MS4 Mapping & GIS Data Connectivity in the Rocky Branch Watershed

City of Columbia Utilities and Engineering Department

Stormwater & GIS Division

University of South Carolina MEERM-AWNES Project

By

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Jingting Sun

Stormwater Management Intern

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Content

Executive Summary

The City of Columbia (CoC) is required by federal and state law to obtain a National Pollutant Discharge Elimination System (NPDES) permit from South Carolina Department of Health and Environmental Control (SCDHEC) for stormwater discharges from the Municipal Separate Storm Sewer System (MS4) to waterbodies (City of Columbia 2010).

The MS4 permit requires stormwater infrastructure mapping within the permitted boundaries. Currently, CoC is focusing on mapping of stormwater channel networks in the Congaree River Watershed, including Rocky Branch Watershed (RBW). However, the existing GIS data for stormwater in the RBW is fragmented, unverified, and far from complete. This project focused on two subbasins of the RBW that straddle the creek—herein named the USC Campus basin—to verify and complete mapping of stormwater infrastructure. This was accomplished by consulting all available plan drawings for details of stormwater infrastructure, performing field work to collect Global Positioning System (GPS) data, adding the data into the stormwater database, and editing it. Based on the stormwater drainage maps, the project also offered a way to track pollution sources, which is also required by the NPDES process for Best Management Practices (BMPs).

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1. Introduction

1.1 Background

Stormwater runoff in the City of Columbia carries pollutants to the waterbodies through the Municipal Separate Storm Sewer System (MS4). In order to control the discharge of pollutants to streams and lakes, the Clean Water Act (CWA)—enacted in 1972—gives the Environmental Protection Agency (EPA) the authority to implement the National Pollutant Discharge Elimination System (NPDES) Stormwater Program (City of Columbia 2010).

SCDHEC issued the stormwater NPDES permit (permit number SCS790001) to the City of Columbia in January 2010. The permit covers a five-year term which started on January 25, 2010. Under the requirement of the permit, the City is not only responsible for the development and implementation of Stormwater Management Plan (SWMP) and Best Management Practices (BMPs), but also responsible foran evaluation of the SWMP and BMPs (City of Columbia 2010).

Part III. A of the NPDES MS4 Permit SCS790001 indicates four watersheds(SC DHEC 2010)as shown in Table 1. For CoC, the current permit term focuses on stormwater infrastructure mapping of the Rocky Branch Watershed (RBW), which is located in the Upper Congaree Basin.

Table 1: City of Columbia Watershed Management by NPDES MS4 Permit SCS790001

Phase	Watershed	Contained Waterbodies	Hydrologic Unit Code
I	Lower Saluda River Watershed	Saluda River, Stoops Creek, Kinley Creek	03050109-210
II	Congaree River Watershed	Rocky Branch, Congaree River, Reeder Mill Branch	03050110-010
III	Broad River Watershed	Broad River, Smith's Branch, Crane Creek, Nicholas Creek	03050106-07
IV	Gills Creek Watershed	Gills Creek, Penn Branch, Wildcat Creek, Kilbourne Creek	03050110-030

1.2 Objectives

The objectives of this project are mapping the storm sewer channel networks in the USC Campus subbasin of RBW, adding stormwater data into the database, and editing the database. Based on the completed map, the project also offers subsequent analysis, including recommendations for BMPs and a tracking process for pollutant sources.

2.Urban Runoff and Stormwater Features

2.1 Impervious Areas and Hortonian Flow

In urbanized regions, impervious land surface areas are one of the major causes of flooding and pollution. The impervious areas of RBW have been mapped in detail as three separate components: buildings, roads, and miscellaneous (Wooten 2008). Miscellaneous are composed by sidewalks, driveways, parking lots, etc. The impervious area data are available in GIS shape files and also include a total impervious area, which is the sum of the three components. The infiltration capability in urbanized areas is lower than pervious areas, such as forested watersheds or humid rural basins, so it generates more stormflow in the form of Hortonian flow.

Hortonian flow—also known as infiltration-excess runoff—is a dominant flowtype on urbanized land, such as paved areas where infiltration capability is low. It is generated when rainfall intensity is greater than infiltration capacity into the soil. Instead of soaking into soils and becoming subsurface flow, rainfall is diverted to Hortonian flow on impermeable areas which can cause flooding, erosion and water pollution because of its high velocity compared to other runoff (James 2012a). The consequence of greater Hortonian flow is increased flooding, impaired water quality, and degraded aquatic environments.

Understanding where flooding is likely to occur and managing flood risks depend on knowing where and how well storm sewers convey water in various locations within the watershed. Where the MS4 is inefficient at conveying stormwater to creeks, local flooding may occur as surface runoff backs up. Where the MS4 is efficient it delivers storm flows downstream and may generate flooding lower in the watershed. Thus, it is essential to know where storm sewer intakes are located, where storm sewers flow to, and their flow capacities, in order to understanding the spatial nature of flooding in the watershed.

2.2 GIS Application in Stormwater: Literature Review

GIS has been used in stormwater managementfor a long time. Early in 1993, a citywide GIS platform was used to calculate impervious areas (Bryant, Carper and Nicholson 1999). A raster-based GIS was developed by Meyer for an urban subdivision in Colorado, and the results matched the hydrologic studies well (Sample, et al. 2001). In 1996, infrastructure view/query tools, stormwater modeling and a monitoring database were applied in a small scale (Bryant, Carper and Nicholson 1999). During that time, the models applied in GIS include HSPF (Hydrologic Simulation Program- Fortran) and SCS (Soil Conservation Service)-based model. ArcView and SWMM (Stormwater Management Model) were also applied together for the City of Huntington, West Virginia by Shamsi and Fletcher. Shamsi also listed interchange, interface and integration as three forms of information exchange between GIS and SWMM in 1998 (Sample, et al. 2001). Although the application was not used to any major extent due to the restriction of the data source, it provided useful information on how to improve the products to meet stormwater and watershed management requirements in the future. To solve the stormwater maintenance problem, the view/query tools were re-engineered in 1998. Microsoft COM architecture was applied to accomplish integration between modules (Bryant, Carper and Nicholson 1999). A GIS, hydraulic model, and time series were integrated to evaluate stormwater and address flooding problems in Dhaka, Bangladesh. BMPs assessment model was integrated into GIS to evaluate the effectiveness of BMPs. A hydraulic simulator and an economic evaluation model were also used in ArcView to evaluate stormwater sewer design plan. HEC-HMS (Hydrologic Engineering Center- Hydrologic Modeling System) was utilized to determine runoff and delineate drainage basins in 1999 (Sample, et al. 2001).

2.3 Study Area Description

Rocky Branch Creek (RBC) is a major creek in downtown Columbia, SC. It is approximately 2.2 miles in length (PB Americas, Inc. 2007). It originates nearMartin Luther King. Jr. Park and flows through the Five Points area, Maxcy Gregg Park, the southern portion of University of South Carolina campus, the Olympia neighborhood, and into the Congaree River(AMEC Environment & Infrastructure, Inc. June 1, 2012). The RBW is an urbanized sub-watershed located in the Upper Congree Basin. The area of the watershed is approximately 4 mi^2 and 49.1% surface is impervious (Wooten 2008). Like other urbanized areas, the RBW has been facing flooding issues over the years, which not only inflicts economic loss, but also threatens public health.

The RBW has been divided into 9 subbasins (Figure 1) based on visual interpretation of the best-available topographic data at this time; i.e., LiDAR-derived topographic surfaces (Allan James, written communication). These basin divides have not been verified and one of the goals of this project is to compare the MS4 mapping with the map. Given time limits, this project focused on the North USC and South USC basins to map the stormwater drainage systems.The boundary of USC subbasins is approximately from Greene Street to Whaley Street in north-south direction and from Main Street to Saluda Avenue in west-east direction (Figure 2).

Figure 1: Rocky Branch Subwatersheds (James 2012b)

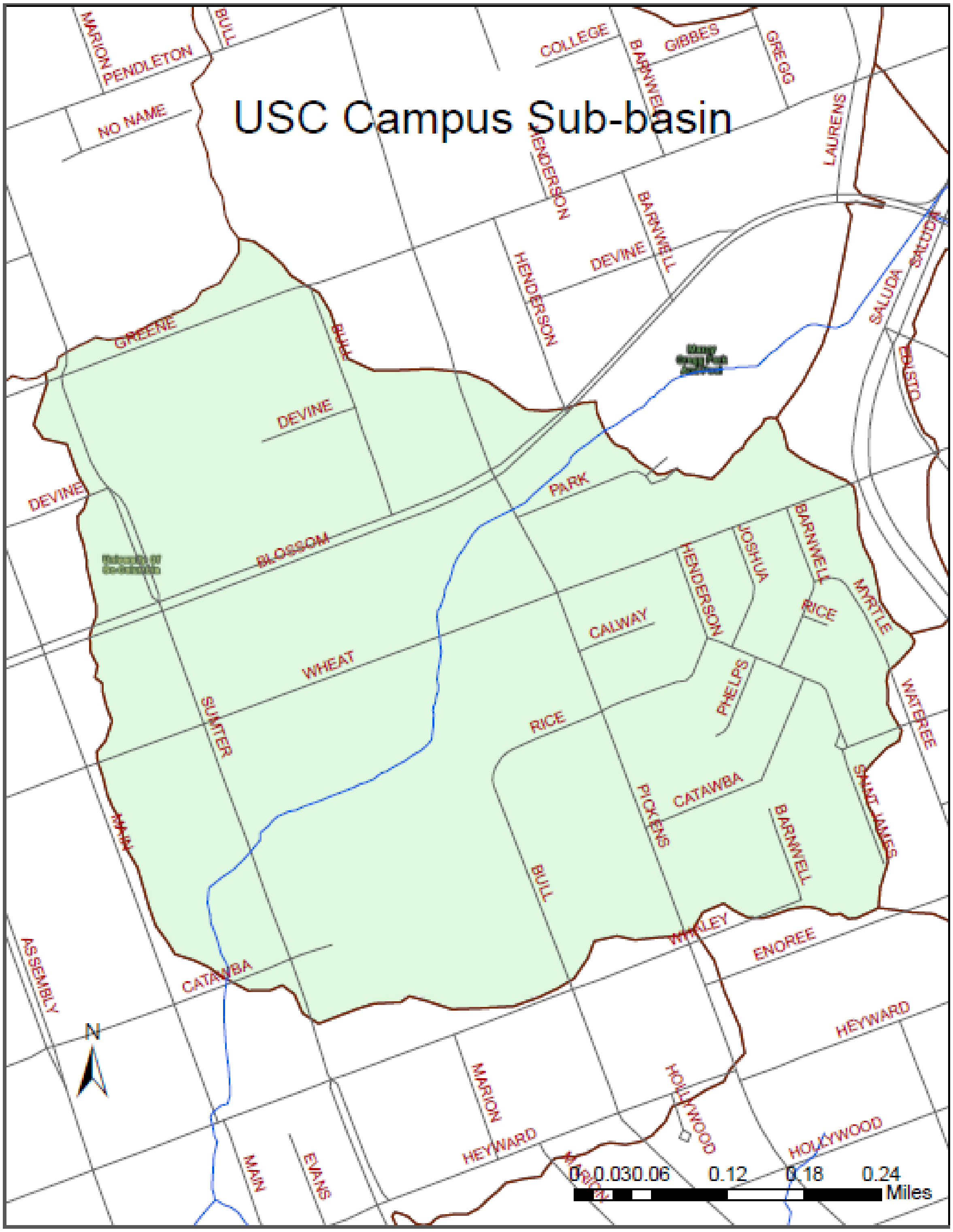


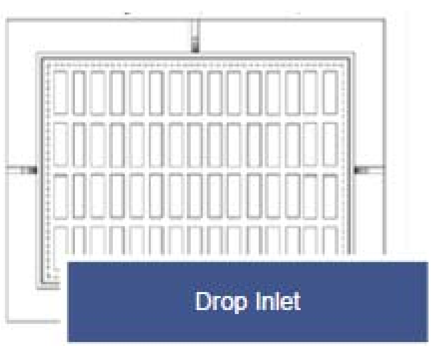
Figure 2: USC Campus subbasin of the RBW (Streets derived from CoC; drainage subbasin drainage divides from James2012b)

2.4 Stormwater Features

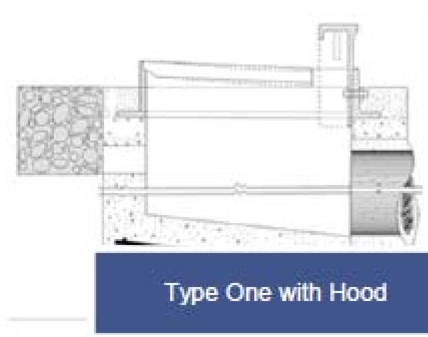
Stormwater features in the City of Columbia have been located and mapped using GPS technology and stored in the GIS stormwater database.

The stormwater features inventory in the GIS database include catchbasins, junction boxes, drainage points, stream points, outlet structures, open channels, ponds, and drainpipes. Each feature has several attributes to describe the properties. For example, a storm-water drain pipe is stored as a linear feature in the GIS database and has attributes such as datasource, ownership, GIS editor, GIS revision date, lifecycle status, facility ID, comment, subtype, pipe diameter, pipe material, pipe shape, pipe inlet elevation, pipe outlet elevation, culvert or not, etc.

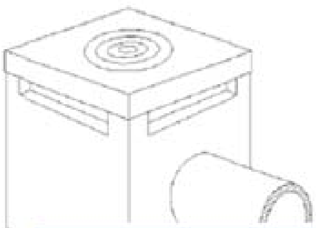
Catchbasin and junction box are two of the most common stormwater features in the RBW. Catchbasin features are recorded as several subtypes such as Drop Inlet, Type 1- Curb inlet without hood, Type 1- Curb inlet with hood, Type 9- Yard inlet, Type 9- Yard inlet with manhole, Type 15- Divided highway inlet, Type 16- Prefab slanted throat (small), Type 17- Prefab slanted throat (med), Type 18- Prefab slanted throat (large), Florida Style, Other, etc. Some of these stormwater feature types are shown in Figure 3.



Type One
with Hood



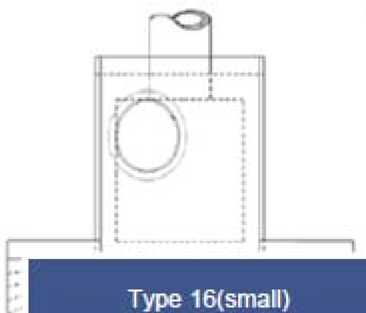
Type One with Hood



Type 9 Yard Inlet

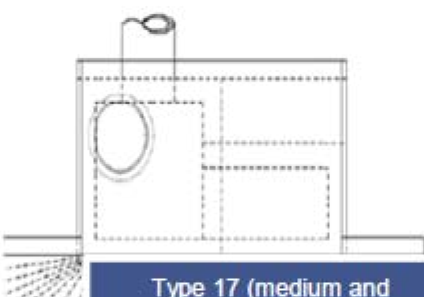
Type 9 Yard Inlet w MH

Type 9-Yard Inet no MH



Type 16(small)

Type 16



Type 17 (medium and
asymetrical)

Type 17

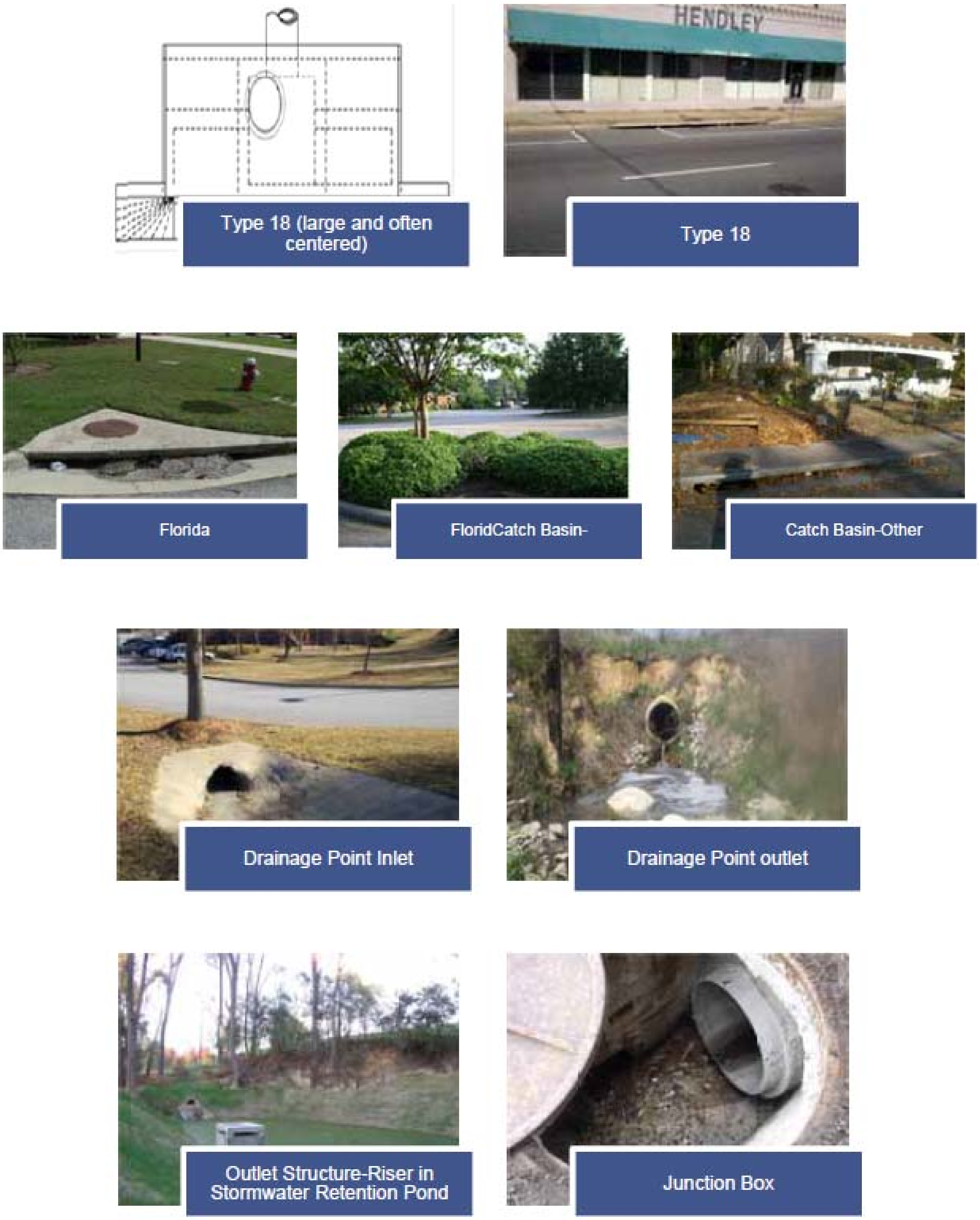


Figure 3: Stormwater Features (City of Columbia 2012)

3. Stormwater Data Collection

Stormwater drainage system mapping requires three components: locating plan drawings for stormwater infrastructure from the city file; GPS data collection in the field; final GIS stormwater data entry, editing, and mapping.

3.1 Search for Plan Drawings

Plan drawings are essential to identifying the stormwater systems. Good plan drawings for stormwater infrastructure usually contain the attributes needed in the GIS database such as pipe materials, pipe diameter, elevation, etc., which not only helps populate the stormwater database, but also provides an important reference for collecting GPS data in the field. Flat File Search, City File Search and Plan Drawing Reading are three steps to achieve this goal (details see Appendix A).

3.2 GPS Data Collection

The Global Positioning System (GPS) is a space-based satellite navigation system created by the U.S. Department of Defense. It computes the position of points, lines and polygons when a GPS unit receives a signal from GPS satellites. The computations are stored as coordinates. Most GPS units have the capability to output the collected positions into point, line or polygon features (Collecting Field Data n.d.).

The GPS data collection equipment used by the City of Columbia is a small handheld device Trimble GeoXT 6000 (Figure 4).It provides an accurate and quick method to verify stormwater infrastructure locations. The process of collecting GPS data is shown in Appendix B.

Figure 4: GPS Unit-TrimbleGeoXT 6000

3.3 GPS Data Quality

Although GPS offers the most accurate method to collect data for the City's stormwater database, it has some limitations. The accuracy of the data can be affected by many factors. The amount and angle of satellites both can affect the date quality. GPS requires at least four satellites to produce the location estimates (Anderson 2012). The accuracy is better when the satellites spread around the sky (Briggs n.d.). In downtown area, the signals are often obstructed by tall buildings, trees, etc. To indicate when satellite geometry provides the most accurate results, position dilution of precision (PDOP) was used to do the differential correction of the collected data (Clifton, written communication). The horizontal accuracy is represented in meters, and the ideal accuracy after differential correction should be less than 1 meter.

Some stormwater features are not functioning anymore such as abandoned pipes or junction boxes. In that case the GPS attribute should be saved as inactive.

4. GIS Mapping and Database Editing

4.1 Georeference Plan Drawings

Digitized as-built drawings were georeferenced so they could be incorporated into the GIS. During the process, picking proper Ground Control Points (GCP) is an essential step. The control points should be found on both the digital drawing and on the GIS data layers. Use the GCPs with good accuracy, like the corner of a sidewalk. Identify at least three pairs of points to align the drawing to the data. The control points should be distributed evenly around the drawing, which is being fixed by triangle. The plan drawing should match the imagery pretty well if the process goes smoothly. All stormwater features shown on the plan drawings are added to GIS database. In the end, all the drawings are rectified in Arc to facilitate future review. The details for georeference procedure are shown in Appendix C.

4.2 Editing Stormwater Database

This data-development process refers to adding attribute data to the GIS stormwater database from plan drawings through a digitizing process (Benedict, Michael; Bieberitz, Michael 2006).

Drain Pipe is the key component that needs to be edited. All the information that can be found was input into the attribute table, especially the pipe size. It is important to determine the pipe flow direction before adding it into the database. Generally, the direction is not shown directly on the drawings, but a reasonable estimation is possible by several approaches, such as differences in pipe inlet/outlet elevations (pipe flows from high to low), pipe diameters (pipe flows from smaller to bigger), and topographic contours (discussed later).

For process details see Appendix D.

5. GIS Data Connectivity

One of the challenges of this project is to connect the MS4 for the areas in which there are no plan drawings available. Topography from a contour map and GIS assessment of QA/QC were used to finish this process.

5.1 Contour Lines Application

A digital topographic map created by the United States Geological Survey (USGS) was used as a reference to estimate the flow direction. It can also help to determine the watershed's boundaries. The shape of the surface is represented by contour lines on the topographic map (USGS 2012). Closely spaced contour lines represent rapid changes in elevation, and sparse contour lines indicate the flat areas (Department of Environmental Protection n.d.). Based on the shape of contour lines, high points and low points can be determined, which helps to identify the potential beginning point of the MS4 and outfall location. The contour lines database was only used as a reference because of its accuracy limitation. Besides, there are too many possible ways the runoff can follow which cannot be known for sure. Field verification is the most reliable way to finish the data connectivity.

5.2 Quality Assurance and Quality Control

A GIS method of Quality Assurance/Quality Control (QA/QC) is essential to ensure the accuracy and quality for all published datasets. Topology and geometric network methods were used to clean up the data by CoC.

Topology is used to manage point, line and polygon features when they share coincident geometry (ESRI, Inc 2010). The topology rules used for both drainage pipes and streams are “Must Not Intersect Or Touch Interior”, “Must Not Overlap”, “Must Not Self-Intersect” and “Must Not Self-Overlap”. An additional rule for pipes is “Must Not Be Single Part”.

The geometric network tool was used to check data connectivity. It helps to identify the features which violate the connectivity rules in the network. For this project, geometric network determines whether all pipes connect to the storm sewer systems and whether the network is complete. If the entire stormwater feature can be traced upstream from the terminal outfall without loop or disconnected features, it means the data connectivity is complete and the overall GIS data quality is verified.

6. Results, Analysis and Discussion

6.1 Revise USC Campus Subbasin

Based on the stormwater drainage map, the USC Campus subbasin boundaries should be broader in area than shown on the preliminary map (Figure 1 and 2). It should include the areas around Henderson and Barnwell Street which are located south of Greene Street. The southwest boundary should be expanded to Whaley Street. In addition, the “outfall break point” of USC Campus subbasin and University Hill subbasin should be moved east along Rocky Branch Creek, which means most of the west portion of Maxcy Gregg Park should be included in the USC basin. The area of the USC Campus subbasin increases from 0.72 km^2 to 0.91 km^2. To adjust the boundaries, the topology editing tool was used by City employees. This tool allows editing features that share geometry or connect to each other (ESRI, Inc. 2012). The revised USC Campus subbasin is shown in Figure 5. Since the MS4 data connectivity has not been completed in other subbasins, the project only adjusted the boundaries of USC Campus subbasin and those adjacent to it sharing a boundary.

Figure5: Revised Rocky Branch Subwatersheds (CoC)

In total, the MS4 map (Figure 6) includes10 miles of storm sewer, 739 drainage pipes, 533 catch basins, 179 junction boxes, 82 drainage points and 2 outlet structures within the adjusted USC Campus subbasin.

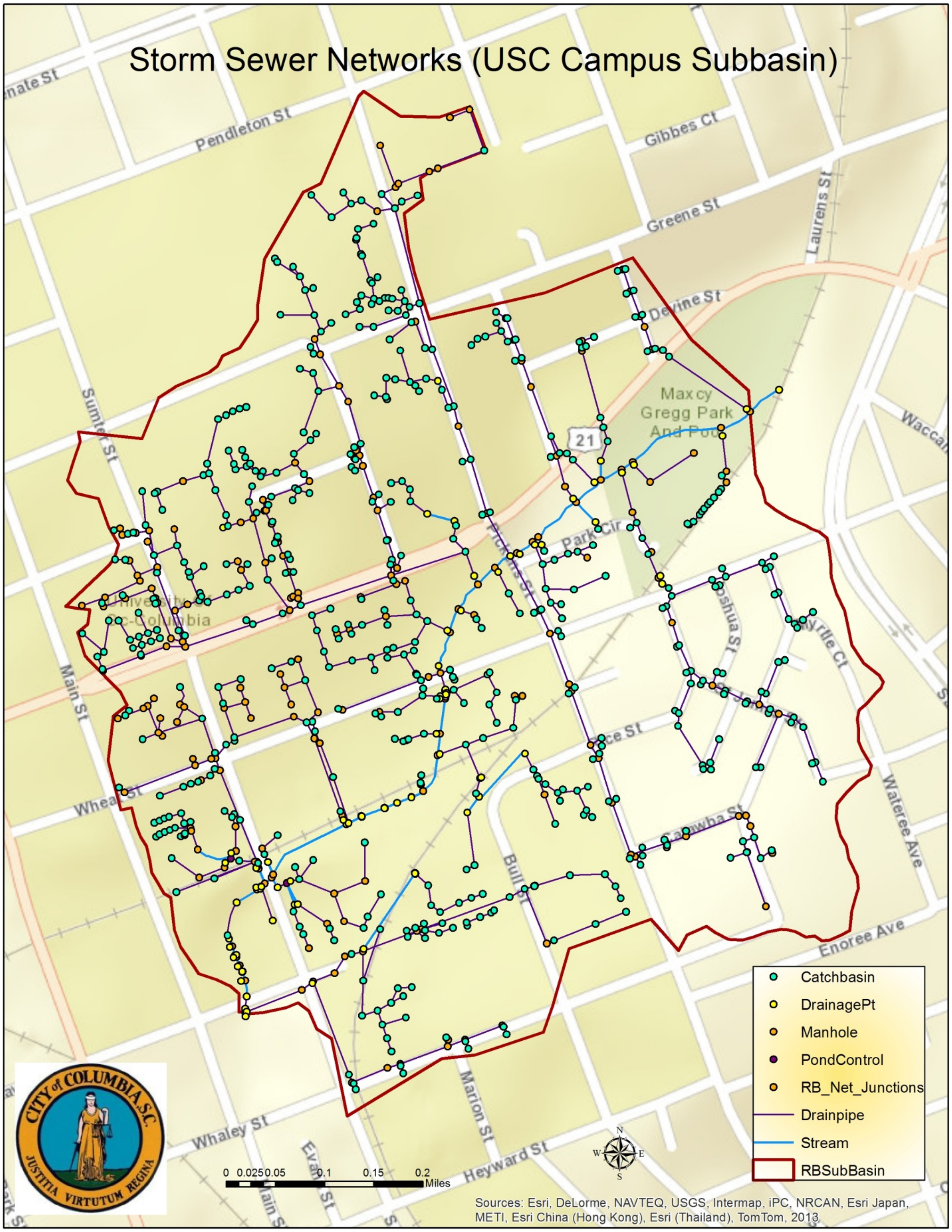


Figure 6: Stormwater Sewer Networks (USC Campus Subbasin)

6.2 Geometric Network Analysis

Geometric network provides a way to trace upstream or downstream for the source or fate of sediment or other illicit discharges. This ability should reduce the time needed to identify pollutant discharges and is required by the NPDES process for Best Management Practices (BMPs).

Soil erosion and sedimentationis a significant environmental concern for the RBW. Geometric network analysis allows for a trace upstream to identify the possible sources of sediment, which will be beneficial to the sediment-control process. For example, sediment was found in the RBC near the Maxcy Gregg Park and the MS4 map shows the possible sources which are highlighted in red (Figure 7).

In another example, during field work, an illicit discharge was found near the Chemistry and Biochemistry Department building at a junction box shown by green square sign in Figure 8. Besides reporting the situation to the City in time, the most important concern is to check whether the stream is contaminated. Geometric network analysis provides a way to trace pollutants downstream to identify the terminal outfall point. Along the highlighted red line, the pollutant has the potential to flow with stormwater along Sumter Street, then east to Blossom Street and enter the stream at the drainage point near Park Circle.

By tracing the stormwater sewer network, GIS plays a significant role in narrowing down the possible sources of sediment or contamination and reducing the time to identify the illicit discharge source once the discharge point is placed.

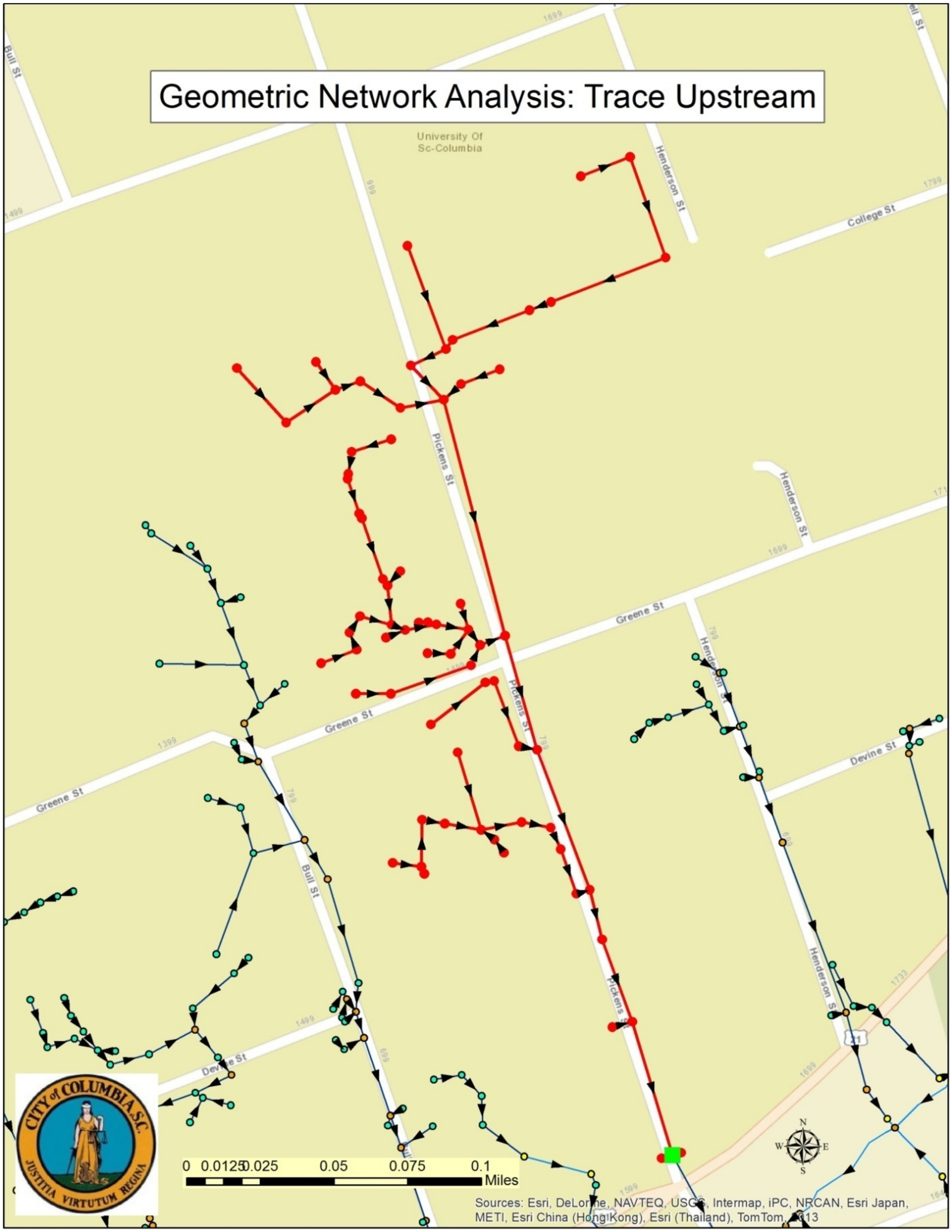


Figure 7: Geometric Analysis: Trace Upstream

Figure 8: Geometric Analysis: Trace Downstream

6.3 Recommendations

Based on the pipe-size information, some hydraulic and hydrology analysis can be processed to estimate the potential flooding points. Once the points are identified, subsequent flood-control measures can be offered to minimize downstream effects. However, some pipe information such as elevation and depth is still lacking in the City's stormwater database, which restricts the application of stormwater management models.

The current GIS mapping can support both point and nonpoint source pollution. Within the USC Campus subbasin boundary, the major focus should be on nonpoint source pollution. Construction activities such as the Thomas Cooper Library repair activities are common in the subbasin. Defective BMPs for construction activities can result in large discharges of sediment to the MS4 (EPA 2012). An effective Stormwater Pollutant Prevention Plans (SWPPP) for construction activities should be taken seriously as a part of BMPs.

7. Conclusion

The map of stormwater infrastructure for the North USC subbasin and South USC subbasin was accomplished by both office work—includingconsulting all available plan drawings for details of stormwater infrastructure and stormwater database editing—and field work, such as collecting GPS data and map verification.

1.) Based on the drainage map, the USC Campus subbasin should be larger which increases it from 0.72 km^2 to 0.91 km^2. The surrounding subbasins such as University Hill and Mill Villages were narrowed accordingly. Since the MS4 mapping for other subbasins is still underway, the project only adjusted the USC Campus boundaries.

2.) Within the adjusted USC Campus subbasin, there are 10 miles of storm sewers, 739 drainage pipes, 533 catch basins, 179 junction boxes, 82 drainage points and 2 outlet structures in total.

3.) The geometric analysis tool provided a way to trace up or down the MS4 networks for the source or fate of sediment or other illicit discharges. This ability narrows down the possible sources of sediment or contamination. It also reduces the time needed to identify the illicit discharge source once the discharge point is placed, which is required by the NPDES process for Best Management Practices (BMPs).

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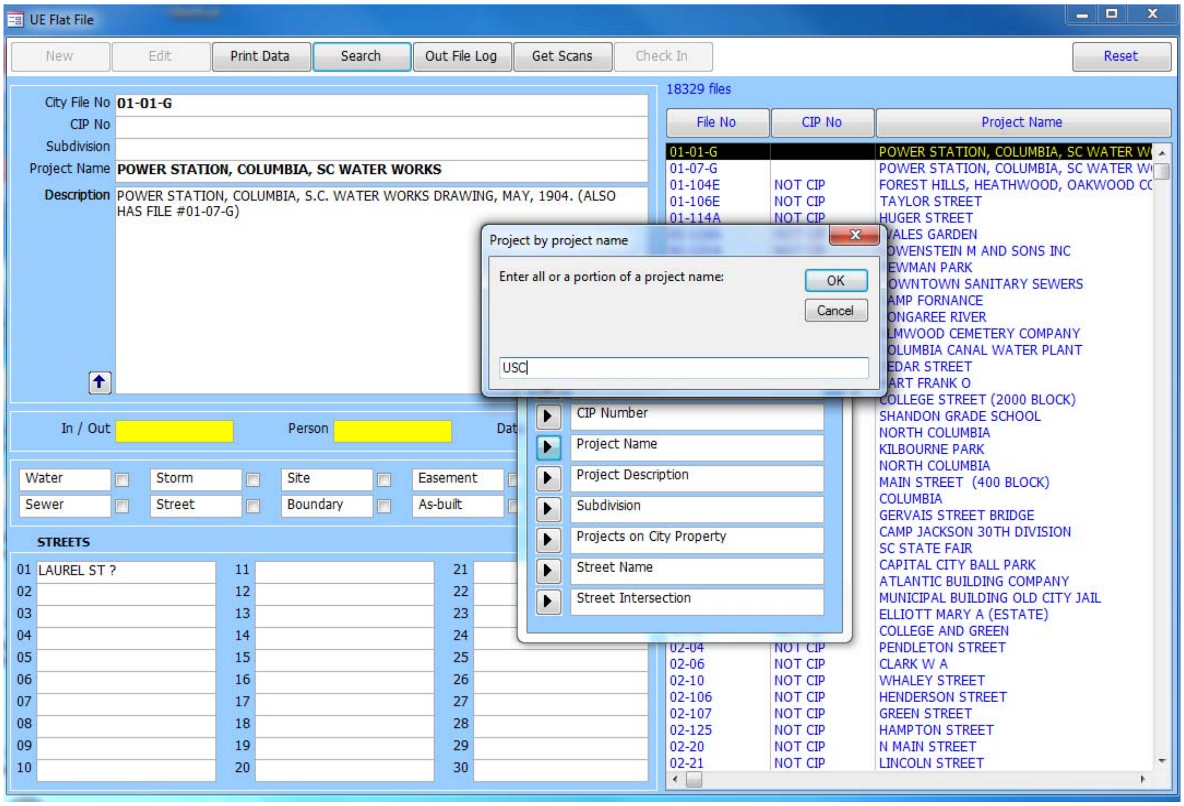
Appendices

Appendix A: Search for Plan Drawings

Flat File Search

The first step in looking for plan drawings that may show storm information is a flat file search. All file information is stored in the CoC's UE Flat File Access database. The UE Flat File provides basic information for each file such as City File No., Project Name, Streets, and what the file is about. Different tabs under the "search" button were used to select the files in specific areas. The search list included "City File Number", "CIP Number", "Project Name", "Project Description", "Subdivision", "Projects on City Property", "Street Name" and "Street Intersection". The "Street", "Project Name" and "Project Description" tabs usually give good results. Figure 9 shows a series of windows that result when typing "USC" under "PROJECT NAME".



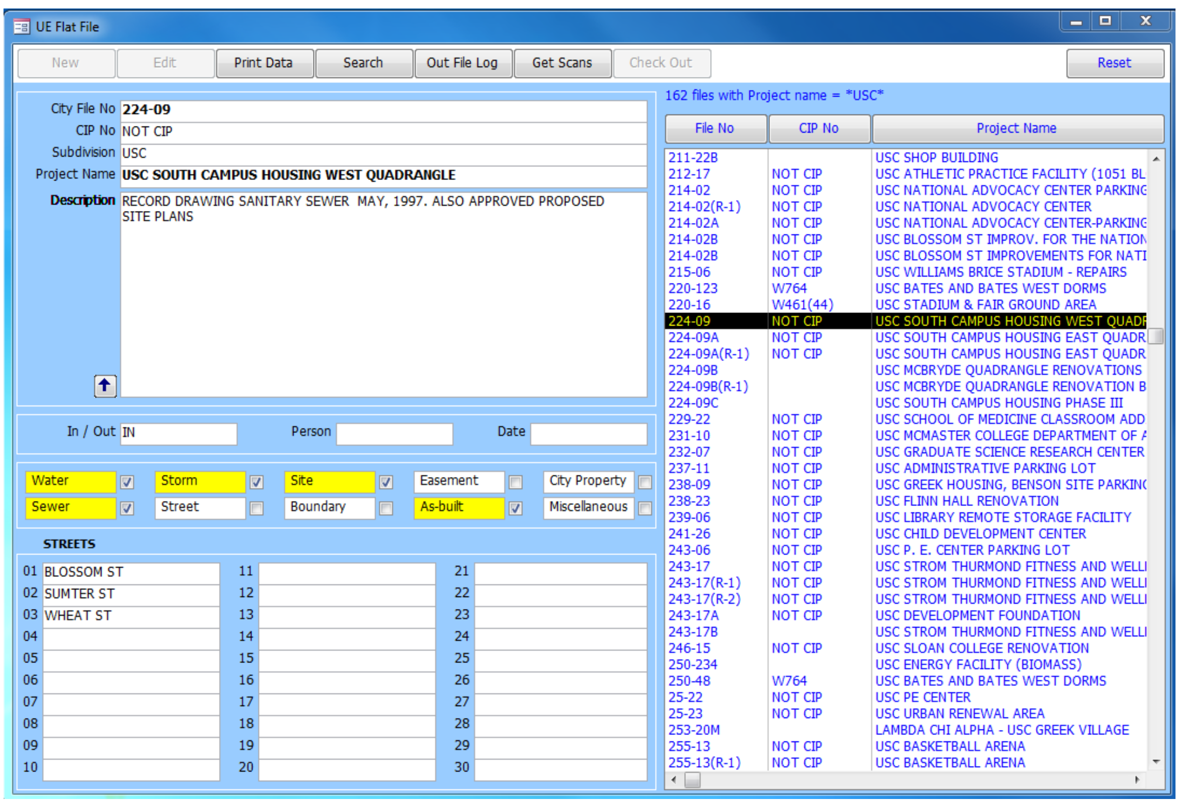


Figure 9: UE Flat File Database the City of Columbia

City File Search

The City File No. is the number used to search scans or scan folders from the DEPARTMENT STAFF folder on the City's hard drive. Figure 10 shows52 files that come up under "224-09". File "224-09" is the drawing of "USC South Campus Housing West Quadrangle," which contains "Storm" infrastructure information. Some drawings also contain stormwater information without showing it by the "Storm" checkbox, so it is better to check it when only "Water" or "Sewer" is highlighted, especially when the file is defined as "As-built" drawing.

The next step was to open each drawing to find the one that represents the stormwater infrastructure best. Other information such as elevation, pipe size, pipe materials could be found on a separate attachment. In this case, the drawing not only contained USC West Quadrangle plan drawings, but also included East Quad and South Quad. All of the needed drawings were saved in a temporary file and renamed for the street or building name, which helped to review them later.

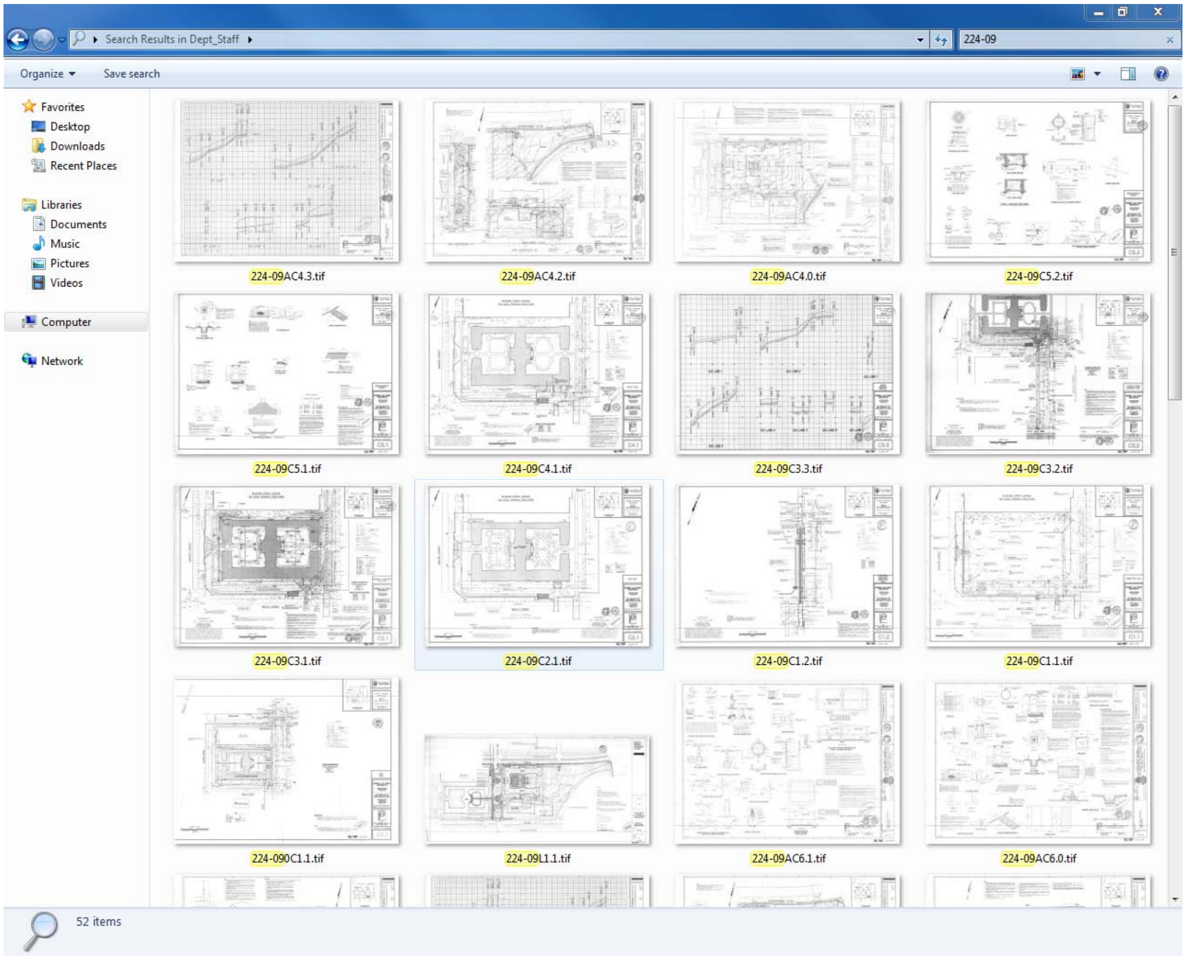


Figure 10: City File Search

Read Plan Drawings

Most of the storm drainage system plans are mixed in with grading, erosion, and sanitary drainage plans. Getting familiar with the storm feature abbreviations used by engineers and planners contributes to finding the stormwater infrastructure information effectively. Table 2 gives a list of common MS4 abbreviations that distinguish MS4 features in plan drawings.

Table 2: Abbreviation List in Plan Drawings

Abbreviation	**SD**	**SS**	**RD**	**CB**	**JB**	**MH**
Meaning	StormDrain	Sanitary Sewer	Roof Drain	Catch Basin	Junction Box	Manhole

After the plan drawings were selected, they were printed out and all the stormwater features were labeled and used as a reference when collecting GPS data in the field. Figure 11 is the plan drawing used to map MS4 in the USC South Campus Housing West Quadrangle area. This drawing illustrates the level of detail and complexity that may underlie comprehensive MS4 mapping at the watershed scale.

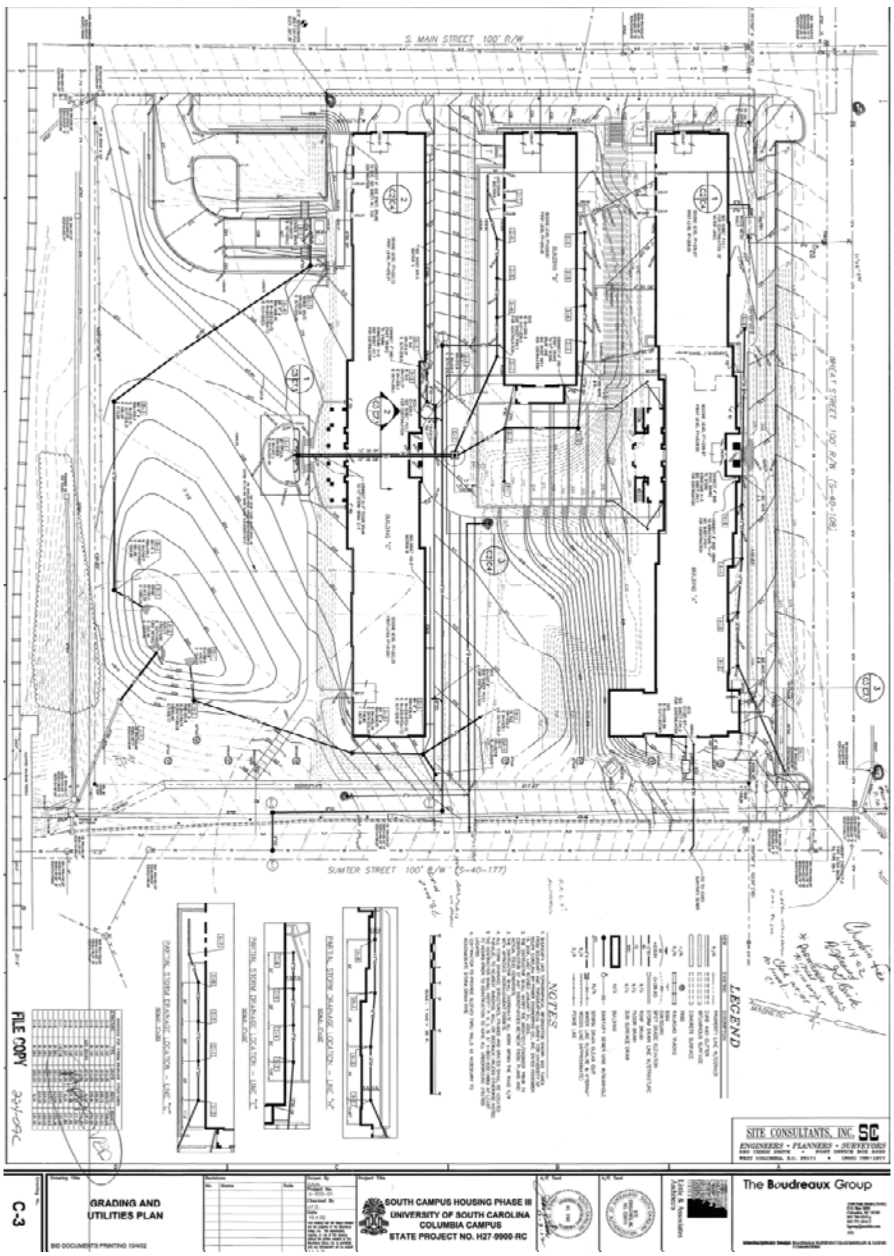


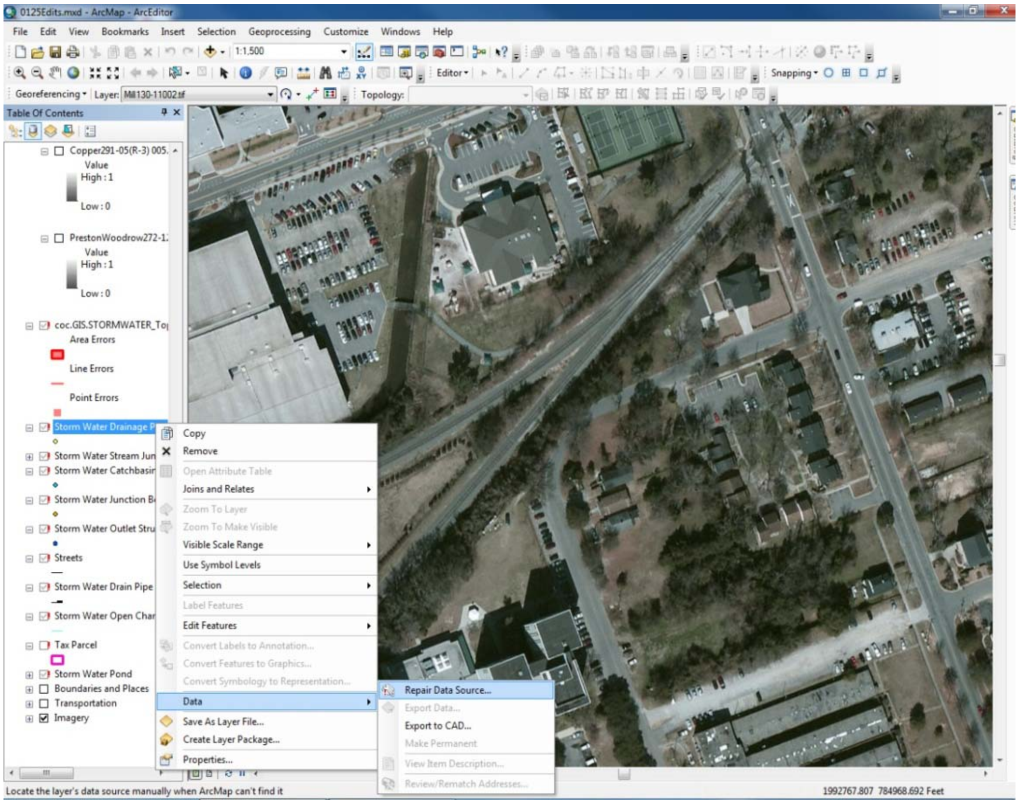
Figure 11: USC West Quadrangle Plan Drawing

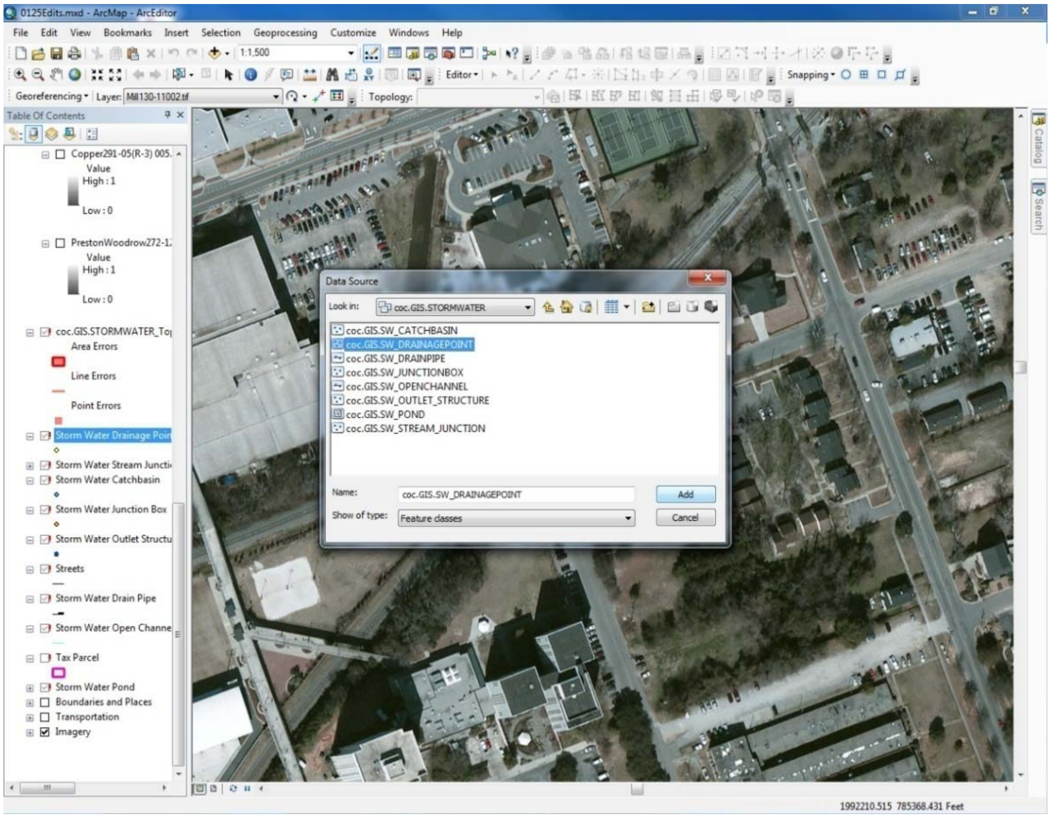
Appendix B: GPS Data Collection

When using the Trimble, the device was turned on and given time to acquire satellites, and an existing map was opened in ArcPad. Point coordinates for a feature were collected by standing on the middle of the stormwater feature. The GPS unit needs to be held steady with the top surface horizontal and away from the body. Since the study area is downtown Columbia, sometimes the signal is obstructed by tall buildings, which can result in poor accuracy. Good accuracy should be less than 1 meter. The worst acceptable accuracy for a point taken in this project was seven meters.

The GPS data collection layer includes every attribute of stormwater features which is in line with the GIS database. Field notes were taken to describe MS4 features if necessary and they were saved as “comments” in the Trimble GPS. The notes can include pipe size, pipe material, pipe direction, and any other description helpful to edit the database.

GIS Analyst Christopher D. Clifton uploaded all the GPS data into ArcGIS. Each time that new GPS data were entered, the data source needed to be repaired and a new version created before mapping and editing in ArcMap. This process is shown in Figure 12.





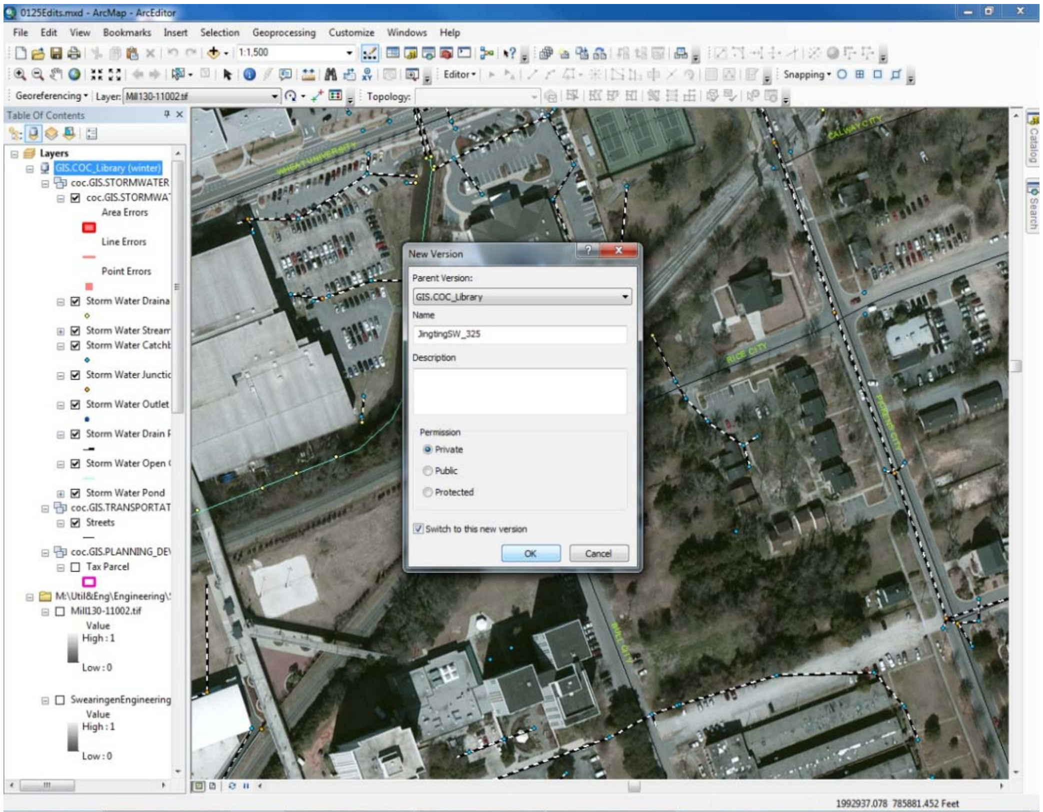


Figure 12: Data Source Repair and New Version Creation

Appendix C: Georeference Plan Drawings

Add the Plan Drawinginto ArcMap

To georeference a plan drawing, firstly, it was added into the “Table of Contents” in ArcMap. Using Naval and Marine Corps Reserve Center as an example, a dialog box on pyramids and a reminder of “Unknown Spatial Reference” show up sequentially after the drawing is pasted (Figure 13). Click “Yes” and “OK” button to add the drawing into ArcMap.

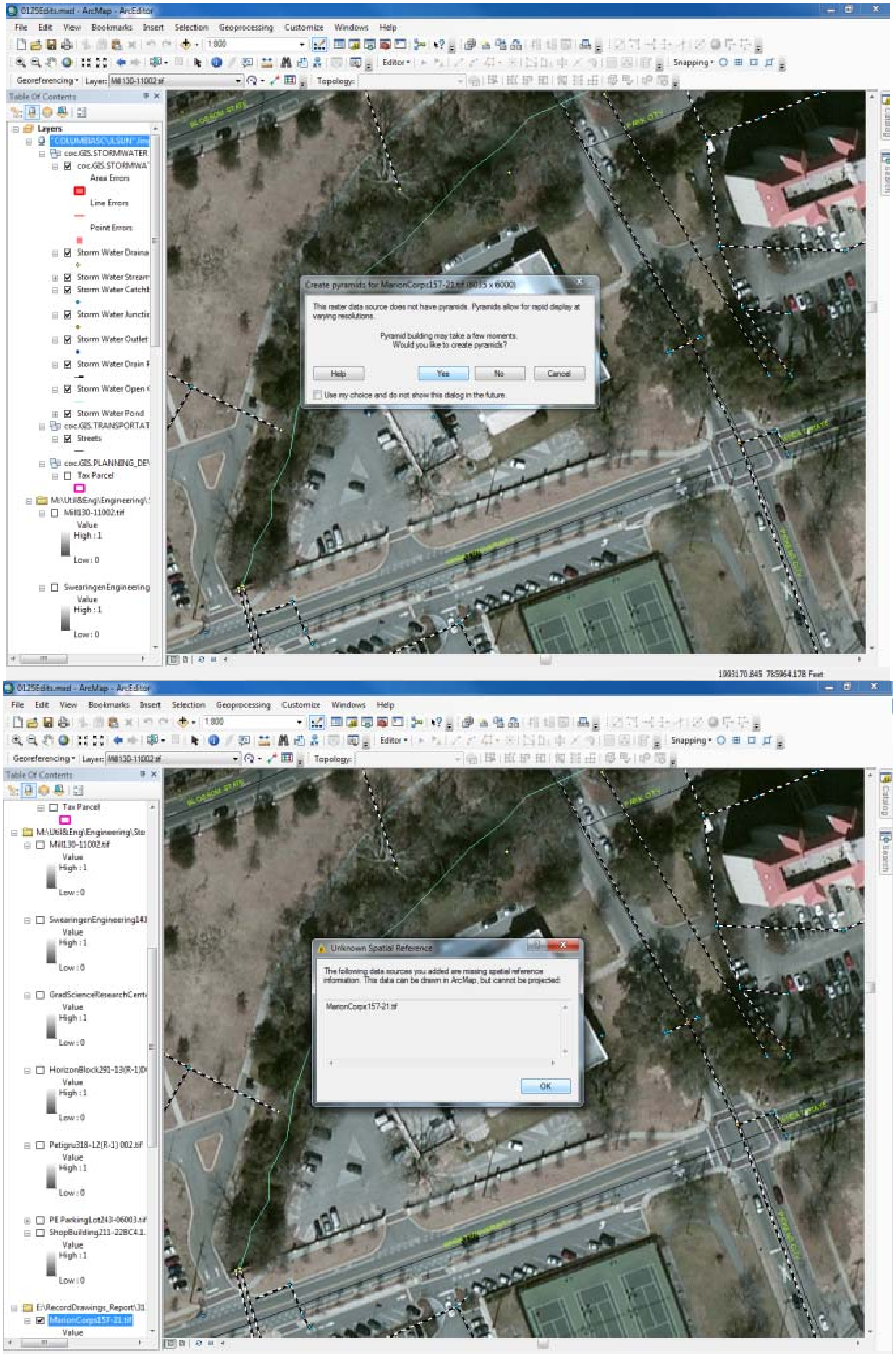


Figure 13: Add the plan drawing into ArcMap

Fit to Display

Before the next step, make sure the “Layer” next to “Georeferencing” shows the coordinate drawing. Click “Fit to Display” in the pull-down menu under “Georeferencing”. The drawing will appear in the page. Change the transparency to 30% under the “Layer Properties” to avoid the GIS layers being blocked by the drawing.

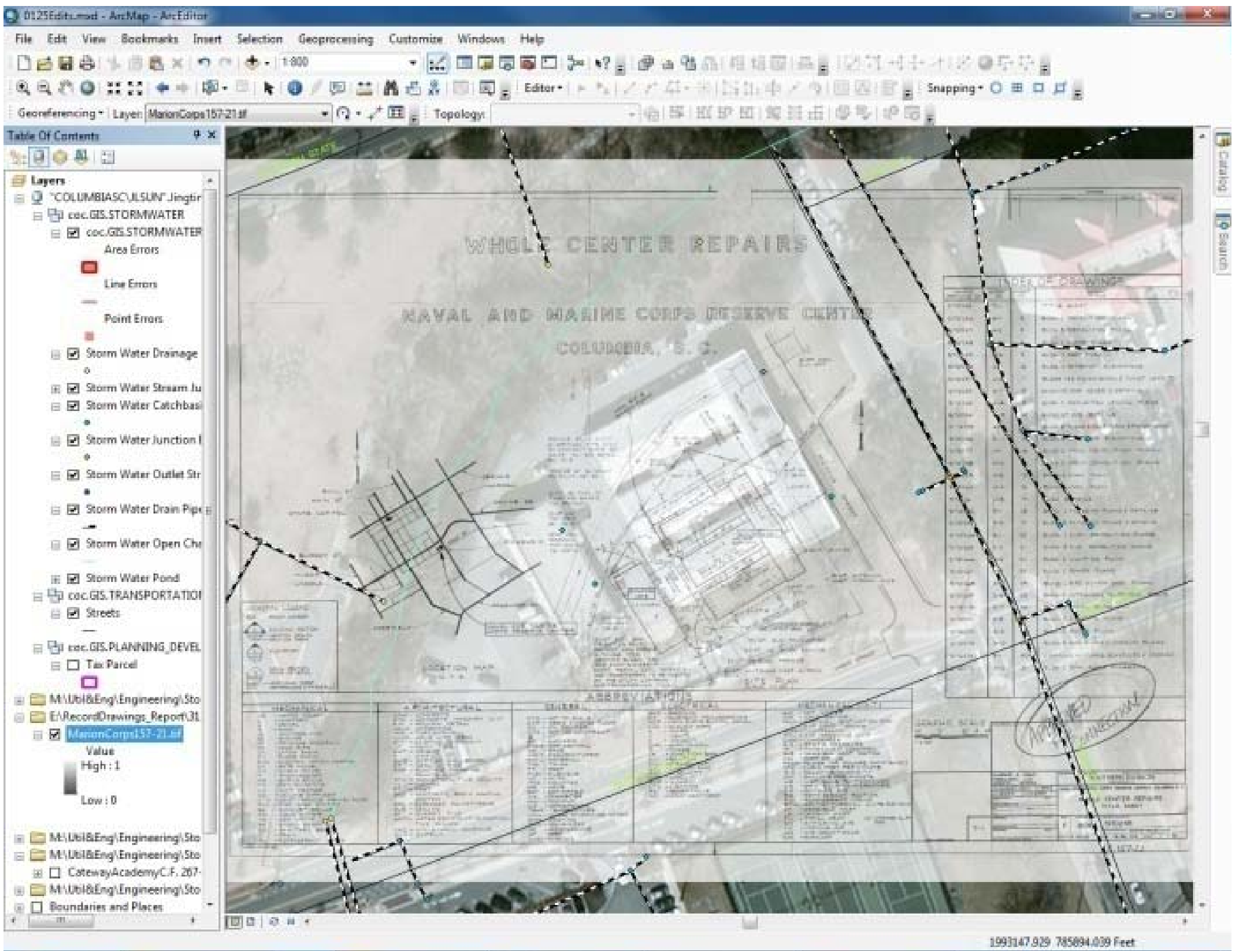


Figure 14: Fit to Display

Add Control Points

Select and review the points collected by GPS can compare the plan drawing with the GIS data to determine the ground control points (GCPs). After added the control points, the plan drawing will match the imagery pretty well (Figure 15).

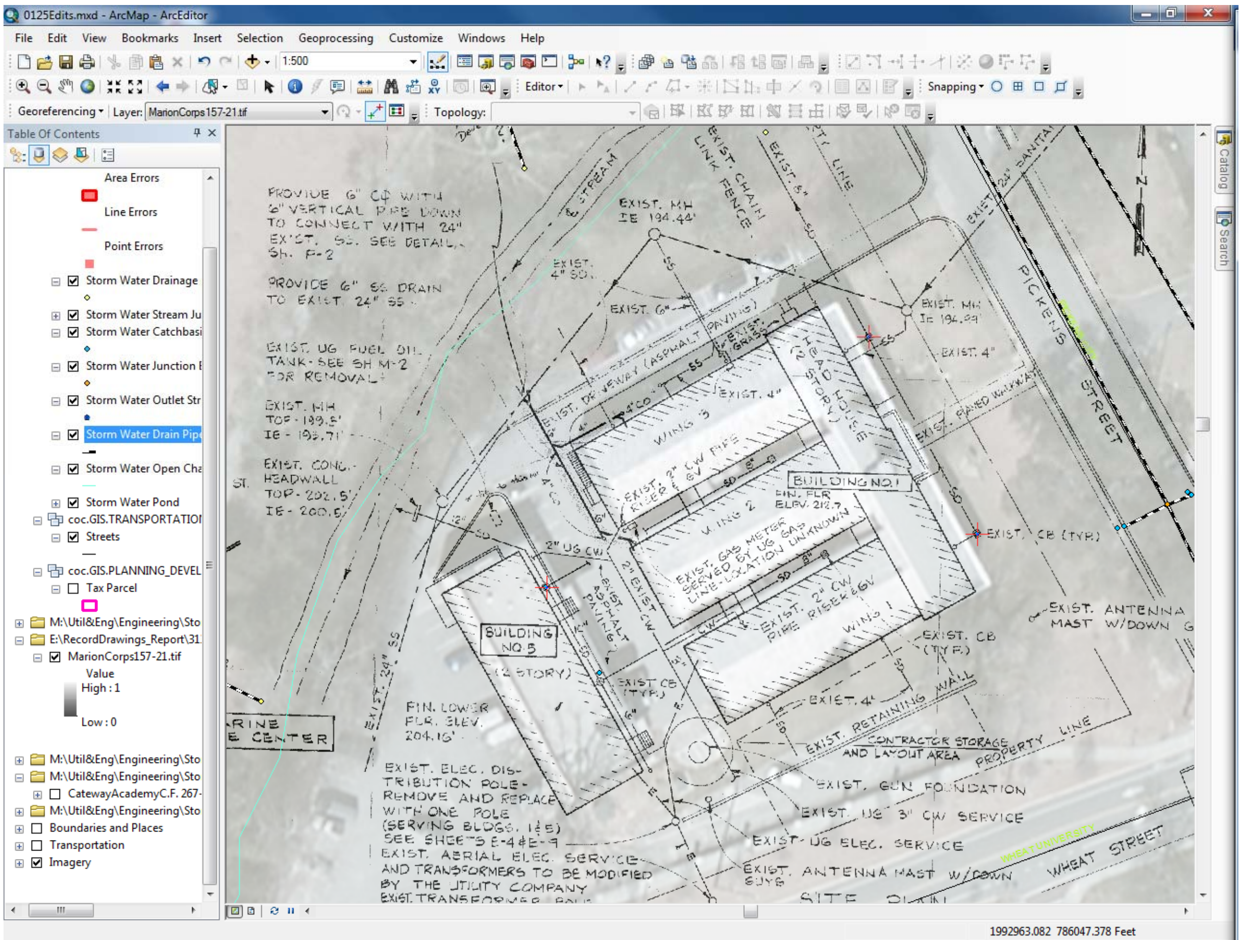


Figure 15: Georeference Result (Marine Corp example)

The example above is the simplest one. Most other plan drawings have more complex stormwater features. However, no matter how much stormwater information is contained, three or four control points are usually enough to stick the plan drawing to the data.

Appendix D: Stormwater Database Editing

Start Editing and Snapping

Click “Start Editing” under “Editor” toolbar. First, beforeediting, set the snapping environment; i.e., the distance between points or features below which they are joined together. Point to “Snapping” in the editor menu and click “Options”. Under the General tab, check “Use classic snapping”. Then open “Snapping Window” and when “Snapping Environment” appears, check vertex, edge, and end boxes for the stormwater layers as shown in Figure 16.

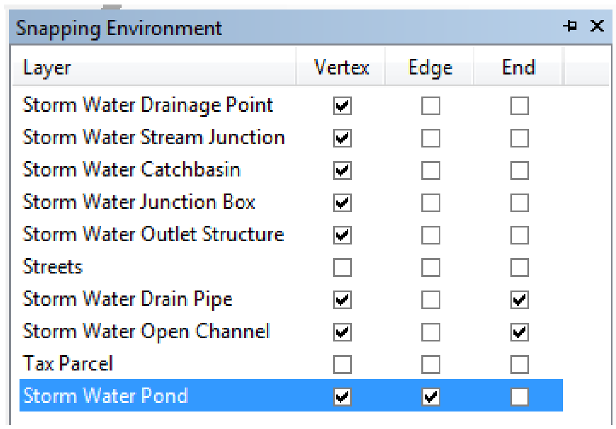


Figure 16: Snapping Environment on Stormwater features

Edit Stormwater Database

Open the attribute table of Catch Basin, Junction Box, Drainage point and Drain Pipe. Use plan drawings and comments as references to add stormwater points and pipes. The subitems under some other critical attributes are listed in Table 3.

Table 3: List of Critical Drain Pipe Attributes

Attribute	Datasource	Ownership	Lifecycle Status	Pipe Material
Subitem	GPS	City	Active	Reinforced Concrete
	Survey	State	Inactive	PVC
	COGO	County	Removed	HDPE
	Imagery	Private	Demolished	Corrugated Metal
	Asbuilt-Digital	Federal	Abandoned	Terra Cotta
	Asbuilt-Georeference	University	Field Verification	Corrugated Aluminum
	Legacy CAD		Proposed	Corrugated Plastic
				Asbestos Concrete
				Orangeburg
				Metal-General
				Plastic-General
				PVC