BROOKER CREEK WATERSHED EVALUATION

Prepared for:

Southwest Florida Water Management District &

Pinellas County

Prepared by:

URS Corporation

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Tampa, Florida 33607-1462

September 26, 2006

WATERSHED EVALUATION
TABLE OF CONTENTS

Page

WATERSHED EVALUATION
TABLE OF CONTENTS

Page

WATERSHED EVALUATION
TABLE OF CONTENTS

TABLES

Page

FIGURES

Page

APPENDIX A: LARGE MAPS

Referred Text Section

BROOKER CREEK WATERSHED (L068)
WATERSHED EVALUATION

EXECUTIVE SUMMARY

The Southwest Florida Water Management District (SWFWMD) in cooperation with Pinellas County contracted the URS Team to develop *Digital Topographic Information* and a *Watershed Evaluation* in preparation of a basin- wide stormwater study of the Brooker Creek Watershed. The purpose of this report is to describe the information collected for the development of the Digital Topographic Information and Watershed Evaluation performed under Work Order 2 of this contract.

The Brooker Creek watershed occupies approximately 39 square miles in the northwest portion of Hillsborough County and the northeastern portion of Pinellas County, Florida. The watershed contains 37 named lakes, multiple wetlands and Brooker Creek, which is the primary tributary to Lake Tarpon. The land surface elevation decreases dramatically near the Pinellas–Hillsborough County line, and the morphology of the area changes from a lake-dominated landscape in Hillsborough County to an upland forest and wetland-dominated landscape in Pinellas County.

Several tasks were performed as part of this contract. These include (1) digital terrain model (DTM) development (2) Hydrologic Feature Inventory (3) Hydraulic Feature Inventory (4) Field Reconnaissance (5) Identification of Surveys to be Performed (6) Preliminary Junction/Reach Development and (7) Surface Water Assessment.

The digital terrain model was developed in the form of a TIN – Triangulated Irregular Network. URS used multiple data sources since the Brooker Creek Watershed spans 3 Counties (Pasco, Hillsborough, and Pinellas). The Southwest Florida Water Management District (SWFWMD) provided URS Corporation with 2004 LiDAR data for Pasco County and the 1999-2000 data for Pinellas County. The Pasco County LiDAR data was created by Earth Data International and evaluated by Watershed Concepts in September 2004. The Pinellas County Data was flown in May 1999 and September 2000 and was filtered by USF. The 2002 Hillsborough County data was provided in 1ft Contour data and was developed in a joint effort between the City of Tampa and SWFWMD.

The development of the Hydrologic Inventory followed Southwest Florida Water Management District Guidelines and Specifications. Subbasins were delineated using a Raster image created from the TIN produced in the previous exercise. The raster image was created from the TIN using a 10 foot pixel base. Preliminary statistics reveal one hundred ninety-three (193) subbasins within the 10,831-acre Brooker Creek Watershed, with the minimum basin size of 7.2 acres and a maximum basin size of over 744 acres.

The Hydraulic Feature Inventory development process started with the development of the digital terrain model. A preliminary hydraulic network was created based on the topography. This network was compared to aerials during which points for field reconnaissance efforts were identified. Field reconnaissance was performed by Water Resource Associates (WRA).

A total of approximately 110 locations were visited during the field reconnaissance. Many of these locations were excluded in the hydraulic features inventory because it was determined that they either did not discharge to the Brooker Creek Watershed or they drained small areas. The data for the conveyance features was collected based on the field reconnaissance effort and the hydraulic feature inventory. The data collected was developed into database tables according to the G&S requirements and are included in the Brooker Creek Geodatabase along with the Conveyance Inventory feature class.

The URS project team has conducted data collection within the Brooker Creek watershed. Approximately 182 structures and other features were identified and inventoried by the URS project team. Of the approximately 182 features inventoried, approximately 36 hydraulic features require the collection of additional survey information within Pinellas County. The total estimated field survey cost is $56,400.

A preliminary junction / reach coverage for the Pinellas County portion of the Brooker Creek Watershed was developed by URS Corporation in the form of line (Network_arcs) and point (Network_nodes) feature classes. The preliminary network consists of a group of nodes connected by a series of reaches to represent the movement of water within the watershed. Flow directions are assumed based on the digital elevation model. Additionally, historical flow directions where used where these are known.

Development of the Surface Water Assesment Inventory includes the establishment of the methodology to model pollutant loads and the selection of the hydrologic-hydraulic model to be used for the Brooker Creek Watershed. Pollutant loads for selected pollutants (chemicals, parameters) will be estimated using the SWFWMD supplied spreadsheet model. Pollutants considered may include the following parameters: BOD, TSS, oil/grease, TN, Nox, TKN, TP, TDP, Cd, Cu, Pb, and Zn.

Model selection includes an evaluation of the benefit of using a surface water model or an integrated surface/groundwater model for the Brooker Creek Watershed. Hillsborough County is finalizing the update of the Brooker Creek SWMM surface water model for areas of the Brooker Creek Watershed within Hillsborough County. This update is generally being completed to meet the current SWFWMD Guidelines and Specifications for Watershed Management Programs. URS has developed the preliminary model input information (basin areas, junction-reach data, hydraulic inventory, etc.) for the Pinellas County portion of the Brooker Creek watershed that could be easily input to a SWMM model. The Hillsborough County SWMM model could then be linked to the Pinellas County SWMM model to provide an overall Brooker Creek Watershed surface water model. This linked surface water model would allow the evaluation of modifications to the surface water drainage system within and adjacent to the Brooker Creek Preserve and also allow for evaluations of future development changes on flooding conditions within the Preserve and the watershed. The SWMM model could also evaluate future water quality considerations related to NPDES or TMDL requirements. However, the SWMM model would **not** be able to easily evaluate the impacts of adjacent wellfields on groundwater conditions in the Brooker Creek Preserve area.

Based upon the model information currently available, the data requirements and the ease of use of the model, URS recommends that the Hillsborough County Brooker Creek SWMM model be modified and utilized to evaluate potential hydrologic modifications in the Pinellas County Brooker Creek Preserve and watershed.

1.0 INTRODUCTION

The Southwest Florida Water Management District (SWFWMD) in cooperation with Pinellas County contracted the URS Team to develop a Watershed Evaluation in preparation of a basin- wide stormwater study of the Brooker Creek Watershed. This report summarizes the data that was collected as well as describes the sources of this data.

Southwest Florida Water Management Districts Watershed Management Program Guidelines and Specifications, hereafter referred to as the G&S, state that there are five major elements that make up a Watershed Management Program: (1) Digital Topographic Information, (2) Watershed Evaluation, (3) Watershed Management Plan, (4) Implementation of Best Management Plans, and (5) Database Maintenance and Watershed Model Updates. This report focuses on the first and second elements, Digital Topographic Information and Watershed Evaluation.

1.1 Authorization

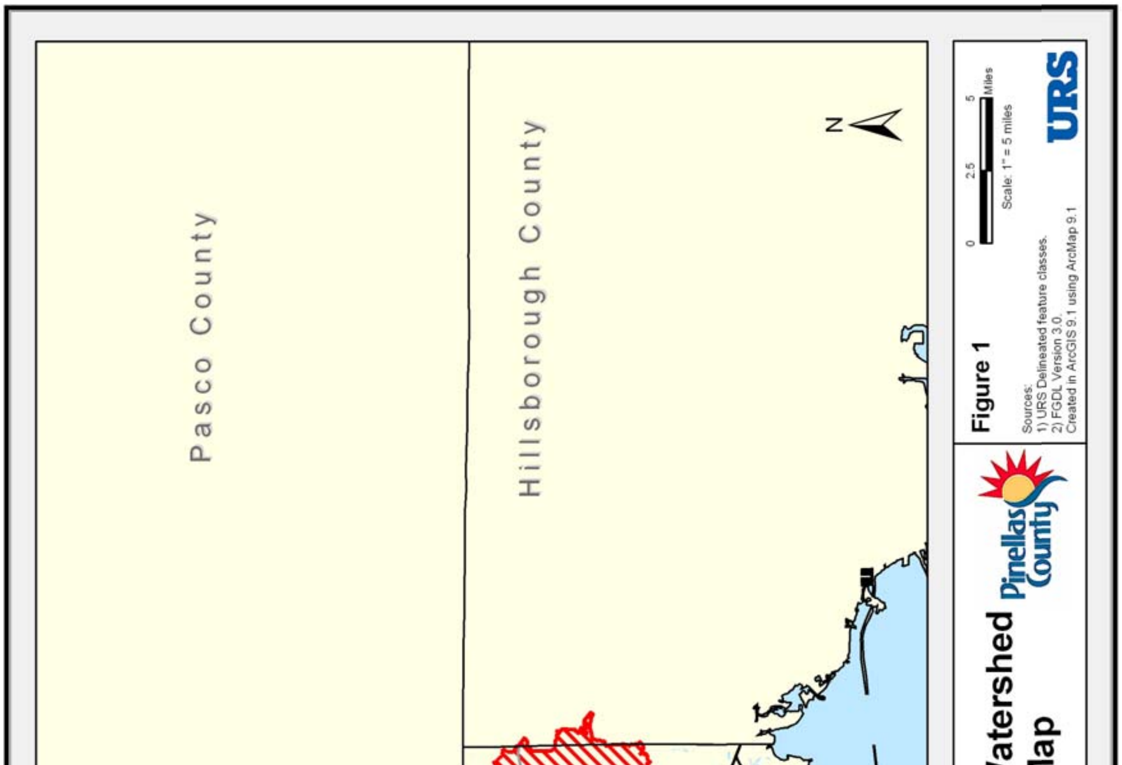
URS Corporation Southern has been contracted by the Southwest Florida Water Management District to complete elements of a Watershed Management Program for the Brooker Creek Watershed (L068) in Hillsborough and Pinellas Counties. Tasks conducted under this Work Order are per Agreement No. 04CONC00006.

1.2 Project Location and General Description

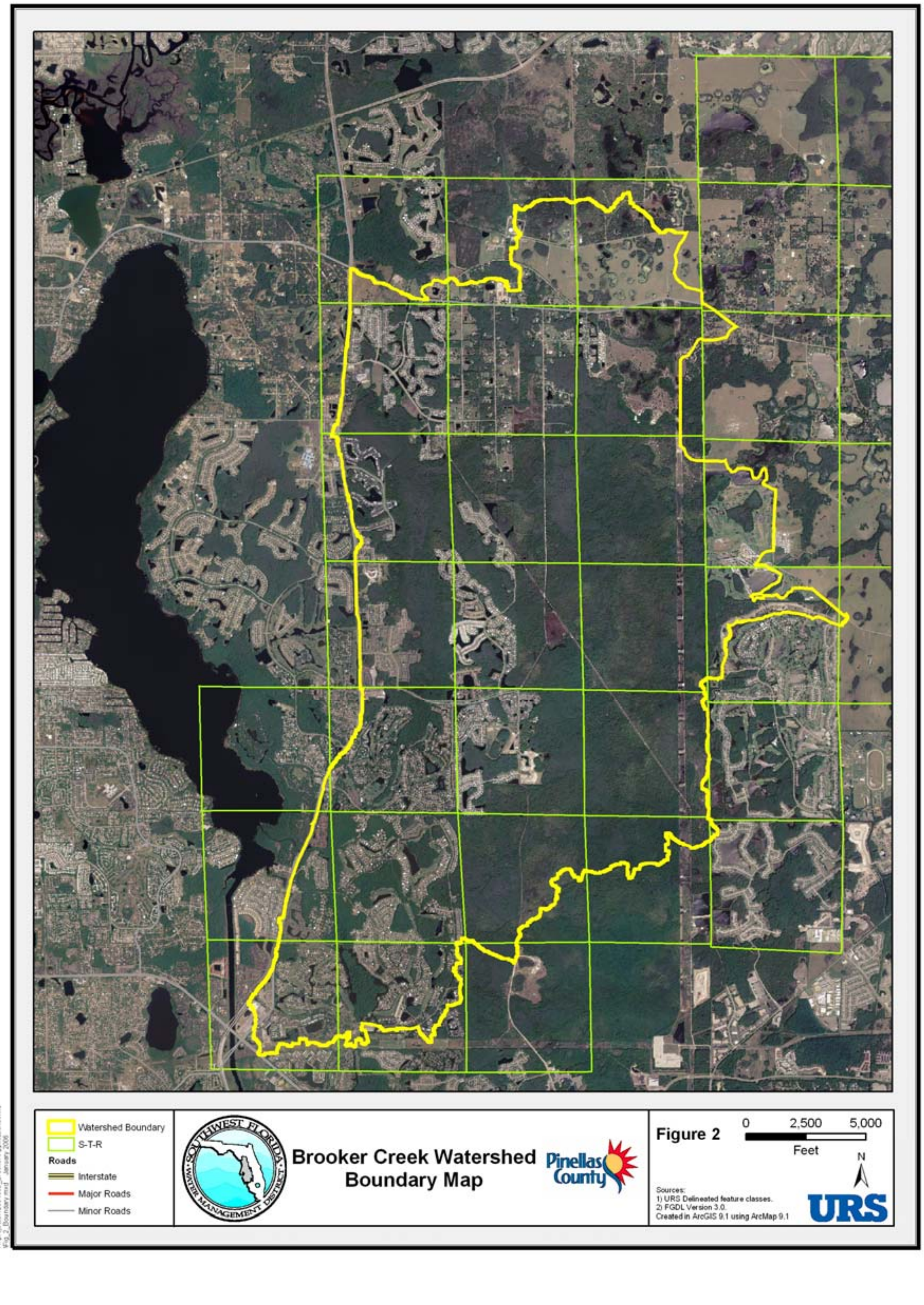
The Brooker Creek Watershed extends across northeastern Pinellas County and northwestern Hillsborough County, just south of the Pasco County line. The watershed is approximately bordered on the west by East Lake Road, on the north by Tarpon Springs Road and Gunn Highway, on the east by the Veteran's Expressway and Gunn Highway, and on the south by Racetrack Road, as indicated in Figure 1. The watershed is primarily urban and comprises approximately 39 square miles, and the ultimate discharge point for the watershed is Lake Tarpon. The portion of the watershed located within Hillsborough County was the subject of a Stormwater Management Plan prepared by Advance Engineering in 2001 and currently being updated by Post, Buckley, Schuh and Jernigan, Inc. (PBS&J). The current PBS&J study includes updating of a Stormwater Management Model (SWMM) model of the Hillsborough County portion of the Brooker Creek watershed. To date, no comprehensive study of the Pinellas County portion of the Brooker Creek watershed has been completed.

1.3 Purpose and Objectives

The purpose of this report is to describe the information collected for the development of the Digital Topographic Information and Watershed Evaluation performed under Work Order 2 of this contract. Several tasks were performed as part of this contract. These include (1) digital terrain model (DTM) development (2) Hydrologic Feature Inventory (3) Hydraulic Feature Inventory (4) Field Reconnaissance (5) Identification of Surveys to be Performed (6) Preliminary Junction/Reach Development and (7) Surface Water Assessment.



Pasco County
Hillsborough County
Pinellas County
N
Interstate
U.S. and State Roads
Other Major Roads
Watershed
Hydrography
County Boundaries
Brooker Creek Watershed
Location Map
Figure 1
Sources:
1) URS Delineated feature classes.
2) FGDL Version 3.0.
Created in ArcGIS 9.1 using ArcMap 9.1
0
2.5
5
Miles
Scale: 1" = 5 miles


Watershed Boundary
S-T-R
Roads
Interstate
Major Roads
Minor Roads
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
Brooker Creek Watershed
Boundary Map
Pinellas County
Figure 2
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2,500
5,000
Feet
N
Sources:
1) URS Delineated feature classes.
2) FGDL Version 3.0.
Created in ArcGIS 9.1 using ArcMap 9.1
URS

2.0 WATERSHED INVENTORY

The generation of the watershed inventory requires obtaining information from numerous sources. In general the information obtained can be classified into three categories, (1) digital terrain model (DTM) development, (2) hydrologic information, and (3) hydraulic information. The first category, DTM, includes all the information needed to generate a DTM such as contour information, additional topography and aerial photography. Hydrology contains information that is required to convert rainfall into runoff. This would include land use, soils, basin delineations, and curve numbers. The hydraulic information is required to adequately model the movement of runoff through the watershed. This would include culvert location, size, material, and condition; overland flow location, and characterization; channel location, size, type, and roughness estimations; location of bridges and associated information; and interconnectivity of all hydraulic features.

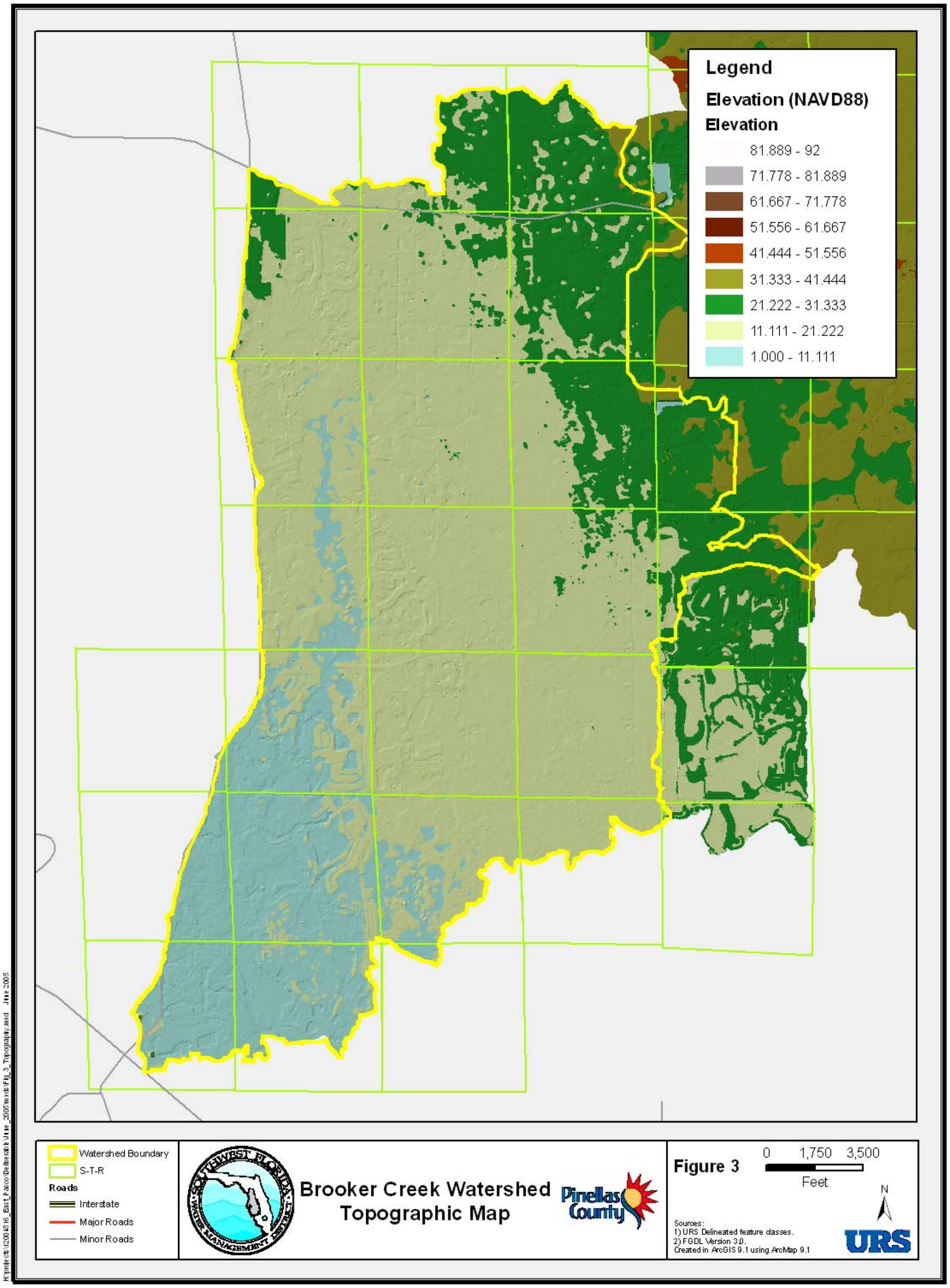
2.1 Characterization of the Watershed and Subwatersheds

The Brooker Creek watershed occupies approximately 39 square miles in the northwest portion of Hillsborough County and the northeastern portion of Pinellas County, Florida. The elevation of the land surface across the watershed ranges from approximately 70 feet NGVD in the northeastern portion of the area near the Suncoast Parkway to approximately of 3 feet NGVD at the Brooker Creek outfall to Lake Tarpon. The land surface elevation decreases dramatically near the Pinellas–Hillsborough County line, as the physical character of the area changes from a lake-dominated landscape in Hillsborough County to an upland forest and wetland-dominated landscape in Pinellas County. The landscape in the Hillsborough County portion of the watershed is generally gently rolling to level with numerous lakes and smaller surface water bodies that are surrounded by residential development and small commercial areas. The portion of the watershed situated in Pinellas County is flat and wooded, with large areas of wetlands in the eastern one-half and large residential and commercial development in the western one-half.

2.2 Digital Terrain Model Development

The digital terrain model was developed in the form of a TIN – Triangulated Irregular Network. A TIN is, essentially, an assemblage of contiguous triangles. Each triangle face has a specific elevation, slope, and aspect. Any one of these surface characteristics can be displayed in a TIN. TINs are usually created from a combination of vector data sources, including points, lines, and polygons (See Figure 3: Topographic Map).

Using ESRI GIS software, TINs can be created with the ArcGIS 3D Analyst extension or by using TIN commands at the ArcInfo workstation command prompt. For ease of use, URS elected to use the 3D Analyst extension for TIN creation. ArcInfo workstation was used to assemble the data provided for Pasco County, but the final TIN creation was conducted in ArcGIS 3D Analyst.


Legend
Elevation (NAVD88)
Elevation
81.889 - 92
71.778 - 81.889
61.667 - 71.778
51.556 - 61.667
41.444 - 51.556
31.333 - 41.444
21.222 - 31.333
11.111 - 21.222
1.000 - 11.111
Watershed Boundary
S-T-R
Roads
Interstate
Major Roads
Minor Roads
Brooker Creek Watershed
Topographic Map
Figure 3
0 1,750 3,500
Feet
N
Sources:
1) URS Delineated feature classes.
2) FGDL Version 3.0.
Created in ArcGIS 9.1 using ArcMap 9.1

2.2.1 Data Sources

URS used multiple data sources since the Brooker Creek Watershed spans 3 Counties (Pasco, Hillsborough, and Pinellas). The Southwest Florida Water Management District (SWFWMD) provided URS Corporation with 2004 LiDAR data for Pasco County and the 1999-2000 data for Pinellas County. The Pasco County LiDAR data was created by Earth Data International and evaluated by Watershed Concepts in September 2004. The Pinellas County Data was flown in May 1999 and September 2000 and was filtered by USF. The Hillsborough County data was provided in 1ft Contour data and was developed in a joint effort between the City of Tampa and SWFWMD. The Hillsborough County data is from 2002.

The LiDAR data for Brooker Creek was provided in ArcInfo generate format, as pol, pnt and lin files (polygons, points and lines). The files were named by section–township–range (STR) and included a suffix after the name.

Examples:
012416ca.lin
012416sp.pnt
012416v.pnt
012416v.pol
012416w.pol

It was determined that the 'w' is for water and the 'sp' is for spot elevations.

The Hillsborough County data was provided in ArcGIS polylineZ Shapefile format.
Other data sources used for reference include 1980 and 1985 aerial topographic paper maps and 2004 digital aerial photography in tif format.

2.2.2 Conversion to North American Vertical Datum of 1988

The LIDAR and contour data is already in the NAVD88 vertical datum, therefore no conversion is necessary.

2.2.3 Creation of TINs

The Pinellas and Pasco County datasets were delivered in an archaic export format from the ArcInfo command line. These datasets required AML programs to provide the useable TINs for each STR. The AMLs use the "createtin" ArcInfo command and the "generate" ArcInfo command to reconstruct the TINs from the raw data files. The AML defines the projection system as:

Projection STATEPLANE
Zone 3626
Datum HPGN
Units FEET
Spheroid GRS1980

The AMLs were run on both the Pasco and Pinellas County data, producing 2 separate TINs. The Hillsborough County Contour data was used to create a Hillsborough County TIN using ArcGIS 3D Analyst. Once all three TINs were created they were combined into an area wide TIN using ArcGIS 3D analyst that covered all of the Brooker Creek area plus distances around the watershed depending on the outside limits of the STR boxes that were used in Pinellas and Pasco counties.

This completed TIN still needed to be revised for the lake levels, since it has been our experience that the LiDAR data provided to us has been over exaggerating the elevations for water features. URS' remedy to this has been to use a lake polygon layer that is then attributed with the NAVD88 elevation for the lake. These have been found on the 1980 and 1985 topographic paper aerial maps. Once all of the lakes were attributed correctly they were used in a final TIN creation process, using the lake polygon layer as a Hard Replace item in the TIN creation process. This literally means that for the entire extent of the polygon that is designated as a lake the software will use the single NAVD88 elevation for the lake surface. This is easily reviewed on the screen because it creates a tabling effect in the TIN.

The TIN gets one last processing feature when it is clipped to the boundary of the watershed. After the TIN gets clipped a DTMSpot and DTMHardbreak file was created and added into the geodatabase. Geodatabases are currently incapable of containing TINs in their native format so the DTMSpot and DTMHardbreak files are created so that the essence of the final TIN is contained within the geodatabase.

2.2.4 Topographic Voids

Topographic voids represent areas where the available topographic information does not represent the current topography. The LiDAR data for Pasco County was flown in 2004, while the Pinellas County data was flown in 1999-2000. These are both the most recent and technologically advanced datasets for both counties and therefore should closely represent the current topography.

Pinellas County used SURFER Ver. 7 to filter the LiDAR points. They were filtered for the removal of buildings and vegetation then thinned to a spacing of 1 point per 7 foot cell size.
The Hillsborough County data was produced in 2002 and should be considered just as relevant as the LiDAR data. Until LIDAR is widely available and QA/QC'd appropriately for Hillsborough County the contour data is the most complete and accurate available. No topographic voids have been identified.

2.2.5 QA/AC Process Description

QA/QC is performed throughout the watershed evaluation exercise. Routine GIS checks are performed to ensure no gross errors have occurred. These checks include the following:

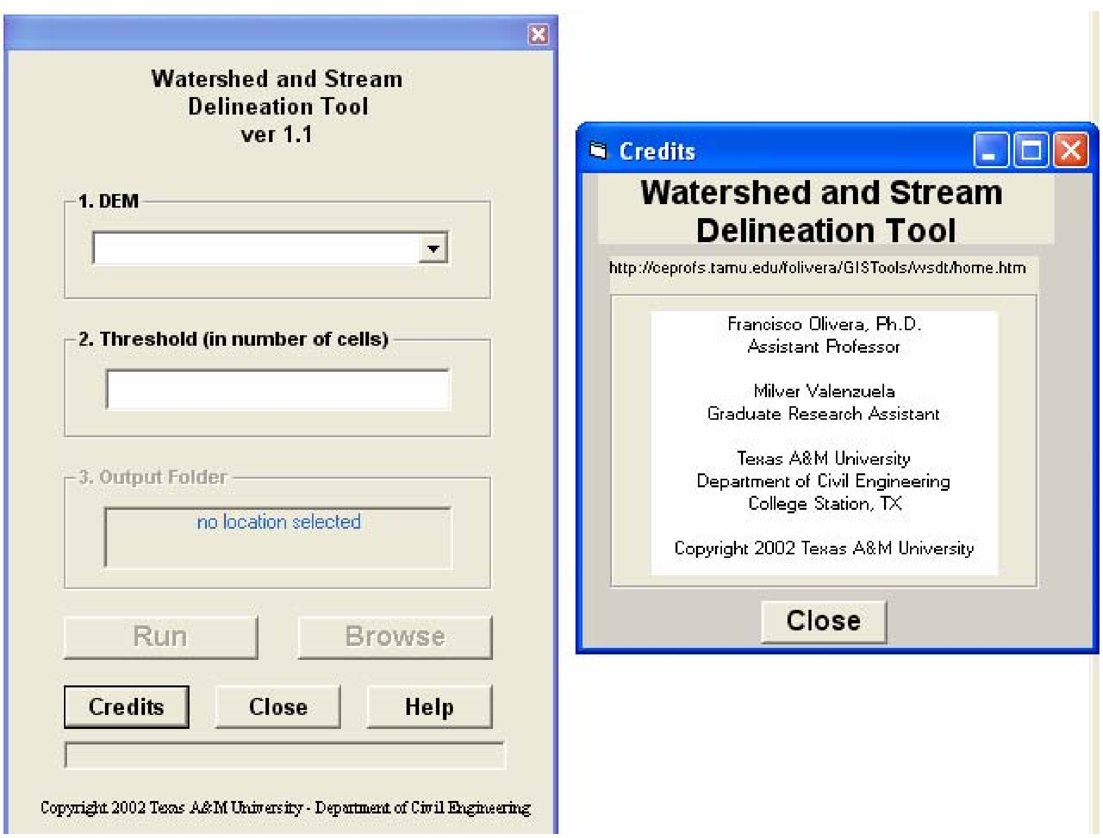
The water surface elevations assigned to the hardbreak (water bodies) shapefile were checked against the elevations shown on the 1980 and 1985 aerial topographic paper maps to ensure they are reasonable. As well, the water body boundaries were compared to the 2004 aerial photography to check for accuracy. Any missing water bodies were digitized and attributed using the 2004 aerial photography and aerial topographic paper maps.

2.3 Hydrologic Inventory

The most basic hydrologic information was provided by SWFWMD in the form of GIS coverages and shape-files; i.e., contour information and LiDAR data. From these, a DTM was developed that would; in conjunction with soils, land use, and basin delineations, aid in the development of other hydrologic information such as flow lengths, curve numbers, lag time, etc. This section summarizes the efforts required to characterize and catalog hydrologic information.

2.3.1 Sub-basin Delineation Process

Subbasins were delineated using a Raster image created from the TIN produced in the previous exercise. The raster image was created from the TIN using a 10 foot pixel base. This created a coverage of 100 SqFt per pixel. *See attached screen capture for tool inputs and creation credits.*
The “GRID” was used as an input in the Watershed and Stream Delineation Tool created by the Texas A&M University Civil Engineering Dept.



URS used 10,000 Cells as the minimum threshold for basin delineation. In this process the tool tries to create basins with the minimum threshold designated. URS used this tool as an initial basin creation in order to produce an approximate basin coverage. Using aerial photos, topography, and existing surface hydrology inputs, the basins were finalized and incorporated into the project geodatabase.

2.3.2 Characterization of Subwatersheds

Preliminary statistics reveal one hundred ninety-three (182) subbasins within the 10,831-acre Brooker Creek Watershed, with the minimum basin size of 7.2 acres and a maximum basin size of over 744 acres. Mean basin size is 60 acres. The smaller subbasins are mainly located in the pockets of urban developments encountered throughout the watershed.

2.3.3 Subwatershed Sizes

Table 1: Brooker Creek Watershed Summary Statistics of Subbasin Sizes by Tributary

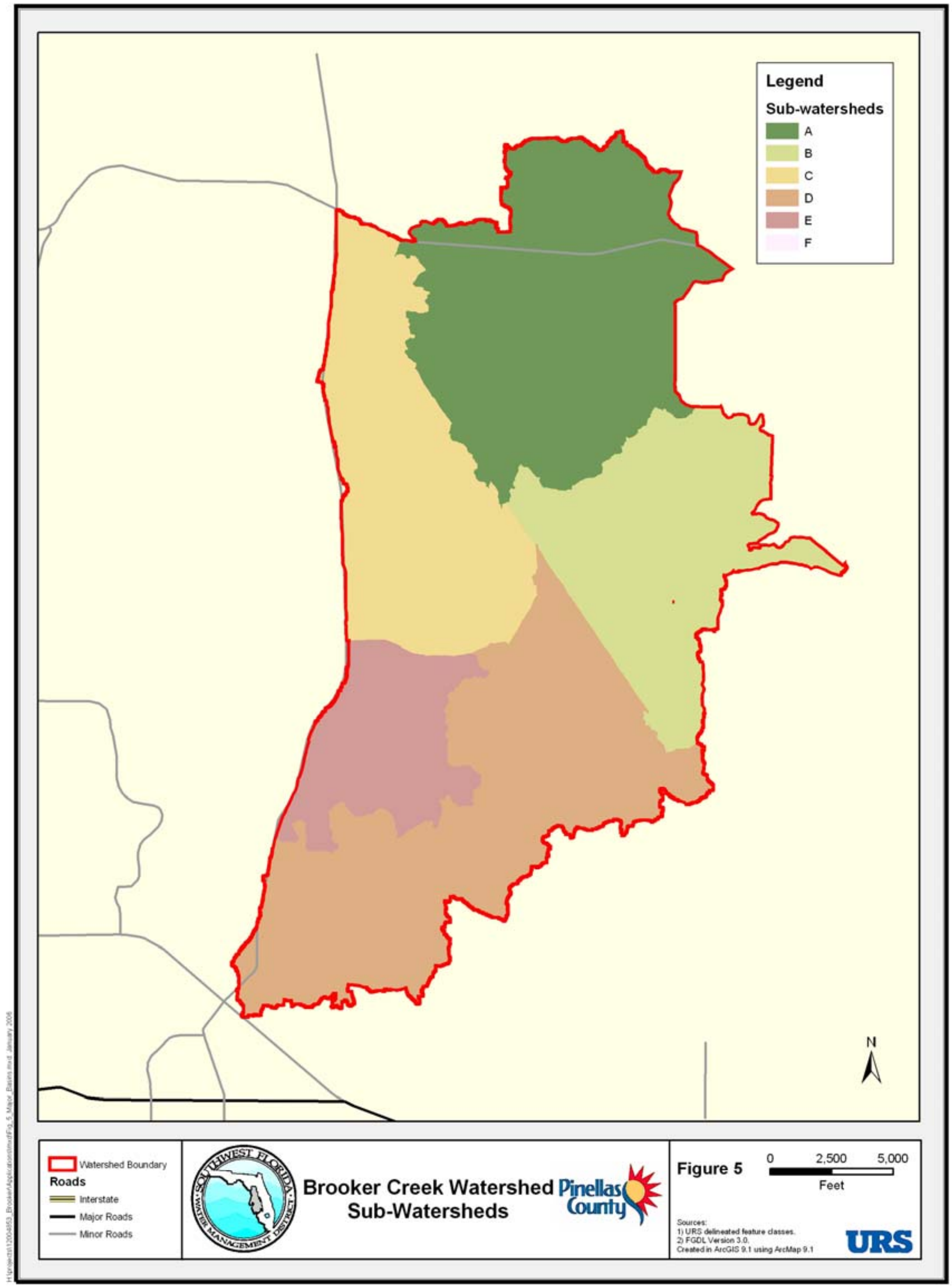
Sub-Watershed	Subbasin Count	Total Area (acres)
A	49	2856.3
B	23	1909.8
C	35	2074.4
D	55	3026.6
E	20	964.1
Totals	182	10831.2

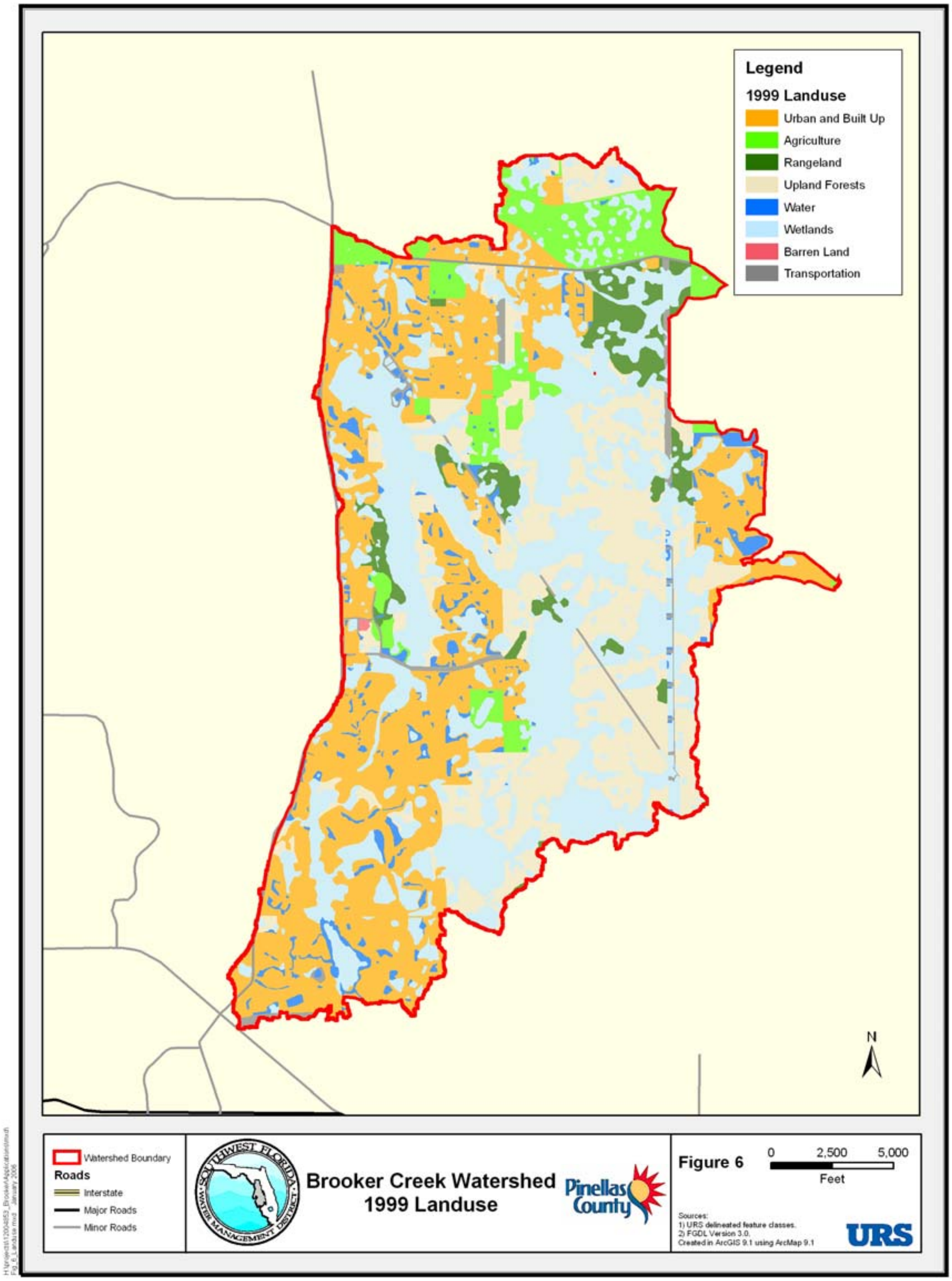
2.3.4 Subwatershed Land Use Characterization

The Brooker Creek Watershed primary land use classifications are wetlands and urban areas. This is evident in the Table 3, which shows that subwatersheds A, C, D, and E contain the bulk of urban areas. Land use information within the Brooker Creek watershed is presented graphically as Figure 6.

Table 2: Brooker Creek Watershed Summary Statistics of Land Use by Subwatershed

Land Use by Sub-Watersheds (Acres)						
Type	**A**	**B**	**C**	**D**	**E**	**Total**
Agriculture	549.1	17.4	98.0	59.2	1.2	724.8
Barren Land	--------	--------	4.5	--------	--------	4.5
Rangeland	234.2	73.5	67.4	34.0	--------	409.2
Transp., Comm. and Utilities	47.8	33.2	81.4	52.2	16.1	230.6
Upland Forests	434.1	715.5	222.4	704.5	61.5	2138.1
Urban and Built Up	607.0	288.5	735.7	983.8	592.7	3207.7
Water	43.8	67.7	117.1	119.3	48.6	396.6
Wetlands	940.2	714.0	747.9	1148.6	169.0	3719.8
Total	2856.2	1909.8	2074.5	3101.5	889.1	10831.2


Legend
Sub-watersheds
A
B
C
D
E
F
N
Watershed Boundary
Roads
Interstate
Major Roads
Minor Roads
Brooker Creek Watershed
Sub-Watersheds
Pinellas County
Figure 5
0
2,500
5,000
Feet
Sources:
1) URS delineated feature classes.
2) FGDL Version 3.0.
Created in ArcGIS 9.1 using ArcMap 9.1
URS


Legend
1999 Landuse
Urban and Built Up
Agriculture
Rangeland
Upland Forests
Water
Wetlands
Barren Land
Transportation
N
Watershed Boundary
Roads
Interstate
Major Roads
Minor Roads
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
Brooker Creek Watershed
1999 Landuse
Pinellas County
Figure 6
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5,000
Feet
Sources:
1) URS delineated feature classes.
2) FGDL Version 3.0.
Created in ArcGIS 9.1 using ArcMap 9.1
URS

2.3.5 Subwatershed Soil Characterization

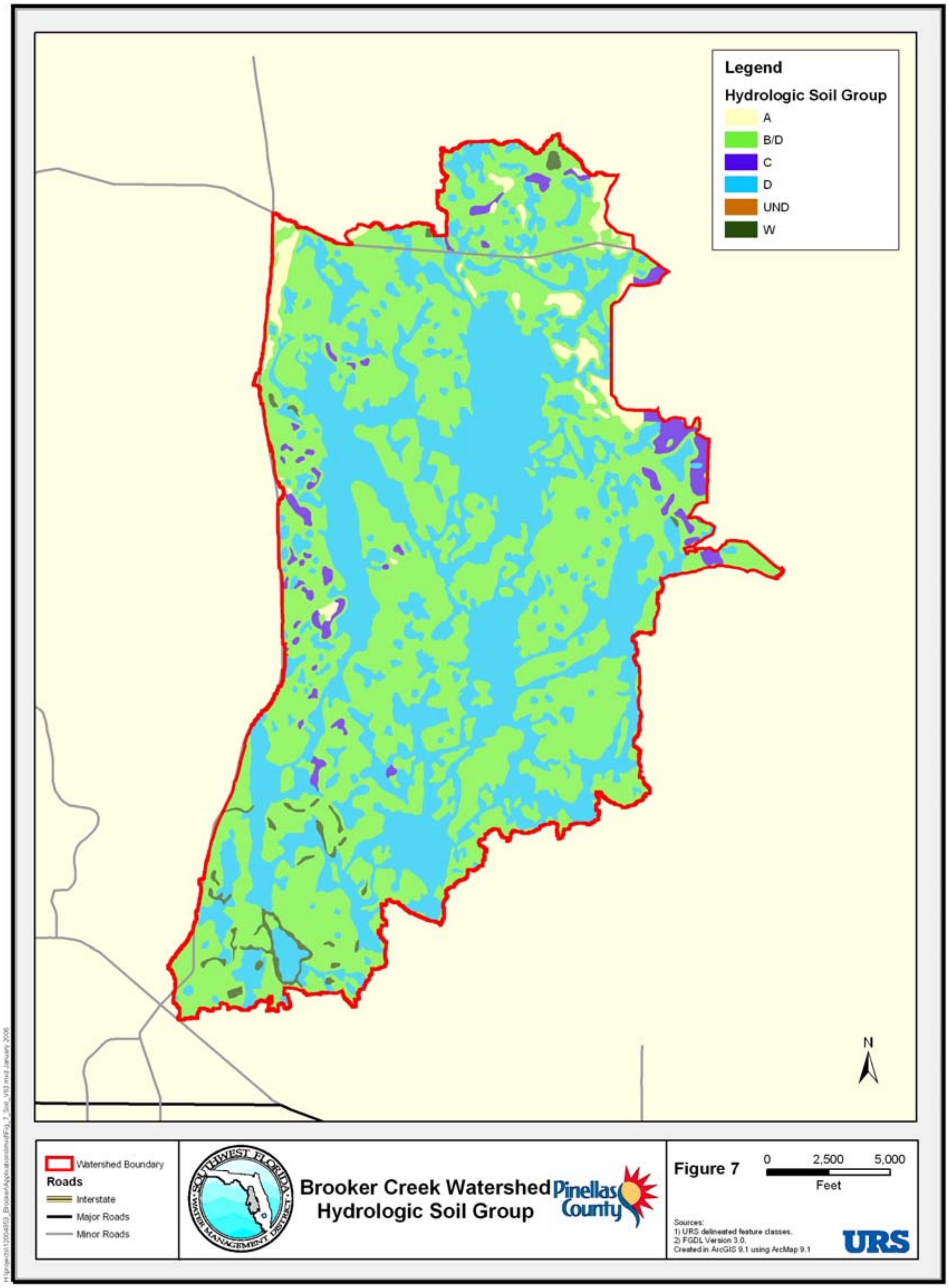
Table 3: Brooker Creek Watershed Summary Statistic of Soils Information by Tributary

Hydrologic Soil Group Areas by Subwatershed (Acres)					
Group	**A**	**B**	**C**	**D**	**E**
A	167.8	12.5	81.0	0.0	0.0
B/D	1412.0	1084.2	1143.0	1675.5	600.3
C	45.5	105.7	68.2	1.0	21.9
D	1219.9	705.7	777.2	1277.2	331.7
W	11.2	1.7	5.0	72.9	10.2
Total	2856.3	1909.8	2074.4	3026.6	964.1

2.3.6 Subwatershed Hydrologic Parameterization

The Soil Conservation Service (SCS) Runoff Curve Number method will be used to compute rainfall excess values. Runoff Curve number calculations will be based on a GIS intersection of the SWFWMD land use coverage with the SWFWMD soil coverage and with the sub-basin boundaries. The resulting intersected polygons will be associated with attributes of soil type and FLUCCS code as represented in the SWFWMD GIS coverages. Each soil type was then associated with a hydrologic soil group (A, B, C, or D), and each FLUCCS code was associated with an SCS land use category. A CN value will be then assigned to each polygon based on the specific hydrologic soil group and land cover classification. A database lookup table can then used to associate each FLUCCS code with an SCS land use category for purpose of computing runoff numbers (CN). The average area weighted CN value will then be computed for each subbasin.

Time-of-concentration (T_c) estimates can be made by totaling the travel time from the hydraulically most remote point in a catchment to the catchment outlet. The methods used for calculating travel times are based on the method described in the United States Department of Agriculture Soil Conservation Service - Technical Release No. 55 – Urban Hydrology for Small Watersheds. That publication takes a detailed approach, accounting for the travel lengths and various types of flow regimes as runoff travels through the catchment. The resulting time of concentration can then used as input to the model.


Legend
Hydrologic Soil Group
A
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Watershed Boundary
Roads
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Brooker Creek Watershed
Hydrologic Soil Group
Pinellas County
Figure 7
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Feet
Sources:
1) URS delineated feature classes.
2) FGDL Version 3.0.
Created in ArcGIS 9.1 using ArcMap 9.1
URS

2.3.7 QA/QC Process Description

Preliminary subbasin delineations were produced using the DTM and the Watershed Delineation Tool discussed above. Various sources were utilized to examine the resulting basins. These include: 2004 aerial photography, 1980 and 1985 aerial topographic paper maps (2-ft contours), and hydraulic structure location data obtained through field reconnaissance. The subbasins were modified where appropriate according to the aerials and DTM. Further delineation of the subbasins was based on SWFWMD criteria for stormwater management storage areas (SMSAs), depressions greater than 1 acre and 2 ft in depth and storage areas greater than 5 acres.

2.4 Hydraulic Feature Inventory

The G&S states that the 5 major components of the hydraulic feature inventory are (1) the storage areas, (2) the hydraulic control features and associated data, (3) hydraulic interconnectivity, (4) parameters for characterization, and (5) system scale.

2.4.1 Hydraulic Feature Inventory Development Process

The hydraulic feature inventory development process started with the development of the digital terrain model. A preliminary hydraulic network was created based on the topography. This network was compared to aerials during which points for field reconnaissance efforts were identified.

The preliminary estimate characterized each basin crossing as conveyance structures or overland flow weirs. In addition to basin boundary crossings, additional points were identified where the preliminary network crossed a road even though the crossing may not have been coincident with a subbasin boundary.

The G&S methodology was utilized in determining the Hydraulic Feature ID. The Hydraulic Feature ID includes the use of section, township, and range (STR) followed by a three-digit suffix extension assigned sequentially.

2.4.2 Sources of Data

The following table details the available information that was gathered and used to develop the hydraulic feature inventory.

Table 4: Sources of Hydraulic Data Used

DATA	SOURCE	DESCRIPTION
1999-2000 LiDAR	SWFWMD	Pinellas County Elevation Data, used to develop preliminary network.
2004 Orthophotos	SWFWMD	Latest set of detailed photographic information of the watershed, to identify current conditions.
USGS Quadrangles	USGS	Identify and confirm large scale flow patterns.
FIRMs	FEMA	For future comparison of model results.
Aerial Topographic Maps	SWFWMD	Used to define preliminary basin delineations, flow network, creation of DTM
Pinellas County Tarpon Woods Survey	Pinellas County	Identify hydraulic feature data

2.4.3 Field Reconnaissance

Prior to the field reconnaissance effort, Water Resource Associates (WRA) staff reviewed SWFWMD topographic maps, aerial photographs, previous studies and met with Pinellas County Department of Environmental Management staff to identify potential areas for conducting the field reconnaissance of the Pinellas County portions of the Brooker Creek Watershed and those portions of the Watershed located within Hillsborough County but not included in the Hillsborough County 2001 *Brooker Creek Area Stormwater Management Master Plan (Update No. 1)* surface water model. Potential culvert structures, weir structures, and improved channel reaches (Channels L and F) were identified. WRA's field reconnaissance occurred between October 2005 and December 2005. A total of approximately 110 locations were visited during the field reconnaissance. Many of these locations were excluded in the hydraulic features inventory because it was determined that they either did not discharge to the Brooker Creek Watershed or they drained small areas.

Hydraulic Feature Evaluation Forms; provided by SWFWMD, were filled in during the field reconnaissance to provide a general description of the location of the structure, give indication as to the type of structure, identify which pictures are associated with the particular structure, and to describe its immediate maintenance requirements.

The SWFWMD guidelines and specifications require several digital pictures to be taken at each structure location. Upstream and downstream photographs of the structures were taken. Digital photographs have been labeled with the following information: hydraulic identification, XY coordinate using the state plane (NAD83) datum, structure type, and photograph orientation.

Field Data Collection Methodology

The following is a description of the field data collection methodology.

- The preliminary data were used to identify critical locations where drainage facilities, channels or drainage divides required verification.
- Each facility was assigned a unique reference number beginning with the Section/Township/Range, followed by a digit suffix.
- Field crews were dispatched to the field to locate, verify and photographically document the facility conditions.
- The location of each facility was plotted using handheld Global Positioning System (GPS) receivers. General locational accuracies were estimated to be within a few meters.
- Facilities were photographed to document site conditions. The majority of the facilities were also physically measured to verify their dimensions. Note that submerged facilities and those which were inaccessible were not physically measured
- Notes were taken to describe any immediate maintenance requirements. These notes included siltation, damaged and deformed facilities or other field conditions requiring maintenance to bring the facility to its design capacity.

- Facility type and construction, photograph numbers and descriptions were noted on the field inventory sheets.
- Field data sheets, GPS coordinates (State Plane Coordinate System), photographs and other data were then reviewed for accuracy and completeness.
- Any data deficiencies/discrepancies or unclear photographs were identified and revisited to rectify any inconsistencies or to attempt access to points that were previously inaccessible.
- Once the field inventory sheets, locations and photographs were completed and checked for accuracy, the data was compiled by Section, Township and Range and Facility I.D. number.
- The field data was then compiled into a "Field Inventory Data Report" and was available for use in future modeling efforts.

2.4.4 Summary of Water Body Features by Subwatershed and Type

How the Lake Feature Class was Created

1) The lake feature class was created by first making a copy of the hardbreak feature class and renaming it lake.
2) All polygons which did not correspond to a network node or were not part of a network node system of polygons, were deleted.
3) Using the 2004 aerial photography as reference, missing water bodies were digitized if they were part of a network node system.
4) Lake elevation values were attributed based on the TIN and the water surface elevations on the aerial topographic paper maps.

There are 252 lake features located in the Watershed. The areas for each lake were computed per subwatershed. Table 5 summarizes the areas of these water bodies by acre.

Table 5: Summary Statistics of Water Body Features Inventoried by Subwatershed

WATERBODIES	A	B	C	D	E	Total
TOTAL	41.3	38.8	92.1	100.2	46.8	319.2

2.4.5 Summary of Conveyance Features by Subwatershed and Type

The data for the conveyance features was collected based on the field reconnaissance effort and the hydraulic feature inventory. The data collected was developed into database tables according to the G&S requirements and are included in the Brooker Creek Geodatabase along with the Conveyance Inventory feature class.

The following table summarizes the types of conveyance features found within the Brooker Creek watershed.

Table 6: Summary of Hydraulic Features within Brooker Creek Watershed

TYPE	A	B	C	D	E	Total
CULVERT	7	6	9	4	3	29
BRIDGE	-	-	1	1	3	5
WEIR	47	22	36	53	19	177
XSECT	-	-	-	4	-	4
Grand Total	54	28	46	62	25	215

2.4.6 Subwatershed Hydraulic Connectivity

A preliminary junction / reach coverage for the Pinellas County portion of the Brooker Creek Watershed was developed by URS Corporation in the form of line (Network_arcs) and point (Network_nodes) feature classes. The preliminary network consists of a group of nodes connected by a series of reaches to represent the movement of water within the watershed. Flow directions are assumed based on the digital elevation model. Additionally, historical flow directions where used where these are known.

URS Corporation also obtained the junction-reach coverage updated by PBS&J for the Hillsborough County portion of the watershed. The Hillsborough County Data was incorporated into the Brooker Creek Geodatabase as separate feature classes. These data will be joined with the Pinellas County data to create single junction reach coverage that encompasses the entire watershed at a later stage.

The Junction-Reach map is presented as Figure 8. An additional figure, Figure 9, adds hill shading to the background of this figure to facilitate review of the basins and network.

3.0 IDENTIFICATION OF SURVEYS TO BE PERFORMED

The URS project team has conducted data collection within the Brooker Creek watershed. Approximately 182 structures and other features were identified and inventoried by the URS project team. These facilities included culverts, weirs, channels, stormwater detention/retention areas and related facilities. The inventory of the facilities is located within the accompanying GIS data tables.

Additional field survey information will be required to supplement the information collected by URS project team to complete the hydrologic and hydraulic modeling of the watershed. This information will include invert elevations, locations, facilities type, size and configuration verification, stormwater pond size estimates, conveyance channel cross sections and other information.

3.1 Establishment of Elevation Control for Watershed

The SWFWMD G&S requires the survey to be in the NAVD 88 datum. The survey contractor will research all benchmarks in the vicinity to identify the datum at each benchmark. If NGVD 29 datum is used, conversions with verifications will be made to convert the datum and survey information from NGVD 29 to NAVD 88.

3.2 Field Survey Method

Elevations will be determined by using conventional differential leveling, trigonometric leveling and GPS. Differential leveling will meet third order accuracy. This approach may be used under tree cover where GPS will not provide the required accuracy. If control points are set using GPS methods, this method will be used as a check between the control points.

Trigonometric Leveling – This method may be used when control points having a horizontal & vertical position have been set near the structure. The elevations and cross sections are collected using a Total Station and a data collector. This method should be used for limited distances of up to about 500-750 feet.

GPS Leveling- National Geodetic Survey (NGS) and or Florida Department of Transportation (FDOT) Control will be used. Points will be set at approximately two-mile intervals throughout the project area. By using GPS static sessions of 30 minutes, elevations will be computed on these points.

Surveyed elevations using GPS will follow SWFWMD’s guidelines for hard and soft targets. Hard targets examples include cut squares within concrete structures, roadway overtopping, bridge elevations, or pipe invert elevations. An example of a soft target would be cross sections taken at natural ground or overland flow saddle. Vertical accuracy for soft targets = +/- 0.50 feet, while hard targets +/-0.25 feet.

3.3 Required Surveys by Subwatershed and Costs

Required surveys have been identified and grouped by individual subwatersheds. The Scope of Services for the Brooker Creek Watershed Management Plan requires that additional survey information be collected to supplement existing information and to provide details on specific facilities identified during the field reconnaissance.

3.3.1 Fixed Hydraulic Feature Surveys

Of the approximately 182 features inventoried, approximately 36 hydraulic features require the collection of additional survey information within Pinellas County. This list is a total of all of the location for which additional information is desired. A map showing the locations of the survey sites is provided as Figure 13: Survey Map.

For all 36 New Sites:

- Determine horizontal coordinates
- Determine/ verify facility type, number, dimensions, length, shape and material
- Determine facility upstream and downstream invert elevations
- Provide facilities sketches
- Note condition of facility and/or maintenance requirements
- Assemble data in the required format for field notebooks
- Determine roadway overtopping elevations and coordinates

3.3.2 Stream Cross Section Surveys

The majority of the Brooker Creek Watershed is made up of semi-closed basins with limited stream channels. Therefore, no channel cross-section surveys are proposed for the Brooker Creek area.

3.3.3 Groundwater Level Surveys

Three piezometer locations are proposed in order to evaluate wetland response at the Brooker Creek Preserve and gather water table fluctuation data for the modeling effort. The piezometers will be located at locations in the preserve where a hydraulic gradient across the preserve can be established.

3.3.4 Estimated Field Survey Costs

The estimated costs to provide the survey data described above are presented in the Table 7. These costs are estimated based upon an average per point cost to survey all of the types and number of points described. For new structure surveys, the estimated per location cost was assumed to be $1500 per location. The estimated cost for the piezometers was assumed to be $800 per location. Reductions or additions to the number of points and types and level of accuracy of information will alter the estimated survey costs.

Table 7: Survey Cost Estimates for the Brooker Watershed

Subwatershed	Number of Locations	Cost per Location ($)	Total ($)
A	7	1500	$10,500
B	6	1500	$9,000
C	9	1500	$13,500
D	6	1500	$9,000
E	8	1500	$12,000
Piezometers	3	800	$2,400
TOTAL	39	--------------	**$56,400**

3.3.5 Field Survey Recommendation

The survey costs provided above are based upon the desired completion of "missing" or incomplete data for all of the inventoried facilities without survey data or existing permit data. The unit cost reflects the increased efficiency afforded by the use of Global Positioning Systems (GPS) in obtaining both horizontal and vertical data. Additionally, it may also be possible to obtain some survey information from Pinellas County.

4.0 SURFACE WATER RESOURCE ASSESMENT INVENTORY

We anticipate that the pollutant loads for selected pollutants (chemicals, parameters) will be estimated using the SWFWMD supplied spreadsheet model. Pollutants considered may include the following parameters: BOD, TSS, oil/grease, TN, Nox, TKN, TP, TDP, Cd, Cu, Pb, and Zn. The model may utilize rainfall values for a specified time period (e.g. annual or seasonal), subbasin land use category, and hydrologic soil type and look up table of runoff coefficients to determine the runoff coefficient with land use and soil type as input variables. Using the EMC for a selected pollutant, the model may then estimates average pollutant loads using rainfall, runoff coefficient, and EMC values.

First, gross loads without existing condition BMPs will be calculated for each land use and for each subbasin. Then the existing condition BMPs information (type of BMP and land use area draining to each BMP) will be obtained from the County, SWFWMD, FDOT and FDEP permit files. Four types of BMPs will be included: wet detention, dry detention, percolation, and grassy swales. The model may selects treatment efficiencies from a built-in table of treatment or pollutant removal efficiencies corresponding to each of these BMPs and pollutants. The model would then compute the net loads i.e., existing condition loads with BMPs by applying the removal efficiencies to the gross load. Finally, the water quality level of service (LOS) is calculated by comparing the actual net load to the load for a low-density single family residential land use without treatment of the same areas. Five levels of LOSs are considered (A, B, C, D, and F). Depending upon the difference in these loads, LOS designation ranging from A through F is determined in the model for each land use and for the overall subbasin.

4.1 Existing Conditions Gross Loads

The pollutant load calculation uses the rainfall, runoff coefficient, and event mean concentration data as discussed in this section. The runoff coefficient depends on the land use and hydrologic soil group. Each of these variables is discussed below.

Rainfall Data

Average annual and average seasonal rainfall data was obtained by averaging the SWFWMD rainfall data for the Northwest Hillsborough Basin. The wet season was taken to be May through September and the dry season was taken to October through April.

Land Use

Major land uses in the basin was developed from County land use maps and include:

- Low/medium density residential
- High density residential
- Light industrial
- Agriculture

- Commercial
- Institutional
- Highway/Utility
- Recreational
- Open land
- Extractive (Mining)/Disturbed

Soil Characteristics

Soil characteristics identified from NRCS maps are specified by hydrologic soil group A through D as follows:

- Group A (Low runoff potential): high infiltration rates even when thoroughly wetted and a high rate of water transmission; typical maximum infiltration rate of 10 inch/hour when dry and 0.5 inch/hour when saturated.

- Group B (Moderately low runoff potential): Moderate infiltration rates even when thoroughly wetted and a moderate rate of water transmission; typical maximum infiltration rate of 8 inch/hour when dry and 0.4 inch/hour when saturated.

- Group C (Moderately high runoff potential): slow infiltration rate when wetted and slow water transmission rate; typical maximum infiltration rate of 5 inch/hour when wetted and 0.25 inch/hour when saturated.

- Group D (high runoff potential): very slow infiltration rate when wetted and a very slow rate of water transmission rate; typical maximum infiltration rate of 3 inch/hour when dry and 0.10 when saturated.

In many instances in Florida, during wet season because of high water table the infiltration rate will be low and hence soil group D but during dry season the water table will be low and the infiltration rate will be high and hence soil group A or B thus the soil will be classified as A/D or B/D.

EMC

The event mean concentration (EMC) data for different pollutants and land uses will be derived from a number of studies including the EPA NURP, Hillsborough and Pinellas County and other studies in Florida.

Existing condition gross pollutant loads will be calculated using the model by inputting the land use, soil type, and the corresponding drainage area.

4.2 Existing Conditions Loads with BMP's

Stormwater treatment facilities may include wet detention, dry detention, grassy swales, and exfiltration trenches. In addition to the four standard BMPs, other BMPs can be modeled using this model. These measures remove pollutants to varying degrees and are referred to as the BMPs. BMP data needs to be developed for each land use and for each subbasin. The type of BMP and proportion of the drainage area being treated need to be specified.

The existing condition BMPs will be determined using SWFWMD permit information. The BMPs considered in this study include wet detention, dry detention (percolation), infiltration trench (under drains) and grassed swales. The model will be run with the BMPs and the loads again calculated.

To compare the basins and to rank them based on loadings, the unit area loads (lb/acre) will be computed by dividing the loads by the subbasin drainage area.

4.3 Proposed Conditions Loads with BMP's & Water Quality Level of Service

The proposed condition loads water quality level of service (LOS) will be determined by calculating the proposed water quality pollutant loading and comparing with the benchmark single family residential (SFR) loading as was done for the existing condition discussed above. The LOS will be evaluated for the proposed condition water quality improvement alternatives developed as part of the BMP alternative development process. The pollutant loads and LOS will be determined for those subbasins whose runoff will be treated in the proposed conditions by water quality improvement BMP's.

5.0 MODEL SELECTION

The purpose of this section of the report was to identify and summarize sources of surface water and groundwater-related data that could be utilized in developing a numerical model of the surface water system, groundwater system, or the integrated surface-groundwater system of the watershed. Using the developed model, the effects of wetland and flow restoration projects within the Preserve could be predicted, as well as cumulative affects of upstream development projects on the flow regime within the watershed and the Brooker Creek Preserve.

5.1 Surface Water Model

Surface water modeling within the portions of the Brooker Creek watershed located in Hillsborough and Pinellas Counties, respectively, has been performed by Consultants on behalf of each county. However, none of these previous surface water modeling efforts have crossed county lines; that is, the boundaries of the watershed were placed entirely within the county funding the model and conditions in the other county were not included in the model. The Brooker Creek modeling effort for Hillsborough County was performed in October 2001, which consisted of preparation of an existing conditions Surface Water Management Model (SWMM) model, which was used to develop a Storm Water Management Master Plan (SWMMP) for the portion of the Brooker Creek watershed within Hillsborough County. Hillsborough County (in a cooperatively funded study with SWFWMD) is currently updating this model, for new land use and topography data and to generally meet SWFWMD WMP guidelines and specifications.

SWMM modeling was performed for the Pinellas County portion of the Brooker Creek Watershed during the preparation of the Surface Water Improvement and Management Plan (SWIMP) for Lake Tarpon, completed in 1991.

5.2 Integrated Surface Water / Groundwater Model

The use of integrated models requires large amounts of data to model both the surface water and groundwater components of the hydrologic cycle alone, as well as modeling the interaction between the surface water and groundwater components. Therefore, an integrated model would require more time for development, calibration, and simulation execution relative to just a surface water or groundwater model. These requirements would likely increase the cost of a project relative to the use of a stand-alone surface water or groundwater model. The cost increase might be considered justified if the model output were to effectively meet the needs of a majority of the users of the output. Typically, water quality issues are not considered in an integrated model due to the complexity of the interaction between flow regimes and calibration issues.

Data requirements for fully-integrated surface water and groundwater simulations are much more intensive than for surface water-only or groundwater-only models, increasing the costs and timeframes required for completion and calibration of the model. For example, if a grid size of 500 feet by 500 feet was utilized over the 39 square mile Brooker Creek Watershed

area, the resulting model would incorporate approximately 4,350 cells. Each cell would require input data for surface water flow characteristics, physical parameters such as soil type and porosity, groundwater flow and aquifer parameters as well as atmospheric input such as rainfall and evapotranspiration (ET). Available data for some of these parameters, such as groundwater table elevation, are voluminous while the availability of data in other categories (such as ET) is much less. In cases where data coverage is sparse, estimated values must be used in the model, potentially affecting the calibration and overall validity of the model output. To gather and catalog the required data to a degree justified by the raw cost and labor costs for a model such as MIKE SHE could potentially have a timeframe on the order of years.

5.3 Recommendations

Hillsborough County is finalizing the update of the Brooker Creek SWMM surface water model for areas of the Brooker Creek Watershed within Hillsborough County. This update is generally being completed to meet the current SWFWMD Guidelines and Specifications for Watershed Management Programs. URS has developed the preliminary model input information (basin areas, junction-reach data, hydraulic inventory, etc.) for the Pinellas County portion of the Brooker Creek watershed that could be easily input to a SWMM model. The Hillsborough County SWMM model could then be linked to the Pinellas County SWMM model to provide an overall Brooker Creek Watershed surface water model. This linked surface water model would allow the evaluation of modifications to the surface water drainage system within and adjacent to the Brooker Creek Preserve and also allow for evaluations of future development changes on flooding conditions within the Preserve and the watershed. The SWMM model could also evaluate future water quality considerations related to NPDES or TMDL requirements. However, the SWMM model would **not** be able to easily evaluate the impacts of adjacent wellfields on groundwater conditions in the Brooker Creek Preserve area.

Based upon the model information currently available, the data requirements and the ease of use of the model, URS recommends that the Hillsborough County Brooker Creek SWMM model be modified and utilized to evaluate potential hydrologic modifications in the Pinellas County Brooker Creek Preserve and watershed.

APPENDIX A

LARGE MAPS