROSS-SECTION

THIS PAGE INTENTIONALLY LEFT BLANK.

4. CAPITAL IMPROVEMENT PLAN

4.1 Introduction

The goal of the Sandy Springs WIP is to improve and where possible restore watershed function. This goal is achieved by implementing a watershed CIP to meet specific water quality goals. A sound approach must be employed to evaluate and prioritize potential CIP projects.

A combination of tools was used in evaluating watershed projects. First, the watershed planning, water quality model, WIP Tools, was used to determine watershed-wide water quality conditions, and to assist in evaluating individual projects. Second, a spreadsheet with numerous functions called the CIP Prioritization Tool was utilized. The CIP Prioritization Tool is used to calculate removal efficiencies for new and retrofit projects, assign project scores based on the Sandy Springs Prioritization Matrix, generate project summary sheets and calculate total estimated project costs. Project costs include engineering, construction, easement value, and a contingency factor. The following section details the project evaluation process.

4.2 Project Evaluation

One of the key aspects of Watershed Improvement Planning is developing a CIP to meet specific water quality goals. This study used a robust approach to evaluate and prioritize potential projects including a Prioritization Matrix developed by the City of Sandy Springs. The prioritization criteria contained in the matrix cover a range of considerations that are important in the evaluation of potential watershed improvement projects. The City of Sandy Springs developed the Prioritization Matrix to evaluate watershed, infrastructure, and floodplain projects. The Prioritization Matrix was incorporated into the CIP Prioritization Tool.

The Prioritization Matrix was developed using an asset management approach that includes the likelihood of failure or non-compliance of the project and the consequence of that failure. Each project was ranked for both the existing condition (likelihood of failure) and the proposed, improved condition (reduced likelihood of failure). The criteria used to rank watershed projects include the current condition of the BMP outlet structure or stream bank, the water quality and environmental benefits, permitting issues, as well as public acceptance of the project, among other factors. Table 4-1 outlines all of the prioritization criteria, possible scores and the weighting for each criterion. In addition, the technical memorandum in Appendix B details each of the prioritization criterion and the methods used to assign scores for the criterion.

The difference between the existing condition score and the proposed condition score is considered the change in risk score. The greater the change in the risk score is, the greater the improvement to the watershed conditions. This final score is then divided by a scaled project cost. The following equation is used to calculate the overall project score.

Benefit Cost Score= (Existing Likelihood Score x Existing Consequence Score) – (Proposed Likelihood Score x Proposed Consequence Score) / Scaled Project Cost

Table 4-1. Prioritization Matrix – Likelihood and Consequence of Failure

Category Criteria	BMPs			Stream Projects		
	Score Possibilities	Weighting Factor	Score x Weighting Factor	Score Possibilities	Weighting Factor	Score x Weighting Factor
Physical Condition (60%)						
TSS Yield	1-10	0.2	0.2-2.0	1-10	0.25	0.25-2.5
Bank Erosion	N/A	N/A	N/A	1,2,3,4,6,8,10	0.30	0.3-3.0
Fecal Coliform Yield	1-10	0.2	0.2-2.0	1-10	0.05	0.05-0.5
Condition of Structure	1,2,4,5,6,8,10	0.2	0.2-2.0	N/A	N/A	N/A
Performance (40%)						
Storage Volume	1-10	0.35	0.35-3.5	N/A	N/A	N/A
Habitat Score	N/A	N/A	N/A	1,2,3,4,6,8,10	0.35	0.35-3.5
Work Order Requests	1,5,10	0.05	0.05-0.5	1,5,10	0.05	0.05-0.5
Likelihood of Failure Score		**1.0**	**1.0-10.0**		**1.0**	**1.0-10.0**
Environmental (30%)						
Compliance with regulations	10	0.1	1.0	5	0.1	0.5
Fecal Coliform TMDL	1,10	0.1	0.1,1.0	1,10	0.1	0.1,1.0
Biota TMDL	1,10	0.1	0.1,1.0	1,10	0.1	0.1,1.0
Social (40%)						
Public Impact	N/A	N/A	N/A	1,5,10	0.2	0.2-2.0
City Property	1,5,10	0.2	0.2-2.0	1,5,10	0.2	0.2-2.0
Urban/Rural Discharge Ratio	1,5,10	0.2	0.2-2.0	N/A	N/A	N/A
Economic (30%)						
Property Damage – based on field assessment	N/A	N/A	N/A	1,5,10	0.3	0.3-3.0
Property Damage – BMP height	1,2,4,5,6,8,10	0.15	0.15-1.5	N/A	N/A	N/A
Property Damage – BMP Volume	1-10	0.15	0.15-1.5	N/A	N/A	N/A
Consequence of Failure		**1.0**	**1.0-10.0**		**1.0**	**1.0-10.0**

Table 4-2 Prioritization Matrix Results
for BMP Projects

		Existing Consequence								Existing Likelihood							Proposed Consequence								Proposed Likelihood							Benefit			
	Category	Environmental (30%)			Social (40%)		Financial (30%)			Physical Condition (60%)			Performance (40%)				Environmental (30%)			Social (40%)		Financial (30%)			Physical Condition (60%)			Performance (40%)							
	Weight	0.10	0.10	0.10	0.20	0.20	0.15	0.15	1.00	0.20	0.20	0.20	0.35	0.05	1.00		0.10	0.10	0.10	0.20	0.20	0.15	0.15	1.00	0.20	0.20	0.20	0.35	0.05	1.00					
Project ID	**Asset Number**	Reg comp.	Fecal TMDL	Biota TMDL	City Property	U/R Ratio	Height of Dam	Volume	Consequence Score	TSS Yield	Fecal Yield	Structural Condition	Storage Volume	Work Orders	Likelihood Score	**Existing Risk**	Reg comp.	Fecal TMDL	Biota TMDL	City Property	U/R Ratio	Height of Dam	Volume	Consequence Score	TSS Yield	Fecal Yield	Structural Condition	Storage Volume	Work Orders	Likelihood Score	**Proposed Risk**	**Change in Risk**	**Cost**	**Cost Scale**	**Benefit /Cost**
17 00930004075-BMP-1	AGM_03093	1.00	1.00	1.00	0.20	2.00	0.75	0.60	5.95	1.20	1.80	1.60	3.32	0.05	7.97	**47.40**	1.00	1.00	1.00	0.20	0.20	0.75	0.60	4.15	0.20	0.40	0.20	3.32	0.05	4.17	**17.29**	**30.11**	**$473,000**	**4**	**7.53**
17 00680006002-BMP-1	AGM_01401	1.00	1.00	1.00	0.20	2.00	0.45	0.15	5.65	1.20	1.60	0.80	3.50	0.05	7.15	**40.40**	1.00	1.00	1.00	0.20	0.20	0.45	0.45	3.85	0.20	0.40	0.20	1.92	0.05	2.77	**10.66**	**29.74**	**$436,000**	**4**	**7.43**
17 00690005022-BMP-3	AGM_02944	1.00	1.00	1.00	0.20	1.00	0.15	0.15	4.35	1.20	1.60	1.00	3.50	0.05	7.35	**31.97**	1.00	1.00	1.00	0.20	0.20	0.45	0.45	3.85	0.20	0.40	0.20	0.35	0.05	1.20	**4.62**	**27.35**	**$366,000**	**4**	**6.84**
17 00380001117-BMP-1	AGM_04766	1.00	1.00	1.00	0.20	2.00	0.15	0.30	5.35	1.00	1.60	1.00	3.29	0.05	6.94	**37.12**	1.00	1.00	1.00	0.20	0.20	0.15	0.45	3.55	0.20	0.40	0.20	1.92	0.05	2.77	**9.84**	**27.28**	**$414,000**	**4**	**6.82**
17 00690005022-BMP-1	AGM_02952	1.00	1.00	1.00	0.20	2.00	1.05	0.30	6.25	1.00	1.60	0.40	3.50	0.05	6.55	**40.94**	1.00	1.00	1.00	0.20	0.20	1.05	0.45	4.45	0.20	0.40	0.20	3.28	0.05	4.13	**18.37**	**22.57**	**$311,000**	**4**	**5.64**
17 00930004071-BMP-1	AGM_03729	1.00	1.00	1.00	0.20	2.00	0.45	0.30	5.65	1.20	1.80	0.40	2.99	0.05	6.44	**36.41**	1.00	1.00	1.00	0.20	0.20	0.45	0.30	3.85	0.20	1.80	0.20	2.99	0.05	5.24	**20.19**	**16.22**	**$219,000**	**3**	**5.41**
17 00690005022-BMP-2	AGM_02823	1.00	1.00	1.00	0.20	1.00	0.45	0.15	4.65	1.20	1.60	1.60	3.42	0.05	7.87	**36.60**	1.00	1.00	1.00	0.20	0.20	0.45	0.15	3.85	0.20	1.60	0.20	3.42	0.05	5.47	**21.06**	**15.54**	**$162,000**	**3**	**5.18**
17 0019 LL132-BMP-1	AGM_05731	1.00	1.00	1.00	0.20	2.00	0.45	0.75	5.65	1.00	1.40	1.00	3.50	0.05	6.95	**39.27**	1.00	1.00	1.00	0.20	2.00	0.45	0.75	5.65	0.20	0.40	0.20	1.64	0.05	2.49	**14.08**	**25.19**	**$725,000**	**5**	**5.04**
17 0019 LL121-BMP-1	AGM_05826	1.00	1.00	1.00	0.20	2.00	0.45	0.30	5.65	1.00	1.60	1.00	3.50	0.05	7.15	**40.40**	1.00	1.00	1.00	0.20	0.20	0.45	0.45	3.85	0.20	0.40	0.20	3.25	0.05	4.10	**15.77**	**24.63**	**$502,000**	**5**	**4.93**
17 00680008022-BMP-1	AGM_01352	1.00	1.00	1.00	0.20	1.00	0.15	0.15	4.35	0.60	1.80	0.40	2.89	0.05	5.74	**24.96**	1.00	1.00	1.00	0.20	1.00	0.15	0.30	4.35	0.20	0.40	0.20	0.50	0.05	1.35	**5.87**	**19.09**	**$350,000**	**4**	**4.77**
17 0037 LL045-BMP-1	AGM_08860	1.00	1.00	1.00	0.20	2.00	0.15	0.45	5.35	1.40	1.60	0.80	3.50	0.05	7.35	**39.32**	1.00	1.00	1.00	0.20	0.20	0.15	0.60	3.55	0.20	0.40	0.20	2.54	0.05	3.39	**12.05**	**27.27**	**$938,000**	**6**	**4.55**
17 00150006013-BMP-1	AGM_02066	1.00	1.00	1.00	0.20	2.00	1.35	0.60	6.55	1.40	1.80	0.80	3.50	0.05	7.55	**49.45**	1.00	1.00	1.00	0.20	2.00	1.35	0.60	6.55	0.60	0.60	0.20	3.50	0.05	4.95	**32.42**	**17.03**	**$479,000**	**4**	**4.26**
17 00180009013-BMP-1	AGM_05146	1.00	1.00	1.00	0.20	2.00	1.05	0.90	6.25	0.80	0.60	0.80	3.05	0.05	5.30	**33.10**	1.00	1.00	1.00	0.20	0.20	1.05	0.90	4.45	0.20	0.40	0.20	3.05	0.05	3.90	**17.33**	**15.76**	**$456,000**	**4**	**3.94**
17 0014 LL110-BMP-1	AGM_00601	1.00	1.00	1.00	0.20	1.00	1.05	0.15	5.25	0.20	1.40	2.00	0.35	0.05	4.00	**21.00**	1.00	1.00	1.00	0.20	0.20	1.05	0.15	4.45	0.20	1.40	0.20	0.35	0.05	2.20	**9.79**	**11.21**	**$246,000**	**3**	**3.74**
17 0016 LL171-BMP-1	AGM_04600	1.00	1.00	1.00	0.20	2.00	0.15	0.15	5.35	1.40	2.00	1.00	3.50	0.05	7.95	**42.53**	1.00	1.00	1.00	0.20	0.20	0.45	0.90	3.85	0.20	0.60	0.20	0.35	0.05	1.40	**5.39**	**37.14**	**$2,857,000**	**10**	**3.71**
17 0016 LL167-BMP-1	AGM_09262	1.00	1.00	1.00	0.20	1.00	0.75	0.15	4.95	1.00	1.80	1.00	3.50	0.05	7.35	**36.38**	1.00	1.00	1.00	0.20	1.00	0.75	0.15	4.95	0.20	0.40	0.20	3.50	0.05	4.35	**21.53**	**14.85**	**$358,000**	**4**	**3.71**
17 0040 LL161-BMP-1	AGM_00607	1.00	1.00	1.00	0.20	2.00	0.45	0.90	5.65	1.60	0.60	1.20	3.05	0.05	6.50	**36.74**	1.00	1.00	1.00	0.20	0.20	0.45	0.90	3.85	0.20	0.40	0.20	3.05	0.05	3.90	**15.02**	**21.71**	**$822,000**	**6**	**3.62**
17 00160002063-BMP-1	AGM_09548	1.00	1.00	1.00	0.20	2.00	0.75	0.30	5.95	1.20	1.80	1.00	1.68	0.05	5.73	**34.10**	1.00	1.00	1.00	0.20	1.00	0.75	0.30	4.95	1.00	1.80	0.20	1.68	0.05	4.73	**23.42**	**10.68**	**$229,000**	**3**	**3.56**
17 0017 LL093-BMP-1	AGM_06017	1.00	1.00	1.00	0.20	2.00	1.05	0.45	6.25	1.20	1.80	0.80	0.35	0.05	4.20	**26.25**	1.00	1.00	1.00	0.20	0.20	1.05	0.45	4.45	0.40	1.80	0.20	0.35	0.05	2.80	**12.46**	**13.79**	**$361,000**	**4**	**3.45**
17 0019 LL121-BMP-2	AGM_05833	1.00	1.00	1.00	0.20	2.00	0.45	0.45	5.65	1.00	1.60	1.00	0.35	0.05	4.00	**22.60**	1.00	1.00	1.00	0.20	0.20	0.45	0.45	3.85	0.20	1.60	0.20	0.35	0.05	2.40	**9.24**	**13.36**	**$253,000**	**4**	**3.34**
17 0019 LL130-BMP-1	AGM_05717	1.00	1.00	1.00	0.20	2.00	0.45	0.45	5.65	1.00	1.80	0.80	0.35	0.05	4.00	**22.60**	1.00	1.00	1.00	0.20	0.20	0.45	0.45	3.85	0.20	1.80	0.20	0.35	0.05	2.60	**10.01**	**12.59**	**$332,000**	**4**	**3.15**
17 00930006131-BMP-1	AGM_03418	1.00	1.00	1.00	0.20	2.00	1.05	0.30	6.25	1.00	1.60	1.00	3.50	0.05	7.15	**44.69**	1.00	1.00	1.00	0.20	2.00	1.05	0.45	6.25	0.60	0.80	0.20	3.50	0.05	5.15	**32.19**	**12.50**	**$345,000**	**4**	**3.13**
17 0039 LL078-BMP-1	AGM_02304	1.00	1.00	1.00	0.20	1.00	0.45	0.60	4.65	0.80	1.60	1.00	0.39	0.05	3.84	**17.85**	1.00	1.00	1.00	0.20	1.00	0.45	0.60	4.65	0.20	0.40	0.20	0.39	0.05	1.24	**5.76**	**12.09**	**$423,000**	**4**	**3.02**
17 00670001082-BMP-1	AGM_03367	1.00	1.00	1.00	0.20	2.00	0.45	0.15	5.65	1.00	1.60	1.20	3.50	0.05	7.35	**41.53**	1.00	1.00	1.00	0.20	2.00	0.45	0.15	5.65	0.80	1.20	0.20	3.50	0.05	5.75	**32.49**	**9.04**	**$146,000**	**3**	**3.01**
17 00150004003-BMP-1	AGM_02086	1.00	1.00	1.00	0.20	2.00	1.50	0.75	6.70	0.80	0.80	0.40	2.98	0.05	5.03	**33.67**	1.00	1.00	1.00	0.20	0.20	1.50	0.75	4.90	0.20	0.40	0.20	2.98	0.05	3.83	**18.74**	**14.93**	**$548,000**	**5**	**2.99**
17 0018 LL101-BMP-1	AGM_05320	1.00	1.00	1.00	0.20	2.00	1.35	0.90	6.55	0.80	0.60	0.80	2.31	0.05	4.56	**29.84**	1.00	1.00	1.00	0.20	0.20	1.35	0.90	4.75	0.20	0.40	0.20	2.31	0.05	3.16	**14.99**	**14.85**	**$513,000**	**5**	**2.97**
17 0092 LL071-BMP-1	AGM_01688	1.00	1.00	1.00	0.20	1.00	0.45	0.45	4.65	0.80	1.60	0.20	1.95	0.05	4.60	**21.40**	1.00	1.00	1.00	0.20	1.00	0.45	0.60	4.65	0.20	0.40	0.20	0.65	0.05	1.50	**6.98**	**14.42**	**$695,000**	**5**	**2.88**
17 00930006125-BMP-1	AGM_03549	1.00	1.00	1.00	0.20	1.00	0.15	0.15	4.35	1.00	1.80	0.40	2.81	0.05	6.06	**26.37**	1.00	1.00	1.00	0.20	0.20	0.15	0.15	3.55	0.20	1.80	0.20	2.81	0.05	5.06	**17.97**	**8.40**	**$234,000**	**3**	**2.80**
17 0092 LL071-BMP-2	AGM_01692	1.00	1.00	1.00	0.20	1.00	0.45	0.60	4.65	0.80	1.80	0.40	0.35	0.05	3.40	**15.81**	1.00	1.00	1.00	0.20	0.20	0.45	0.60	3.85	0.20	0.40	0.20	0.35	0.05	1.20	**4.62**	**11.19**	**$437,000**	**4**	**2.80**
17 0041 LL036-BMP-1	AGM_00231	1.00	1.00	1.00	0.20	0.20	0.15	0.15	3.55	0.80	1.80	1.00	3.50	0.05	7.15	**25.38**	1.00	1.00	1.00	0.20	0.20	0.15	0.60	3.55	0.20	0.40	0.20	0.99	0.05	1.84	**6.54**	**18.84**	**$1,254,000**	**7**	**2.69**
17 0017 LL084-BMP-1	AGM_06023	1.00	1.00	1.00	0.20	2.00	0.45	0.75	5.65	0.40	0.80	0.40	1.94	0.05	3.59	**20.30**	1.00	1.00	1.00	0.20	0.20	0.45	0.75	3.85	0.20	0.40	0.20	1.94	0.05	2.79	**10.75**	**9.55**	**$419,000**	**4**	**2.39**
17 01190007026-BMP-1	AGM_00764	1.00	1.00	1.00	0.20	1.00	1.05	0.90	5.25	0.20	0.60	1.20	1.89	0.25	4.14	**21.74**	1.00	1.00	1.00	0.20	0.20	1.05	0.90	4.45	0.20	0.40	0.20	1.89	0.05	2.74	**12.20**	**9.54**	**$499,000**	**4**	**2.39**
17 00360002047-BMP-1	AGM_04236	1.00	1.00	1.00	0.20	1.00	0.45	0.15	4.65	1.20	1.80	0.80	0.35	0.05	4.20	**19.53**	1.00	1.00	1.00	0.20	0.20	0.45	0.15	3.85	0.20	1.80	0.20	0.35	0.05	2.60	**10.01**	**9.52**	**$348,000**	**4**	**2.38**
17 00940001092-BMP-1	AGM_03272	1.00	1.00	1.00	0.20	0.20	1.05	0.15	4.45	0.80	1.60	1.20	0.35	0.05	4.00	**17.80**	1.00	1.00	1.00	0.20	0.20	1.05	0.15	4.45	0.20	1.60	0.20	0.35	0.05	2.40	**10.68**	**7.12**	**$238,000**	**3**	**2.37**
17 00710007025-BMP-1	AGM_07609	1.00	1.00	1.00	0.20	1.00	0.45	0.15	4.65	1.20	1.60	0.80	0.35	0.05	4.00	**18.60**	1.00	1.00	1.00	0.20	0.20	0.45	0.15	3.85	0.20	1.60	0.20	0.35	0.05	2.40	**9.24**	**9.36**	**$357,000**	**4**	**2.34**
17 00400003003-BMP-1	AGM_02488	1.00	1.00	1.00	0.20	2.00	0.45	0.60	5.65	0.80	0.80	0.40	3.50	0.05	5.55	**31.36**	1.00	1.00	1.00	0.20	0.20	0.45	0.75	3.85	0.20	0.40	0.20	3.28	0.05	4.13	**15.89**	**15.47**	**$1,184,000**	**7**	**2.21**
17 0018 LL097-BMP-1	AGM_05199	1.00	1.00	1.00	0.20	2.00	0.45	0.75	5.65	1.40	0.60	0.80	3.50	0.05	6.35	**35.88**	1.00	1.00	1.00	0.20	2.00	0.45	0.75	5.65	0.60	0.20	0.20	3.50	0.05	4.55	**25.71**	**10.17**	**$629,000**	**5**	**2.03**
17 00390002047-BMP-1	AGM_02209	1.00	1.00	1.00	0.20	1.00	0.15	0.45	4.35	0.40	0.80	0.80	3.50	0.05	5.55	**24.14**	1.00	1.00	1.00	0.20	0.20	0.15	0.45	3.55	0.20	0.40	0.20	3.14	0.05	3.99	**14.16**	**9.98**	**$523,000**	**5**	**2.00**
17 0068 LL078-BMP-1	AGM_01368	1.00	1.00	1.00	0.20	1.00	0.45	0.15	4.65	1.00	1.80	0.20	0.35	0.05	3.40	**15.81**	1.00	1.00	1.00	0.20	0.20	0.45	0.15	3.85	0.20	1.80	0.20	0.35	0.05	2.60	**10.01**	**5.80**	**$218,000**	**3**	**1.93**
17 0014 LL149-BMP-1	AGM_00575	1.00	1.00	1.00	0.20	2.00	0.45	0.75	5.65	0.80	0.40	0.40	3.13	0.05	4.78	**27.00**	1.00	1.00	1.00	0.20	0.20	0.45	0.90	3.85	0.20	0.20	0.20	3.04	0.05	3.69	**14.19**	**12.81**	**$1,273,000**	**7**	**1.83**
17 01190005040-BMP-1	AGM_00711	1.00	1.00	1.00	0.20	2.00	1.35	1.35	6.55	0.20	0.20	1.00	0.35	0.05	1.80	**11.79**	1.00	1.00	1.00	0.20	0.20	1.35	1.35	4.75	0.20	0.20	0.20	0.35	0.05	1.00	**4.75**	**7.04**	**$332,000**	**4**	**1.76**
17 01190006048-BMP-1	AGM_00746	1.00	1.00	1.00	0.20	1.00	1.05	0.90	5.25	0.20	0.20	1.00	2.42	0.05	3.87	**20.31**	1.00	1.00	1.00	0.20	0.20	1.05	0.90	4.45	0.20	0.20	0.20	2.42	0.05	3.07	**13.66**	**6.66**	**$293,000**	**4**	**1.66**
17 00180002001-BMP-1	AGM_05043	1.00	1.00	1.00	0.20	2.00	1.50	1.20	6.70	0.60	0.80	0.80	0.92	0.05	3.17	**21.25**	1.00	1.00	1.00	0.20	2.00	1.50	1.20	6.70	0.20	0.40	0.20	0.92	0.05	1.77	**11.87**	**9.38**	**$813,000**	**6**	**1.56**
17 0040 LL072-BMP-1	AGM_02570	1.00	1.00	1.00	0.20	1.00	0.15	0.30	4.35	0.60	1.60	0.20	1.52	0.05	3.97	**17.27**	1.00	1.00	1.00	0.20	0.20	0.15	0.30	3.55	0.20	1.60	0.20	1.52	0.05	3.57	**12.68**	**4.60**	**$227,000**	**3**	**1.53**
17 0015 LL097-BMP-1	AGM_02110	1.00	1.00	1.00	0.20	2.00	0.45	0.30	5.65	1.60	1.60	0.40	3.50	0.05	7.15	**40.40**	1.00	1.00	1.00	0.20	2.00	0.45	0.45	5.65	1.00	0.80	0.20	3.50	0.05	5.55	**31.36**	**9.04**	**$750,000**	**6**	**1.51**
17 00920001035-BMP-1	AGM_01660	1.00	1.00	1.00	0.20	1.00	0.15	0.15	4.35	0.80	1.60	0.20	1.88	0.05	4.53	**19.69**	1.00	1.00	1.00	0.20	0.20	0.15	0.15	3.55	0.20	1.60	0.20	1.88	0.05	3.93	**13.94**	**5.75**	**$338,000**	**4**	**1.44**
17 0039 LL066-BMP-1	AGM_02326	1.00	1.00	1.00	2.00	2.00	0.15	0.15	7.15	2.00	1.60	1.00	3.50	0.05	8.15	**58.27**	1.00	1.00	1.00	2.00	2.00	0.15	0.60	7.15	2.00	1.20	0.20	3.50	0.05	6.95	**49.69**	**8.58**	**$763,000**	**6**	**1.43**
17 00670007009-BMP-1	AGM_01957	1.00	1.00	1.00	0.20	1.00	0.45	0.60	4.65	0.20	0.60	1.00	0.35	0.05	2.20	**10.23**	1.00	1.00	1.00	0.20	0.20	0.45	0.60	3.85	0.20	0.40	0.20	0.35	0.05	1.20	**4.62**	**5.61**	**$442,000**	**4**	**1.40**
17 0014 LL104-BMP-1	AGM_00637	1.00	1.00	1.00	0.20	2.00	0.45	0.90	5.65	0.20	0.60	0.40	0.35	0.25	1.80	**10.17**	1.00	1.00	1.00	0.20	0.20	0.45	0.90	3.85	0.20	0.40	0.20	0.35	0.05	1.20	**4.62**	**5.55**	**$499,000**	**4**	**1.39**
17 0036 LL071-BMP-1	AGM_04159	1.00	1.00	1.00	0.20	2.00	0.15	0.15	5.35	1.60	1.40	0.80	3.50	0.05	7.35	**39.32**	1.00	1.00	1.00	0.20	2.00	0.15	0.15	5.35	1.40	1.20	0.20	3.50	0.05	6.35	**33.97**	**5.35**	**$300,000**	**4**	**1.34**
17 00670006005-BMP-1	AGM_03359	1.00	1.00	1.00	0.20	1.00	0.15	0.75	4.35	0.20	0.60	1.00	0.35	0.05	2.20	**9.57**	1.00	1.00	1.00	0.20	0.20	0.15	0.75	3.55	0.20	0.40	0.20	0.35	0.05	1.20	**4.26**	**5.31**	**$293,000**	**4**	**1.33**
17 0015 LL109-BMP-1	AGM_02119	1.00	1.00	1.00	0.20	2.00	0.45	0.45	5.65	1.60	1.60	0.80	3.50	0.05	7.55	**42.66**	1.00	1.00	1.00	0.20	2.00	0.45	0.60	5.65	1.40	1.00	0.20	3.50	0.05	6.15	**34.75**	**7.91**	**$807,000**	**6**	**1.32**
17 0038 LL141-BMP-1	AGM_04850	1.00	1.00	1.00	0.20	2.00	0.15	0.75	5.35	0.40	0.80	0.40	0.35	0.05	2.00	**10.70**	1.00	1.00	1.00	0.20	0.20	0.15	0.75	3.55	0.20	0.40	0.20	0.35	0.05	1.20	**4.26**	**6.44**	**$505,000**	**5**	**1.29**
17 0014 LL140-BMP-1	AGM_00651	1.00	1.00	1.00	0.20	1.00	0.15	0.60	4.35	0.20	0.80	0.40	0.35	0.05	1.80	**7.83**	1.00	1.00	1.00	0.20	0.20	0.15	0.60	3.55	0.20	0.40	0.20	0.35	0.05	1.20	**4.26**	**3.57**	**$464,000**	**4**	**0.89**
17 00400003002-BMP-1	AGM_02493	1.00	1.00	1.00	0.20	2.00	0.45	0.60	5.65	0.40	0.40	0.40	3.50	0.05	4.75	**26.84**	1.00	1.00	1.00	0.20	2.00	0.45	0.60	5.65	0.20	0.20	0.20	3.50	0.05	4.15	**23.45**	**3.39**	**$281,000**	**4**	**0.85**
17 01200001067-BMP-1	AGM_00311	1.00	1.00	1.00	0.20	1.00	0.45	0.60	4.65	0.20	0.60	0.40	0.35	0.05	1.60	**7.44**	1.00	1.00	1.00	0.20	0.20	0.45	0.60	3.85	0.20	0.40	0.20	0.35	0.05	1.20	**4.62**	**2.82**	**$436,000**	**4**	**0.71**
17 0017 LL1053-BMP-1	AGM_05965	1.00	1.00	1.00	0.20	2.00	0.45	0.90	5.65	0.80	0.40	0.40	3.50	0.05	5.15	**29.10**	1.00	1.00	1.00	0.20	2.00	0.45	0.90	5.65	0.40	0.40	0.20	3.50	0.05	4.55	**25.71**	**3.39**	**$689,000**	**5**	**0.68**
17 0013 LL089-BMP-1	AGM_00115	1.00	1.00	1.00	0.20	0.20	0.45	0.90	3.85	0.20	0.60	0.80	0.35	0.05	2.00	**7.70**	1.00	1.00	1.00	0.20	0.20	0.45	0.90	3.85	0.20	0.40	0.20	0.35	0.05	1.20	**4.62**	**3.08**	**$526,000**	**5**	**0.62**
17 0017 LL1053-BMP-2	AGM_05991	1.00	1.00	1.00	0.20	2.00	0.15	1.05	5.35	0.60	0.60	0.40	3.50	0.05	5.15	**27.55**	1.00	1.00	1.00	0.20	2.00	0.15	1.05	5.35	0.60	0.40	0.20	3.50	0.05	4.75	**25.41**	**2.14**	**$714,000**	**5**	**0.43**
17 0017 LL096-BMP-1	AGM_06106	1.00	1.00	1.00	0.20	2.00	0.45	1.35	5.65	0.40	0.40	0.20	3.50	0.05	4.55	**25.71**	1.00	1.00	1.00	0.20	2.00	0.45	1.35	5.65	0.40	0.20	0.20	3.50	0.05	4.35	**24.58**	**1.13**	**$807,000**	**6**	**0.19**

Sandy Springs WIP
Table 4-3 Prioritization Matrix Results for Stream Projects

		Existing Consequence							Existing Likelihood						
	Category	Environmental (30%)			Social (40%)		Financial (30%)		Physical Condition (60%)			Performance (40%)			
	Weight	0.10	0.10	0.10	0.20	0.20	0.30	1.00	0.25	0.30	0.05	0.35	0.05	1.00	
Project ID	**Asset Number**	Reg comp.	Fecal TMDL	Biota TMDL	Public Impact	City Property	Property Damage	Consequence Score	TSS Yield	Bank Erosion	Fecal Yield	Habitat Score	Work Orders	Likelihood Score	**Existing Risk**
17 0014 LL104-STREAM-1	AGM_00635, AGM_00681	0.50	1.00	1.00	0.20	0.20	1.50	4.40	2.00	3.00	0.20	2.10	0.05	7.35	**32.34**
17 00660006039-STREAM-1	AGM_00848, AGM_00195	0.50	1.00	1.00	0.20	0.20	1.50	4.40	1.50	3.00	0.35	1.40	0.05	6.30	**27.72**
17 00380002058-STREAM-1	AGM_04737, AGM_02408	0.50	1.00	1.00	1.00	0.20	1.50	5.20	1.75	3.00	0.40	2.10	0.05	7.30	**37.96**
17 00660001011-STREAM-2	AGM_00867, AGM_00899	0.50	1.00	1.00	2.00	0.20	1.50	6.20	2.00	3.00	0.40	1.40	0.05	6.85	**42.47**
17 00660004021-STREAM-1	AGM_00810, AGM_00773	0.50	1.00	1.00	2.00	1.00	1.50	7.00	2.25	3.00	0.35	1.40	0.05	7.05	**49.35**
17 00670001068-STREAM-1	AGM_01905, AGM_01997	0.50	1.00	1.00	2.00	0.20	1.50	6.20	2.00	1.80	0.40	1.05	0.05	5.30	**32.86**
17 0014 LL119-STREAM-1	AGM_00592, AGM_00681	0.50	1.00	1.00	2.00	0.20	0.30	5.00	1.00	3.00	0.10	2.10	0.05	6.25	**31.25**
17 00150007004-STREAM-1	AGM_02077, AGM_02054	0.50	1.00	1.00	2.00	0.20	0.30	5.00	1.50	2.40	0.20	2.10	0.05	6.25	**31.25**
17 00390002045-STREAM-1	AGM_02252, AGM_02215	0.50	1.00	1.00	1.00	0.20	0.30	4.00	2.25	3.00	0.40	2.10	0.05	7.80	**31.20**
17 00400003002-STREAM-1	AGM_02499, AGM_02578	0.50	1.00	1.00	0.20	0.20	0.30	3.20	0.50	3.00	0.10	1.40	0.05	5.05	**16.16**
17 0014 LL146-STREAM-1	AGM_00665, AGM_00568	0.50	1.00	1.00	2.00	0.20	0.30	5.00	2.00	3.00	0.15	2.10	0.05	7.30	**36.50**
17 0039 LL055-STREAM-1	AGM_02411, AGM_02412	0.50	1.00	1.00	1.00	0.20	0.30	4.00	2.50	3.00	0.35	2.10	0.05	8.00	**32.00**
17 0014 LL151-STREAM-1	AGM_00685, AGM_00655	0.50	1.00	1.00	2.00	0.20	1.50	6.20	1.75	0.90	0.25	2.10	0.25	5.25	**32.55**
17 00410002036-STREAM-1	AGM_00302, AGM_00217	0.50	1.00	1.00	2.00	0.20	1.50	6.20	0.50	0.60	0.40	2.10	0.05	3.65	**22.63**
17 00670001009-STREAM-1	AGM_01221, AGM_02013	0.50	1.00	1.00	1.00	0.20	0.30	4.00	1.75	1.20	0.40	1.05	0.05	4.45	**17.80**

	Proposed Consequence							Proposed Likelihood							Benefit			
Category	Environmental (30%)			Social (40%)		Financial (30%)		Physical Condition (60%)			Performance (40%)							
Weight	0.10	0.10	0.10	0.20	0.20	0.30	1.00	0.25	0.30	0.05	0.35	0.05	1.00					
Project ID	Reg comp.	Fecal TMDL	Biota TMDL	Public Impact	City Property	Property Damage	Consequence Score	TSS Yield	Bank Erosion	Fecal Yield	Habitat Score	Work Orders	Likelihood Score	**Proposed Risk**	**Change in Risk**	**Cost**	**Cost Scale**	**Benefit /Cost**
17 0014 LL104-STREAM-1	0.50	1.00	1.00	0.20	0.20	0.30	3.20	2.00	0.30	0.20	1.75	0.05	4.30	**13.76**	**18.58**	**$110,000**	**3**	**6.19**
17 00660006039-STREAM-1	0.50	1.00	1.00	0.20	0.20	0.30	3.20	0.25	0.30	0.35	0.70	0.05	1.65	**5.28**	**22.44**	**$312,000**	**4**	**5.61**
17 00380002058-STREAM-1	0.50	1.00	1.00	1.00	0.20	0.30	4.00	1.75	0.30	0.40	1.40	0.05	3.90	**15.60**	**22.36**	**$263,000**	**4**	**5.59**
17 00660001011-STREAM-2	0.50	1.00	1.00	2.00	0.20	0.30	5.00	1.75	0.30	0.40	0.70	0.05	3.20	**16.00**	**26.47**	**$674,000**	**5**	**5.29**
17 00660004021-STREAM-1	0.50	1.00	1.00	2.00	1.00	0.30	5.80	2.00	0.30	0.35	1.05	0.05	3.75	**21.75**	**27.60**	**$801,000**	**6**	**4.60**
17 00670001068-STREAM-1	0.50	1.00	1.00	2.00	0.20	0.30	5.00	2.00	0.30	0.40	0.70	0.05	3.45	**17.25**	**15.61**	**$313,000**	**4**	**3.90**
17 0014 LL119-STREAM-1	0.50	1.00	1.00	2.00	0.20	0.30	5.00	1.00	0.30	0.10	1.75	0.05	3.20	**16.00**	**15.25**	**$341,000**	**4**	**3.81**
17 00150007004-STREAM-1	0.50	1.00	1.00	2.00	0.20	0.30	5.00	1.25	0.30	0.20	1.40	0.05	3.20	**16.00**	**15.25**	**$394,000**	**4**	**3.81**
17 00390002045-STREAM-1	0.50	1.00	1.00	1.00	0.20	0.30	4.00	2.25	0.30	0.40	1.40	0.05	4.40	**17.60**	**13.60**	**$483,000**	**4**	**3.40**
17 00400003002-STREAM-1	0.50	1.00	1.00	0.20	0.20	0.30	3.20	0.25	0.30	0.10	0.70	0.05	1.40	**4.48**	**11.68**	**$338,000**	**4**	**2.92**
17 0014 LL146-STREAM-1	0.50	1.00	1.00	2.00	0.20	0.30	5.00	2.00	0.30	0.15	1.40	0.05	3.90	**19.50**	**17.00**	**$853,000**	**6**	**2.83**
17 0039 LL055-STREAM-1	0.50	1.00	1.00	1.00	0.20	0.30	4.00	2.50	0.30	0.35	1.40	0.05	4.60	**18.40**	**13.60**	**$598,000**	**5**	**2.72**
17 0014 LL151-STREAM-1	0.50	1.00	1.00	2.00	0.20	0.30	5.00	0.50	0.30	0.05	1.40	0.05	2.30	**11.50**	**21.05**	**$1,646,000**	**8**	**2.63**
17 00410002036-STREAM-1	0.50	1.00	1.00	2.00	0.20	0.30	5.00	0.25	0.30	0.05	1.40	0.05	2.05	**10.25**	**12.38**	**$1,305,000**	**7**	**1.77**
17 00670001009-STREAM-1	0.50	1.00	1.00	1.00	0.20	0.30	4.00	1.75	0.30	0.40	0.70	0.05	3.20	**12.80**	**5.00**	**$242,000**	**3**	**1.67**

Many pieces of data are needed to generate the results for the Prioritization Matrix. Most of this data was generated in GIS, either through data analysis or the WIP Tools model. The structure of the GIS files was detailed in the GIS data structure technical memorandum located in Appendix C. This technical memorandum included information on how each piece of data is used whether it is for the Prioritization Matrix, WIP Tools model, project summary sheet or some combination of the three. The four GIS files detailed in the technical memorandum were combined and exported as a database file. The database file was imported into the CIP Prioritization Tool spreadsheet. The CIP Prioritization Tool then generated a summary of the Prioritization Matrix results (Tables 4-2 and 4-3), sorted by the benefit/cost score.

In addition, the CIP Prioritization Tool is used to generate project summary sheets which can be found in Appendix D. These sheets include the project cost benefit score, key project information, a site map and site photographs. Limited photographs are available for the BMP projects because there were limited site visits.

Another key component of the CIP Prioritization Tool is the project cost development. The spreadsheet has tabs for retrofit BMPs, new BMPs and stream projects giving the user the ability to easily change or update unit costs or other components of the project cost development. Details of the methods used to generate the estimated project costs are included in a technical memorandum in Appendix E.

4.3 Capital Improvement Plan Summary

A CIP was developed using methods described above. A total of 60 BMP and 15 Stream projects were evaluated. The CIP is flexible, providing the City options to implement projects based on parcel ownership, benefit/cost ranking, cost or other factors. This section outlines those options and presents projects sorted by parcel ownership and benefit/cost score. A suggested implementation schedule is included in this section as well.

Projects can be sorted in various ways in order to prioritize projects for implementation. The CIP is presented below in the following categories: city owned parcels (1 project), "residential attached" assets (2 projects), projects that have a benefit/cost score greater than 5 (8 projects), and all 60 BMP and all 15 stream projects. At this time the City of Sandy Springs is refining the level of service for the stormwater management program. The City will likely concentrate short term on CIP projects on city property or within to the ROW. If the City modifies it's level of service in the future, a prioritized list of CIP projects is available to review and implement as needed. High ranking BMP projects typically include small stormwater BMPs that can be modified to meet water quality and/or channel protection volumes relatively inexpensively. Almost all of the projects evaluated (60 BMP and 15 stream) are on private property.

Costs for implementation depend on which projects are selected. The total estimated cost to implement all 60 BMP projects evaluated is $31,851,000. The cost to implement the one project on city owned property or within the ROW is approximately $$763,000. The top eight benefit/cost ranking BMP projects in Nancy Creek have an estimated cost of $3,106,000 to implement. The costs to implement the 2 projects that are residential attached is estimate to be $503,000. The City can use these results to determine the appropriate projects to implement. Details on these projects are provided in Sections 4.3.1 and 4.3.2.

4.3.1 BMP Projects

Sixty BMP projects were evaluated within the Nancy Creek watershed. In order to improve water quality and aquatic habitat for fish, macroinvertebrates and other stream life, implementing watershed improvements such as stormwater BMPs have numerous benefits. Building new stormwater BMPs or retro-fitting exiting ones mitigate the negative impact of increased hydrologic runoff from impervious surfaces. Controlling the hydrology also decreases the sediment load and associated pollutants that enter City streams, ponds, and lakes. Stormwater BMPs can also be improved aesthetically to create an amenity for a neighborhood.

Projects can be sorted in various ways in order to prioritize projects for implementation. For example, there is one potential stormwater BMP project located on city owned property or within the right of way (Table 4-4). The City may also want to consider smaller, demonstration-type BMPs to implement on City facilities such as rain gardens or other low impact development projects.

Table 4-4. Projects Located on City Owned Parcels or Within ROW

Project ID	Type	Benefit/Cost	Cost
17 0039 LL066-BMP-1	New	1.43	$763,000
Total			**$763,000**

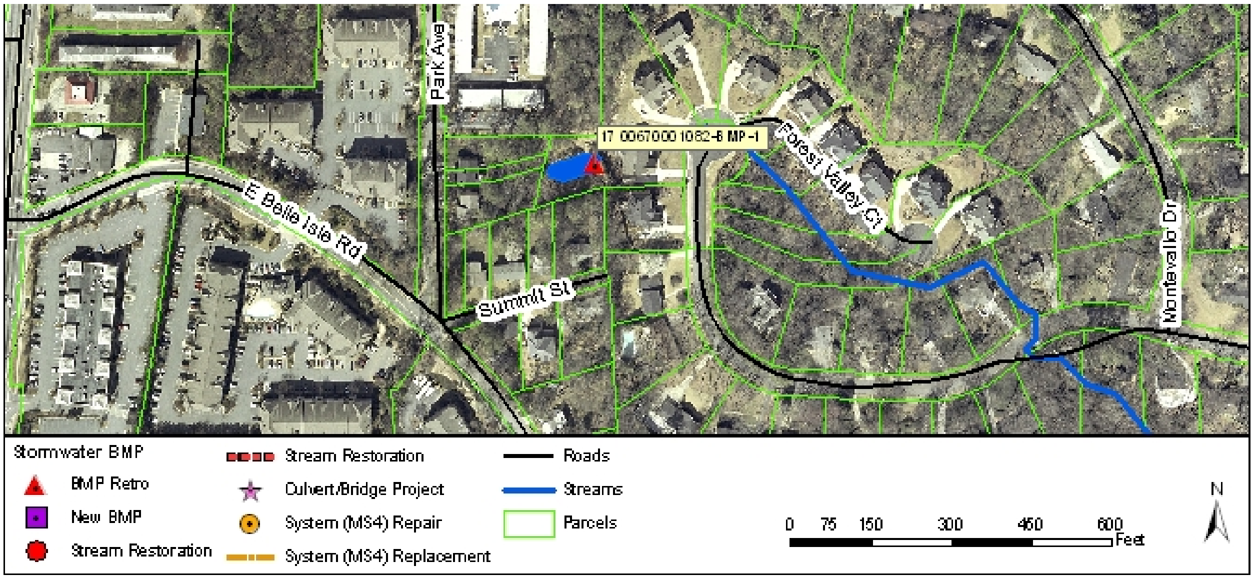
Project 17 0039 LL066-BMP-1 involves building a new wet pond. This project is located on a City park near Northland Drive and Georgia 400. A wet pond on a city park may have multiple uses, including water quality benefits, aesthetics, and recreation. Coordination with other City departments would be necessary to successfully implement this project. Off-line detention should be considered to simplify permitting issues. This project could be in combination with an upstream stream restoration project.

In the future, the City of Sandy Springs may expand the level of service to "residential attached" assets. "Attached" is defined as having a piped network connection from the road right of way flowing onto private parcels. There are two stormwater BMP projects within the Nancy Creek Watershed that are part of this "attached" designation (Table 4-5).

Table 4-5. BMP Projects with Single Family Residential Attached Designation

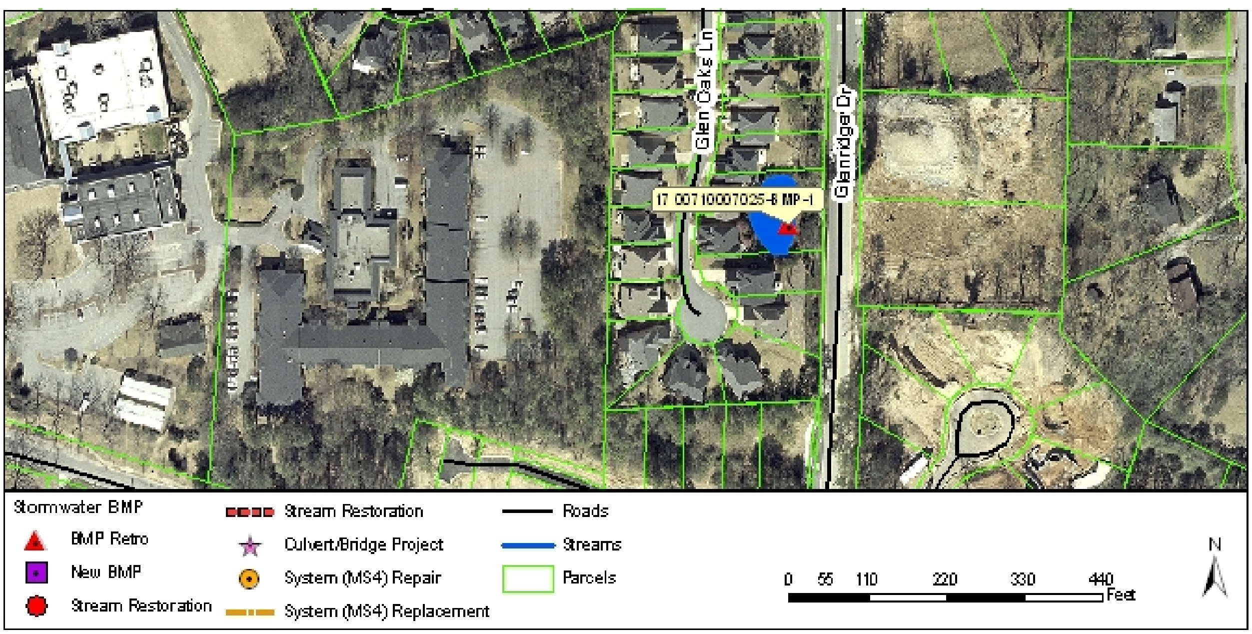
Project ID	Type	Benefit/Cost	Cost
17 00670001082-BMP-1	Existing	3.01	$146,000
17 00710007025-BMP-1	Existing	2.34	$357,000
Total			**$503,000**

Project 17 00670001082-BMP-1 includes retrofitting an existing dry pond into a micropool extended detention pond. The BMP is located near Forest Valley Court in a residential area. In a dry extended detention basin, the channel protection volume is stored and released over 24 hours. Temporary storage may also be provided for larger storm events. The proposed retrofit will achieve water quality benefits by converting the facility into a micropool extended detention pond and redesigning the outlet control structure.



BMP Project (1700670001082-BMP-1) with Single Family Attached Asset Designation

Project 17 00710007025-BMP-1 includes retrofitting an existing dry pond into a dry extended detention basin. The existing BMP is located in a residential area. This proposed retrofit will achieve full channel protection benefits by converting it to a dry extended detention basin and redesigning the control structure. Additional modifications include building a sediment forebay.



BMP Project (17 00710007025-BMP-1) with Single Family Attached Asset Designation

Another method to review stormwater BMP projects is solely by benefit/cost score. These projects would have the most benefit per dollar for environmental, social, and financial criteria as defined by the Prioritization Matrix. Table 4-6 presents the stormwater BMP projects that have a benefit/cost score above a 5. Asset ownership is excluded from this sorting procedure but it is included in the table for reference. Appendix D contains the projects sheets for more information.

Table 4-6. BMP Projects with a Benefit/Cost Score Greater than Five

Project ID	Type	Benefit/Cost	Cost	Asset Ownership
17 00930004075-BMP-1	Existing	7.52	$473,000	Non-single family attached
17 00680006002-BMP-1	Existing	7.43	$436,000	Non-single family non-attached
17 00690005022-BMP-3	New	6.83	$366,000	Non-single family non-attached
17 00380001117-BMP-1	Existing	6.81	$414,000	Single family non-attached
17 0019 LL132-BMP-1	Existing	5.75	$725,000	Non-single family attached
17 00690005022-BMP-1	Existing	5.64	$311,000	Non-single family non-attached
17 00930004071-BMP-1	Existing	5.40	$219,000	Non-single family non-attached
17 00690005022-BMP-2	Existing	5.17	$162,000	Non-single family non-attached
Total			**$3,106,000**	

The following table presents the list of all 60 BMP projects with type, cost, and benefit/cost score. As the City receives stormwater related service requests, this complete list of stormwater BMP projects can be compared to the service request to determine if there is a watershed benefit to the project.

Table 4-7. Complete BMP Project List for the Nancy Creek Study Area

Project ID	Type	Benefit/Cost	Cost
17 00930004075-BMP-1	Existing	7.53	$473,000
17 00680006002-BMP-1	Existing	7.43	$436,000
17 00690005022-BMP-3	New	6.84	$366,000
17 00380001117-BMP-1	Existing	6.82	$414,000
17 00690005022-BMP-1	Existing	5.64	$311,000
17 00930004071-BMP-1	Existing	5.41	$219,000
17 00690005022-BMP-2	Existing	5.18	$162,000
17 0019 LL132-BMP-1	Existing	5.04	$725,000
17 0019 LL121-BMP-1	Existing	4.93	$502,000
17 00680008022-BMP-1	Existing	4.77	$350,000
17 0037 LL045-BMP-1	Existing	4.55	$938,000
17 00150006013-BMP-1	Existing	4.26	$479,000
17 00180009013-BMP-1	Existing	3.94	$456,000
17 0014 LL110-BMP-1	Existing	3.74	$246,000
17 0016 LL171-BMP-1	New	3.71	$2,857,000
17 0016 LL167-BMP-1	Existing	3.71	$358,000

Table 4-7. Complete BMP Project List for the Nancy Creek Study Area

Project ID	Type	Benefit/Cost	Cost
17 0040 LL161-BMP-1	Existing	3.62	$822,000
17 00160002063-BMP-1	Existing	3.56	$229,000
17 0017 LL093-BMP-1	Existing	3.45	$361,000
17 0019 LL121-BMP-2	Existing	3.34	$253,000
17 0019 LL130-BMP-1	Existing	3.15	$332,000
17 00930006131-BMP-1	Existing	3.13	$345,000
17 0039 LL078-BMP-1	Existing	3.02	$423,000
17 00670001082-BMP-1	Existing	3.01	$146,000
17 00150004003-BMP-1	Existing	2.99	$548,000
17 0018 LL101-BMP-1	Existing	2.97	$513,000
17 0092 LL071-BMP-1	Existing	2.88	$695,000
17 00930006125-BMP-1	Existing	2.80	$234,000
17 0092 LL071-BMP-2	Existing	2.80	$437,000
17 0041 LL036-BMP-1	New	2.69	$1,254,000
17 0017 LL084-BMP-1	Existing	2.39	$419,000
17 01190007026-BMP-1	Existing	2.39	$499,000
17 00360002047-BMP-1	Existing	2.38	$348,000
17 00940001092-BMP-1	Existing	2.37	$238,000
17 00710007025-BMP-1	Existing	2.34	$357,000
17 00400003003-BMP-1	Existing	2.21	$1,184,000
17 0018 LL097-BMP-1	Existing	2.03	$629,000
17 00390002047-BMP-1	Existing	2.00	$523,000
17 0068 LL078-BMP-1	Existing	1.93	$218,000
17 0014 LL149-BMP-1	Existing	1.83	$1,273,000
17 01190005040-BMP-1	Existing	1.92	$332,000
17 01190006048-BMP-1	Existing	1.82	$293,000
17 00180002001-BMP-1	Existing	1.56	$813,000
17 0040 LL072-BMP-1	Existing	1.53	$227,000
17 0015 LL097-BMP-1	Existing	1.51	$750,000
17 00920001035-BMP-1	Existing	1.44	$338,000
17 0039 LL066-BMP-1	New	1.43	$763,000
17 00670007009-BMP-1	Existing	1.40	$442,000
17 0014 LL104-BMP-1	Existing	1.39	$499,000
17 0036 LL071-BMP-1	Existing	1.34	$300,000
17 00670006005-BMP-1	Existing	1.33	$293,000
17 0015 LL109-BMP-1	Existing	1.32	$807,000

Table 4-7. Complete BMP Project List for the Nancy Creek Study Area			
Project ID	**Type**	**Benefit/Cost**	**Cost**
17 0038 LL141-BMP-1	Existing	1.29	$505,000
17 0014 LL140-BMP-1	Existing	0.89	$464,000
17 00400003002-BMP-1	Existing	0.85	$281,000
17 01200001067-BMP-1	Existing	0.71	$436,000
17 0017 LL1053-BMP-1	Existing	0.68	$689,000
17 0013 LL089-BMP-1	Existing	0.62	$526,000
17 0017 LL1053-BMP-2	Existing	0.43	$714,000
17 0017 LL096-BMP-1	Existing	0.19	$807,000
Total			**$31,851,000**

4.3.2 Stream Restoration Projects

The City of Sandy Springs does not currently include stream restoration projects as part of its stormwater management program. However, for future reference, 15 stream projects were identified and evaluated within the Nancy Creek study area. Stream restoration projects provide numerous benefits including water quality, aquatic habitat, public safety, and infrastructure improvements within the watershed. In addition, aesthetics will be improved from many of these projects. Many of these projects are outside the City's LOS area and on private property.

In some cases, property damage is likely without stabilization efforts. Project 17 00670001068-STREAM-1 with a benefit/cost score of 3.9 (see photo above) is one such example where stream is eroding toward a retaining wall and will threaten the property if left unchecked.

Stream Restoration Project 17 00670001068-Stream-1

Another example of a stream project is located near a residential area is Project 17 00660006039-STREAM-1 with a benefit/cost score of 5.61. This project is a level 2 stream restoration located behind houses on Pine Forest Road. The stream is incising and widening and encroaching into fences and properties on right bank. A Level 2 approach includes restoring the stream and floodplain within the existing channel at the present elevation or a new channel adjacent to the old but at the same elevation. The new channel will be based on the dimension, pattern, and profile characteristic of a stable reference reach.

All stream projects and associated costs and benefit/cost scores are presented in Table 4-8.

Table 4-8. Complete Stream Project List for the Nancy Creek Study Area			
Project ID	**Type**	**Benefit/Cost**	**Cost**
17 0014 LL104-STREAM-1	Stream	6.19	$110,000
17 00660006039-STREAM-1	Stream	5.61	$312,000
17 00380002058-STREAM-1	Stream	5.59	$263,000
17 00660001011-STREAM-2	Stream	5.29	$674,000
17 00660004021-STREAM-1	Stream	4.60	$801,000
17 00670001068-STREAM-1	Stream	3.90	$313,000
17 00150007004-STREAM-1	Stream	3.81	$394,000
17 0014 LL119-STREAM-1	Stream	3.81	$341,000
17 00390002045-STREAM-1	Stream	3.40	$483,000
17 00400003002-STREAM-1	Stream	2.92	$338,000
17 0014 LL146-STREAM-1	Stream	2.83	$853,000
17 0039 LL055-STREAM-1	Stream	2.72	$598,000
17 0014 LL151-STREAM-1	Stream	2.63	$1,646,000
17 00410002036-STREAM-1	Stream	1.77	$1,305,000
17 00670001009-STREAM-1	Stream	1.67	$242,000
Total			**$8,673,000**

4.4 Implementation Recommendations and Schedule

The City of Sandy Springs has embarked on an extensive effort to better understand the scope and cost of developing a comprehensive stormwater program. The Nancy Creek Watershed Improvement Plan outlines dozens of projects that when implemented, will improve water quality and aquatic habitat, as well as comply with federal and state regulations. This section outlines a plan that will allow the City to move forward with implementation over the short- and long-term.

4.4.1 Year One

- Implement a new stormwater pond on a city owned parcel, project # 17 0039 LL066-BMP-1.
- Continue to review service requests that may overlap with a watershed protection project.

Total Project Cost: Approximately $763,000 (1 BMP project)

4.4.2 Year Two through Five

- Implement one BMP project per year, starting with the highest scoring projects on the "attached" residential or highest benefit/cost score project lists. Project implementation will be determined by property owner cooperation and legal review.
- Continue to review service requests that may overlap with a watershed protection project.
- Re-evaluate level of service and adjust implementation schedule as needed.

Total Project Cost: Approximately $1.0 million (one $250,000 BMP project per year for 4 years)

4.4.3 Year Five through Ten

- Implement additional BMP projects where possible from residential attached or highest benefit/cost score lists. The City may wish to retrofit existing BMPs before looking at new construction. Continue to review service requests that may overlap with a watershed protection project.
- Re-evaluate level of service and adjust implementation schedule as needed.

Total Project Cost: approximately $1.25 million (one $250,000 BMP project per year for 5 years).

This implementation recommendation and schedule should be revisited at least annually to ensure the watershed improvement plan is meeting the City of Sandy Springs goals.

4.4.4 Optional Tasks

In addition to the recommendations listed above, Sandy Springs may want to consider some optional tasks during years 1 through 10 as opportunities arise:

- Stream restoration projects.
- Identify and install a Low Impact Development (LID) demonstration project, such as a rain barrel or rain garden, sand filter, pervious pavers, or green roof on city-owned property. Installing in a high visibility area such as a park or area where customers pay bills will increase public outreach.
- Evaluate cost-share program for stormwater BMPs clean-outs and outlet modifications.
- Implement other educational and outreach efforts such as Adopt-A-Stream, stormdrain stenciling, informational brochures on stream buffers, etc.
- Buffer protection program.
- Mitigation banking.

Following this implementation recommendations plan will allow the City of Sandy Springs to protect and improve conditions in the Nancy Creek watershed. New opportunities may arise and should be evaluated in a similar manner to the projects above. Use of the prioritization matrix and the WIP Tools model will assist with this comparison.