BIG SAND LAKE WATERSHED MANAGEMENT PLAN

WATERSHED EXISTING CONDITIONS ASSESSMENT

TECHNICAL MEMORANDUM

April 2017

ORANGE COUNTY GOVERNMENT FLORIDA

Geosyntec consultants

engineers | scientists | innovators

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Prepared For:

Stormwater Management Division

4200 South John Young Parkway

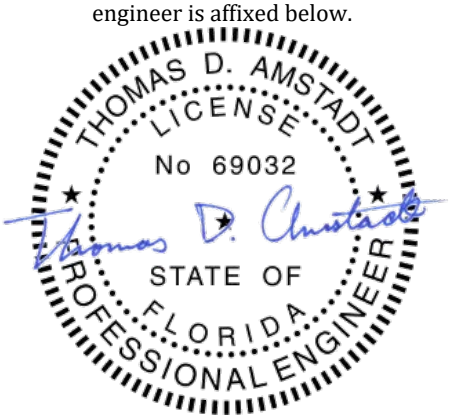
Orlando, Florida 32839

Prepared By:

1511 East State Road 434, Suite 1005

Winter Springs, FL 32708

The engineering material and data contained within the enclosed report was prepared by Geosyntec Consultants, Inc. for sole use by the Orange County Stormwater Management Division. This report was prepared under the supervision and direction of the respective undersigned, whose seal as a registered professional engineer is affixed below.



Thomas D Amstadt, PE, CFM
Project Engineer
Florida PE# 69032

Geosyntec consultants

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www.geosyntec.com

04 April 2017

Orange County Public Works
Stormwater Management Division
Attn: Kelly Nowell, PE, CFM, LEED AP
4200 South John Young Parkway
Orlando, FL 32839

Subject: **Final Big Sand Lake Watershed Existing Conditions Assessment Technical Memorandum**
Big Sand Lake Watershed Management Plan
Orange County, Florida
Orange County Contract Number Y11-901C

Dear Ms. Nowell:

Geosyntec Consultants is pleased to submit three (3) signed and sealed hard copies of the Final Big Sand Lake Watershed Existing Conditions Assessment Technical Memorandum for the County's use. A disk with a pdf copy of the technical memorandum and electronic deliverables of backup data are also included.

Geosyntec is pleased to provide our services to Orange County on this project. If you have any questions regarding the attached, please contact us at 407-321-7030.

Sincerely,
GEOSYNTEC CONSULTANTS

Thomas D. Amstadt, PE, CFM
Project Engineer
tamstadt@geosyntec.com

Mark W. Ellard, PE, CFM, D.WRE
Project Manager
mellard@geosyntec.com

Enclosures: Three (3) copies of the Final Big Sand Lake Watershed Existing Existing Conditions Assessment Technical Memorandum.

Final electronic deliverables on disk.

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1. INTRODUCTION AND BACKGROUND

1.1 Introduction

This report represents the results of the Watershed Existing Conditions Assessment task of the Big Sand Lake Watershed Management Plan (WMP). Geosyntec Consultants was tasked by the Orange County Stormwater Management Division to complete this report. The work was performed under the Orange County continuing stormwater engineering services contract Y11-901C.

1.2 Background and Location

The Big Sand Lake Watershed study area is comprised of approximately 5410 acres (8.5 square miles) of unincorporated areas of Orange County within Sections 1, 2, 3, 10, 11, 12, 13, 14, 15 of Township 24 South, Range 28 East and Sections 22, 23, 25, 26, 27, 33, 34, 35, and 36 of Township 23 South, Range 28 East. More specifically, the study area is located south of Conroy Windermere Road, north of International Drive, east of South Apopka Vineland Road, and west of Interstate 4. The study area is located within the jurisdiction of the South Florida Water Management District (SFWMD), within County Commission Districts 1 and 6, within the Shingle Creek Watershed, and within the County's Taft, John Young, and West Orange Maintenance Districts. Refer to **Figure 1-1** - Vicinity Map and **Figure 1-2** - Site Map.

The watershed drains either directly to Big Sand Lake in the central and southern portion of the watershed or to one of the other lakes in the watershed. The other lakes in the watershed include Little Sand, Spring, Willis, Serene, Tucker, Sloat, Mirror (Boo Boo) and Crowell. Big Sand Lake discharges through a network of drainage pipes to the southeast under Interstate 4 to a Valencia Water Control District drainage canal. Refer to **Figure 1-2** for the location of the Big Sand Lake outfall.

1.3 Purpose of Study

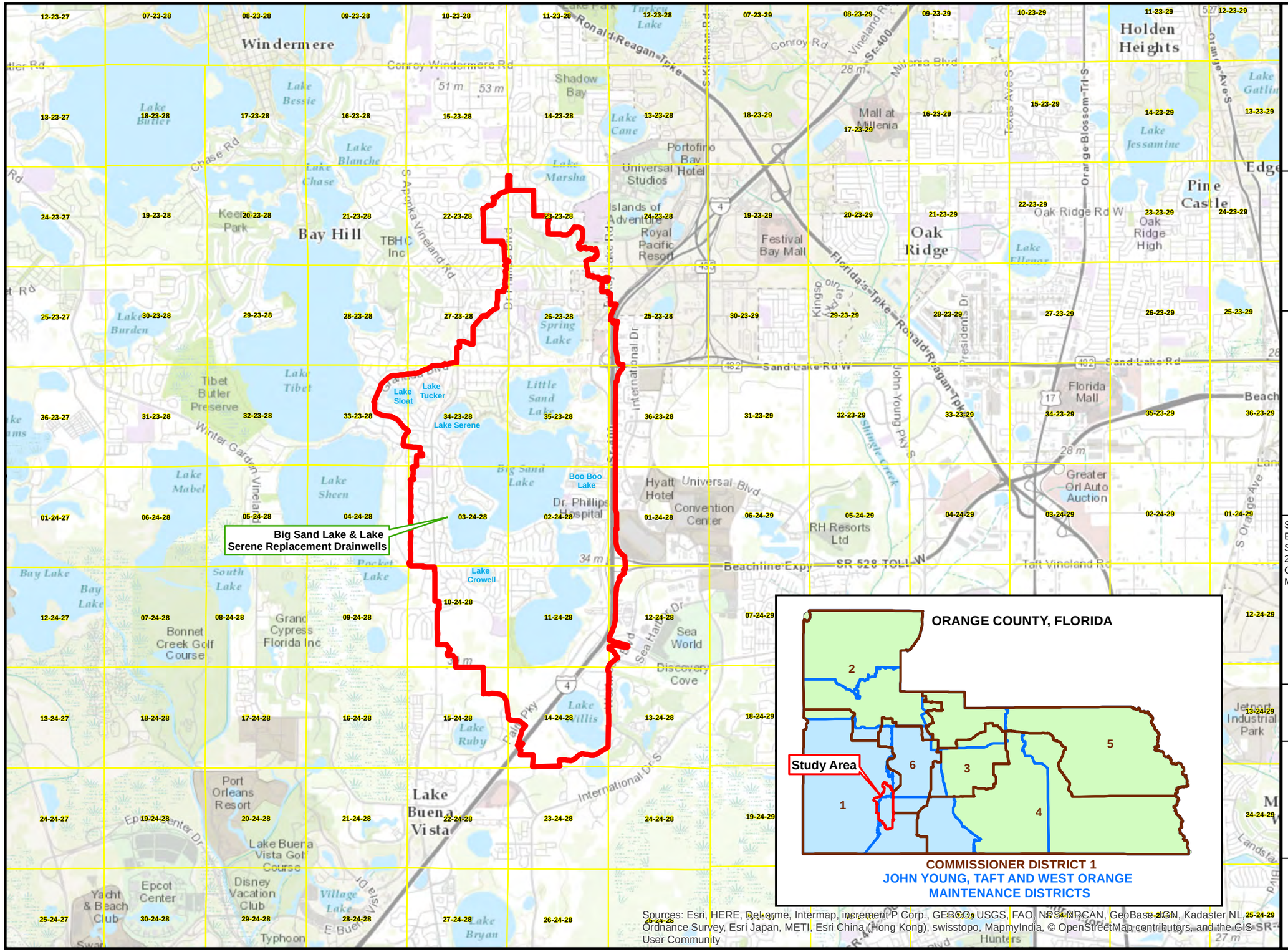
The purpose of the study is to develop a comprehensive drainage and flood level of service evaluation of the Big Sand Lake Watershed area including floodplain delineations. The primary focus of the study is Big Sand Lake and the flood protection provided by the drainwells (both existing and proposed). The floodplain elevations and flood control LOS of the primary drainage systems (lakes, ponds, main culverts, etc.) in the watershed will be assessed. The deliverables for the WMP include the following documents:

- **Watershed Evaluation Technical Memorandum** – This report included a compilation and summary of the data collection and preliminary watershed data development. The existing topographic and watershed feature data were collected and compiled and initial features necessary for the development of a watershed model were generated. A comprehensive GIS geodatabase was used to manage watershed data, including topographical data (LiDAR, contours, etc.) physical characteristics (soils, land use, hydrographic features), and drainage infrastructure data (culverts, control structures, conveyance features). This provided the basis for relevant site characteristics as well as general level of detail for the development of the existing conditions hydrologic and hydraulic model.

- **Watershed Existing Conditions Technical Memorandum (This Report)** – This effort included finalizing initial inventory and network connectivity features developed during the watershed evaluation, development of the existing conditions hydrologic/hydraulic model, existing conditions model simulation results, level of service (LOS) assessment, and floodplain delineations. The report integrated data and pages from the Watershed Evaluation Technical Memorandum and provided a narrative summary of the existing conditions modeling and evaluation efforts.

1.4 Data Management

The Southwest Florida Water Management District (SWFWMD) Geographical Watershed Information System (GWIS) geodatabase schema (version 1.6) was used to manage watershed data for this study. The GWIS is based on the ArcHydro Data Model and is capable of storing watershed related cartographic, hydrographic, hydrological, topographic, infrastructure inventory, and model data in a single geodatabase location.



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

ORANGE COUNTY GOVERNMENT FLORIDA

N

0 2,500 5,000 Feet

Legend

- Study Area
- Section-Township-Range

Sources:
Background: ESRI
Section-Township-Range: Orange County, 2013
Commissioner District: Orange County, 2013
Maintenance District: Orange County, 2013

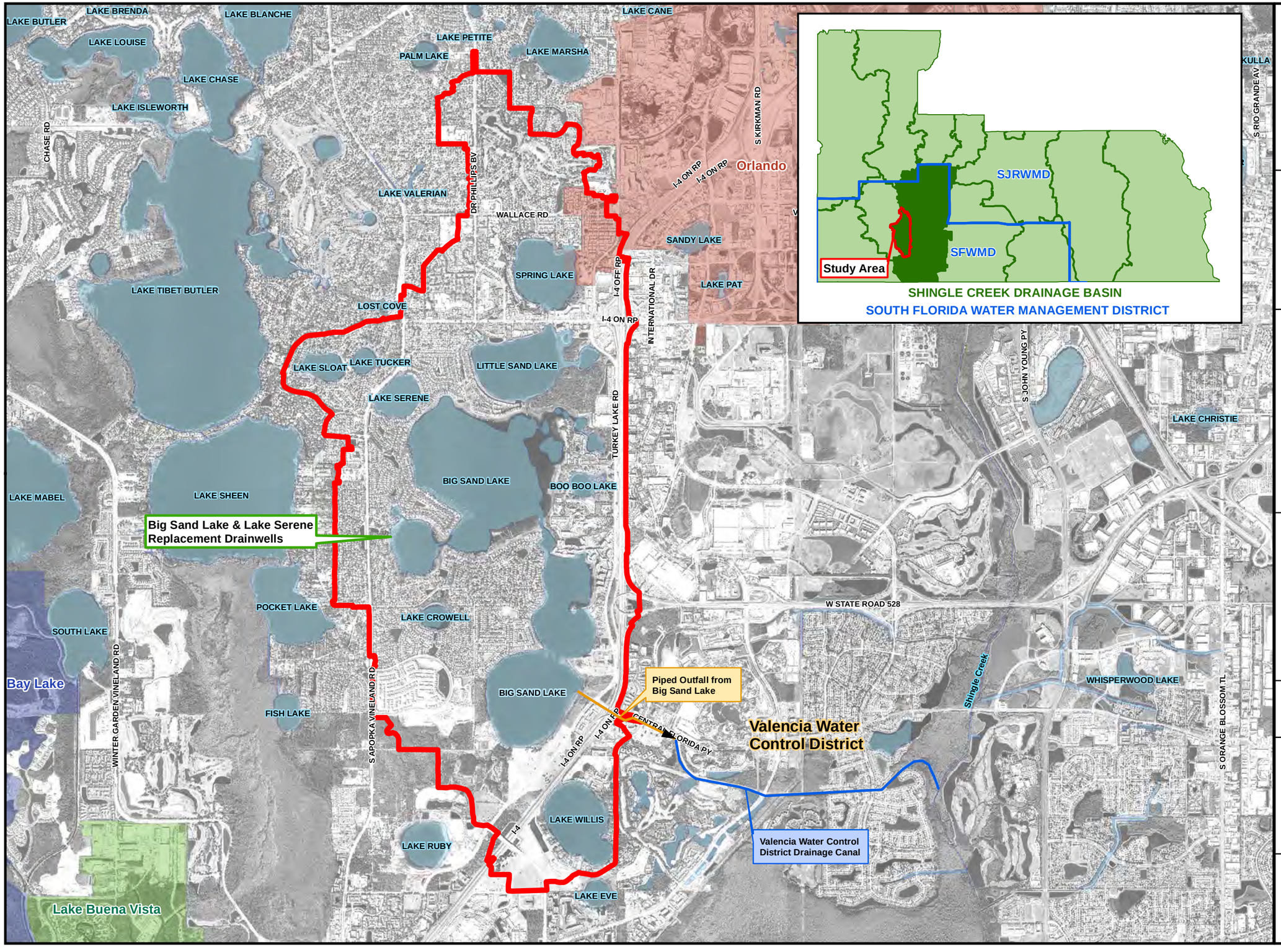
Figure
1-1

Vicinity Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants



ORANGE COUNTY GOVERNMENT FLORIDA

N

0 1,750 3,500
Feet

Legend

- Study Area
- Hydrology

City Limits

- Bay Lake
- Lake Buena Vista
- Orlando

Sources:
Aerial: OCPA, 2016
Hydrology: Orange County, 2013
City Limits: Orange County, 2013

Figure
1-2

Site Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

2. EXISTING WATERSHED FEATURE DATA EVALUATION AND ASSEMBLY

2.1 Previous Watershed Studies

Shingle Creek Drainage Basin Master Stormwater Management Study, DRMP, May 1997: The Shingle Creek study developed for Orange County was reviewed in general and specifically for data relevant to the current study. The overall purpose of the study was to address water quantity (flood analysis and management), water quality (constituent analysis and pollutant load reduction) and ecological impacts to wetlands within the watershed, and provide recommendations and an associated implementation schedule to assist the County in providing improved levels of service in meeting their desired goals. A PDF copy of the study is included with the electronic deliverables accompanying this report.

The model data within the report was found to be of limited use for the current study modeling effort. Each lake within the watershed and the interconnections between the lakes were modeled, however the areas surrounding the lakes were modeled as contributing area only, and so surface storage upstream of the lakes was not accounted for in the model. Also, based on review of historical aerials large portions of the watershed have been developed since the date of the model so the runoff characteristics of the contributing basins to the lakes have significantly changed. In addition, some of the interconnections between the lakes and the Big Sand Lake outfall appear to have been modified since the date of the model. The Big Sand Lake replacement drainwell was constructed in 2004 after the date of the model as well.

Big Sand Lake Outfall Conceptual Improvements, Camp Dresser and Mckee, Inc. (CDM), January 2004: The Big Sand Lake study developed for Orange County was reviewed in general and specifically for data relevant to the current study. Between 2000 and 2003 significant increases in lake stages were observed which presented a significant flooding concern for the County. As a result, the study was initiated to evaluate the feasibility of alternative flood control improvements associated with the Big Sand Lake outfall. After the study was initiated, higher than normal rain totals during the 2003 wet season caused the elevations of Big and Little Sand Lakes to rise to levels that caused concerns for the residents around the lakes. The issue was further exacerbated by the failure of the retaining wall between Big and Little Sand Lakes, which caused the elevation of Big Sand Lake to peak at approximately 97 feet NAVD. A stormwater model for the existing watershed was developed using the EPA Stormwater Management Model (SWMM) from several data sources. Long term continuous simulations using historical rainfall data for the watershed were executed and compared to the actual historical lake stages. The existing conditions model results provided the basis for modeling of improvement alternatives to reduce flood stages in Big Sand Lake. The evaluated alternatives included providing an additional lake outfall to the southeast, constructing aquifer recharge drainwells, constructing a stormwater pump station, and stormwater reuse. The study recommended the aquifer recharge with drainwells alternative due to its feasibility and cost relative to the other alternatives. A PDF copy of the study is included with the electronic deliverables accompanying this report.

The study report was reviewed for data that could be applied for use in the current study. The study model utilized the 1997 Shingle Creek study model as a starting point and refined the basin boundaries, updated the interconnections between the lakes, added detail to the Big Sand Lake outfall, and refined storage and overland flow connections based on updated topography data. However, similar to the 1997 study this study did not model areas upstream of the lakes in detail. As a result, the basin delineations and model connectivity data are of limited use for the current study model. The data input for the lake interconnections appears to still be valid in most cases. However, because the model was developed within the outdated SWMM model version 4.4, it was considered easier to reference the source data than try to extract the data directly from the model. Also, because the Big Sand Lake drainwell was constructed in 2004, after this study was completed, the calibrated model results would no longer be valid as a reference to predict future lake conditions.

Flood Mitigation Justification Report Additional & Replacement Drainage Well Installations Big Sand Lake & Lake Serene, Devo Engineering, June 2013: This drainwell study developed for Orange County was reviewed in general and for information relevant for this study. The purpose of the study was to review historic flooding issues and hydrologic changes within the watershed that affect lake stage elevations. The study included a review of historical aerials, lost and existing drainwell detail summaries, review of historical lake levels, discharge rates from Big Sand Lake outfall, the 2004 CDM report (discussed above), Floridan aquifer influences, 2003-2004 newspaper articles related to flooding in the lake, and comparison with a similar project at Lake Sherwood. The study also reviewed the potential flood mitigation that would be provided by the existing Big Sand Lake and conceptually approved Lake Serene replacement drainwell. The study recommended that four (4) total 12 inch drainwells are needed for effective lake level control. A PDF copy of the study is included with the electronic deliverables accompanying this report.

2.2 Vertical Datum

Elevation data utilized for this study is referenced to the North American Vertical Datum of 1988 (NAVD88). The average vertical datum conversion factor for the Shingle Creek Watershed was referenced from the 2009 Orange County Flood Insurance Study (FIS). Based on the referenced conversion factor, elevation data from sources such as construction plans that reference the NGVD29 datum were converted to NAVD88 by subtracting elevations by 0.91 feet. **The NAVD 1988 vertical datum was consistently used throughout this report**.

2.3 Lake Historical Stage Data

The lakes Big Sand, Little Sand, Willis, Spring, Serene, Tucker, Sloat, Boo Boo (Mirror), and Crowell are listed in the Orange County Lakes GIS layer. The referenced data is included as **Table 2-1** below. The Lakes GIS Layer is included with the electronic deliverables accompanying this report.

Table 2-1 – Lake Elevation Data from Orange County Lake Index

Lake Name	100 Year[1] (ft)	NHWE[2] (ft)
Big Sand	100.5	89.03
Little Sand	100.9	94.51
Willis	107.0	103.59
Spring	101.2	97.71
Serene	95.49	93.21
Tucker	105.49	101.5
Sloat	101.12	101.12
Mirror	100.5	96.12
Crowell	102.6	99.51

1 – Corresponds to the 100 year flood elevation on the FEMA FIRM map, with exception of Lakes Serene, Tucker, and Sloat which have County accepted 100 year elevations.
2 – Normal High Water Elevation

Historic water level data was provided by the County for lakes Big Sand, Little Sand, Willis, Spring, Serene, Tucker, Sloat, and Crowell. The vertical datum of the data prior to October 2010 was NGVD29. After October 2010, the vertical datum of the data is NAVD88. Time series plots of the lake stages, converted to NAVD88 where necessary, are shown on **Figures 2-1** to **2-8** below. The historical lake elevation data are included with the electronic deliverables accompanying this report.

Figure 2-1: Historical Lake Levels, Big Sand Lake

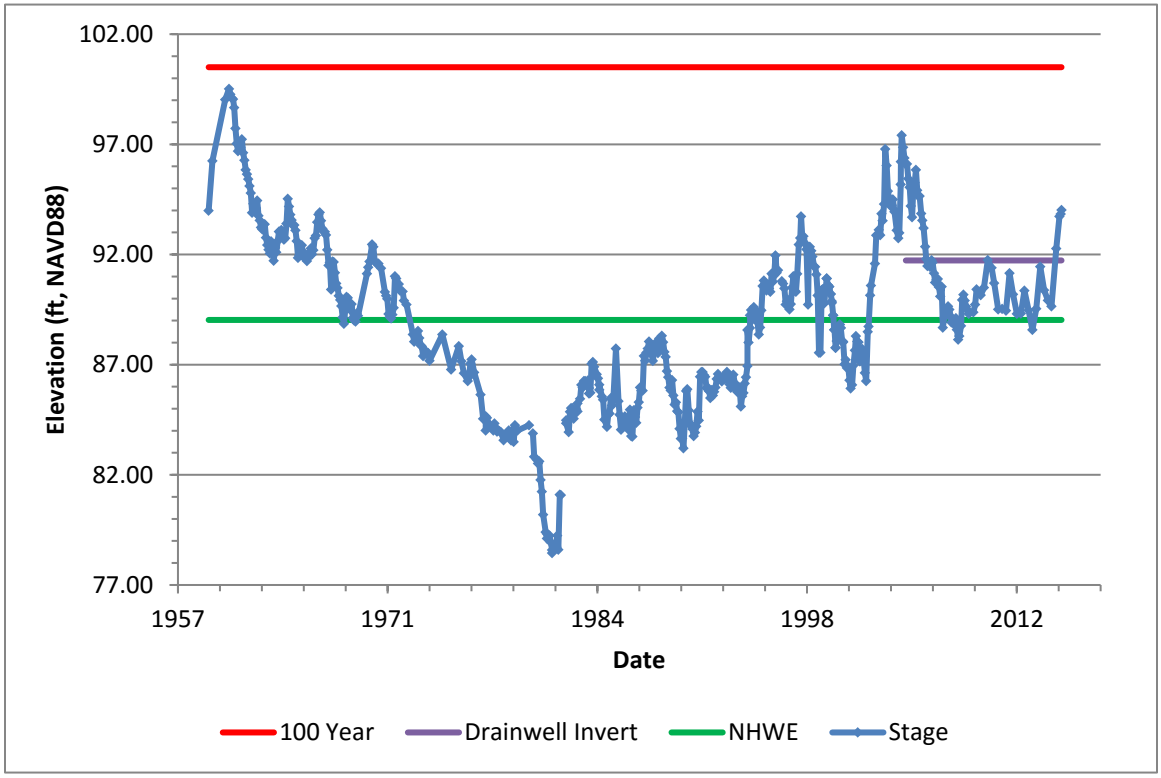


Figure 2-2: Historical Lake Levels, Little Sand Lake

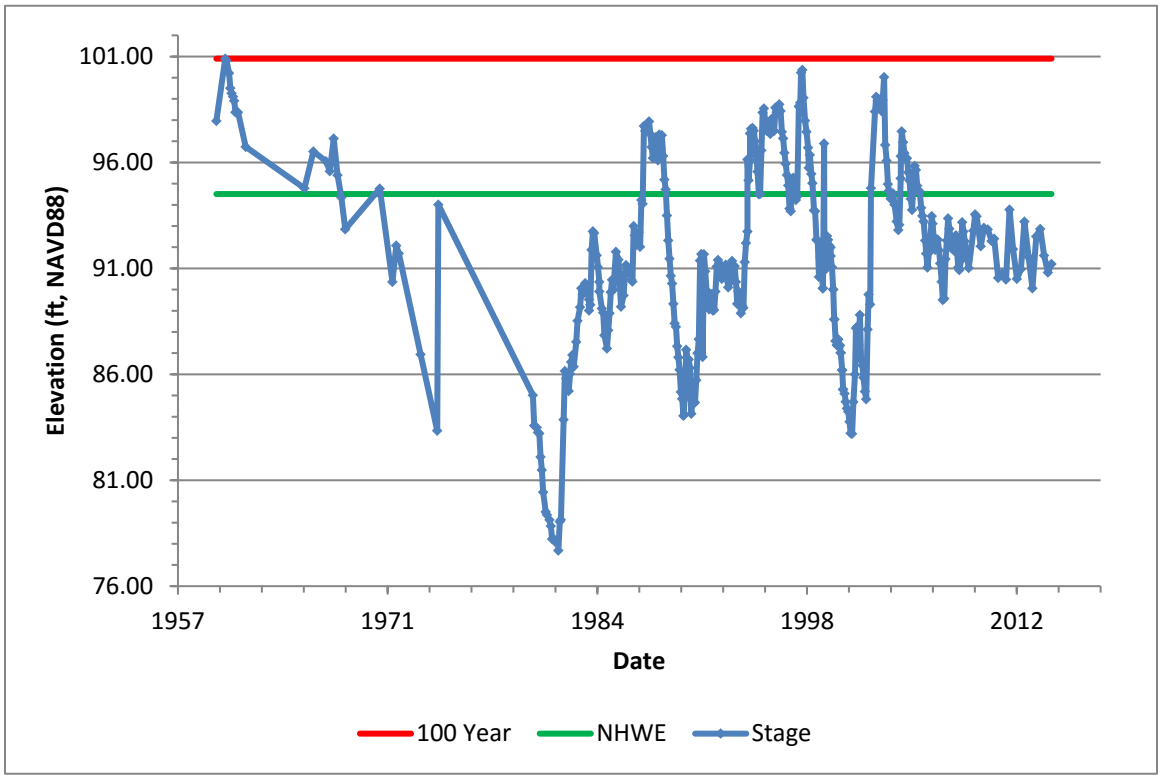


Figure 2-3: Historical Lake Levels, Willis Lake

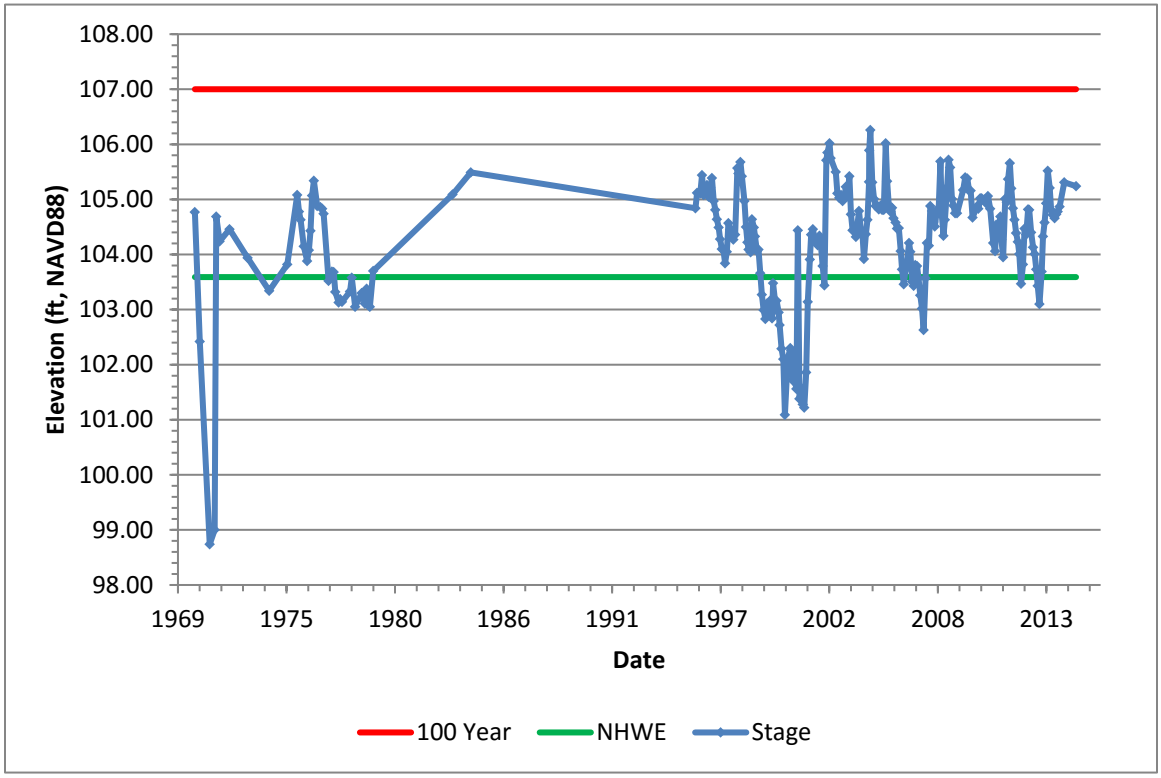


Figure 2-4: Historical Lake Levels, Spring Lake

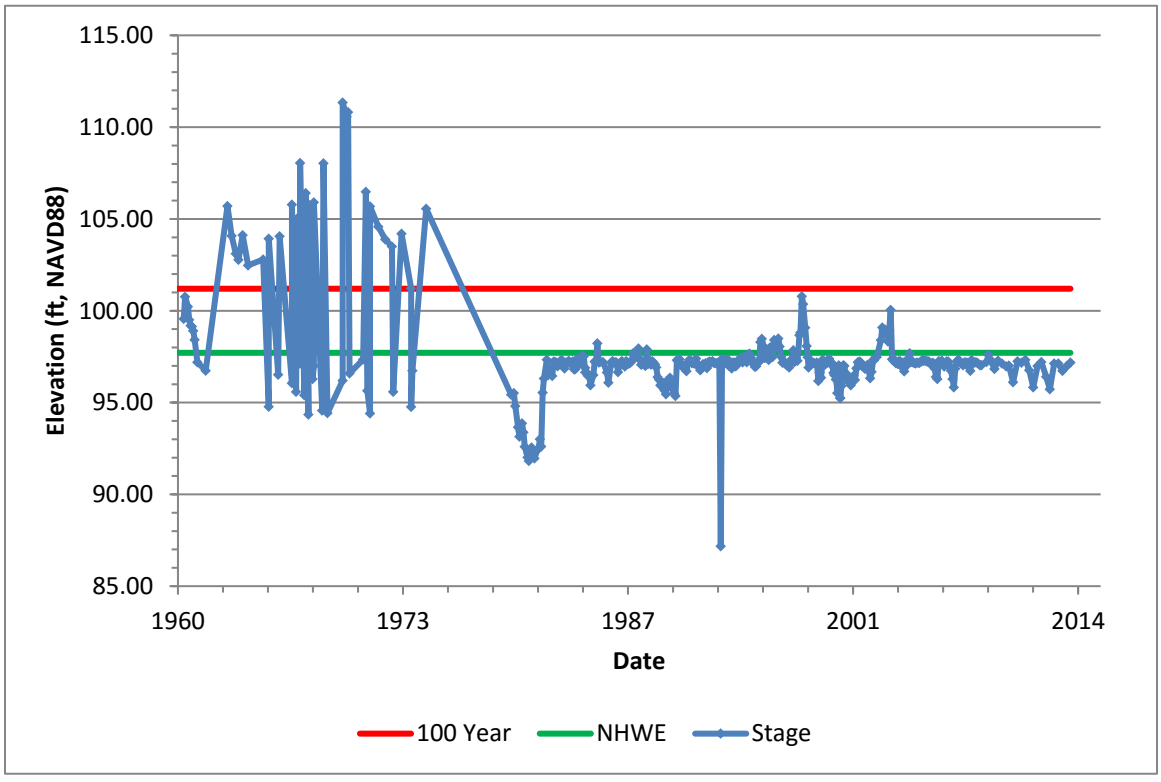


Figure 2-5: Historical Lake Levels, Lake Serene

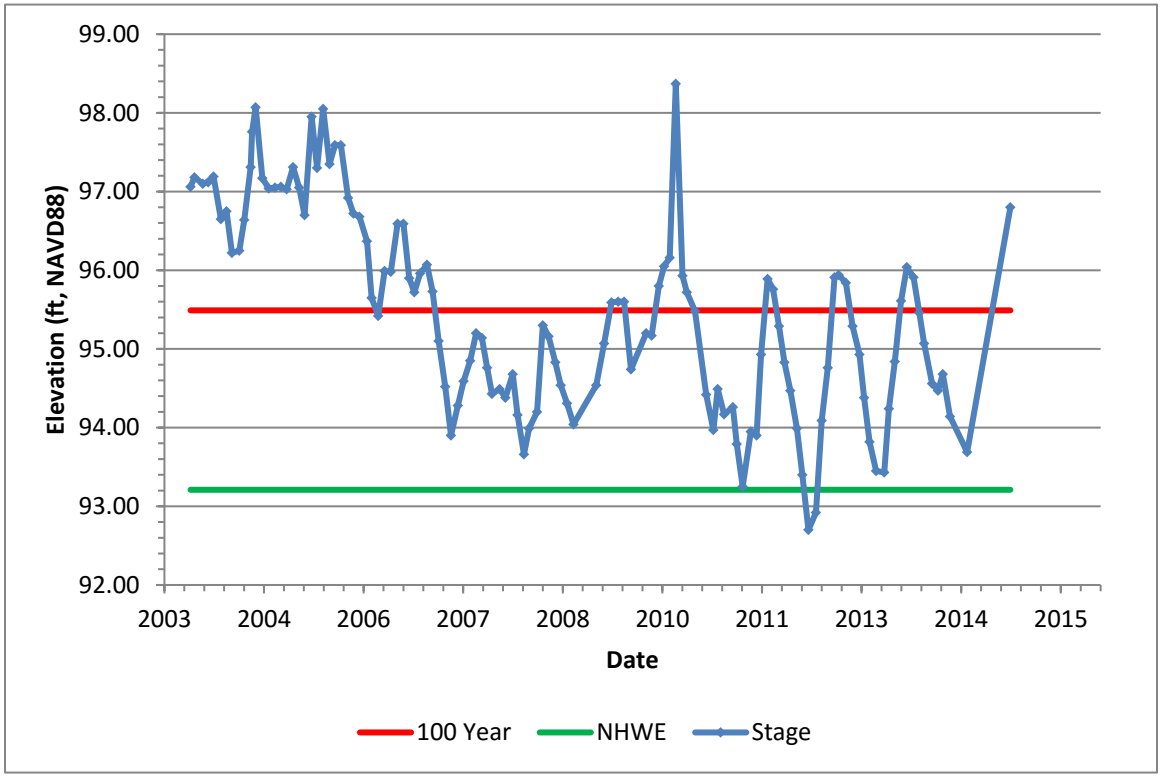


Figure 2-6: Historical Lake Levels, Lake Tucker

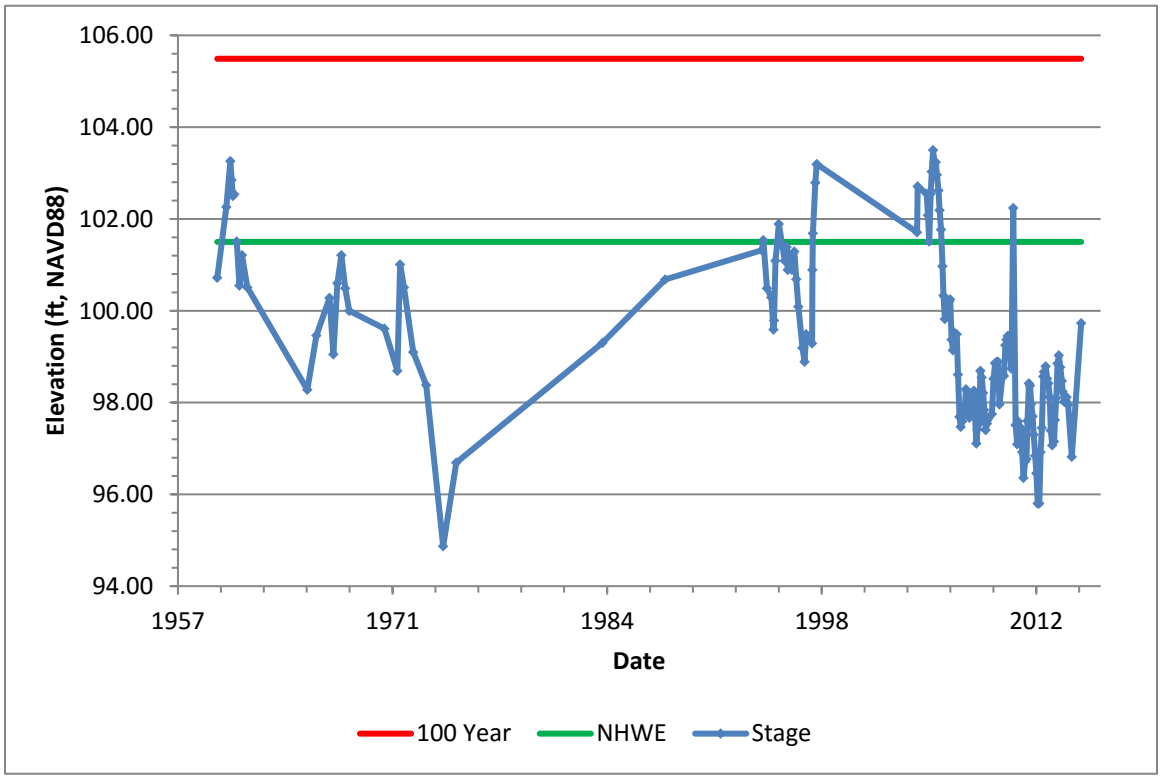


Figure 2-7: Historical Lake Levels, Lake Sloat

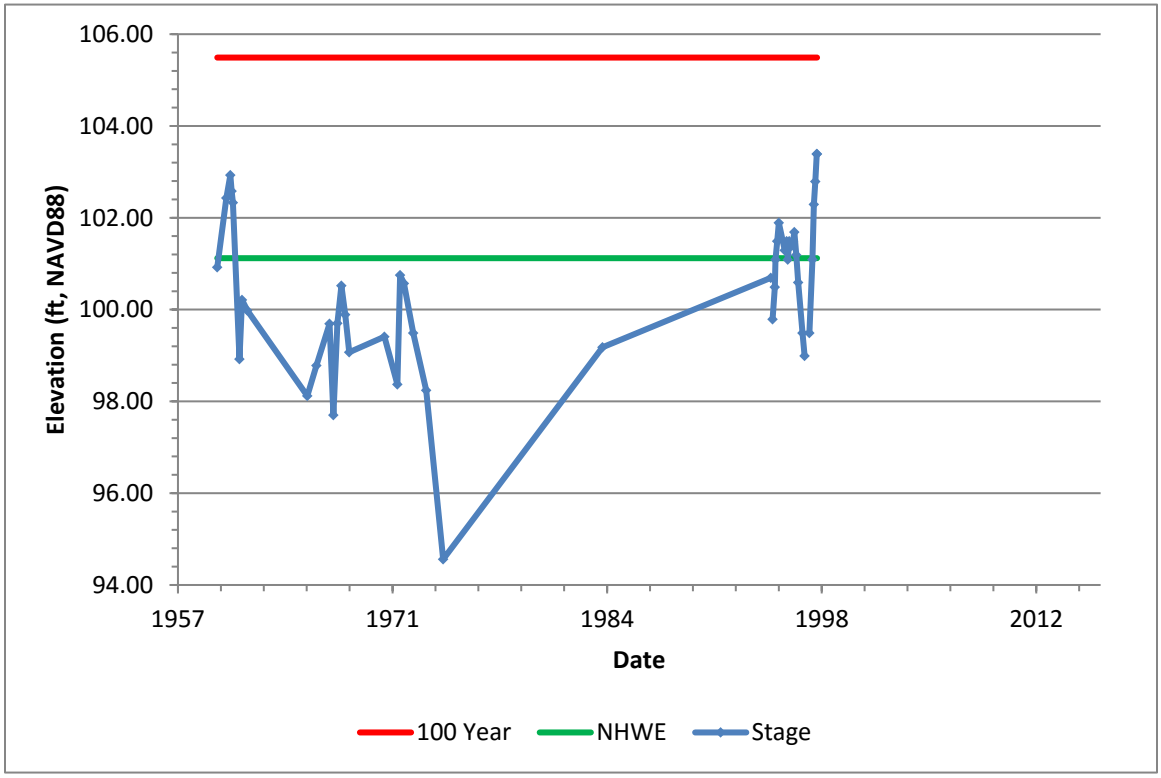
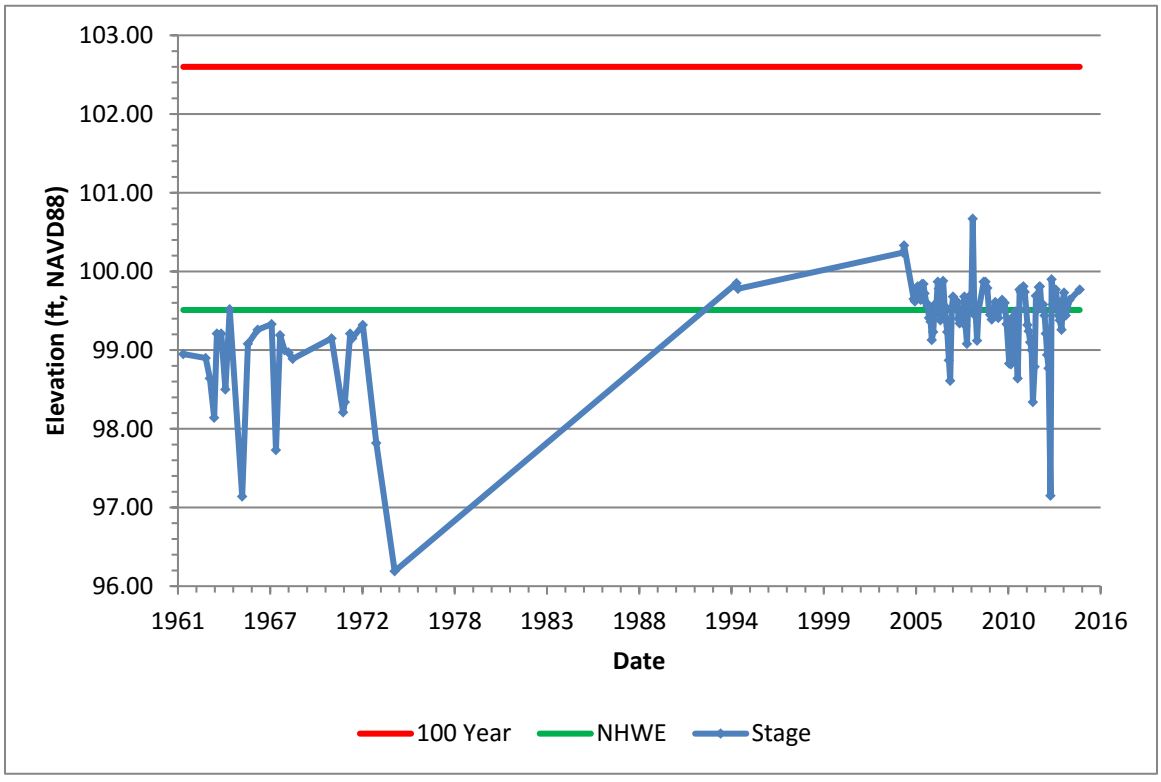


Figure 2-8: Historical Lake Levels, Lake Crowell



A historical lake and rainfall level chart for Big Sand Lake was also provided by the County. Refer to Figure 2-9 for a graphic of the chart below, which shows lake elevations and annual rainfall from 1959 to 2013. Note that lake elevation appears to correspond closely with changes in annual rainfall.

2.4 GIS Data Collection

Geographic Information System (GIS) site characteristics data was collected and compiled for this project from various sources. The GIS data collected is listed below.

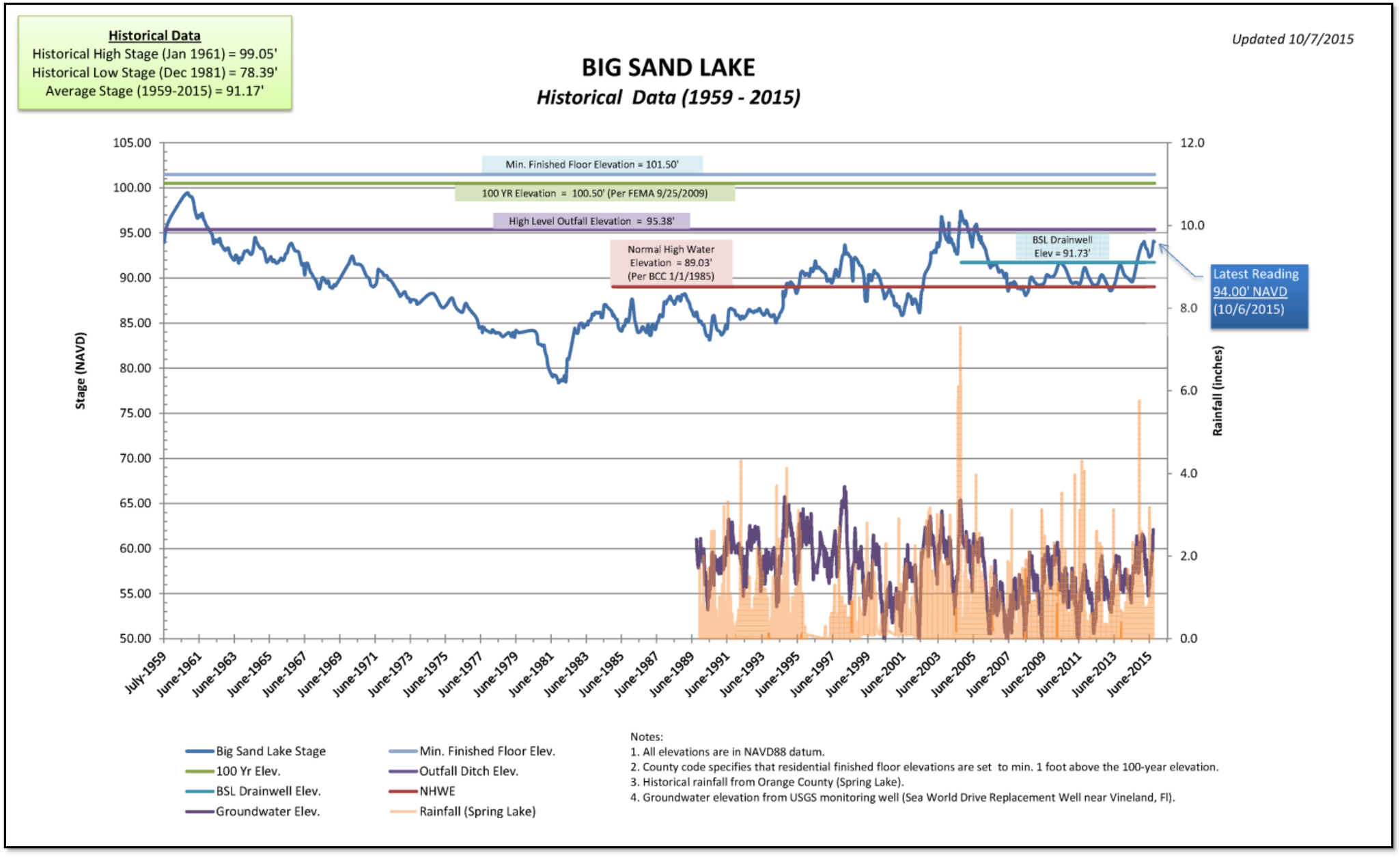
- SFWMD Land Use and Land Cover polygons (2008)
- Soil data polygons were downloaded from the Natural Resources Conservation Service (NRCS) web soil survey website (2013). The soils data is based on the Soil Survey Geographic (SSURGO) database for Florida, U.S. Department of Agriculture, Natural Resources Conservation Service, approximately 1990.
- Orange County Property Appraiser (OCPA) 3-inch resolution color aerials (2014)
- Orange County topographic data from the following watershed areas:
    - Shingle Creek (2002) - breakline, contour and spot elevation data
    - Reedy and Cypress Creek (2005) - LiDAR based ground points, breaklines, and contours
- US Geological Survey (USGS) 7.5' quadrangles (1980)
- FEMA Flood Insurance Rate Maps (FIRM), 2009
- Orange County GIS data including jurisdictional boundaries, subdivisions boundaries, maintenance district boundaries, section-township-range (STR) divisions, water management district boundaries, roads, and parcel polygons (2013).

The GIS data is included with the electronic deliverables accompanying this report.

2.5 FEMA Floodplains

FEMA Flood Insurance Rate Maps (FIRM) from the 2009 Orange County Flood Insurance Study (FIS) were reviewed to determine if any areas in the study area are within a FEMA designated special flood hazard area (SFHA). The majority of the study area is classified as 'Zone X', which defines areas determined to be outside the 0.2% annual chance floodplain. Lakes Serene, Tucker, and Sloat in the western portion of the study area are classified as 'Zone A'. 'Zone A' is a SFHA subject to the 1% annual chance storm event, however no base flood elevations have been determined. Lakes Big Sand, Little Sand, Spring, Willis, and Crowell are classified as 'Zone AE' with base flood elevations (BFE) of 100.5, 100.9, 101.2, 107, and 102.6 feet respectively. Boo Boo (Mirror) Lake is included with the Big Sand Lake AE flood zone area. 'Zone AE' is a SFHA subject to the 1% annual chance storm event, where base flood elevations have been determined. The FIRM's elevations reference the NAVD88 vertical datum. Refer to **Figure 2-9** – FEMA Floodplains Map for FEMA floodplain classifications within the study area.

Figure 2-9: Big Sand Lake Historic Water Elevations



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD EVENT

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

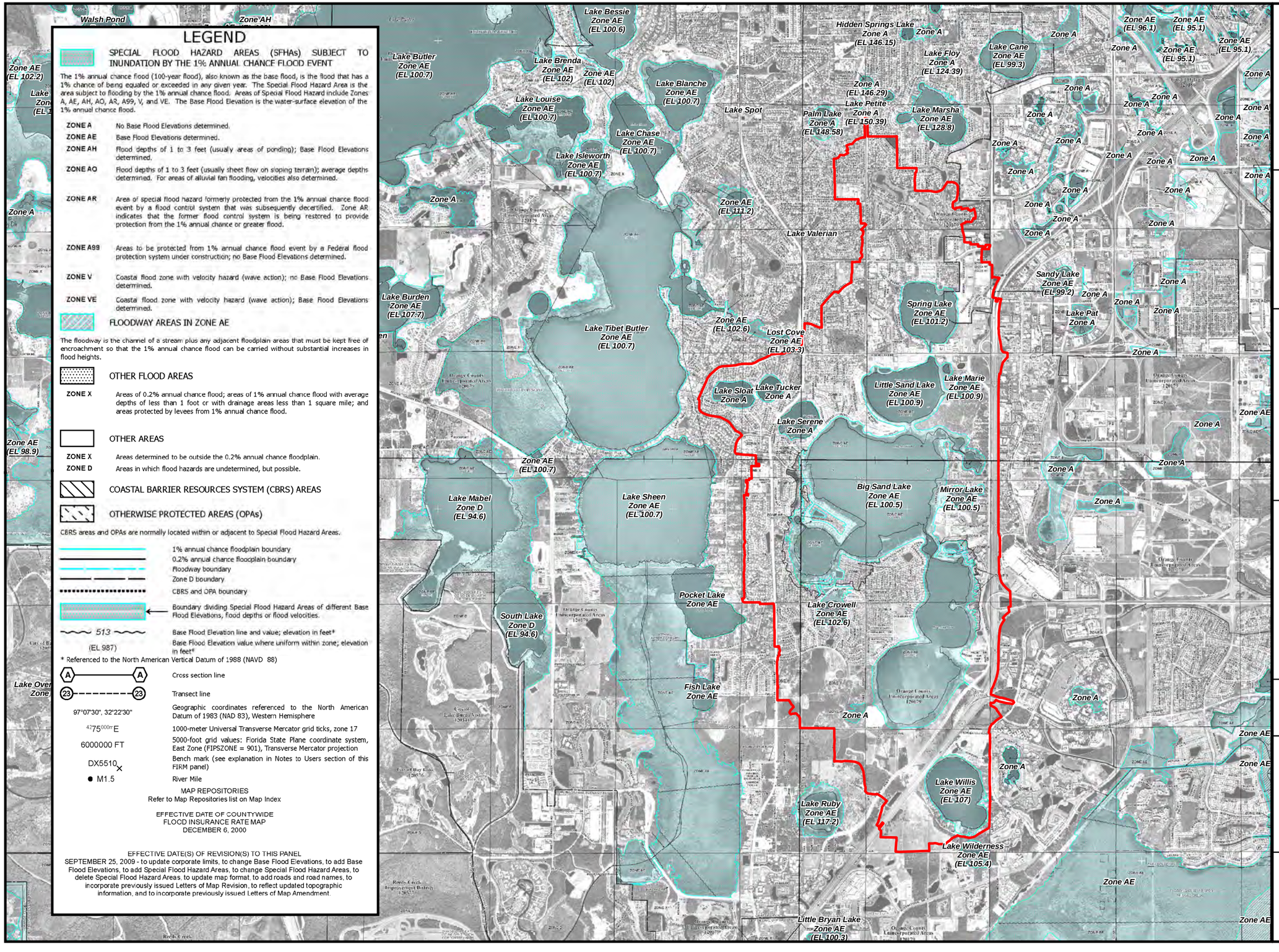
* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 — 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE	1000-meter Universal Transverse Mercator grid ticks, zone 17
6000000 FT	5000-foot grid values: Florida State Plane coordinate system, East Zone (FIPSZONE = 901), Transverse Mercator projection
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
DECEMBER 6, 2000

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
SEPTEMBER 25, 2009 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to update map format, to add roads and road names, to incorporate previously issued Letters of Map Revision, to reflect updated topographic information, and to incorporate previously issued Letters of Map Amendment.



ORANGE COUNTY GOVERNMENT FLORIDA

N

0 2,000 4,000 Feet

Legend

Study Area

Source:
FEMA Flood Insurance Rate Maps (FIRM), 2009

Notes:
Vertical Datum: NAVD 1988
Zone X: Areas determined to be outside 500-year floodplain
Special Flood Hazard Areas Inundated by 100-Year Flood
Zone A: No base flood elevations determined
Zone AE: Base flood elevations determined

Figure
2-10

FEMA Floodplain Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

2.6 Review of Complaint Logs and County Maintenance Staff Interviews

Complaint logs for the streets in the study area were obtained from County maintenance staff for a time period from January 2000 – April 2014. The majority of the complaint log entries were unrelated to drainage issues. The drainage related complaints were scattered throughout the study area. The County Stormwater Management Division is primarily tasked with maintenance and improvement of the County's primary drainage systems. Therefore, the drainage complaints that appear to be associated with County maintained primary drainage system deficiencies are listed below. Refer to **Exhibit 1** – Complaint Logs Map for the locations of the apparent drainage deficiency complaints and a summary table of the complaints.

- **Big Sand Lake Flooding Complaints along Southern Breeze Drive (Complaint Numbers 3 to 11)** – Each complaint refers to a need for sand bags presumably due to high stages from Big Sand Lake flooding the residents' property. Complaints 3 to 10 occurred in late August to early September 2003. According to the Spring Lake Rain gauge, 14.71 inches were recorded during the month preceding the complaints. This is approximately double the average monthly precipitation for this time of year in Central Florida. Complaint 11 occurred on October 13, 2004 which is approximately two weeks after Hurricane Jean and over a month after Hurricane Frances impacted the area. According to the Spring Lake Rain gauge, 14.59 inches were recorded during the month of September preceding the complaint. The above normal precipitation prior to the above complaints may have caused high stages in Big Sand Lake that threatened or appeared to threaten the homes around the lake. However, based on the information provided in the complaint logs, the residential structures were not flooded as a result of the high lake stages. Also, based on the **Figure 2-9**, lake levels peaked at approximately 97.4 feet during this time. Based on the topography and aerials this would have encroached somewhat on the back yards of the residential properties and may have flooded some private boat docks. Due to the size of the lake, strong winds may have caused waves that heightened flood impacts.
- **Apopka Vineland Road pond flooding (Complaint Number 13)** – The complaint appears to be related to high stages in the Apopka Vineland Road pond behind the resident's property. According to the Spring Lake Rain gauge 0.57 inches of rain were recorded the day (9/24/2002) of the complaint. The gauge recorded a total of 5.62 inches of rain for the week prior to the complaint, which is higher than normal precipitation but is not considered an extreme rainfall event.
- **Lake Willis Flooding Complaints along Lake Willis Drive (Complaint Numbers 17 and 18)** – Each complaint refers to the problem as "FLOODING" without additional explanation. The flooding is assumed to be related to high stages in Lake Willis. According to the Lake Willis stage gauge the lake level was at approximately 105.8 feet NAVD near the time of complaint 17 (7/22/2002) and 105.5 feet NAVD near the time of complaint 18 (9/5/2003). From the topographic data and aerials these lake elevations would not appear to be a threat to the residential structures at these properties. Also, according to the Spring Lake rain gauge only small amounts

of rain occurred on and near the complaint dates above so these complaints do not appear to be related to a major rain event.

The complaints listed above will be reviewed for modeled LOS deficiencies during the Existing Conditions Analysis.

There were also several mapped complaints that indicated potential drainage collection or conveyance system LOS deficiencies that appear to be associated with secondary or private drainage systems. These complaint locations are shown on **Exhibit 1** and categorized separately from the primary drainage complaints. These secondary drainage system locations may be of concern for the County, but will not be investigated further in this study because they are not within the purview of the County Stormwater Management Division.

Many of the drainage complaints appear to be related to maintenance issues, such as clogged pipes or roadway pavement problems, rather than drainage level of service (LOS) deficiencies. These complaints were highlighted in the complaint logs but were not mapped.

Copies of the complaint logs are included with the electronic deliverables accompanying this report. The rainfall data referenced above are also included with the electronic deliverables.

A telephone interview was conducted with John Young maintenance Foreman Duane Alvarado and Westside Maintenance Coordinator Brian Nead, to inquire about any flooding problems in the study area. Those interviewed indicated that they were not aware of any on-going drainage problems in the study area. They indicated that they provide preventative cleaning, inspections, and maintenance activities to ditches, pipes, and outfalls on a monthly basis.

2.7 Construction Plans and As-Builts

Construction plans and As-Builts were obtained from the Orange County Archives and FDOT District 5. The gathered construction plans covered projects encompassing much of the study area, including several subdivisions, commercial properties, utilities and roads. Drainage infrastructure data referenced from the plans were digitized in GIS. Copies of construction plans are included with the electronic deliverables accompanying this report. Plans for the following projects were collected:

- "Immediate Needs" Renovation Dr. Phillips Elementary School, Berryman and Henigar, July 2000
- Apopka-Vineland Road Improvements Phase 1, Glace & Radcliffe, Inc., 1999
- Bay Meadows Relief Elementary School, WBQ Design and Engineering, September 2004.
- Big Sand Lake Outfall Right of Way Map, Mehta & Associated, Inc. July 1993
- Drury Inn & Suites, Vanasse Hangen Brustlin, Inc., April 2009
- Granada DP Dellagio DP Phase I, Avid Engineering, Inc., May 2006
- Granada Villas Phase Two and Three, Civil Design Group, Inc., June 1984
- Greenleaf, Bowyer-Singlton and Associates, Inc., December 1985
- Lake Street Construction Plans, Kimley-Horn and Associates, Inc., 2010
- Master Grading Plan for The Doctor Phillips Community, Watson and Company, June 1971
- Orange Bay, FAM Associates, Inc., 1980
- Orange Tree Country Club Units 1 through 6, Bowyer-Singleton & Associates, 1983 to 1987
- Park Terrace Phase I and II, The Civil Design Group, 1985 and 1987
- Phillips Landing Phase 1, Wall Plans, Miller Sellen Conner and Walsh, September 2005.
- Phillips Landing Phase 3, Miller Sellen Conner and Walsh, June 1997
- Phillips Landing Phase I Village B, Miller Sellen Conner and Walsh, September 1995
- Phillips Landing, Lake Serene Emergency Outfall, Miller Sellen Conner and Walsh, July 1998
- Plaza Venezia Phase I, II, and III, Professional Engineering Consultants, 2000 to 2002
- Ruby Lake PD, Miller Sellen Conner and Walsh, 2005 to 2007
- Saint Ives, Bowyer-Singlton & Associates, Inc., 1990
- Sand Lake Cove, Yovaish Engineering Services, Inc., July 1995
- Sand Lake Hills, Michaels Stiggins, Inc., 1972 to 1980
- Sand Lake Hospital Garage Addition, GAI Consultants, Inc., February 2006
- Sand Lake Plaza, Lochrane Engineering, 1986
- Sand Lake Point Unit 1, FAM Associates, Inc., 1986
- Sand Lake Point Units 2 and 3, Donald W. Mcintosh, Inc., 1989
- Sand Pine Estates, Davidson Engineering Company, March 1984
- Somerset Shores at the Villages of Spring Lake, Professional Engineering Consultants, 1986
- Little Sand Lake/Spring Lake Outfall survey, 2003

- Stonewood at the Villages of Spring Lake, Professional Engineering Consultants, 1984
- Storm As-Built Survey (Big Sand Lake Drainwell Intake), Geomarks Land Surveyors, Inc. December 2005
- Streets E, F, & L for Dr. Phillips Community Center, Mayes, Sudderth & Etheredge, Inc., March 1980
- Technical Plans and Specifications for Lake Serene (DW-005) Drainage Well Replacement, Devo Engineering, 2004
- Wallace Road and Dr. Phillips Blvd. Intersection Improvements, Metric Engineering, Inc., 2007
- Wildwood Area Road Network District No.1, Kimley-Horn and Associates, Inc., 2007

2.8 ERP Information

Available Environmental Resource Permit (ERP) documents for developments within and adjacent to the study area were downloaded from the SFWMD website. The ERP documents were reviewed for drainage infrastructure, modeling, and geotechnical data that may be used for model development. The downloaded ERP documents are included with the electronic deliverables accompanying this report. Refer to **Table 2-2** for a list of the researched ERP documents**.**

Table 2-2 Environmental Resource Permit Projects

Permit No.	Permit Name		Permit No.	Permit Name
060606-15	Turkey Lake Office Building		48-00846-S	Sand Lake Cove
48-00097-S	Orange Tree Country Club		48-00865-S	Southwest Water Plant
48-00097-S-02	Orange Tree Country Club		48-00881-P	Bay Harbor
48-00097-S-02	Dr Phillips Elementary School		48-00881-P	Phillips Landing
48-00103-S	Deluca Spring Lake		48-00892-P	Apopka-Vineland Road
48-00103-S	Kindercare at Work Universal Studios		48-00918-P	Sand Lake Hills Stormwater Outfall
48-00103-S	Kirkman Road Conveyance System		48-00933-P	Palm Parkway to Apopka Vineland Connector Rd
48-00103-S-02	Nabavi Office Building		48-00969-P	Phillips Bay
48-00103-S-03	Professional Office on Wallace Road		48-00993-P	Marbella Master Drainage Plan
48-00104-S	Bay Vista Estates		48-00998-P	Eden Springs Resort
48-00110-S-02	Somerset Shores		48-01043-P	Toledo Inc
48-00110-S-03	Phillips Cove		48-01059-P	Horizons at Orlando
48-00110-S-04	Foutains at Bay Hill		48-01068-P	Vizcaya Condominiums
48-00126-S	Dr Phillips Marketplace Parking Improvements		48-01077-P	Plaza Venezia Phase 3
48-00126-S-02	Marketplace at Dr Phillips		48-01088-P	Sand Lake Property AKA Vizcaya
48-00126-S-03	Expansion at Marketplace - Sand Lake Road		48-01088-P	Vizcaya Townhomes Tract A Sand Lake Property
48-00126-S-04	Della Drive Office		48-01133-P	Sand Lake Groves
48-00138-S	Westgate Lakes Fka Sand Lake Resort		48-01205-P	McDonalds Restaurant
48-00138-S	Westgate Lakes Phase IV		48-01205-P	Phillips View Tower Building
48-00148-S	Orlando Regional Med		48-01239-P	Vizcaya III
48-00148-S	Sand Lake Medical Park		48-01243-P	I-4 Auxillary Lane SR 535 to SR529
48-00174-S-02	Sand Lake Commons		48-01243-P	I-4 Auxillary Lanes
48-00248-S	Bay View Reserve		48-01468-P	Crown Lake Eve Condos
48-00284-S	Sand Lake Office Center		48-01495-P	Point Cypress
48-00293-S	Park Terrace Apartments		48-01517-S	Vistas at Phillips Commons
48-00307-S	Sand Lake Point Unit V		48-01526-P	Dr P Phillips Community Park
48-00454-S	Emerald Forest Unit 1		48-01526-P	Dr Phillips Community Park 2
48-00490-S	Brentwood Club		48-01583-P	Wildwood Area Roadway Network
48-00498-S	Apopka-Vineland Rd-Lake Tibet-Lake Sheen		48-01622-P	Walmart at Dr Phillips Landing
48-00501-S	Sand Lake Post Office Expansion		48-01645-P	Sand Lake Estates Pd (Venezia)
48-00530-S	Southwest Middle School Classroom Addition		48-01746-P	Dellagio Phase 3
48-00542-S	Carriage Homes		48-01746-P	Dellagio
48-00542-S	Carriage Homes at South Hampton		48-01748-P	Alta-Rialto
48-00558-S	Dr Phillips YMCA Building Expansion		48-01770-P	Vineland Point Condos
48-00633-S	SR528 Bee Line Expressway Widening I4 to McCoy		48-01919-P	The Reserve at Westgate Lakes
48-00693-S	Majorca		48-01959-P	Drury Inn & Suites
48-00693-S	Turkey Lake Road Property		48-02014-P	Dr Phillips Office Building
48-00751-S	Emerald Forest Units 1 2 4		48-02178-P	Parkside P D Tract 2
48-00781-S-02	Bay Meadows Elementary School Relief		83-00064-S-02	Phillips Crossing
48-00790-S	The Vinings at Sand Lake		88-00029-S	I-4 and Sand Lake Road Interchange

2.9 Existing GIS Drainage Infrastructure Data

Drainage infrastructure data, already digitized in GIS, was available from two data sets. The digitized drainage infrastructure was reviewed for data relevant to the study and assimilated into the study drainage infrastructure data. Each data set is listed below.

- **Orange County Stormwater Digitized Drainage Infrastructure –** This data consists of a geodatabase of drainage infrastructure digitized from available County plans and survey. PDFs of the reference documents were included with the data set. The County infrastructure digitization project is ongoing. County GIS staff are developing the geodatabase for the Environmental Protection Department (EPD).
- **SSMC Combined Orange County Stormwater –** This data consists of a geodatabase of surveyed drainage infrastructure at numerous locations scattered throughout Orange County. The data was provided by Southeastern Surveying and Mapping Corporation, Inc. (SSMC) as a compilation of the known SSMC drainage infrastructure survey data collected for the County.

The above GIS data sets are included with the electronic deliverables.

2.10 Drainage Infrastructure

The drainage infrastructure in the study area consists of predominantly closed storm sewer drainage systems that drain to one of the stormwater ponds in the study area. The majority of the subdivisions and commercial developments in the study area have onsite stormwater treatment ponds required by modern stormwater regulations. There are a few developments, however, where development appears to have occurred prior to the implementation of modern stormwater regulations. As a result, the drainage systems in these older developments drain directly to a lake or pond external to the development without flow attenuation and water quality treatment in an onsite stormwater pond. The digitized drainage infrastructure is shown on **Exhibit 2** – Drainage Infrastructure Map.

2.11 Field Reconnaissance

A detailed field investigation of the study area was conducted by Geosyntec personnel on April 19, 21, and 22, 2014. The purpose of the field investigation was to inspect the watershed and locate drainage infrastructure not available from reference data, confirm drainage boundaries, and observe drainage patterns. Photos and notes from the field inspection are included with the electronic deliverables accompanying this report.

3. DRAINWELL DATA EVALUATION AND ASSEMBLY

Based on the available data there were originally two (2) drainwells within the Big Sand Lake watershed. The two (2) original drainwells were apparently abandoned at some point and locations subsequently lost. One of the drainwells was at Big Sand Lake and was replaced by the County in 2004. The other drainwell was northwest of Lake Serene and a replacement drainwell was constructed approximately 25 feet from the existing Big Sand Lake drainwell in April 2015. Refer to **Figure 3-1** for the locations of the original and replacement drainwells. The data sources referenced below are included with the electronic deliverables.

3.1 Former and Replacement Big Sand Lake Drainwell

The former drainwell was located on the west side of the southern portion of the lake approximately 200 feet southeast of the intersection of Pointview Court and Lundy Court. According to a "Drainage Well Inventory" fact sheet from SFWMD the drainwell is lost.

In response to flooding problems at Big Sand Lake in 2004, the County received emergency approval from the FDEP to construct a replacement drainwell for the lost drainwell mentioned above. The replacement drainwell, constructed in 2005, is located on the west side of the lake approximately 750 feet east of Apopka Vineland Road. Based on a load test report dated May 26, 2015, by The Colinas Group, Inc. the well open borehole was increased from its original depth of 381 feet to 450 feet in 2015. Based on the survey performed on 12/09/2013 for the Lake Serene Drainage Well Replacement, water from the lake flows to the drainwell superstructure through a 30" CMP pipe. Refer to **Figure 3-1** for a tabular summary of the drainwell characteristics based on the SFWMD fact sheet and County "Drainwell Summary Report" dated 3/3/2009.

3.2 Former and Replacement Lake Serene Drainwell

The former drainwell was located on the northwest side of Lake Serene. According to the 2004 CDM report the drainwell "was used for the stormwater management system on the property that was formerly owned and operated by Minute Maid Corporation".

The County constructed a replacement drainwell for the former Lake Serene drainwell in April 2015. The replacement drainwell was constructed on Big Sand Lake for flood mitigation purposes. Based on the Lake Serene DW-005 Drainage Well Replacement plans, the replacement Lake Serene drainwell is approximately 25 feet from the existing Big Sand Lake drainwell. In lieu of constructing a second intake from the lake, the drainwell superstructure was connected to the existing Big Sand Lake drainwell superstructure by an 18" RCP. Refer to **Figure 3-1** for a tabular summary of the drainwell characteristics based on the SFWMD fact sheet.

Approximate Location of Former Lake Serene Drainwell

Replacement Big Sand Lake Drainwell

Replacement Lake Serene Drainwell

Approximate Location of Former Big Sand Lake Drainwell

Summary of Drainwell Characteristics

Parameter	[1]Former Lake Serene Drainwell	[1]Former Big Sand Lake Drainwell	[2]Replacement Big Sand Lake Drainwell	[3]Replacement Lake Serene Drainwell
Status	Lost Historical Drainwell	Lost Historical Drainwell	Replacement Drainwell	Replacement Drainwell
Year Constructed	unknown	1931	2005	2015
Casing Diameter (inch)	12	10	12	12
Casing Depth (feet)	114	173	172	150
Open Borehole Depth (feet)	356	484	450	450
Top of Casing Elevation (feet)	Unknown	Unknown	91.73	90
Lake Intake Elevation (feet)	Unknown	Unknown	89.96	89.96
USGS ID	282636081300801	282514081290301	N/A	N/A
SFWMD ID	1494053494574	1485920500541	N/A	N/A
Orange County ID	N/A	N/A	DW003	DW005

Data Sources:
1 - SFWMD Drainwell Fact Sheet.
2 - County Fact Sheet and survey completed for the Lake Serene Drainwell Replacement Project. Open borehole depth from Hydraulic Load Tests Report, The Colinas Group Inc.
3 - Technical Plans and Specifications for Lake Serene (DW-005) Drainage Well Replacement

ORANGE COUNTY GOVERNMENT FLORIDA

N

0 500 1,000 Feet

Legend

- Drainwells

Sources:
Aerial: OCPA, 2016
Hydrology: Orange County, 2013
Roads: Orange County, 2015

Figure
3-1

Drainwell Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

4. DIGITAL ELEVATION MODEL DEVELOPMENT

Aerial-based topographic data available from the County was collected and utilized to develop a digital topographic surface of the watershed. This surface was utilized to aide in the development of the subbasin boundaries, watershed connectivity, and develop parameters needed to conduct the hydrologic/hydraulic modeling for this study. The collected topographic data was compiled in the GWIS geodatabase included with the electronic deliverables accompanying this report.

4.1 Topographic Data

There is a moderate amount of topographic relief in the study area, ranging between approximately 163 feet to 87 feet NAVD88. The topography generally slopes toward Big Sand Lake located in the central portion of the watershed.

Two (2) datasets of aerial based topography for the study area were provided by Orange County. Each topographic dataset is discussed briefly below.

- **Shingle Creek Topography** – This traditional photogrammetry-based dataset includes digital one foot contours, spot elevations, and breaklines for the watershed. The data are dated 2002 and reference the NAVD88 vertical datum.
- **Reedy and Cypress Creek Topography** – This LiDAR based dataset includes ground points, breaklines, and one foot contours for areas just outside the western edge of the watershed. The data are dated 2005 and reference the NAVD88 vertical datum.

Refer to **Exhibit 3** for a map of the topography of the study area and the boundaries of the various topographic data sources.

4.2 Initial Raster Digital Elevation Model (DEM) Development

The aerial-based topography datasets provided by Orange County were utilized to create a raster-based digital elevation model (DEM) for topographic analysis in the study area. The topographic GIS features were initially compiled within the GWIS geodatabase and used as inputs to create an ESRI Terrain dataset for the study area. The inputs to the Terrain included the breaklines and spot elevations from the Reedy and Cypress Creek data and the contours and spot elevations from the Shingle Creek data. The initial DEM was generated by converting the terrain dataset to a 1 foot cell size raster using GIS tools.

4.3 Final Raster DEM Development

The initial raster DEM was reviewed and compared to recent aerial photography to identify any topographic voids that may exist in the DEM. Topographic voids include areas where there is a low confidence that the ground surface is accurately represented, which can be caused by development that has occurred since the collection of the topography or where the density of tree canopy or other above-ground features sufficiently obscure the ground surface. Several topographic voids due to recent development were identified within the study area. The majority of the topographic void areas were a result of commercial or residential subdivision developed after the aerial topographic data was collected. Due to the predominantly urban / suburban land use in the watershed, there did not appear to be

any significant low confidence areas due to thick tree or shrub vegetation. Refer to **Exhibit 3** for a summary of the topographic void locations and tabular summary of topographic voids identified in the study area. The summary indicates whether sufficient data was available to correct the topographic void in the DEM.

Breaklines and elevation points were generated to replace the outdated existing aerial topography at the topographic void locations where plans or survey data was available. The breaklines and elevation points were developed in GIS from the contours and spot elevations shown on the referenced plans or survey. In many cases, breaklines were created by connecting referenced spot elevations along curbs, road centerlines, walls and other continuous features. A final (1) foot cell size raster DEM was generated from the updated terrain dataset. Refer to **Exhibit 3** for a map of the final DEM.

Note that any development projects that had not started construction as of the date of the field investigation (April 19, 2014) were not treated as topographic voids. Projects that were under construction based on our field investigation were addressed using available construction plans.

5. HYDROLOGIC FEATURE INVENTORY

The watershed hydrologic GIS features include soils polygons with hydrologic classes for infiltration capacity calculations, land use type polygons to estimate imperviousness, and subbasin polygons to calculate rainfall excess at areas of interest. These features were utilized to develop the hydrologic parameters (area, curve number, time of concentration, etc.) of each subbasin area, which are required by the hydrologic model to simulate subbasin runoff hydrographs. The study hydrologic features are compiled in the GWIS geodatabase included with the electronic deliverables accompanying this report.

5.1 Subbasin Delineation

The study area was discretized into 215 subbasin catchment areas for use in the hydrologic model. The subbasin boundaries were determined using the project DEM, drainage infrastructure, and field observations. Refer to **Exhibit 3** for a map of the subbasin delineations.

5.2 Soils Characterization

A GIS polygon feature class of soils data which was digitized from the Soil Survey for Orange County was acquired from the NRCS web soil survey. The hydrologic classes of the soils in the study area, based on the soils data, are summarized in a table on **Exhibit 4**. Dual classification soils (A/D, B/D, and C/D) would be categorized within hydrologic class 'D' for runoff estimation purposes. Urban Land soils (no hydrologic class provided by NRCS) would be categorized within hydrologic class 'D' for runoff estimation purposes. Also, water areas were considered 100% impervious for runoff estimation purposes.

The soils in the study area were compared to the SWFWMD soils lookup table which included additional soils data useful for runoff and percolation calculations from the NRCS, SSURGO and University of Florida IFAS databases. Site specific geotechnical data gathered from ERPs was also referenced to be potentially used for percolation calculations in the model. Refer to **Exhibit 4** for a map of the soils and table of soil parameters in the study area.

5.3 Land Use Refinement

GIS polygon feature classes dated 2008 of land use data was acquired from SFWMD. The land use polygons were edited for the specific purposes of this study in calculating runoff curve numbers of the subbasins for the model. Refer to **Exhibit 4** for the land use types in the study area.

6. HYDRAULIC FEATURE INVENTORY

The data collected from ERPs, existing GIS drainage inventories, construction plans, topographic survey and field investigations were utilized to inventory the hydraulic features in the watershed. These features were utilized to digitize the drainage infrastructure and develop the model schematic. The model schematic was used to evaluate the level of detail of the modeling conducted during the Existing Conditions Assessment.

6.1 Hydro and HEP Network Development

The drainage infrastructure in the study area was digitized as hydrojunctions and hydroedges within the GWIS based on data collected from previous surveys, existing GIS based drainage infrastructure inventories, as-built and construction plans, or field observations. Many of the drainage structures digitized as hydrojunction / edges were also digitized as hydraulic element points (HEPs), which consist of HEPs at the upstream and downstream invert of each culvert, at drop structure weirs, and structural weirs. HEP lines were digitized between upstream and downstream culvert HEPs to represent culverts.

The digitized hydrojunctions / edges and HEPs are related to the pipe and weir tables in the GWIS for the structures that will be included in the hydraulic model. Specific structure details such as pipe invert, length, diameter, etc., are contained in GWIS tables related to the hydrojunctions/edges and HEPs by relationship classes within the GWIS. The feature and tabular data are related by a unique ID field stored in both the digitized features and related table. As a result, the structure details of the modeled drainage infrastructure elements were populated in the GWIS during model development. Details of other drainage infrastructure not included in the model were not populated in the GWIS. Refer to **Exhibit 2** – Drainage Infrastructure Map for a map of the hydrojunctions and hydroedges network for the study area. Note that the HEPs and HEP lines overlap the hydrojunction and edges and are therefore not shown on **Exhibit 2** or a separate map. The HEPs and HEP lines are included in the GWIS provided with the electronic deliverables.

6.2 Model Network

A model network (nodes and links) was developed based on the digitized drainage infrastructure and the model level of detail considered necessary to meet the objectives of the Existing Conditions Analysis. In general, the network included the primary drainage system in the watershed which includes the retention/detention ponds and lakes in the study area and the connectivity between them. The model schematic is shown on **Exhibit 5.** The watershed features included in the model network are summarized below:

- All retention / detention ponds, lakes and depressions of significance in the study area
- The culverts and manholes / inlets where between connected ponds or lakes
- The Big Sand Lake gravity outfall
- Areas of concentrated percolation (refer to Section 6.3 below)
- The Big Sand Lake and Lake Serene drainwells (refer to Section 6.4 below)

A total of 582 nodes and 785 links were included in the model network.

6.3 Percolation Locations

Locations where concentrated percolation would be expected in the study area were identified. The 20 identified locations included dry ponds or depressions where a review of the recent aerials, referenced ERP geotechnical data or SSURGO soils data indicate that the groundwater table is below the pond bottom and the soils below the pond / depression are well drained. Refer to **Exhibit 6** – Model Network for the percolation link locations. These locations were represented as percolation links in the watershed hydraulic model.

It should be noted that FEMA does not have specific guidance or requirements with regard to the use of percolation as an outfall in ICPR models. There is, however, precedence of their acceptance of its use for floodplain studies conducted by the Southwest Florida Water Management District, which have resulted in FEMA approved FIRM updates.

6.4 Big Sand Lake and Lake Serene Drainwells

Refer to Section 3 of this memorandum for information about the Big Sand Lake and Lake Serene replacement drainwells. A County drainwell fact sheet, hydraulic load test, geophysical logs, and as-built plans are included in the electronic deliverables. Refer to **Exhibit 2** – Drainage Infrastructure Map for the location of the Big Sand Lake drainwells. Refer to Section 7.3 for details regarding the rating curves developed to simulate flow through the drainwells.

7. EXISTING CONDITIONS MODEL DEVELOPMENT

The Interconnected Channel and Pond Routing computer model (ICPR, Version 3.1 SP11) was used as the primary engineering modeling tool for the project. ICPR was used for the hydrological simulation of rainfall and runoff and the hydraulic routing of the runoff on the land surface and subsurface. ICPR uses a node–link representation of real world conditions. Using the site characteristics and the SCS Runoff Hydrograph Method (or other hydrologic schemes), ICPR calculates rainfall rates, soil infiltration rates, and available storage capacity, for discrete storm events. This in turn simulates a runoff hydrograph that can be applied to an area of hydraulic interest within the study area. The calculated runoff can then be hydraulically routed through any number of surface and/or subsurface conveyance structures to evaluate their effectiveness in conveying stormwater.

ICPR is a hydrodynamic stormwater modeling system that can model natural (irregular) channels, prismatic channels, in-line ponds and other storage entities, including the accommodation of overbank flooding. Various control structures can also be simulated including pipes, culverts, drop structures, weirs, orifices, etc. The program can also accommodate the simulation of time dependent tailwater conditions and the effects of submerged and reverse flows. Model output includes detailed stage, storage, and flow data representations versus time for all nodes and links. The ICPR PercPack™ plug-in provides additional functionality that allows the model to simulate groundwater infiltration. The plug-in has the ability to simulate vertical infiltration through a fixed or varied ground surface area as well as horizontal infiltration mounding analysis.

7.1 Model Integration with Previous Study Models

Shingle Creek Drainage Basin Master Stormwater Management Study ICPR Model (DRMP, May 1997) – The study ICPR model includes the Orange County portion of the Shingle Creek watershed, including the Big Sand Lake subwatershed area. Additional details about the study were discussed previously in Section 2.1. One of the purposes of the Big Sand Lake study is to update and refine the existing conditions ICPR model in the Big Sand Lake subwatershed area and replace the existing model elements in that portion of the existing Shingle Creek ICPR model and GWIS database. A project to migrate the Shingle Creek ICPR model to GWIS is ongoing. The draft Migrated Shingle Creek Model GWIS is currently undergoing County review. After the Shingle Creek Model GWIS is final, it is recommended to integrate the updated Big Sand Lake GWIS elements into the Shingle Creek GWIS.

7.2 Hydrologic Parameters Development

The extent of the hydrologic model developed for this study included all of the contributing areas to the study area lakes, which include Big Sand, Little Sand, Spring, Serene, Willis, Crowell, Mirror, Tucker, and Sloat. The ICPR model input and results are included with the electronic deliverables that accompany this report.

To assess the impacts of stormwater runoff in the watershed, the study area was divided into discrete subbasin areas which represent specific contributing areas to a location of interest (pond, inlet, culvert, ditch, etc.). Subbasin delineation was conducted using the raster DEM developed for the project to determine boundaries between subbasins. The

watershed was discretized into a total of 215 subbasins suitable for use in the floodplain and level of service analysis. The model subbasins are depicted on **Exhibit 5**.

The model uses the subbasins to provide the hydrologic parameters used to generate the runoff volume routed in the hydraulic portion of the model. Using the SCS Runoff Hydrograph Method, each basin is assigned the appropriately determined curve number parameters, time of concentration, and unit hydrograph peaking factor to simulate the runoff from the represented area. Each basin translates a hydrograph to one specific assigned model node. These parameters are described in more detail below.

7.2.1 Rainfall Distribution, Depths, Duration, and Frequency

The SCS Unit Hydrograph Method was used for the project. To implement the SCS Unit Hydrograph Method, a rainfall distribution must be specified for the desired storm event as a function of time for the subbasin's unit hydrograph. Standard SCS or SFWMD rainfall distributions are commonly used in this region of Florida if no local distribution has been established. However, Orange County has developed its own rainfall distribution which is considered reasonable for 24 hour duration storm analysis.

The rainfall events simulated for this study are the Mean Annual, 10 year, 25 year and 100 year / 24 storms with rainfall depths of 4.5, 7.5, 8.6, and 10.6 inches, respectively. Each of the 24 hour events were simulated using the Orange County rainfall distribution. Additionally, the 100 year / 72 hour storm event was simulated using a rainfall depth of 14 inches and utilized the SFWMD-72 hour rainfall distribution.

One historic rain event from 2003, which caused high stages in Big Sand Lake was also simulated in the existing conditions model. Development of the 2003 rain event model is discussed in Section 7.4.

7.2.2 Curve Number

Area weighted curve numbers (CN) were developed for each subbasin by intersecting the soil type (hydrological factor) and land use data within each subbasin using ArcGIS tools. Literature derived CN values based from the NRCS's Technical Release 55 (TR-55) were assigned to each of the soil type/land use combinations. A weighted CN was then calculated for each subbasin based on the relative percentages of the various land use and soil types within it. Refer to the electronic deliverables for the CN calculations. The model subbasin CN values are summarized on **Exhibit 5**.

7.2.3 Time of Concentration

The SCS Unit Hydrograph method requires a time of concentration (Tc) be specified for each subbasin. The Tc represents the amount of time it takes for a particle of water to travel from the hydraulically most distant point in the drainage basin to its outlet. The Tc is computed by summing all the travel times for consecutive flow components (sheet flow, shallow concentrated flow, channel flow) of the subbasin conveyance system in accordance with TR-55.

Sheet flow is flow over plane surfaces of less than 100'. After 100' sheet flow is assumed to become shallow concentrated flow. Shallow concentrated flow is also used for flow in very small channels such as water flowing along a street curb. Open channel flow is used for

flow in ditches or pipes. A minimum Tc of 10 minutes was used in the calculations. Refer to the electronic deliverables for the Tc flow paths and calculations. The model subbasin time of concentrations are summarized on **Exhibit 5**.

7.2.4 Peaking Factor

The SCS Unit Hydrograph Method requires a unit hydrograph peak rate factor (K') be specified. The selection of a K' depends on the geographical area and local conditions. Selection of K' were based on the procedures outlined in the document entitled "Procedure for Selection of SCS Peak Rate Factors for Use in MSSW Permit Applications", SJRWMD, April 1990. Specifically, the K' value of 256 was used in the watershed, which based on the SJRWMD 1990 report is "an average of peak rate factors determined for several measured runoff hydrographs from several basins (in addition to the Kissimmee) in central and southern Florida by the U.S. Army Corps of Engineers". In addition, from the SJRWMD 1990 report the K' of 256 is appropriate for the following:

- Watersheds with very mild slopes, recommend by SCS (NRCS) for watershed with average slope of 0.5% or less. Significant surface storage throughout the watershed. Limited on-site drainage ditches.

7.3 Hydraulic Parameters Development

7.3.1 Node-Link Network

The model node-link network was discussed in Section 6.2. Refer to **Exhibit 6** for a map of the model Node Link network.

7.3.2 Nodes

Nodes in the model are typically either defined as Stage/Area or Time/Stage. Stage/Area nodes are used to model storage areas like water bodies/depressions and can also be used as junctions in channels and manholes in pipe networks. Nodes designated as "Manhole Nodes" are essentially Stage/Area nodes that invoke a manhole loss algorithm in the model. Time/Stage nodes typically represent the discharge point(s) or boundary condition(s) in the model. A total of 554 total Stage/Area and 28 Time/Stage nodes were utilized in the existing conditions model.

Initial Stages were set such that the model simulation would begin in static equilibrium. In dry pond locations the initial stage was set at the pond bottom based on the DEM. Wet pond initial stages were set at the pond control structure. The model initial stage of each lake was determined by reviewing the lake historical stage data, County NHWE, and lake control elevation (if applicable). If the lake has a control elevation (drainwell casing, weir, etc.), the initial stage was set at the control elevation. Landlocked lake initial stages were set at the lake NHWE. Note that the Lake Serene control elevation is approximately three (3) feet above the reported NHWE and approximately 0.5 feet above the 100 year elevation in the County Lake GIS layer. However, based on historical stage data for Lake Serene, lake stages regularly exceed both the NHWE and reported 100 year elevation and periodically exceed the lake control elevation. Therefore, it appears reasonable to set the Lake Serene initial stage at the control elevation. The initial stage of each lake is summarized in **Table 7-1** below.

Table 7-1 – Lake Model Initial Stages

Lake Name	Initial Stage	Initial Stage Description
Big Sand	91.73	Drainwell casing elevation.
Little Sand	92.1	Overland weir elevation between Little and Big Sand Lake.
Spring	97.16	Outfall weir elevation.
Serene	96.12	Outfall pipe elevation.
Willis	103.29	Outfall pipe elevation.
Tucker	101.5	NHWE
Sloat	101.12	NHWE
Crowell	99.51	NHWE
Mirror	96.12	NHWE

Warning Stages were set at the elevation at which flooding of concern is expected to occur. Typically, this would include pond berm overtopping, roadway overtopping, manhole top, structure flooding elevation, etc. Refer to **Table 8-2** in Section 8.1 for a node by node description of warning stage rationale.

Stage/Area for each Stage/Area type node was defined below the node initial stage and above the peak node stage from the model results for each node. This was done to accurately define the available storage in each node and prevent extrapolation or performance issues in the model. The stage/area information for storage nodes was extracted from the study DEM using GIS spatial analysis tools.

Boundary Conditions - The following nodes were used to represent the tailwater boundary conditions in the model

- NBSL5420 - Represents the model tailwater condition where the Big Sand Lake outfall storm sewer system discharges into a drainage ditch within the Valencia Water Control District. The model time-stage results for a node within the drainage ditch node were referenced from the draft migrated Shingle Creek model to be used as the model boundary condition at this location.
- NBSL5161 and NBSL5164 - These nodes represent the aquifer that receives flow from the Big Sand Lake and Lake Serene replacement drainwells. The model stage was set at an arbitrarily low elevation (0 feet NAVD) to allow for a free discharge through the drainwell to the aquifer and is held constant for the duration of all modeled storm events. This was considered appropriate because the stage in the

aquifer is not expected to impact stages in the drainwell based on the assumption of full capacity flow.

- Percolation Link Downstream Nodes - These nodes were specified as the downstream boundary of their respective percolation links. The model stage of each boundary node was set at an arbitrarily low elevation (0 feet NAVD) to allow for a free discharge from the percolation link and is held constant for the duration of all modeled storm events.
- Overtopping Weir Link Downstream Nodes – These nodes were specified as the downstream boundary for weir links included to simulate flow overtopping to areas outside of the model domain. The model stage of these nodes was set at an arbitrarily low elevation (0 feet NAVD) to allow for a free discharge from the weir link and is held constant for the duration of all modeled storm events.

7.3.3 Links

The model analyzed flow in links allowing the evaluation of conveyance effectiveness between nodes. Entrance/exit/bend/ head losses were incorporated where appropriate.

Pipes – These links were used to represent the various pipe and culvert sections included in the model. A total of 390 pipe links were used in the existing conditions model. Pipe inverts, dimensions, geometry, and material data were referenced from a combination of project topographic survey data, survey data from other sources, as-built plans, and construction plans. Roughness coefficients (Manning's n) were varied based on material as follows:

- Corrugated Metal Pipe (CMP) 0.023
- Reinforced Concrete Pipe (RCP) 0.012
- High Density Polyethylene (HDPE) 0.012
- Plastic Pipe (i.e., PVC, etc.) 0.01
- Ductile Iron Pipe (DIP) 0.012

Entrance and exit losses were assigned to pipes where appropriate based on the outlet condition at the end of the pipe. These values were assigned based on literature values, or default values were used where exact conditions were uncertain. In general, the values were applied as follows:

- Entrance Losses – a representative average value of 0.5 was used for all pipes
- Exit Losses – for discharge into a static water body 1 was used

For submerged inlet face conditions, end treatment designations were also assigned for pipes based on standard FHWA values. Where exact end treatment geometry was uncertain, typical values were used by default (i.e., square-edges headwall for pipes, elliptical inlet face for mitered end sections, etc.).

Weirs - These links are used to represent outflow weirs at ponds, inlet characteristics to some outfall structures, and to represent overtopping of roadways, or overland flow. 227

weir links were used in the model for this study. The specific geometry of the weir was input into the model. In general, horizontal weirs were used to model flat inlet structures and ditch bottom inlets. Vertical weirs were used to model control structure slots and bleeders along with true weir structures (sharp or broad crested) and overtopping situations. Where complex multi-level weirs are present, two or more separate model weirs were used to account for outflow. Each weir was assigned a specific weir coefficient based on its configuration. Weir coefficients were applied as follows:

- Overland / Saddle Flow / Overtopping Roadway 2.8
- Sharp Crested Weir (typically pond outfall) 3.2

For weirs associated with outfall structures, regular geometric cross-sectional properties (i.e., trapezoidal, triangular, etc.) were used. For the vast majority of weirs representing overland flow and/or overtopping, location-specific irregular cross-section data were extracted from the project DEM. The extracted weir cross-section data were reviewed and manually adjusted where necessary to ensure proper length and invert were represented. These extracted cross-sections were considered a reasonable approximation as best available information where no survey data exists. It should be recognized that vegetation can typically obscure finer details of flow lines when derived from an aerial based topographical surface.

Drop Structures - Typically, the application for drop structures was to represent the control structure at one of the ponds in the study area. The weir and pipe data associated with these links is identical to the weir and pipe data discussed above. These links were also used to simulate inlet-to-pipe in series combinations. 145 drop structure links were used in the model for this study.

Channels - These links are used to represent open drainage ways like ditches, swales, creeks etc, in the model. Channel geometry was represented by irregular cross-sections extracted from project survey data. One (1) channel link was used in the model for this study.

Cross Sections – Location specific irregular cross-sections were extracted from the project DEM, topographic survey, or as-built plans for use in the model. Cross-sections were assigned to specific weir or channel links in the model to provide the irregular geometric properties for these links. For the case of cross-sections used in channel links, the cross-sections are used to store Manning's roughness values as well as geometric data. 18 individual cross-sections were developed for the project.

Rating Curves – 2 rating curve links were used in the model for this study to represent the Big Sand Lake and the Lake Serene replacement drainwells. The parameter development at each model link is described below.

- **Big Sand Lake and Lake Serene Replacement Drainwells** - A brief memorandum summarizing the methodology of the model rating curve development for the Big Sand Lake drainwell was submitted to the County previously and is included in the electronic deliverables. The rating curve for the well was developed based on theoretical weir/orifice and "morning glory" vertical shaft hydraulics calculations

up to the point that aquifer transmissivity aquifer transmissivity would limit the hydraulic capacity of the well. Generally, this methodology was utilized to develop the rating curves at both the Big Sand Lake drainwell and Lake Serene Replacement drainwells.

A constant flow rate hydraulic load test was conducted by the Colinas Group, Inc. at the Big Sand Lake drainwell in May 2015 after the well depth was increased from 381 to 450 feet. A similar constant flow rate hydraulic load test was conducted by Devo Engineering at the Lake Serene Replacement drainwell in April 2015. The load test results were utilized to estimate the hydraulic capacity of each well based on well capacity and calculated aquifer transmissivity. As a result, load test results at each well were utilized for model rating curve development using the methodology summarized above.

Percolation links – These links were used to model percolation as an outfall for dry ponds or other dry depressions. Twenty (20) percolation links were used in the model for this study. Seventeen (17) percolation links were added at dry ponds and three (3) percolation links were added at underground stormwater chambers. Percolation links were added to nodes in the model that met the following general criteria:

- Absence of obvious free water surface or wetland area;
- The average SHWT indicated by the geotechnical data (from site specific or NRCS data) was below the pond bottom and less than 5% of the contributing area to the node had an apparent SHWT within 2' of the surface;
- Based on the results of the 100-year / 24 and 96 hour model simulations without percolation links, enough runoff occurred in the node contributing area to cause stages in the node to increase significantly above the node initial stage (i.e., if little or no runoff was generated, no percolation link was added); and
- Stages in the node would potentially impact floodplain elevations or the LOS assessment in the study area.
- Data from plans or permit indicate that an underground stormwater chamber recovers a significant wet weather storage volume through infiltration to groundwater.

All percolation links included vertical (unsaturated flow) percolation with a user specified flow area. Site-specific geotechnical data from ERPs was used at fifteen (15) of the percolation links. A hydrojunction with a hyperlink to the ERP source data was provided at these percolation links. SSURGO reference data were used for soil hydraulic properties where geotechnical data from ERPs was not available. The following information is provided relevant to the parameter development:

- Vertical and Horizontal Hydraulic Conductivity (ft/day) – Vertical hydraulic conductivity was referenced from the soil parameters (referenced from SWFWMD soils lookup table) table shown on **Figure 5-2**. A factor of safety of two was applied to the vertical hydraulic conductivity. A factor of 1.5 was then applied to the vertical

hydraulic conductivity to calculate the horizontal hydraulic conductivity used in the percolation links.

- Effective Porosity and Suction Head– The effective porosity from the referenced geotechnical data was 0.3 or lower. As a result, the effective porosity applied to the percolation links whose data were referenced from the SWFWMD lookup data were reduced to 0.3. The suction head was referenced from the soils data provided by SWFWMD.
- Annual Recharge Rate – Set to zero for the single event modeling performed for this study.
- Layer Thickness – Calculated as the difference between the apparent SHWT elevation at the upstream node and upstream node bottom elevation.
- Horizontal Infiltration - According to the ICPR v3 Help System (Streamline Technologies, Inc., 2008), *"Three perimeter lengths (P1, P2 and P3) must be specified for saturated horizontal flow computations. P1 is located at the edge of the pond, or better said, at the edge of the unsaturated vertical flow zone. The other two can be placed anywhere beyond the first one, but far enough away from the pond to allow the groundwater mound to dissipate into the ambient water table. All points along a given outer perimeter must be offset an equal distance from the first perimeter. In addition to the three perimeter lengths, the distances from P1 to P2 and from P2 to P3 must be specified. These do not have to be equal. As a matter of fact, the distance from P1 to P2 is typically less than P2 to P3. Also, the number of computational cells between P1 and P2 and between P2 and P3 must be specified."* In the project ICPR model, 50 and 250 foot percolation ring buffers were used for horizontal infiltration. Perimeters of the resulting rings were calculated using buffers in GIS based on the percolation area shape and input into the model. Where significant radial interference of adjacent percolation areas or water bodies was present, the percolation ring buffers were cutoff to not double count horizontal percolation area.

7.4 2003 Storm Event Model Development

Per the project scope, a model simulation was developed and executed representing the major rainfall events from 2003. The purpose of the simulation was to evaluate the relative difference the drainwells would have on stages in the lake during and after heavy rain events that occurred in 2003. Rain events in 2003 were chosen for the simulation due to the historically high stages that occurred during the wet season that year.

Based on review of the daily rainfall totals from the Spring Lake gauge, the high stages in Big Sand Lake in 2003 appeared to be caused by heavier than normal cumulative rainfall during the 2003 wet season rather than a single extreme rain event. However, the model developed for this project is limited to simulating single events. Based on review of synthetic single event storms developed within Florida, the longest duration rainfall event considered appropriate for single event modeling was a five (5) day event. Rainfall simulations lasting more than five (5) days would need to account for additional watershed parameters not included in the study model, such as soil storage and recovery (typically using Green-Ampt), evaporation, lake interaction with groundwater, etc. Therefore, a five

(5) day storm event was developed from the five (5) consecutive days with the highest total rainfall based on review of the Spring Lake gauge. The time period selected for the simulation was from August 18 through 22, 2003.

The August 18 through 22, 2003 rain event simulation was developed from 5 minute increment rainfall data at the County's Spring Lake rain gauge. This data was referenced in the ICPR Hydrology Simulation control for the event.

The final step to developing the 2003 storm event was to adjust the modeled initial stages to the nearest historical lake stage prior to the event, if available. For Big Sand Lake and the other lakes in the watershed, the historical lake stage prior to the event was recorded on August 4, 2003. The initial stages of the lakes where no historical stage record was available near the time of the storm event were not adjusted. Note that the stage recorded at Little Sand Lake on August 4, 2003 was 100.03 feet. This stage was recorded approximately five (5) days before the retaining wall between Little and Big Sand Lakes failed. Based on survey, the current overtopping elevation between these lakes is approximately 92.1 feet. As a result, it was considered appropriate for current model conditions to set the Little Sand Lake initial stage equal to the Big Sand Lake initial stage of 94.29 feet.

It was noted that based on the historical Big Sand Lake stage data, the rainfall from 2004 Hurricanes resulted in higher peak stages than the 2003 wet season rainfall including the high stages caused by the aforementioned retaining wall failure. As a result, the County may consider simulating one of the 2004 hurricane rainfall events to evaluate the level of flood reduction the drainwells may have provided.

8. EXISTING CONDITIONS MODEL RESULTS

8.1 ICPR Model Scenarios and Results

The existing condition in the watershed includes both the Big Sand Lake and Lake Serene replacement drainwells in operation. However, for the purpose of observing the relative modeled peak flood reduction and recovery benefits provided by the drainwells, three model scenarios were simulated, consisting of (A) both drainwells in operation (existing condition), (B) only the Big Sand Lake drainwell in operation, and (C) no drainwells in operation.

8.2 LOS Criteria

A flooding LOS is a criterion by which infrastructure related flooding problems can be assessed for potential deficiencies. The criteria are typically tied to a specific design storm event, the runoff from which must be accommodated by the stormwater facility.

Based on a review of the Orange County Stormwater Management criteria, the LOS standards considered applicable for the stormwater facilities assessed in this project are summarized on **Table 8-1** below.

Table 8-1 – Criteria for Study LOS Assessment Modeling

FLOODING LEVEL OF SERVICE (LOS) STANDARDS / CRITERIA			
Facility	**Storm Frequency / Duration**	**Physical Elevation Reference**	**Example in Project Area**
Local Road or Property Storm sewer or Culvert	10 year / 24 hour	Road Edge of Pavement or Manhole Top Elevation	Storm sewer inlet on Glen Crest Way
Arterial Road Storm sewer or Culvert	25 year / 24 hour	Road Edge of Pavement or Manhole Top Elevation	Storm sewer inlet on Turkey Lake Road
Drainage Detention Area (with positive outfall)	25 year / 24 hour	Pond Top of Bank	Pond in subdivision near Big Sand Lake
Floodplains / Lakes	100 year / 24 or 72 hour	Structure Finished Floor Elevation	Residential properties within study watershed.

Refer to **Appendix A** for the model node peak stages, depth of flooding, and duration of flooding compared to the node warning stages for each of the modeled storm events.

8.3 Primary Drainage Infrastructure Level of Service Evaluation

Based on the criteria listed in **Table 8-1**, the majority of the modeled primary drainage infrastructure passed applicable LOS criteria. However, as shown on **Appendix A**, there were nodes where the warning stage was exceeded during the applicable LOS design storm. Refer to **Exhibit 6** for the locations of nodes that failed to meet applicable LOS. Also, refer to **Exhibit 6** for locations where the model peak stages indicated that habitable or commercial structure flooding occurs during the 100 year storm event. Note that the LOS assessment was performed for the existing condition (both drainwells operating) only.

The primary drainage locations that failed to meet LOS criteria based on the modeling are discussed below. The modeled LOS problem areas were also compared to the three (3) potential primary infrastructure flooding problem areas identified from the County complaint logs (refer to Section 2.6) in an effort to determine whether or not the modeled flooding was related to observed flooding issues. Refer to **Exhibit 6** for the LOS deficiency locations.

Drainage Deficiencies, Action Warranted:

Development of improvement alternatives under a separate future study appears warranted at the following locations associated with primary drainage infrastructure. Note that due to the moderate resolution of the topography at these locations (Shingle Creek one foot contours, non-LiDAR), survey confirmation of structure finished floor elevations is recommended to confirm flood risk prior to engaging in a small area study.

- **Big Sand Lake and Southern Breeze Drive (NBSL5160)** – The model indicates that lake stages would encroach on the back yards of numerous residential properties during the 100 year / 72 hour event. Also, the stages appear close to several residential structures. Due to the large size of the lake, it is possible that structures could be impacted by wave action during high winds. Several complaints (**Complaint Numbers 3 to 11**) describe problems with high stages in Big Sand Lake threatening homes that border Big Sand Lake on Southern Breeze Drive and Elliots Court. Starting during the 10 year / 24 hour storm event, the model indicates high stages from the pond in this subdivision floods Southern Breeze Drive and several residential lots. During the 100 year / 72 hour event, the model indicates possible flooding of 3 residential lots on Southern Breeze Drive and Elliots Court due to high stages in the subdivision pond. Confirmation of finished floor elevations would be needed to confirm any flood impacts of structures. Due to impacts to residential lots and the flooding complaints, further action to evaluate improvement alternatives appears warranted.
- **Bay Harbour subdivision / Lake Serene Drive (NBSL1950, NBSL1790)** – Water from Lake Serene encroaches on residential lots beginning during the 10 year / 24 hour event. Six residential lots on the southwest side of Lake Serene appeared to flood during the 100 year / 72 hour event. Also, the model indicates Lake Serene Drive floods beginning during the 10 year / 24 hour event. Note that the Lake Serene Drive flooding is a secondary drainage issue and the ponds and streets in this subdivision are not County maintained. No related flooding issues were identified

in the complaint logs. Due to the impact to residential lots, further action to evaluate improvement alternatives appears warranted.

- **Lake Crowell and Darlene Drive (MSBU Pond 7311) Pond (NBSL0630, NBSL0640, NBSL0649, NBSL0650)** – The model indicates Lake Crowell overtops its top of bank beginning during the 10 year / 24 hour event. During the 100 year / 72 hour event, the model indicated possible structure flooding due to high lake stages at 5 residential lots. The model also indicated possible structure flooding from the pond at Darlene Drive at one residential lot starting during the mean annual event. No related flooding issues were identified in the complaint logs. Due to the impact to residential lots, further action to evaluate improvement alternatives appears warranted.
- **Lake Willis along Lake Willis Drive (NBSL0080) –** The 100 year model results indicates flooding of a residential lot around the lake. The modeled flooding appears to correspond to three flooding complaints (**Complaint Numbers 17, 18, 29**) related to high stages in Lake Willis. Due to the number of complaints and the modeled residential lot flooding, further evaluation of the drainage system at Lake Willis is warranted.

Drainage Deficiency, No Further Action:

No further action appears warranted at the following location associated with primary drainage infrastructure.

- **Apopka Vineland Road pond flooding (NBSL1200)** – The model indicates the pond overtops starting during the 10 year event, but the flood water does not appear to impact the residential structure at this location. A complaint (**Complaint Number 13**) at this location is associated with water coming up to a resident's home on Lake Serene Drive. The issue appears to be related to high stages in the Apopka Vineland Road pond behind the resident's property. Because no property impacts were indicated in the model and only one complaint was identified, no further action is recommended regarding the Apopka Vineland Road pond.

The flood complaints do not indicate the severity of flooding or the number of structures, if any, that were impacted. Note that this assessment is based on inspection of elevations from the project DEM which represents only land surface. The actual finished floor elevations of these structures are not known and some of the structures may reside above the modeled flood stage. The County may wish to consider surveying the finished floor elevation of the structures modeled flooding areas as a reference relative to the modeled flood stages.

8.4 Secondary Drainage Infrastructure Level of Service Evaluation

Based on the criteria listed in **Table 8-1**, the majority of the modeled secondary drainage infrastructure passed applicable LOS criteria. However, as shown on Appendix A, there were nodes where the warning stage was exceeded during the applicable LOS design storm. Refer to Exhibit 6 for the locations of nodes that failed to meet applicable LOS. Also, refer to Exhibit 6 for locations where the model peak stages indicated that habitable or

commercial structure flooding occurs during the 100 year storm event. Note that the LOS assessment was performed for the existing condition (both drainwells operating) only.

The secondary drainage locations that failed to meet LOS criteria based on the modeling are discussed below.

Drainage Deficiencies, Action Warranted: Further investigation of modeled flooding appears warranted under a separate future study at the following secondary drainage infrastructure locations due to reported flooding problems and possible structure flooding. Note that due to the moderate resolution of the topography at these locations (Shingle Creek one foot contours, non-LiDAR), survey confirmation of structure finished floor elevations is recommended to confirm flood risk prior to engaging in a small area study.

- **Bay Lakes at Granada subdivision pond (NBSL1441, and NBSL1443**) – The model indicates the pond floods into San Ambrosio Drive beginning during the 10 Year / 24 hour event. 13 residential lots appear to be impacted by the flooding during the 100 year / 72 hour event. No flood related complaints were identified in the area.
- **Stonewood Manorhomes/Dr. Phillips Boulevard (NBSL2790)** – The model indicates an overtopping pond within the apartment complex floods two buildings starting at the mean annual storm event. **Complaint number 26** indicated that the drain running from the pond to the canal along Dr. Phillips Boulevard backs up into the street at this location.
- **Della Drive/ West Sand Lake Road intersection (NBSL2140, NBSL2220, NBSL2230, NBSL2540, NBSL2550)** - Modeling indicates street flooding at the intersection of Della Drive and West Sand Lake Road beginning at the mean annual storm event. No flood related complaints were identified in the area.
- **Somerset Shores (NBSL2870, NBSL2880, NBSL2890, NBSL2910) -** The model indicates four of the subdivision ponds overtop beginning during the mean annual event flooding one building. Twelve residential buildings within the subdivision appear to be within the 100 year / 72 hour flooding. No related issues were identified in the complaint logs. Note that Somerset Shores is a private subdivision.
- **Orange Tree and Phillips Bay subdivisions stormwater system and hydraulic connected structures along Dr Phillips Boulevard (NBSL3230, NBSL3240, NBSL3350, NBSL3360, NBSL3370, NBSL3380, NBSL3390, NBSL3400, NBSL3410, NBSL3420, NBSL3510, NBSL3550, NBSL3560, NBSL3570, NBSL3580, NBSL3590, NBSL3600, NBSL3610, NBSL3650, NBSL3680, NBSL3690, NBSL3710, NBSL2931)** – The model indicates 13 drainage structures and 9 ponds fail level of service requirements and flood Doubletrace Lane, Wallace Road and an inlet on Dr. Phillips Drive beginning with the 10 hour storm event. No related flooding issues were identified in the complaint logs. Note that Orange Tree and Phillips Bay are private subdivisions.
- **Spring Lake Villas (NBSL3840, NBSL3850)** - The model indicates street flooding along Wallace Road beginning during the 25 year / 24 hour event and 10 year level

of service failure of a manhole structure within the Spring Lake Villas subdivision. A complaint (**Complaint Number 15**) was identified within the subdivision related to flooding on Spring Villas Circle within the subdivision.

- **Pond off Turkey Lake Road (NBSL4250, NBSL4270)** - The model indicates the commercial pond and a small area of Turkey Lake Road floods starting at the mean annual event. The model did not indicate any structures would be impacted and no related flooding issues were identified in the complaint logs.
- **Interstate-4 Intersection (NBSL5220, NBSL5230)** – The model indicates an inlet and manhole structure at the interchange of I-4 and Central Florida Parkway flood into Central Florida Parkway starting during the mean annual storm event. No related flooding issues were identified through complaint logs.

Drainage Deficiencies, Monitoring Warranted: Based on no reported history of flooding problems, the drainage infrastructure is outside the County's jurisdiction, or the flooding appears to be a private drainage deficiency, further investigation at the following locations does not appear warranted. However, these areas should be monitored in the event problems are identified in the future.

- **Bay Meadows Elementary (NBSL0940) -** The model indicates the peak stage of the pond on this property exceeds its top of bank starting during the 10 year storm event, flooding the street in front of the school. No related flooding complaints were identified.
- **Clubhouse Estates subdivision pond (NBSL1470, NBSL1480, NBSL1490)** - The model indicates the subdivision pond will overtop the top of bank beginning during the mean annual storm event and overflow into the street. No structures are impacted by the flooding and no related flooding complaints were identified.
- **Marketplace (NBSL2340)** – The model indicates the peak stage of the pond on this property exceeds its top of bank impacting the parking lot starting during the 10 year storm event. No related flooding issues were identified in the complaint logs.
- **Granada Villas pond (NBSL2620, NBSL2620)** – The model indicates the peak stage of the ponds within this subdivision overtop their top of bank beginning during the mean annual event. The ponds overflow to nearby drainage inlets and no property appears to be impacted. No flooding complaints were identified in the area.
- **Dr. Phillips Marketplace (NBSL2850) -** The model indicates flooding of a commercial structure in this area beginning during the 10 year event. This appears to be a private property drainage deficiency. No flooding complaints were identified in this area. Note that the model indicates flooding despite the use of a percolation link at the pond at this location.
- **YMCA property (NBSL2670, NBSL2680)** –The model indicates the ponds within the property overtop and flood the buildings beginning during the 10 year storm event. The ponds are located within private property. No flooding complaints were identified for the area.

- **Condos at Toscana pond (NBSL4060) -** The model indicates the pond overtops the top of bank starting during the 10 year / 24 hour storm event and discharges directly to Spring Lake. No related complaint issues were identified.
- **Phillips Crossing pond (NBSL4520)** –The model indicates the pond within the Phillips Crossing development overtops during the 25 year / 24 hour storm event and floods the parking lot. The pond is located within private property. No flooding related complaints were identified for the area.
- **Storm sewer structure on Turkey Lake Road (NBSL4580)** – The model indicates the peak stage at this manhole will exceed the manhole lid beginning at the 25 year/24 hour storm event. The model did not indicate any related road or structure flooding and no issues were identified in the complaints for this area.
- **Walmart Development ponds (NBSL4830, NBSL4840)** – The model indicates that the ponds within the Walmart development will overtop beginning during the mean annual storm event. The ponds overflow directly into Big Sand Lake, not impacting the commercial property. No complaint issues were identified in this area.
- **Lakeview Medical Park Condo Development (NBSL4980)** – The model indicated overtopping of the pond during the 10 year event. The property lies within a topographic void area so the finished floor and parking lot elevations would need to be verified to determine whether the property experiences flooding. Also, this appears to be a private drainage issue. There were no flooding complaints identified in this area.
- **Westgate Lakes pond (NBSL5090) -** The model indicates that a pond within the Westgate Lakes subdivision will overtop beginning during the mean annual storm event. The pond overflows directly into Big Sand Lake, not impacting any structures or property. Also, this appears to be a private drainage issue and no related flooding complaints were identified.

The flooding complaint locations discussed in Section 2.6 were revisited based on the LOS analysis results. No flooding or level of service issues associated with flooding complaint numbers 2, 23, 14, 20, 21, 22, 24, and 29 were indicated by the model results.

8.5 Modeled Floodplains

The floodplain extents within the watershed were delineated from the model peak stage results and the final project DEM using GIS spatial analysis tools. Some further processing to smooth boundaries and remove floodplain polygons smaller than 250 square feet resulting from the GIS tools was also performed. The model peak stages from the 100 year / 72 hour event were the same or higher than the 100 year / 24 hour event for all model nodes. Therefore, the 72 hour event was used to delineate the 100 year floodplains. The 10 year and 25 year / 24 hour floodplain extent polygons were also delineated using GIS spatial analysis tools, however no further processing of these polygons was performed. Refer to **Exhibit 7** for the floodplain polygons.

It was noted that the modeled 100 year peak stages are significantly lower for Big Sand Lake and Little Sand Lake compared to the FEMA 100 year flood elevations. Refer to **Table**

8-2 below for a comparison of the model 100 year peak stage and FEMA 'Zone AE' elevation. Based on review of the Orange County FIS, the FEMA lake elevations appear to be based on the results of a previous flood study that utilized ICPR to simulate lake stages. However, the specific model parameters utilized in the study model referenced by the FIS were not reviewed as part of this study. As a result, the reasons for the differences between the FIS and current study 100 year stages are not known.

Table 8-2 - Comparison of Big and Little Sand Lake Modeled and FEMA Stages

Lake Name	Modeled 100 Year Peak Stage	FEMA 100 Year Flood Elevation
Little Sand Lake	95.31	100.9
Big Sand Lake	94.97	100.5

The modeled 100 year floodplains were compared to the 2014 aerials to identify locations of possible residential or commercial structure flooding. 71 total possible structure flooding locations were identified. Refer to **Exhibit 7** for the possible structure flooding locations. A GIS feature of locations where the structure(s) may be impacted by the modeled 100 year floodplain is included in the electronic deliverables. Note that this assessment is based on inspection of elevations from the project DEM which represents only land surface. The actual finished floor elevations of these structures are not known and some of the structures may reside above the modeled flood stage. The County may wish to consider surveying the finished floor elevation of the structures in this area as a reference relative to the modeled flood stages.

8.6 Existing Conditions Model Results Summary

Based on the foregoing, the following is noted:

- **Primary Drainage Deficiencies, Action Warranted:**
  Under separate future study, development of primary drainage infrastructure improvement alternatives appears warranted at the following locations (discussed in Section 8-3). Note that due to the moderate resolution of the topography at these locations (Shingle Creek one foot contours, non-LiDAR), survey confirmation of structure finished floor elevations is recommended to confirm flood risk prior to engaging in a small area study.:
  - Big Sand Lake/Southern Breeze Drive
  - Bay Harbour subdivision / Lake Serene Drive
  - Lake Crowell and the Darlene Drive pond
  - Lake Willis Drive
- **Secondary Drainage Deficiencies, Action Warranted:** Further investigation of modeled flooding appears warranted under a separate future study at the following locations (discussed in Section 8-4). Note that due to the moderate resolution of the topography at these locations (Shingle Creek one foot contours, non-LiDAR), survey confirmation of structure finished floor elevations is recommended to confirm flood risk prior to engaging in a small area study.

- Bay Lakes at Granada subdivision pond
- Stonewood Manorhomes/Dr. Phillips Boulevard
- Della Drive/ West Sand Lake Road Intersection
- Somerset Shores
- Orange Tree and Phillips Bay subdivisions
- Spring Lake Villas
- Pond off Turkey Lake Road
- Interstate-4 Interchange

- **Secondary Drainage Deficiencies, Monitoring Warranted:** Based on no reported history of flooding problems, the drainage infrastructure is outside the County's jurisdiction, or the flooding appears to be a private drainage deficiency, further investigation at the following locations (discussed in Section 8-4) does not appear warranted. However, these areas should be monitored in the event problems are identified in the future.
  - Marketplace subdivision pond
  - Granada Villas subdivision pond
  - Dr. Phillips Marketplace stormsewer
  - YMCA property ponds
  - Condos at Toscana pond
  - Storm sewer structure on Turkey Lake Road
  - Walmart Development ponds
  - Lakeview Medical Park Condo Development
  - Westgate Lakes pond

9. DRAINWELL EFFECTIVENESS AND PERFORMANCE ASSESSMENT

9.1 Major Storm Event Flood Reduction Benefit

The County is concerned with assessing the relative flood performance of Big Sand Lake during major storm events with and without the drainwells. As mentioned previously, three model scenarios [(A) both Big Sand Lake drainwells operational, (B) only the Big Sand Lake drainwell constructed in 2004 operating, and (C) no drainwells operating] were simulated for each modeled storm event. A comparison of the model peak stage results from each scenario for Big Sand Lake is provided in **Table 9-1** below.

Table 9-1 – Big Sand Lake Drainwells On Vs Off Peak Stage Comparison

Storm Event	Peak Stage (Feet)		
	(A) Both Drainwells Operational	(B) Only 2004 Drainwell Operational	(C) No Drainwells Operational
Mean Annual/ 24 Hour	92.30	92.30	92.31
10 Year / 24 Hour	93.00	93.01	93.02
25 Year / 24 Hour	93.30	93.31	93.31
100 Year / 24 Hour	93.86	93.87	93.88
100 Year / 72 Hour	94.97	94.98	95.00
August 2003 Event	95.39	95.41	95.43

As shown on **Table 9-1** above, the drainwells have a small effect on the modeled peak stages in Big Sand Lake. This appears to be due to the relative quantity of modeled inflow to the lake compared to the modeled outflow through the drainwells. For example, the model peak inflow to the lake during the Mean Annual / 24 Hour event (smallest modeled storm event) is approximately 1,314 cfs, whereas the peak outflow from the lake through the drainwells is only approximately 2.84 cfs. In other words, the peak outflow from the drainwells is approximately 0.2% of the peak inflow to the lake during the smallest modeled storm event. Consequently, based on the model results, it appears evident that the drainwells would provide minimal peak flood stage reduction benefit during a major storm event.

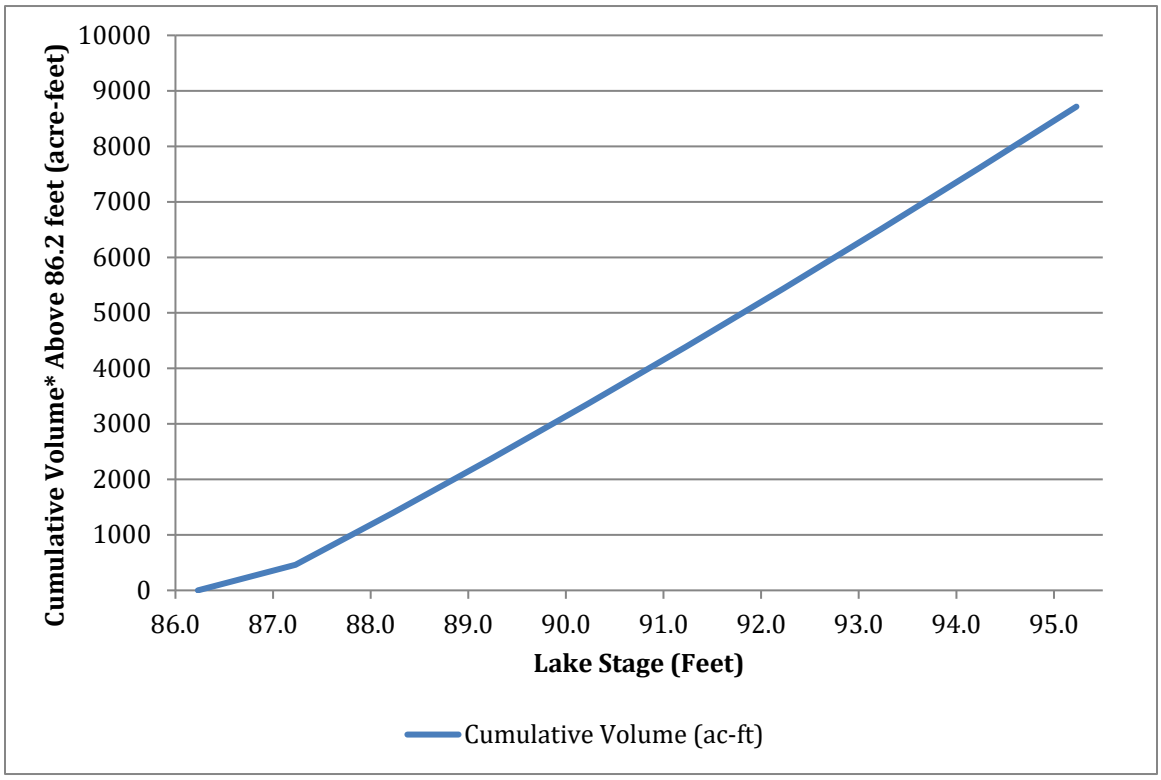
9.2 Seasonal Flood Reduction Benefit

The County is also concerned with assessing the effectiveness of the drainwells at reducing and recovering high stages in Big Sand Lake during long periods of heavy precipitation. Based on review of historical rainfall and lake stage data, high lake stages are

predominantly a result of cumulative heavy rains over several weeks to more than a month rather than the result of a single major rain event. For example, based on the Spring Lake rain gauge, the rainfall that caused high stages during the Fall of 2003 did not exceed three (3) inches during any 24 hour period. As a result, the main function of the drainwells may be to reduce flooding in the lake resulting during periods of long term heavy precipitation.

As mentioned previously, because the model developed for this project does not account for soils storage and recovery, evapotranspiration, and groundwater interaction, the model is limited to simulating single events. As a result, the potential flood relief provided by the drainwells during periods of long term heavy rain could not be explicitly simulated using the existing model. However, an average monthly stage reduction potentially provided by the drainwells when the lake stage is more than 0.5 feet above the drainwell casing elevation was calculated. This was done by calculating the volume that could potentially discharge through the drainwells, then relating the volume discharged to the lake's stage volume curve (**Figure 9-1**). The resulting monthly lake stage reduction provided by the drainwells, with the lake starting at the existing conditions 100 year / 72 hour peak elevation of 94.97 feet, is provided in **Table 9-2** below. Note that the calculated stage reductions shown in the table below do not account for potential volume recovery resulting from evapotranspiration or groundwater interaction with the lake, which may be significant.

Figure 9-1: Big Sand Lake Stage-Volume Curve



*Volume extracted from final project DEM using GIS spatial analysis tools. The lowest elevation from the DEM is approximately 86.2 feet.

Table 9-2 – Big Sand Lake Drainwells Stage Recovery

Drainwell Scenario	Initial Stage (feet)	Drainwell Flow (cfs)	Average Monthly Discharge (acre-feet)	Final Calculated Stage[1] (feet)	Monthly Drawdown (feet)
Both Drainwells	94.97	2.84	171.3	94.77	0.20
2005 Drainwell Only	94.97	1.38	93.3	94.89	0.08

1. Final calculated stage based on one month of lake stage recovery through the drainwells. Soil storage, evapotranspiration, groundwater interaction, rainfall, not accounted for in calculation.

As shown on **Table 9-2** and **Figure 9-1** above, the total volume the drainwells could potentially discharge in a month is small relative to the total lake volume, which resulted in only small calculated stage decreases. However, it should be noted that the drainwell recently constructed in 2015 approximately doubled the theoretical maximum flow capacity of the drainwells.

9.3 Drainwell Assessment Summary

Based on the foregoing, the following is noted:

- **Drainwell Major Storm Event Flood Reduction Benefits** – Based on the model results, the drainwells provide a small peak flood reduction benefit during the modeled storm events.
- **Drainwell Seasonal Flood Reduction Benefit** – Based on the calculated volume that could potentially discharge through the drainwells in a month relative to the total volume in the lake, the potential flood stage recovery benefit of the drainwells is limited.

10. BIG SAND LAKE OUTFALL EVALUATION

10.1 Big Sand Lake Outfall Description

The Big Sand Lake outfall is located on the southeast side of the southern lobe of the lake. The outfall consists of a series of various size culverts and short ditches that connect from the lake to a Valencia Water Control District (VWCD) Canal. The culverts west of Interstate 4 (I-4) are sloped to the west towards Big Sand Lake, such that the discharge (high) point of the outfall is on the east side of the I-4 On Ramp west of I-4. From the culvert under I-4, the culverts are sloped to the east to a 48" RCP storm sewer system that flows along the south side of the Central Florida Parkway prior to discharging through a 66" RCP into a VWCD canal. Based on review of the series of the outfall culverts and ditches, the discharge capacity of the outfall appears to be restricted by this 48" RCP. The VWCD canal eventually discharges eastward into Shingle Creek. Refer to **Exhibit 8** for the location of the Big Sand Lake outfall and details of the outfall shown in both plan and profile views.

10.2 Outfall Evaluation Alternatives

As indicated previously on **Table 7-2**, the initial stage of Big Sand Lake in the model was set at the drainwell invert (91.73 feet), which was considered the control elevation of the lake for existing conditions modeling purposes. Due to the large lake volume, the modeled lake stages remained below the Big Sand Lake outfall discharge elevation during the modeled storm events, with the exception of the 2003 Storm Event simulations, which resulted in peak stages less than 0.1 feet above the outfall discharge elevation. As a result, three (3) alternative model scenarios were developed for the purpose of evaluating the effectiveness of the Big Sand Lake outfall at controlling elevations in the lake. The alternative model scenarios are described below.

- ***Alternative 1: Existing Outfall*** - This alternative model scenario consisted of raising the initial stage of Big Sand Lake in the model to the outfall discharge elevation (95.34 feet). The initial stage in other model nodes directly connected to the Big Sand Lake node were also raised to this elevation. Otherwise, this alternative model was the same as the existing conditions model scenario (both drainwells operating).
- ***Alternative 2: Lowered Outfall*** **–** This alternative model scenario consisted of lowering the elevations of the existing outfall pipes to the lowest physically feasible elevation given downstream constraints. Based on conversations with County staff, it is considered infeasible to replace the existing 48" RCP storm sewer pipes that parallel Central Florida Parkway. As a result, the lowest effective elevation the outfall pipes could be lowered to is the invert of these pipes at 94.5 feet. Therefore, in order to evaluate the effect of lowering the existing lake outfall, the model pipe and channel link inverts along the outfall were lowered as needed to make the lake discharge at an elevation of 94.5 feet. Also, the Big Sand Lake node (and any other directly connected model nodes) initial stage was set at the alternative discharge elevation of 94.5 feet.

  Please note that the Alternative 2 modeling scenario did not include conceptual hydraulic design of an alternative proposed Big Sand Lake outfall. The alternative modeling consisted of simply adjusting downwards pipe inverts and node initial

stage elevations only, not changing dimensions or cross-sections. An actual proposed outfall system hydraulic design would consist of replacement of the existing culverts and channel sections with consistently graded and sized outfall drainage system.

- ***Alternative 3: Removed Outfall –*** This alternative model scenario was included for comparison purposes to show the flood reduction benefit of the existing outfall compared to a scenario where the piped outfall was not available. In this model scenario, the initial stage of Big Sand Lake was raised to the existing outfall discharge elevation (95.34 feet) and the flow of the model pipe link "PBSL5340 was set to "None" to prevent water from discharging from Big Sand Lake to the Central Florida Parkway 48" RCP storm sewer pipe.

10.3 Outfall Evaluation Results

Alternatives 1 and 2 Comparison - Based on comparing the Alternative 1 (Existing Outfall) and 2 (Lowered Outfall) model results, lowering the effective discharge elevation of the outfall may provide improved control of peak lake levels. For example, the peak lake level during the 100 Year / 72 Hour event was 0.73 feet lower for Alternative 2 than Alternative 1. Note that the benefit appears to be mostly attributable to the lower lake initial stage in the Alternative 2 model. Refer to **Table 10-1**, for a comparison of the Alternative 1 and 2 model results.

Also, based on the Alternative 1 and 2 model results, the 48" RCP storm sewer pipe along Central Florida Parkway (as stated above, the overall outfall capacity is restricted by this 48" RCP) was at less than full capacity for the majority of the modeled storm events. Although not considered feasible due to downstream constraints, this appears to indicate that further lowering the outfall discharge elevation could provide additional lake level control benefits.

In addition to control of peak lake levels, the capability of the existing outfall to recover high lake stages was evaluated. Based on the modeled stage discharge relationship of the lake outfall, it would take approximately one (1) month for the lake stages to recover approximately two (2) feet from the 100 Year / 72 Hour peak elevation (98.08 feet) and more than two (2) months for stages to recover to the outfall discharge elevation (95.34 feet). Because both Alternative 1 and 2 scenarios ultimately discharge through the same downstream pipe, the lake level recovery times of the scenarios are similar. Note that the above recovery time estimates do not account for factors such as evapotranspiration, input from rainfall / runoff, groundwater interaction, etc.

Table 10-1 – Big Sand Lake Outfall Alternatives 1 and 2 Outfall Comparison

Storm Event	Alternative 1				Alternative 2			
	Lake Peak Stage (Feet)	Stage Above Discharge Elevation (Feet)[1]	Peak Stage at Upstream End of 48" RCP (Feet)[2]	% of 48" RCP Full Capacity	Lake Peak Stage (Feet)	Stage Above Discharge Elevation (Feet)[3]	Peak Stage at Upstream End of 48" RCP (Feet)[2]	% of 48" RCP Full Capacity
Mean Annual/ 24 Hour	95.91	0.57	96.43	48%	95.08	0.58	96.17	42%
10 Year / 24 Hour	96.55	1.21	97.30	70%	95.75	1.25	97.00	62%
25 Year / 24 Hour	96.81	1.47	97.53	76%	96.01	1.51	97.26	69%
100 Year / 24 Hour	97.29	1.95	97.96	86%	96.5	2.00	97.70	80%
100 Year / 72 Hour	98.13	2.79	98.81	100%	97.4	2.9	98.70	100%

1 – Node NBSL 5160, Discharge elevation = 95.34 feet
2 – Node NBSL5350 located at upstream end of 48" RCP storm sewer on the south side of Central Florida Parkway.
3 – Node NBSL 5160, Discharge elevation = 94.5 feet

Alternatives 1 and 3 Comparison

Based on comparing the Alternative 1 and Alternative 3 (Removed Outfall) model results, the existing Big Sand Lake outfall appears to provide only a small flood reduction benefit compared to no outfall during large storm events. For example, the lake peak stage was only 0.02 feet lower with the outfall than without the outfall during the Mean Annual event and 0.26 feet lower during the 100 Year / 72 Hour event. Refer to **Table 10-2**, for a comparison of the Alternative 1 and 3 model peak stage results. The Alternative model scenarios input and results are included in the electronic deliverables.

Table 10-2 – Big Sand Lake Alternative 1 and 3 Outfall Peak Stage Comparison

Storm Event	Alternative 1	Alternative 3	Lake Peak Stage Difference (Feet)
	Lake Peak Stage (Feet)	Lake Peak Stage (Feet)	
Mean Annual/ 24 Hour	95.91	95.93	0.02
10 Year / 24 Hour	96.55	96.61	0.06
25 Year / 24 Hour	96.81	96.88	0.08
100 Year / 24 Hour	97.29	97.39	0.10
100 Year / 72 Hour	98.13	98.39	0.26

It should be noted that the 100 Year / 72 Hour Big Sand Lake peak stage from the Alternative 1 and 3 modeling was significantly lower than the FEMA 100 Year elevation

(100.5 feet), even though the model initial stage was set at the higher lake outfall discharge elevation and the existing outfall was removed (Alternative 3).

As shown on **Table 10-2** above, the existing outfall has a small effect on the modeled peak stages in Big Sand Lake. This appears to be due to the relative quantity of modeled inflow to the lake compared to the modeled outflow through the outfall. For example, the model peak inflow to the lake during the 100 Year / 72 Hour events (largest modeled storm event) was approximately 8,892 cfs, whereas the peak outflow from the lake through the 48" RCP storm sewer were only approximately 62.07 cfs. In other words, the peak outflow from the outfall is approximately 0.7% of the peak inflow to the lake during the largest modeled storm event. Consequently, based on the model results, it appears evident that the outfall would provide minimal peak flood stage reduction benefit during a major storm event. However, the outfall does appear to provide for long term recovery of lake stages.

Due to the limited ability of the existing outfall to control peak lake stages during large storm events, lengthy estimated time for lake level recovery through the existing outfall, and high elevation of the existing outfall discharge elevation, it is **recommended that the County evaluate improvements to the existing Big Sand Lake outfall and / or alternative outfalls for the lake under a future study effort.**

11. SUMMARY AND CONCLUSIONS

The purpose of this technical memorandum was to provide a summary of the watershed existing conditions assessment performed during the Watershed Existing Conditions phase of the project. The first six sections of this technical memorandum include a summary of the data compiled during the Watershed Evaluation phase of the study. The following tasks completed during the Watershed Evaluation effort are reiterated below:

- Watershed feature data were assembled, compiled, and evaluated.
- The collected County complaint logs were reviewed and potential primary drainage deficiencies were identified.
- A study area DEM was developed from topographic data provided by Orange County and voids in the data were corrected with construction plans.
- The watershed was discretized into subbasin areas and the soils and landuse runoff parameters were developed.
- The drainage infrastructure was inventoried and utilized to develop a Hydro Network.
- The preliminary model node-link network was developed based on the above.
- Topographic survey needs for key drainage structures, channels, and ponds were identified and prioritized.

The following tasks were completed during the Watershed Existing Conditions effort.

- Generate final DEM from additional data provided in the project survey.
- Using data collected during the Watershed Evaluation and Topographic Survey, build and execute the existing conditions hydrologic and hydraulic ICPR Model.
- Use ICPR Model results to assess LOS of drainage infrastructure in the watershed.
- Delineate the 10, 25, and 100 year floodplains from the existing conditions model simulation and evaluate LOS deficiencies.
- Assess hydraulic performance of the existing drainwells on Big Sand Lake.

The above data collection, inventory, modeling, and assessment tasks provide the basis for potential future improvement alternatives development efforts of the Watershed Management Plan. The above tasks also provide a basis for submittal of the data to FEMA to update the area DFIRM map if the County desires.

Refer to **Exhibit 8** for a summary of the watershed existing conditions assessment data.

Flooding / LOS Assessment: Flooding / LOS deficiencies were identified in this report that may warrant additional investigation and development of possible improvement alternatives. The areas that may warrant further action under a future effort are listed below. Refer to Section 8 for more details about each location.

- **Primary Drainage Deficiencies, Action Warranted:** Under a future study, development of primary drainage infrastructure improvement alternatives appears warranted at the following locations:
  1. Big Sand Lake/Southern Breeze Drive
  2. Bay Harbour subdivision / Lake Serene Drive
  3. Lake Crowell and the Darlene Drive pond (MSBU Pond 7311)
  4. Lake Willis Drive
- **Secondary Drainage Deficiencies, Action Warranted:** Further investigation of modeled flooding appears warranted under a separate future study at the following locations. Note that due to the moderate resolution of the topography at these locations (Shingle Creek one foot contours, non-LiDAR), survey confirmation of structure flooding elevations is recommended to confirm flood impacts.
  - Bay Lakes at Granada subdivision pond
  - Stonewood Manorhomes/Dr. Phillips Boulevard
  - Della Drive/ West Sand Lake Road Intersection
  - Somerset Shores
  - Orange Tree and Phillips Bay subdivisions
  - Spring Lake Villas
  - Pond off Turkey Lake Road
  - Interstate-4 Interchange

Floodplain Assessment: The floodplain extents within the watershed were delineated from the model peak stage results and the final project DEM using GIS spatial analysis tools. The modeled 100 year floodplains were compared to the 2014 aerials to identify locations of possible residential or commercial structure flooding. 77 total possible structure flooding locations were identified. Note that due to lack of detailed topography and surveyed structure finished floor elevation in the watershed, structures within the floodplain are considered possible flooding only.

Drainwell Assessment: The effectiveness of the drainwells at reducing and recovering high stages in Big Sand Lake was assessed as part of the existing conditions evaluation. Based on the drainwell assessment, the following was noted:

- **Drainwell Major Storm Event Flood Reduction Benefits** – Based on the model results, the drainwells provide a limited flood reduction benefit during large storm events.
- **Drainwell Seasonal Flood Reduction Benefit** – Based on the calculated volume that could potentially discharge through the drainwells in a month relative to the total volume in the lake, the potential flood stage recovery benefit of the drainwells is limited.

Outfall Effectiveness Assessment: The effectiveness of the lake outfall at controlling and recovering high stage in Big Sand Lake was also evaluated. Due to the limited ability of the existing outfall to control peak lake stages during large storm events, lengthy estimated time for lake level recovery through the existing outfall, and high elevation of the existing outfall discharge elevation, it is recommended that the County evaluate improvements to the existing Big Sand Lake outfall and / or alternative outfalls for the lake under a future study effort.

As noted in Sections 9 and 10 above, the modeled inflows to the lake far exceed the outflows either through the drainwells or piped outfall. For example the peak lake inflow during the 100 year / 72 hour storm was approximately 8,892 cfs, but the peak flow through the drainwells and piped outfall were only 2.84 and 62.07 cfs, respectively. Thus, it appears evident that the existing drainwells and piped outfall provide only minimal peak flood stage reduction benefits during a major storm event. However, the drainwells and piped outfall does appear to provide for long term recovery of lake stages.

REFERENCES

Refer to section 2 of this memorandum for a list of referenced construction plans, as-built plans, and ERPs.

1. Combined Orange County Survey, Southeastern Surveying and Mapping Corporation.
2. Corpscon 6.0.1, U.S. Army Corps of Engineers Engineer Research and Development Center Topographic Engineering Center, Alexandria, Virginia, http://www.tec.army.mil/.
3. FEMA Flood Insurance Rate Maps (FIRM), 2009.
4. Lake Index Unincorporated Orange County, Florida, Orange County Stormwater Management Division, Public Works Department, June 2009.
5. Landuse and Land Cover GIS polygons, SFWMD, 2008.
6. Orange County Water Atlas, http://www.orange.wateratlas.usf.edu/.
7. Shingle Creek 1 foot contours, Orange County Public Works Department Stormwater Management Division, 2002.
8. Shingle Creek Drainage Basin Master Stormwater Management Study, DRMP, May 1997.
9. Three (3) inch resolution color aerials, Orange County Property Appraiser, 2013.
10. Big Sand Lake Outfall Conceptual Improvements, Camp Dresser and Mckee, Inc. (CDM), January 2004.
11. Flood Mitigation Justification Report Additional & Replacement Drainage Well Installations Big Sand Lake & Lake Serene, Devo Engineering, June 2013.
12. Drainage Well Inventory Well ID1485920500541, SFWMD, January 2003.
13. Drainage Well Inventory Well ID1494053494574, SFWMD, January 2003.
14. Drainwell Summary Report DW-003 Big Sand Lake, Orange County Roads and Drainage Division, 2009.
15. Hydraulic Load Test Big Sand Lake Drainage Well, The Colinas Group, Inc., October 2004.

APPENDIX A

Geosyntec consultants

APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL0020	127.62	Control Elevation	133.50	Top of Bank	128.25	0.00	0.00	128.90	0.00	0.00	129.13	0.00	0.00	129.56	0.00	0.00	130.13	0.00	0.00
NBSL0025	112.00	Control Elevation	112.00	Top of Bank	110.14	0.00	0.00	111.16	0.00	0.00	111.48	0.00	0.00	111.80	0.00	0.00	**112.19**	0.19	2.50
NBSL0030	108.00	DEM Water Surface	112.00	Top of Bank	110.12	0.00	0.00	110.40	0.00	0.00	110.49	0.00	0.00	110.76	0.00	0.00	111.60	0.00	0.00
NBSL0040	103.59	Downstream Water Elevation	112.00	Edge of Pavement	103.73	0.00	0.00	106.14	0.00	0.00	108.79	0.00	0.00	109.95	0.00	0.00	110.80	0.00	0.00
NBSL0041	103.59	Downstream Water Elevation	111.12	Top of Structure	103.73	0.00	0.00	105.65	0.00	0.00	107.74	0.00	0.00	108.72	0.00	0.00	109.51	0.00	0.00
NBSL0050	107.00	DEM Water Surface	111.00	Top of Bank	108.38	0.00	0.00	110.09	0.00	0.00	110.25	0.00	0.00	110.46	0.00	0.00	**111.12**	0.12	1.67
NBSL0060	104.00	DEM Water Surface	109.00	Top of Bank	105.47	0.00	0.00	106.97	0.00	0.00	108.01	0.00	0.00	108.06	0.00	0.00	108.21	0.00	0.00
NBSL0070	105.12	DEM Water Surface	117.50	Top of Bank	106.01	0.00	0.00	107.75	0.00	0.00	108.47	0.00	0.00	109.85	0.00	0.00	112.01	0.00	0.00
NBSL0080	103.59	Normal High Water Elevation	105.00	Edge of Property	103.73	0.00	0.00	104.15	0.00	0.00	104.31	0.00	0.00	104.62	0.00	0.00	**105.16**	0.16	45.30
NBSL0090	103.15	Invert	108.00	Edge of Pavement	104.18	0.00	0.00	104.72	0.00	0.00	104.89	0.00	0.00	105.18	0.00	0.00	107.14	0.00	0.00
NBSL0100	103.43	DEM Water Surface	108.00	Edge of Pavement	104.03	0.00	0.00	104.52	0.00	0.00	104.68	0.00	0.00	104.99	0.00	0.00	106.57	0.00	0.00
NBSL0110	102.43	Invert	110.00	Edge of Pavement	103.53	0.00	0.00	104.07	0.00	0.00	104.38	0.00	0.00	104.88	0.00	0.00	106.11	0.00	0.00
NBSL0120	127.12	Control Elevation	132.00	Top of Bank	127.95	0.00	0.00	128.87	0.00	0.00	129.21	0.00	0.00	129.81	0.00	0.00	130.29	0.00	0.00
NBSL0130	101.62	Invert	109.00	Edge of Pavement	103.03	0.00	0.00	103.99	0.00	0.00	104.30	0.00	0.00	104.80	0.00	0.00	105.82	0.00	0.00
NBSL0140	93.80	Invert	105.20	Edge of Pavement	95.60	0.00	0.00	96.90	0.00	0.00	97.71	0.00	0.00	99.02	0.00	0.00	104.66	0.00	0.00
NBSL0150	93.63	Invert	104.70	Edge of Pavement	95.52	0.00	0.00	96.68	0.00	0.00	97.08	0.00	0.00	97.78	0.00	0.00	101.55	0.00	0.00
NBSL0160	100.00	Bottom Elevation	105.00	Top of Bank	102.29	0.00	0.00	103.21	0.00	0.00	103.24	0.00	0.00	103.28	0.00	0.00	103.41	0.00	0.00
NBSL0170	92.55	Invert	101.00	Edge of Pavement	94.16	0.00	0.00	95.33	0.00	0.00	95.86	0.00	0.00	96.63	0.00	0.00	98.22	0.00	0.00
NBSL0175	117.00	Bottom Elevation	120.00	Top of Bank	118.64	0.00	0.00	118.81	0.00	0.00	118.86	0.00	0.00	118.93	0.00	0.00	**120.03**	0.03	0.17
NBSL0180	104.00	Bottom Elevation	106.00	Top of Bank	104.10	0.00	0.00	105.15	0.00	0.00	105.20	0.00	0.00	105.31	0.00	0.00	105.59	0.00	0.00
NBSL0190	93.12	Invert	102.10	Edge of Pavement	98.00	0.00	0.00	99.12	0.00	0.00	99.22	0.00	0.00	99.38	0.00	0.00	100.17	0.00	0.00
NBSL0200	95.12	Invert	99.60	Top of Bank	98.00	0.00	0.00	99.12	0.00	0.00	99.21	0.00	0.00	99.36	0.00	0.00	**99.73**	0.13	1.00
NBSL0210	93.12	Invert	99.90	Edge of Pavement	98.00	0.00	0.00	99.13	0.00	0.00	99.23	0.00	0.00	99.39	0.00	0.00	99.71	0.00	0.00
NBSL0220	93.12	Invert	100.40	Edge of Pavement	98.00	0.00	0.00	99.13	0.00	0.00	99.25	0.00	0.00	99.41	0.00	0.00	99.70	0.00	0.00
NBSL0230	93.12	Invert	99.90	Edge of Pavement	98.00	0.00	0.00	99.14	0.00	0.00	99.27	0.00	0.00	99.44	0.00	0.00	99.69	0.00	0.00
NBSL0240	95.12	Bottom Elevation	99.60	Top of Bank	98.00	0.00	0.00	99.14	0.00	0.00	99.29	0.00	0.00	99.49	0.00	0.00	**99.69**	0.09	1.17
NBSL0250	113.20	Invert	121.50	Top of Bank	115.25	0.00	0.00	117.51	0.00	0.00	118.34	0.00	0.00	119.51	0.00	0.00	120.96	0.00	0.00
NBSL0260	113.00	Invert	121.50	Top of Bank	115.25	0.00	0.00	117.51	0.00	0.00	118.34	0.00	0.00	119.51	0.00	0.00	120.95	0.00	0.00
NBSL0270	110.88	Invert	124.10	Edge of Pavement	110.88	0.00	0.00	110.88	0.00	0.00	110.88	0.00	0.00	110.88	0.00	0.00	112.86	0.00	0.00
NBSL0280	110.7	Invert	121.10	Edge of Pavement	110.70	0.00	0.00	110.70	0.00	0.00	110.70	0.00	0.00	110.70	0.00	0.00	112.70	0.00	0.00
NBSL0290	110.58	Invert	119.00	Edge of Pavement	110.58	0.00	0.00	110.58	0.00	0.00	110.58	0.00	0.00	110.58	0.00	0.00	112.57	0.00	0.00
NBSL0300	123.00	Ground Elevation	126.00	Edge of Pavement	124.01	0.00	0.00	125.19	0.00	0.00	125.54	0.00	0.00	**126.02**	0.02	53.50	**126.10**	0.10	66.50
NBSL0310	97.62	Invert	108.50	Edge of Pavement	99.38	0.00	0.00	101.73	0.00	0.00	102.85	0.00	0.00	105.93	0.00	0.00	**108.75**	0.25	0.67
NBSL0320	115.00	Bottom Elevation	118.10	Top of Bank	115.00	0.00	0.00	115.48	0.00	0.00	115.71	0.00	0.00	115.97	0.00	0.00	116.32	0.00	0.00
NBSL0321	112.44	Invert	118.50	Edge of Pavement	113.14	0.00	0.00	113.93	0.00	0.00	114.09	0.00	0.00	114.40	0.00	0.00	115.16	0.00	0.00
NBSL0322	112.21	Invert	118.60	Edge of Pavement	113.14	0.00	0.00	113.93	0.00	0.00	114.09	0.00	0.00	114.40	0.00	0.00	115.16	0.00	0.00
NBSL0330	112.12	Invert	117.00	Top of Bank	113.14	0.00	0.00	113.93	0.00	0.00	114.09	0.00	0.00	114.40	0.00	0.00	115.15	0.00	0.00
NBSL0340	112.12	Bottom Elevation	117.20	Top of Bank	114.10	0.00	0.00	115.17	0.00	0.00	115.36	0.00	0.00	115.50	0.00	0.00	116.42	0.00	0.00
NBSL0350	104.42	Control Elevation	112.50	Edge of Property	106.00	0.00	0.00	108.18	0.00	0.00	109.10	0.00	0.00	109.57	0.00	0.00	110.19	0.00	0.00
NBSL0360	101.62	Bottom Elevation	105.50	Edge of Property	102.95	0.00	0.00	103.21	0.00	0.00	103.27	0.00	0.00	103.66	0.00	0.00	105.43	0.00	0.00
NBSL0365	97.72	Invert	103.71	Top of Structure	98.47	0.00	0.00	99.91	0.00	0.00	101.12	0.00	0.00	102.33	0.00	0.00	**103.72**	0.01	0.33
NBSL0370	97.33	Invert	103.10	Edge of Pavement	98.40	0.00	0.00	99.28	0.00	0.00	99.62	0.00	0.00	100.08	0.00	0.00	100.74	0.00	0.00
NBSL0375	97.2	Invert	103.40	Edge of Pavement	98.39	0.00	0.00	99.12	0.00	0.00	99.41	0.00	0.00	99.72	0.00	0.00	99.99	0.00	0.00
NBSL0380	96.62	Control Elevation	101.00	Top of Bank	98.38	0.00	0.00	98.71	0.00	0.00	98.79	0.00	0.00	98.90	0.00	0.00	99.25	0.00	0.00
NBSL0390	93.34	DEM Water Surface	104.00	Top of Bank	97.92	0.00	0.00	100.63	0.00	0.00	101.38	0.00	0.00	102.77	0.00	0.00	**104.24**	0.24	5.33
NBSL0400	93.19	Invert	105.10	Edge of Pavement	93.16	0.00	0.00	93.59	0.00	0.00	93.70	0.00	0.00	93.90	0.00	0.00	95.05	0.00	0.00
NBSL0405	93.14	Invert	105.00	Edge of Pavement	93.11	0.00	0.00	93.53	0.00	0.00	93.62	0.00	0.00	93.90	0.00	0.00	95.05	0.00	0.00
NBSL0410	92.48	Invert	104.50	Edge of Pavement	92.45	0.00	0.00	93.02	0.00	0.00	93.32	0.00	0.00	93.90	0.00	0.00	95.05	0.00	0.00
NBSL0420	102.62	Control Elevation	107.00	Top of Bank	104.10	0.00	0.00	104.54	0.00	0.00	104.87	0.00	0.00	105.93	0.00	0.00	**107.21**	0.21	1.67
NBSL0430	97.88	Invert	107.00	Edge of Pavement	98.83	0.00	0.00	103.28	0.00	0.00	103.87	0.00	0.00	104.80	0.00	0.00	105.85	0.00	0.00
NBSL0440	97.88	Invert	110.00	Edge of Pavement	98.63	0.00	0.00	102.21	0.00	0.00	102.63	0.00	0.00	103.30	0.00	0.00	104.05	0.00	0.00
NBSL0450	97.49	Invert	107.20	Edge of Pavement	98.23	0.00	0.00	100.60	0.00	0.00	100.77	0.00	0.00	101.04	0.00	0.00	101.35	0.00	0.00
NBSL0460	101.62	Control Elevation	105.50	Top of Bank	102.93	0.00	0.00	103.53	0.00	0.00	103.57	0.00	0.00	103.61	0.00	0.00	103.81	0.00	0.00
NBSL0470	97.07	Invert	104.90	Edge of Pavement	97.87	0.00	0.00	99.51	0.00	0.00	99.51	0.00	0.00	99.52	0.00	0.00	99.52	0.00	0.00
NBSL0480	91.73	Downstream Water Elevation	96.70	Edge of Pavement	92.65	0.00	0.00	94.92	0.00	0.00	95.10	0.00	0.00	95.33	0.00	0.00	95.88	0.00	0.00
NBSL0490	99.12	Control Elevation	105.00	Top of Bank	102.69	0.00	0.00	103.74	0.00	0.00	103.82	0.00	0.00	104.21	0.00	0.00	104.74	0.00	0.00
NBSL0500	98.43	Invert	105.60	Edge of Pavement	98.43	0.00	0.00	100.84	0.00	0.00	102.36	0.00	0.00	103.17	0.00	0.00	103.54	0.00	0.00
NBSL0510	92.00	DEM Water Surface	102.00	Edge of Property	94.79	0.00	0.00	95.73	0.00	0.00	96.46	0.00	0.00	98.06	0.00	0.00	100.49	0.00	0.00
NBSL0520	106.00	DEM Water Surface	112.00	Top of Bank	106.43	0.00	0.00	107.53	0.00	0.00	107.97	0.00	0.00	108.82	0.00	0.00	110.09	0.00	0.00
NBSL0530	103.00	DEM Water Surface	107.00	Top of Bank	106.39	0.00	0.00	106.68	0.00	0.00	106.71	0.00	0.00	106.76	0.00	0.00	106.98	0.00	0.00
NBSL0540	99.51	Downstream Water Elevation	105.50	Top of Bank	100.53	0.00	0.00	101.20	0.00	0.00	101.45	0.00	0.00	101.85	0.00	0.00	103.57	0.00	0.00
NBSL0550	99.51	Downstream Water Elevation	105.00	Edge of Pavement	100.53	0.00	0.00	101.13	0.00	0.00	101.35	0.00	0.00	101.71	0.00	0.00	102.85	0.00	0.00
NBSL0560	99.51	Downstream Water Elevation	104.60	Edge of Pavement	100.53	0.00	0.00	101.13	0.00	0.00	101.35	0.00	0.00	101.71	0.00	0.00	102.52	0.00	0.00

Geosyntec consultants

APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL0570	107.04	Control Elevation	114.50	Top of Bank	108.44	0.00	0.00	110.24	0.00	0.00	111.02	0.00	0.00	112.28	0.00	0.00	112.71	0.00	0.00
NBSL0580	104.51	Invert	114.70	Edge of Pavement	105.23	0.00	0.00	105.96	0.00	0.00	106.12	0.00	0.00	106.60	0.00	0.00	108.11	0.00	0.00
NBSL0590	104.38	Invert	115.00	Edge of Pavement	104.94	0.00	0.00	105.69	0.00	0.00	105.85	0.00	0.00	106.23	0.00	0.00	107.11	0.00	0.00
NBSL0600	103.99	Invert	114.00	Edge of Pavement	104.72	0.00	0.00	105.44	0.00	0.00	105.59	0.00	0.00	105.89	0.00	0.00	106.35	0.00	0.00
NBSL0610	103.08	Invert	107.00	Edge of Pavement	103.75	0.00	0.00	104.47	0.00	0.00	104.61	0.00	0.00	105.11	0.00	0.00	105.51	0.00	0.00
NBSL0620	100.44	Invert	107.00	Edge of Pavement	101.12	0.00	0.00	101.95	0.00	0.00	102.12	0.00	0.00	102.65	0.00	0.00	103.76	0.00	0.00
NBSL0630	99.51	Normal High Water Elevation	102.00	Edge of Property	100.53	0.00	0.00	101.13	0.00	0.00	101.34	0.00	0.00	101.70	0.00	0.00	**102.42**	0.42	13.17
NBSL0640	97.00	Control Elevation	100.00	Top of Bank	**100.17**	0.17	60.83	**101.01**	1.01	63.17	**101.02**	1.02	63.50	**101.05**	1.05	63.83	**101.10**	1.10	153.00
NBSL0649	96.9	Invert	101.00	Ground Elevation	96.90	0.00	0.00	**101.13**	0.13	16.83	**101.29**	0.29	29.17	**101.81**	0.81	38.83	**102.98**	1.98	43.67
NBSL0650	95.93	Invert	100.00	Edge of Pavement	96.28	0.00	0.00	**100.01**	0.01	1.83	**100.21**	0.21	23.33	**100.48**	0.48	33.67	**101.00**	1.00	38.83
NBSL0660	96.9	Invert	101.00	Edge of Pavement	97.26	0.00	0.00	97.84	0.00	0.00	98.02	0.00	0.00	98.34	0.00	0.00	99.80	0.00	0.00
NBSL0670	95.82	Invertv	100.00	Edge of Pavement	96.28	0.00	0.00	97.99	0.00	0.00	98.17	0.00	0.00	98.42	0.00	0.00	99.75	0.00	0.00
NBSL0680	94.77	Invert	99.70	Edge of Pavement	95.40	0.00	0.00	96.94	0.00	0.00	97.24	0.00	0.00	97.51	0.00	0.00	98.52	0.00	0.00
NBSL0690	94.56	Invert	99.10	Edge of Pavement	95.40	0.00	0.00	96.33	0.00	0.00	96.69	0.00	0.00	96.96	0.00	0.00	97.83	0.00	0.00
NBSL0700	91.4	Invert	99.40	Edge of Pavement	95.40	0.00	0.00	96.07	0.00	0.00	96.22	0.00	0.00	96.48	0.00	0.00	97.22	0.00	0.00
NBSL0710	91.00	DEM Water Surface	100.00	Top of Bank	95.40	0.00	0.00	96.03	0.00	0.00	96.13	0.00	0.00	96.27	0.00	0.00	96.80	0.00	0.00
NBSL0720	95.00	DEM Water Surface	99.50	Top of Bank	97.69	0.00	0.00	98.15	0.00	0.00	98.34	0.00	0.00	98.72	0.00	0.00	**99.91**	0.41	1.17
NBSL0730	97.00	DEM Water Surface	100.50	Edge of Pavement	98.92	0.00	0.00	99.10	0.00	0.00	99.16	0.00	0.00	99.26	0.00	0.00	**101.07**	0.56	1.00
NBSL0740	92.9	Invert	98.62	Top of Structure	95.01	0.00	0.00	95.93	0.00	0.00	96.31	0.00	0.00	96.53	0.00	0.00	**100.64**	2.02	1.50
NBSL0750	92.12	Invert	100.10	Edge of Pavement	94.07	0.00	0.00	95.14	0.00	0.00	95.52	0.00	0.00	95.64	0.00	0.00	98.19	0.00	0.00
NBSL0760	117.00	Bottom Elevation	120.00	Top of Bank	118.69	0.00	0.00	118.90	0.00	0.00	118.96	0.00	0.00	119.01	0.00	0.00	119.06	0.00	0.00
NBSL0770	114.4	Invert	121.00	Edge of Pavement	114.63	0.00	0.00	115.34	0.00	0.00	115.53	0.00	0.00	117.74	0.00	0.00	118.54	0.00	0.00
NBSL0780	114.12	Invert	122.00	Edge of Pavement	114.29	0.00	0.00	114.96	0.00	0.00	115.13	0.00	0.00	117.45	0.00	0.00	118.20	0.00	0.00
NBSL0790	113.4	Invert	123.00	Edge of Pavement	113.62	0.00	0.00	114.25	0.00	0.00	114.68	0.00	0.00	117.02	0.00	0.00	117.68	0.00	0.00
NBSL0800	112.71	Invert	122.00	Edge of Pavement	112.88	0.00	0.00	113.59	0.00	0.00	114.46	0.00	0.00	116.57	0.00	0.00	117.16	0.00	0.00
NBSL0810	112.26	Invert	121.20	Edge of Pavement	112.50	0.00	0.00	113.27	0.00	0.00	114.33	0.00	0.00	116.24	0.00	0.00	116.77	0.00	0.00
NBSL0820	112.12	Invert	121.00	Edge of Pavement	112.30	0.00	0.00	113.09	0.00	0.00	114.22	0.00	0.00	116.00	0.00	0.00	116.49	0.00	0.00
NBSL0830	111.74	Invert	121.50	Edge of Pavement	111.95	0.00	0.00	112.96	0.00	0.00	114.07	0.00	0.00	115.74	0.00	0.00	116.18	0.00	0.00
NBSL0840	111.47	Invert	121.00	Edge of Pavement	111.68	0.00	0.00	112.87	0.00	0.00	113.93	0.00	0.00	115.48	0.00	0.00	115.87	0.00	0.00
NBSL0850	111.22	Invert	120.20	Edge of Pavement	111.42	0.00	0.00	112.82	0.00	0.00	113.79	0.00	0.00	115.23	0.00	0.00	115.58	0.00	0.00
NBSL0860	111.08	Invert	120.00	Edge of Pavement	111.28	0.00	0.00	112.79	0.00	0.00	113.68	0.00	0.00	115.04	0.00	0.00	115.36	0.00	0.00
NBSL0870	110.43	Invert	119.20	Edge of Pavement	111.00	0.00	0.00	112.69	0.00	0.00	113.46	0.00	0.00	114.64	0.00	0.00	114.89	0.00	0.00
NBSL0880	109.57	Invert	119.00	Edge of Pavement	111.00	0.00	0.00	112.60	0.00	0.00	113.30	0.00	0.00	114.35	0.00	0.00	114.55	0.00	0.00
NBSL0890	109.34	Invert	118.50	Edge of Pavement	111.00	0.00	0.00	112.57	0.00	0.00	113.25	0.00	0.00	114.25	0.00	0.00	114.44	0.00	0.00
NBSL0900	109	Invert	118.00	Edge of Pavement	111.00	0.00	0.00	112.54	0.00	0.00	113.18	0.00	0.00	114.14	0.00	0.00	114.31	0.00	0.00
NBSL0910	109.00	DEM Water Surface	114.00	Top of Bank	111.00	0.00	0.00	112.52	0.00	0.00	113.16	0.00	0.00	**114.10**	0.10	1.33	**114.27**	0.27	2.00
NBSL0920	104	Invert	110.00	Edge of Pavement	106.45	0.00	0.00	108.58	0.00	0.00	109.98	0.00	0.00	**111.41**	1.41	3.17	**111.74**	1.74	3.00
NBSL0930	102.75	Invert	110.49	Top of Structure	105.05	0.00	0.00	106.71	0.00	0.00	108.22	0.00	0.00	109.35	0.00	0.00	109.78	0.00	0.00
NBSL0940	119.00	Bottom Elevation	121.50	Edge of Pavement	**121.86**	0.36	4.83	**122.04**	0.54	7.17	**122.05**	0.55	7.83	**122.06**	0.56	8.83	**122.13**	0.63	9.50
NBSL0950	114.5	Invert	119.00	Edge of Pavement	116.17	0.00	0.00	116.53	0.00	0.00	116.55	0.00	0.00	116.58	0.00	0.00	116.59	0.00	0.00
NBSL0960	114.05	Invert	119.00	Edge of Pavement	115.86	0.00	0.00	116.16	0.00	0.00	116.16	0.00	0.00	116.16	0.00	0.00	116.20	0.00	0.00
NBSL0970	113.09	Invert	118.00	Edge of Pavement	114.21	0.00	0.00	114.57	0.00	0.00	114.57	0.00	0.00	114.61	0.00	0.00	114.81	0.00	0.00
NBSL0980	111.77	Invert	117.00	Edge of Pavement	113.25	0.00	0.00	113.63	0.00	0.00	113.63	0.00	0.00	113.63	0.00	0.00	113.66	0.00	0.00
NBSL0990	110.32	Invert	115.70	Edge of Pavement	111.55	0.00	0.00	111.84	0.00	0.00	112.08	0.00	0.00	112.09	0.00	0.00	112.11	0.00	0.00
NBSL1000	106.56	Invert	115.00	Edge of Pavement	107.88	0.00	0.00	108.17	0.00	0.00	108.38	0.00	0.00	108.38	0.00	0.00	108.60	0.00	0.00
NBSL1010	105.17	Invert	114.00	Edge of Pavement	106.36	0.00	0.00	106.61	0.00	0.00	106.82	0.00	0.00	107.62	0.00	0.00	108.40	0.00	0.00
NBSL1020	103.47	Invert	112.00	Edge of Pavement	104.81	0.00	0.00	105.55	0.00	0.00	106.60	0.00	0.00	107.41	0.00	0.00	108.04	0.00	0.00
NBSL1030	102.67	Invert	111.10	Edge of Pavement	104.41	0.00	0.00	105.43	0.00	0.00	106.38	0.00	0.00	107.18	0.00	0.00	107.75	0.00	0.00
NBSL1035	102.19	Invert	110.49	Top of Structure	103.41	0.00	0.00	105.37	0.00	0.00	106.27	0.00	0.00	107.06	0.00	0.00	107.61	0.00	0.00
NBSL1040	100.87	Downstream Control Elevation	110.58	Top of Structure	102.49	0.00	0.00	105.37	0.00	0.00	106.23	0.00	0.00	107.02	0.00	0.00	107.56	0.00	0.00
NBSL1050	100.87	Downstream Control Elevation	110.35	Top of Structure	102.32	0.00	0.00	104.37	0.00	0.00	104.92	0.00	0.00	105.49	0.00	0.00	106.07	0.00	0.00
NBSL1060	100.87	Downstream Control Elevation	110.05	Top of Structure	102.21	0.00	0.00	103.75	0.00	0.00	104.09	0.00	0.00	104.53	0.00	0.00	105.13	0.00	0.00
NBSL1070	100.87	Control Elevation	109.00	Top of Bank	102.09	0.00	0.00	103.07	0.00	0.00	103.18	0.00	0.00	103.44	0.00	0.00	104.07	0.00	0.00
NBSL1080	91.73	Downstream Water Elevation	101.00	Top of Bank	97.31	0.00	0.00	98.34	0.00	0.00	98.44	0.00	0.00	98.65	0.00	0.00	99.11	0.00	0.00
NBSL1090	111.50	DEM Water Surface	124.00	Edge of Pavement	117.55	0.00	0.00	121.79	0.00	0.00	122.69	0.00	0.00	122.90	0.00	0.00	123.59	0.00	0.00
NBSL1100	116.92	Invert	124.00	Edge of Pavement	116.92	0.00	0.00	116.92	0.00	0.00	118.31	0.00	0.00	119.10	0.00	0.00	123.21	0.00	0.00
NBSL1110	114.82	Invert	120.60	Edge of Pavement	114.79	0.00	0.00	114.79	0.00	0.00	115.17	0.00	0.00	115.96	0.00	0.00	**122.13**	1.53	2.00
NBSL1120	113.97	Invert	124.20	Edge of Pavement	113.94	0.00	0.00	113.94	0.00	0.00	114.27	0.00	0.00	115.07	0.00	0.00	121.33	0.00	0.00
NBSL1130	112.49	Invert	118.70	Edge of Pavement	112.46	0.00	0.00	112.46	0.00	0.00	112.91	0.00	0.00	113.88	0.00	0.00	**120.73**	2.03	2.17
NBSL1140	111.12	Invert	118.10	Edge of Pavement	111.09	0.00	0.00	111.09	0.00	0.00	111.51	0.00	0.00	112.48	0.00	0.00	117.83	0.00	0.00
NBSL1150	109.52	Invert	118.00	Edge of Pavement	109.49	0.00	0.00	109.49	0.00	0.00	109.87	0.00	0.00	110.67	0.00	0.00	112.19	0.00	0.00
NBSL1160	107.56	Invert	117.00	Edge of Pavement	107.53	0.00	0.00	107.53	0.00	0.00	108.00	0.00	0.00	108.86	0.00	0.00	110.82	0.00	0.00
NBSL1170	105.15	Invert	114.20	Edge of Pavement	105.12	0.00	0.00	105.12	0.00	0.00	107.91	0.00	0.00	108.70	0.00	0.00	109.45	0.00	0.00

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APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL1180	97.7	Invert	112.00	Edge of Pavement	99.67	0.00	0.00	102.16	0.00	0.00	102.21	0.00	0.00	102.30	0.00	0.00	102.69	0.00	0.00
NBSL1190	96.12	Downstream Control Elevation	103.40	Edge of Pavement	99.67	0.00	0.00	102.16	0.00	0.00	102.21	0.00	0.00	102.29	0.00	0.00	102.59	0.00	0.00
NBSL1200	96.12	Control Elevation	102.00	Top of Bank	99.67	0.00	0.00	**102.16**	0.16	4.00	**102.21**	0.21	5.00	**102.30**	0.30	6.67	**102.59**	0.59	9.50
NBSL1210	96.2	Downstream Water Elevation	102.50	Edge of Pavement	98.27	0.00	0.00	101.07	0.00	0.00	101.15	0.00	0.00	101.34	0.00	0.00	101.63	0.00	0.00
NBSL1220	96.2	Downstream Water Elevation	102.00	Edge of Pavement	96.89	0.00	0.00	97.87	0.00	0.00	98.19	0.00	0.00	99.00	0.00	0.00	100.35	0.00	0.00
NBSL1230	117.00	DEM Water Surface	120.00	Top of Bank	118.18	0.00	0.00	119.19	0.00	0.00	119.53	0.00	0.00	**120.24**	0.23	4.33	**121.83**	1.83	10.17
NBSL1240	114.28	Invert	119.30	Edge of Pavement	114.25	0.00	0.00	115.20	0.00	0.00	115.41	0.00	0.00	115.69	0.00	0.00	116.26	0.00	0.00
NBSL1250	113.65	Invert	116.00	Edge of Pavement	113.62	0.00	0.00	114.55	0.00	0.00	114.79	0.00	0.00	115.24	0.00	0.00	115.83	0.00	0.00
NBSL1260	108.43	Invert	117.40	Edge of Pavement	108.40	0.00	0.00	113.10	0.00	0.00	113.28	0.00	0.00	113.53	0.00	0.00	113.82	0.00	0.00
NBSL1270	112.42	Invert	117.80	Edge of Pavement	112.39	0.00	0.00	113.01	0.00	0.00	113.17	0.00	0.00	113.38	0.00	0.00	113.63	0.00	0.00
NBSL1280	110.7	Invert	115.40	Edge of Pavement	110.70	0.00	0.00	111.32	0.00	0.00	111.48	0.00	0.00	111.69	0.00	0.00	111.94	0.00	0.00
NBSL1290	108.4	Invert	112.10	Edge of Pavement	108.40	0.00	0.00	109.02	0.00	0.00	109.18	0.00	0.00	109.39	0.00	0.00	109.64	0.00	0.00
NBSL1300	106.6	Invert	111.30	Edge of Pavement	106.60	0.00	0.00	107.22	0.00	0.00	107.38	0.00	0.00	107.59	0.00	0.00	107.84	0.00	0.00
NBSL1310	103.5	Invert	109.20	Edge of Pavement	103.50	0.00	0.00	104.12	0.00	0.00	104.28	0.00	0.00	104.49	0.00	0.00	104.74	0.00	0.00
NBSL1320	97.4	Invert	105.80	Edge of Pavement	97.40	0.00	0.00	98.04	0.00	0.00	98.99	0.00	0.00	100.10	0.00	0.00	100.43	0.00	0.00
NBSL1330	94.1	Invert	104.20	Edge of Pavement	95.31	0.00	0.00	97.62	0.00	0.00	98.98	0.00	0.00	100.03	0.00	0.00	100.31	0.00	0.00
NBSL1340	94	Downstream Water Elevation	104.00	Edge of Pavement	95.31	0.00	0.00	97.61	0.00	0.00	98.95	0.00	0.00	99.98	0.00	0.00	100.23	0.00	0.00
NBSL1350	93.14	Control Elevation	101.00	Top of Bank	95.31	0.00	0.00	97.60	0.00	0.00	98.92	0.00	0.00	99.91	0.00	0.00	100.13	0.00	0.00
NBSL1360	91.73	Downstream Control Elevation	102.10	Edge of Pavement	94.78	0.00	0.00	96.89	0.00	0.00	97.98	0.00	0.00	99.31	0.00	0.00	100.08	0.00	0.00
NBSL1370	91.73	Downstream Control Elevation	102.00	Edge of Pavement	94.71	0.00	0.00	96.56	0.00	0.00	97.55	0.00	0.00	98.97	0.00	0.00	100.05	0.00	0.00
NBSL1380	91.73	Downstream Control Elevation	100.00	Top of Bank	94.64	0.00	0.00	96.29	0.00	0.00	97.14	0.00	0.00	98.61	0.00	0.00	**100.02**	0.02	0.33
NBSL1390	91.73	Downstream Control Elevation	105.70	Edge of Pavement	92.60	0.00	0.00	95.11	0.00	0.00	95.78	0.00	0.00	96.88	0.00	0.00	98.01	0.00	0.00
NBSL1400	91.73	Downstream Control Elevation	101.40	Edge of Pavement	92.30	0.00	0.00	93.53	0.00	0.00	93.93	0.00	0.00	94.50	0.00	0.00	95.26	0.00	0.00
NBSL1410	94.62	Control Elevation	103.50	Top of Bank	95.46	0.00	0.00	97.58	0.00	0.00	99.17	0.00	0.00	99.49	0.00	0.00	100.26	0.00	0.00
NBSL1420	89.00	DEM Water Surface	100.50	Top of Bank	94.13	0.00	0.00	96.45	0.00	0.00	97.41	0.00	0.00	98.66	0.00	0.00	99.09	0.00	0.00
NBSL1430	91.73	Downstream Water Elevation	99.00	Edge of Pavement	92.77	0.00	0.00	94.64	0.00	0.00	95.24	0.00	0.00	96.11	0.00	0.00	96.58	0.00	0.00
NBSL1440	99.00	Bottom Elevation	104.00	Top of Bank	101.44	0.00	0.00	103.33	0.00	0.00	103.68	0.00	0.00	103.92	0.00	0.00	**104.48**	0.48	1.50
NBSL1441	104.57	Bottom Elevation	107.20	Top of Bank	106.88	0.00	0.00	**107.95**	0.75	6.10	**108.60**	1.40	9.20	**109.06**	1.86	13.00	**109.15**	1.95	15.30
NBSL1442	101.28	Downstream Control Elevation	107.74	Top of Structure	102.34	0.00	0.00	106.39	0.00	0.00	106.99	0.00	0.00	107.46	0.00	0.00	107.73	0.00	0.00
NBSL1443	101.12	Downstream Control Elevation	103.65	Top of Structure	102.24	0.00	0.00	**104.10**	0.45	3.17	**104.53**	0.88	8.17	**105.06**	1.41	62.17	**105.85**	2.20	140.17
NBSL1444	105.00	Bottom Elevation	110.00	Top of Bank	107.80	0.00	0.00	108.20	0.00	0.00	108.33	0.00	0.00	108.56	0.00	0.00	**110.06**	0.06	0.24
NBSL1445	101.12	Downstream Control Elevation	107.59	Top of Structure	102.24	0.00	0.00	103.53	0.00	0.00	103.87	0.00	0.00	104.41	0.00	0.00	106.90	0.00	0.00
NBSL1446	103.64	Bottom Elevation	110.00	Top of Bank	106.54	0.00	0.00	108.67	0.00	0.00	108.81	0.00	0.00	109.07	0.00	0.00	**110.03**	0.03	162.50
NBSL1447	101.12	Downstream Control Elevation	105.00	Top of Structure	102.24	0.00	0.00	103.53	0.00	0.00	103.87	0.00	0.00	104.41	0.00	0.00	**106.54**	1.54	140.17
NBSL1448	103.48	Bottom Elevation	110.00	Top of Bank	107.66	0.00	0.00	109.33	0.00	0.00	109.49	0.00	0.00	109.78	0.00	0.00	**110.16**	0.16	158.33
NBSL1449	101.50	Downstream Control Elevation	103.09	Top of Structure	102.00	0.00	0.00	102.65	0.00	0.00	102.92	0.00	0.00	**103.90**	0.81	63.17	**105.75**	2.66	134.17
NBSL1450	102.00	Bottom Elevation	105.00	Edge of Property	104.10	0.00	0.00	104.17	0.00	0.00	104.21	0.00	0.00	104.28	0.00	0.00	104.49	0.00	0.00
NBSL1451	0.00	N/A	0.00	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NBSL1452	101.12	Normal High Water Elevation	105.49	Top of Bank	102.24	0.00	0.00	103.53	0.00	0.00	103.87	0.00	0.00	104.41	0.00	0.00	105.38	0.00	0.00
NBSL1454	101.5	Normal High Water Elevation	105.00	Top of Bank	102.00	0.00	0.00	102.65	0.00	0.00	102.90	0.00	0.00	103.38	0.00	0.00	104.14	0.00	0.00
NBSL1455	103	Bottom Elevation	110.00	Top of Bank	107.83	0.00	0.00	109.29	0.00	0.00	109.45	0.00	0.00	109.73	0.00	0.00	**110.17**	0.17	22.33
NBSL1456	101.5	Downstream Control Elevation	106.59	Top of Structure	102.00	0.00	0.00	102.65	0.00	0.00	102.91	0.00	0.00	103.87	0.00	0.00	105.35	0.00	0.00
NBSL1460	91.00	DEM Water Surface	100.00	Top of Bank	93.55	0.00	0.00	96.96	0.00	0.00	98.06	0.00	0.00	99.20	0.00	0.00	**100.19**	0.19	19.17
NBSL1470	120.00	Bottom Elevation	126.00	Top of Bank	**126.03**	0.03	13.17	**126.11**	0.11	17.00	**126.51**	0.51	17.50	**126.53**	0.53	18.00	**126.59**	0.59	24.33
NBSL1480	120.92	Invert	124.37	Top of Structure	121.51	0.00	0.00	**126.08**	1.71	1.00	**126.51**	2.13	2.67	**126.52**	2.15	3.83	**126.58**	2.21	3.17
NBSL1490	118.62	Invert	124.00	Edge of Pavement	119.22	0.00	0.00	**124.40**	0.40	0.83	**124.75**	0.75	2.67	**124.77**	0.77	3.83	**124.89**	0.89	3.17
NBSL1500	117.72	Invert	122.84	Top of Structure	118.32	0.00	0.00	121.93	0.00	0.00	122.17	0.00	0.00	122.18	0.00	0.00	122.42	0.00	0.00
NBSL1510	116.92	Invert	122.00	Edge of Pavement	117.52	0.00	0.00	120.14	0.00	0.00	120.30	0.00	0.00	120.31	0.00	0.00	120.64	0.00	0.00
NBSL1520	115.42	Invert	122.10	Edge of Pavement	116.34	0.00	0.00	118.37	0.00	0.00	118.44	0.00	0.00	118.45	0.00	0.00	118.86	0.00	0.00
NBSL1530	115.02	Invert	123.00	Edge of Pavement	116.33	0.00	0.00	117.88	0.00	0.00	117.94	0.00	0.00	117.94	0.00	0.00	118.37	0.00	0.00
NBSL1540	114.82	Invert	123.40	Edge of Pavement	116.33	0.00	0.00	117.53	0.00	0.00	117.58	0.00	0.00	117.58	0.00	0.00	118.02	0.00	0.00
NBSL1550	114.52	Invert	123.00	Edge of Pavement	115.05	0.00	0.00	116.25	0.00	0.00	117.23	0.00	0.00	117.37	0.00	0.00	117.67	0.00	0.00
NBSL1560	113.22	Invert	121.00	Edge of Pavement	113.71	0.00	0.00	115.46	0.00	0.00	116.70	0.00	0.00	116.84	0.00	0.00	117.17	0.00	0.00
NBSL1570	112.62	Invert	120.00	Edge of Pavement	113.11	0.00	0.00	115.42	0.00	0.00	116.49	0.00	0.00	116.63	0.00	0.00	116.97	0.00	0.00
NBSL1580	111.65	Invert	119.40	Edge of Pavement	112.21	0.00	0.00	115.32	0.00	0.00	116.24	0.00	0.00	116.38	0.00	0.00	116.73	0.00	0.00
NBSL1590	110.52	Invert	118.70	Edge of Pavement	111.09	0.00	0.00	115.22	0.00	0.00	115.95	0.00	0.00	116.09	0.00	0.00	116.46	0.00	0.00
NBSL1600	109.63	Invert	118.60	Edge of Pavement	111.09	0.00	0.00	115.13	0.00	0.00	115.71	0.00	0.00	115.85	0.00	0.00	116.23	0.00	0.00
NBSL1610	109.12	Invert	117.30	Edge of Pavement	111.09	0.00	0.00	115.06	0.00	0.00	115.53	0.00	0.00	115.67	0.00	0.00	116.07	0.00	0.00
NBSL1620	105.62	Control Elevation	115.50	Top of Bank	111.09	0.00	0.00	114.99	0.00	0.00	115.32	0.00	0.00	115.46	0.00	0.00	**115.88**	0.38	1.00
NBSL1630	119.00	Bottom Elevation	123.50	Top of Bank	121.33	0.00	0.00	121.53	0.00	0.00	121.59	0.00	0.00	122.89	0.00	0.00	**124.62**	1.12	14.67
NBSL1640	113.00	DEM Water Surface	123.50	Top of Bank	115.00	0.00	0.00	119.95	0.00	0.00	121.52	0.00	0.00	122.89	0.00	0.00	**123.75**	0.25	11.17
NBSL1650	118.71	Invert	123.14	Top of Structure	119.93	0.00	0.00	122.17	0.00	0.00	122.41	0.00	0.00	122.89	0.00	0.00	**123.34**	0.20	13.83
NBSL1660	118.57	Invert	123.89	Top of Structure	119.93	0.00	0.00	122.18	0.00	0.00	122.44	0.00	0.00	122.89	0.00	0.00	123.30	0.00	0.00

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APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL1670	117.76	Invert	124.62	Top of Structure	119.93	0.00	0.00	122.20	0.00	0.00	122.49	0.00	0.00	122.92	0.00	0.00	123.24	0.00	0.00
NBSL1680	117.11	Invert	123.64	Top of Structure	119.93	0.00	0.00	122.21	0.00	0.00	122.52	0.00	0.00	122.96	0.00	0.00	123.23	0.00	0.00
NBSL1690	116.00	Bottom Elevation	123.00	Top of Bank	119.93	0.00	0.00	122.21	0.00	0.00	122.53	0.00	0.00	122.98	0.00	0.00	**123.25**	0.25	18.33
NBSL1700	112.63	Invert	118.90	Edge of Pavement	112.60	0.00	0.00	112.60	0.00	0.00	112.60	0.00	0.00	113.14	0.00	0.00	116.82	0.00	0.00
NBSL1710	112.01	Invert	117.60	Edge of Pavement	111.98	0.00	0.00	111.98	0.00	0.00	112.45	0.00	0.00	113.14	0.00	0.00	115.29	0.00	0.00
NBSL1720	109.51	Invert	117.20	Edge of Pavement	109.48	0.00	0.00	109.51	0.00	0.00	112.45	0.00	0.00	113.14	0.00	0.00	113.75	0.00	0.00
NBSL1730	109.33	Invert	116.30	Edge of Pavement	109.30	0.00	0.00	109.51	0.00	0.00	112.45	0.00	0.00	113.14	0.00	0.00	113.64	0.00	0.00
NBSL1740	109.07	Invert	114.70	Edge of Pavement	109.04	0.00	0.00	109.51	0.00	0.00	112.45	0.00	0.00	113.14	0.00	0.00	113.39	0.00	0.00
NBSL1750	108.97	Invert	113.50	Edge of Pavement	108.94	0.00	0.00	109.51	0.00	0.00	112.45	0.00	0.00	113.14	0.00	0.00	113.39	0.00	0.00
NBSL1760	102.72	Invert	113.00	Edge of Pavement	106.04	0.00	0.00	109.51	0.00	0.00	112.45	0.00	0.00	**113.14**	0.14	1.83	**113.39**	0.39	2.17
NBSL1770	102.62	Invert	113.00	Top of Bank	106.04	0.00	0.00	109.51	0.00	0.00	112.45	0.00	0.00	**113.14**	0.14	1.83	**113.39**	0.39	1.83
NBSL1790	96.20	Control Elevation	98.00	Top of Bank	96.89	0.00	0.00	97.68	0.00	0.00	**98.03**	0.03	13.83	**98.87**	0.87	60.17	**100.18**	2.18	139.50
NBSL1800	96.12	Invert	103.30	Edge of Pavement	96.09	0.00	0.00	97.31	0.00	0.00	97.54	0.00	0.00	97.87	0.00	0.00	98.32	0.00	0.00
NBSL1810	93.12	Invert	100.00	Top of Bank	96.79	0.00	0.00	97.41	0.00	0.00	97.60	0.00	0.00	97.94	0.00	0.00	99.39	0.00	0.00
NBSL1820	116.00	Bottom Elevation	123.50	Top of Bank	119.73	0.00	0.00	120.64	0.00	0.00	120.97	0.00	0.00	121.67	0.00	0.00	122.15	0.00	0.00
NBSL1830	116.28	Invert	122.00	Edge of Pavement	117.12	0.00	0.00	117.61	0.00	0.00	117.73	0.00	0.00	117.91	0.00	0.00	118.02	0.00	0.00
NBSL1840	116.16	Invert	122.00	Edge of Pavement	116.92	0.00	0.00	117.21	0.00	0.00	117.31	0.00	0.00	117.50	0.00	0.00	117.61	0.00	0.00
NBSL1850	107.66	Invert	115.10	Edge of Pavement	108.36	0.00	0.00	108.84	0.00	0.00	108.95	0.00	0.00	109.14	0.00	0.00	109.23	0.00	0.00
NBSL1860	106.54	Invert	114.40	Edge of Pavement	107.19	0.00	0.00	107.62	0.00	0.00	107.77	0.00	0.00	108.20	0.00	0.00	108.46	0.00	0.00
NBSL1870	102.00	Bottom Elevation	109.00	Top of Bank	103.55	0.00	0.00	107.40	0.00	0.00	107.66	0.00	0.00	107.95	0.00	0.00	108.41	0.00	0.00
NBSL1880	108.00	Bottom Elevation	116.00	Top of Bank	113.24	0.00	0.00	114.03	0.00	0.00	114.07	0.00	0.00	114.11	0.00	0.00	114.23	0.00	0.00
NBSL1890	102.58	Invert	114.80	Edge of Pavement	102.55	0.00	0.00	104.00	0.00	0.00	104.69	0.00	0.00	105.44	0.00	0.00	109.23	0.00	0.00
NBSL1900	96.48	Invert	100.51	Top of Structure	98.72	0.00	0.00	99.69	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00	100.22	0.00	0.00
NBSL1910	95.2	Invert	100.31	Top of Structure	98.72	0.00	0.00	99.69	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00	100.22	0.00	0.00
NBSL1920	95.15	Downstream Control Elevation	101.00	Edge of Pavement	98.72	0.00	0.00	99.69	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00	100.22	0.00	0.00
NBSL1930	95.15	Downstream Control Elevation	100.24	Top of Structure	98.72	0.00	0.00	99.69	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00	100.22	0.00	0.00
NBSL1940	95.15	Downstream Control Elevation	99.74	Top of Structure	98.72	0.00	0.00	99.69	0.00	0.00	**100.03**	0.29	5.00	**100.11**	0.37	8.33	**100.22**	0.48	24.17
NBSL1950	95.15	Downstream Control Elevation	98.92	Top of Structure	98.72	0.00	0.00	**99.69**	0.77	10.83	**100.03**	1.11	12.33	**100.11**	1.19	15.17	**100.22**	1.30	34.67
NBSL1960	95.15	Downstream Control Elevation	101.16	Top of Structure	98.72	0.00	0.00	99.69	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00	100.22	0.00	0.00
NBSL1970	95.15	Control Elevation	101.50	Top of Bank	98.72	0.00	0.00	99.69	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00	100.22	0.00	0.00
NBSL1980	95	Downstream Water Elevation	104.10	Edge of Pavement	98.72	0.00	0.00	99.60	0.00	0.00	99.89	0.00	0.00	100.07	0.00	0.00	100.19	0.00	0.00
NBSL1990	95	Downstream Water Elevation	101.20	Edge of Pavement	98.72	0.00	0.00	99.50	0.00	0.00	99.75	0.00	0.00	100.06	0.00	0.00	100.16	0.00	0.00
NBSL2000	95	Downstream Water Elevation	101.00	Edge of Pavement	98.72	0.00	0.00	99.44	0.00	0.00	99.66	0.00	0.00	100.05	0.00	0.00	100.15	0.00	0.00
NBSL2010	95	Downstream Water Elevation	102.00	Edge of Pavement	98.72	0.00	0.00	99.34	0.00	0.00	99.52	0.00	0.00	100.03	0.00	0.00	100.12	0.00	0.00
NBSL2020	95	Downstream Water Elevation	102.00	Edge of Pavement	98.72	0.00	0.00	99.28	0.00	0.00	99.44	0.00	0.00	100.03	0.00	0.00	100.11	0.00	0.00
NBSL2030	95	Downstream Water Elevation	102.10	Edge of Pavement	98.72	0.00	0.00	99.21	0.00	0.00	99.33	0.00	0.00	100.01	0.00	0.00	100.09	0.00	0.00
NBSL2040	95.00	DEM Water Surface	101.50	Top of Bank	98.72	0.00	0.00	99.16	0.00	0.00	99.25	0.00	0.00	100.01	0.00	0.00	100.08	0.00	0.00
NBSL2050	98.12	Control Elevation	104.50	Top of Bank	99.10	0.00	0.00	99.64	0.00	0.00	99.82	0.00	0.00	100.06	0.00	0.00	100.50	0.00	0.00
NBSL2060	134.68	Control Elevation	140.00	Top of Bank	137.59	0.00	0.00	139.03	0.00	0.00	139.05	0.00	0.00	139.08	0.00	0.00	139.15	0.00	0.00
NBSL2070	135.5	Invert	140.00	Edge of Pavement	136.71	0.00	0.00	137.58	0.00	0.00	137.59	0.00	0.00	137.60	0.00	0.00	137.62	0.00	0.00
NBSL2080	133.00	Invert	137.30	Edge of Pavement	134.16	0.00	0.00	135.09	0.00	0.00	135.10	0.00	0.00	135.11	0.00	0.00	135.13	0.00	0.00
NBSL2090	132.89	Invert	137.90	Edge of Pavement	134.00	0.00	0.00	134.89	0.00	0.00	134.90	0.00	0.00	134.90	0.00	0.00	134.92	0.00	0.00
NBSL2100	132.32	Invert	137.00	Edge of Pavement	133.53	0.00	0.00	134.40	0.00	0.00	134.41	0.00	0.00	134.41	0.00	0.00	134.43	0.00	0.00
NBSL2110	124.41	Invert	133.20	Edge of Pavement	129.97	0.00	0.00	130.85	0.00	0.00	130.85	0.00	0.00	130.86	0.00	0.00	130.88	0.00	0.00
NBSL2120	124.3	Invert	128.10	Edge of Pavement	125.50	0.00	0.00	126.37	0.00	0.00	126.38	0.00	0.00	126.38	0.00	0.00	126.40	0.00	0.00
NBSL2130	122.96	Invert	127.00	Edge of Pavement	124.14	0.00	0.00	125.01	0.00	0.00	125.01	0.00	0.00	125.02	0.00	0.00	125.04	0.00	0.00
NBSL2140	112	Invert	114.70	Edge of Pavement	113.07	0.00	0.00	**116.10**	1.40	0.67	**116.39**	1.69	2.00	**116.42**	1.72	3.00	**116.48**	1.78	2.83
NBSL2150	117.12	DEM Water Surface	128.00	Top of Bank	121.78	0.00	0.00	125.84	0.00	0.00	126.56	0.00	0.00	**128.06**	0.06	1.67	**128.96**	0.96	8.83
NBSL2160	120.43	Invert	127.90	Edge of Pavement	120.43	0.00	0.00	121.07	0.00	0.00	121.60	0.00	0.00	121.89	0.00	0.00	121.89	0.00	0.00
NBSL2170	116.56	Invert	127.90	Edge of Pavement	116.56	0.00	0.00	118.00	0.00	0.00	118.54	0.00	0.00	118.83	0.00	0.00	119.26	0.00	0.00
NBSL2180	112.57	Invert	126.00	Edge of Pavement	112.57	0.00	0.00	113.18	0.00	0.00	113.70	0.00	0.00	116.33	0.00	0.00	117.37	0.00	0.00
NBSL2190	109.44	Invert	113.60	Top of Structure	109.47	0.00	0.00	112.17	0.00	0.00	112.64	0.00	0.00	113.06	0.00	0.00	113.20	0.00	0.00
NBSL2200	127.00	Bottom Elevation	129.00	Top of Bank	**129.35**	0.35	15.17	**129.57**	0.57	17.67	**129.67**	0.67	18.17	**130.22**	1.22	18.67	**132.18**	3.18	39.00
NBSL2210	124.9	Invert	127.10	Edge of Pavement	125.93	0.00	0.00	126.65	0.00	0.00	127.02	0.00	0.00	**127.52**	0.42	1.83	**128.26**	1.16	1.83
NBSL2220	124.9	Invert	126.00	Edge of Pavement	125.79	0.00	0.00	**126.51**	0.51	2.67	**126.85**	0.85	3.33	**126.90**	0.89	4.33	**126.94**	0.94	3.17
NBSL2230	111.7	Invert	112.00	Edge of Pavement	**112.64**	0.64	5.67	**113.26**	1.26	8.17	**113.69**	1.69	11.50	**115.65**	3.65	13.17	**118.37**	6.37	26.33
NBSL2240	138.71	Control Elevation	145.00	Top of Bank	142.66	0.00	0.00	144.35	0.00	0.00	144.52	0.00	0.00	144.58	0.00	0.00	144.75	0.00	0.00
NBSL2250	137.78	Invert	145.50	Edge of Pavement	139.48	0.00	0.00	141.27	0.00	0.00	142.29	0.00	0.00	142.50	0.00	0.00	142.72	0.00	0.00
NBSL2260	136.48	Invert	142.20	Edge of Pavement	138.73	0.00	0.00	139.93	0.00	0.00	140.40	0.00	0.00	140.49	0.00	0.00	140.59	0.00	0.00
NBSL2270	135.28	Invert	143.00	Edge of Pavement	136.90	0.00	0.00	137.45	0.00	0.00	137.50	0.00	0.00	137.60	0.00	0.00	138.14	0.00	0.00
NBSL2280	133.24	Invert	136.40	Edge of Pavement	134.84	0.00	0.00	135.76	0.00	0.00	135.86	0.00	0.00	135.87	0.00	0.00	135.96	0.00	0.00
NBSL2290	129.48	Invert	134.20	Edge of Pavement	131.09	0.00	0.00	132.40	0.00	0.00	132.53	0.00	0.00	132.61	0.00	0.00	132.86	0.00	0.00
NBSL2300	127.43	Invert	131.40	Edge of Pavement	129.02	0.00	0.00	130.17	0.00	0.00	130.20	0.00	0.00	130.29	0.00	0.00	130.48	0.00	0.00

APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL2305	118.91	Invert	124.00	Top of Structure	120.48	0.00	0.00	121.85	0.00	0.00	122.00	0.00	0.00	121.99	0.00	0.00	122.09	0.00	0.00
NBSL2310	109.7	Invert	115.11	Top of Structure	111.04	0.00	0.00	112.97	0.00	0.00	114.54	0.00	0.00	114.76	0.00	0.00	**115.53**	0.42	0.40
NBSL2320	107.66	Invert	112.32	Top of Structure	109.53	0.00	0.00	111.94	0.00	0.00	112.17	0.00	0.00	112.26	0.00	0.00	**112.60**	0.28	1.50
NBSL2330	104.93	Invert	109.48	Top of Structure	106.93	0.00	0.00	108.78	0.00	0.00	109.28	0.00	0.00	109.44	0.00	0.00	**110.44**	0.96	1.67
NBSL2340	127.00	DEM Water Surface	131.00	Top of Bank	130.09	0.00	0.00	**131.18**	0.18	61.50	**131.26**	0.26	62.33	**131.38**	0.38	63.00	**131.67**	0.67	142.33
NBSL2350	124.65	Invert	129.70	Edge of Pavement	124.62	0.00	0.00	125.34	0.00	0.00	125.70	0.00	0.00	125.83	0.00	0.00	126.94	0.00	0.00
NBSL2360	120.99	Invert	128.00	Edge of Pavement	120.96	0.00	0.00	121.60	0.00	0.00	121.89	0.00	0.00	122.32	0.00	0.00	122.90	0.00	0.00
NBSL2370	118.26	Invert	124.00	Edge of Pavement	118.23	0.00	0.00	118.87	0.00	0.00	119.15	0.00	0.00	119.58	0.00	0.00	120.16	0.00	0.00
NBSL2380	116.58	Invert	123.70	Edge of Pavement	116.55	0.00	0.00	117.19	0.00	0.00	117.48	0.00	0.00	117.90	0.00	0.00	118.49	0.00	0.00
NBSL2390	115.07	Invert	121.50	Edge of Pavement	115.04	0.00	0.00	115.68	0.00	0.00	115.97	0.00	0.00	116.39	0.00	0.00	116.98	0.00	0.00
NBSL2400	114.16	Invert	120.00	Edge of Pavement	114.13	0.00	0.00	114.78	0.00	0.00	115.07	0.00	0.00	115.49	0.00	0.00	116.08	0.00	0.00
NBSL2500	112.79	Invert	120.00	Edge of Pavement	112.76	0.00	0.00	113.39	0.00	0.00	113.68	0.00	0.00	114.11	0.00	0.00	114.69	0.00	0.00
NBSL2510	107.9	Invert	115.00	Edge of Pavement	109.03	0.00	0.00	109.09	0.00	0.00	109.18	0.00	0.00	109.39	0.00	0.00	109.84	0.00	0.00
NBSL2520	107.75	Invert	114.70	Edge of Pavement	109.03	0.00	0.00	109.08	0.00	0.00	109.16	0.00	0.00	109.35	0.00	0.00	109.76	0.00	0.00
NBSL2530	104.00	DEM Water Surface	109.50	Top of Bank	109.03	0.00	0.00	109.08	0.00	0.00	109.09	0.00	0.00	109.11	0.00	0.00	109.27	0.00	0.00
NBSL2540	99.62	Invert	106.40	Edge of Pavement	101.19	0.00	0.00	106.24	0.00	0.00	**106.95**	0.54	1.50	**107.24**	0.84	1.55	**108.68**	2.28	2.17
NBSL2550	99.12	Invert	104.45	Grate Elevation	101.19	0.00	0.00	**106.24**	1.79	2.00	**106.95**	2.50	2.67	**107.24**	2.79	4.10	**108.68**	4.23	3.67
NBSL2560	98.90	Invert	105.72	Grate Elevation	101.04	0.00	0.00	104.63	0.00	0.00	105.41	0.00	0.00	**105.80**	0.08	0.04	**107.52**	1.80	1.67
NBSL2570	98.71	Invert	106.33	Top of Structure	100.87	0.00	0.00	103.11	0.00	0.00	103.91	0.00	0.00	104.39	0.00	0.00	**106.39**	0.06	0.17
NBSL2580	89.00	DEM Water Surface	101.00	Top of Bank	94.21	0.00	0.00	97.37	0.00	0.00	98.06	0.00	0.00	99.51	0.00	0.00	**101.32**	0.32	1.50
NBSL2590	94.30	Invert	104.00	Edge of Pavement	95.54	0.00	0.00	97.89	0.00	0.00	98.55	0.00	0.00	99.70	0.00	0.00	101.01	0.00	0.00
NBSL2600	92.93	Invert	103.40	Edge of Pavement	95.54	0.00	0.00	97.90	0.00	0.00	98.56	0.00	0.00	99.79	0.00	0.00	100.81	0.00	0.00
NBSL2610	98.00	Bottom Elevation	107.00	Top of Bank	98.82	0.00	0.00	99.44	0.00	0.00	99.62	0.00	0.00	99.89	0.00	0.00	100.96	0.00	0.00
NBSL2620	114.60	Bottom Elevation	120.00	Edge of Pavement	**120.10**	0.10	2.83	**120.25**	0.25	6.17	**120.29**	0.29	6.67	**120.37**	0.37	7.67	**120.89**	0.89	8.00
NBSL2630	113.00	Bottom Elevation	120.00	Top of Bank	116.38	0.00	0.00	116.72	0.00	0.00	117.42	0.00	0.00	119.61	0.00	0.00	**120.34**	0.34	1.00
NBSL2640	111.32	Invert	120.10	Edge of Pavement	112.96	0.00	0.00	114.99	0.00	0.00	115.73	0.00	0.00	117.32	0.00	0.00	117.94	0.00	0.00
NBSL2650	110.64	Invert	120.00	Edge of Pavement	112.28	0.00	0.00	114.07	0.00	0.00	114.62	0.00	0.00	115.83	0.00	0.00	116.38	0.00	0.00
NBSL2660	109.17	Invert	115.00	Edge of Pavement	111.49	0.00	0.00	112.87	0.00	0.00	113.17	0.00	0.00	113.86	0.00	0.00	114.34	0.00	0.00
NBSL2665	108.00	Bottom Elevation	113.12	Top of Bank	111.39	0.00	0.00	111.79	0.00	0.00	111.85	0.00	0.00	112.08	0.00	0.00	112.50	0.00	0.00
NBSL2670	153.00	Bottom Elevation	155.00	Top of Bank	154.93	0.00	0.00	**155.00**	0.00	1.00	**155.01**	0.01	1.67	**155.02**	0.02	7.17	**155.07**	0.07	6.83
NBSL2680	153.00	Bottom Elevation	155.30	Top of Bank	154.89	0.00	0.00	**155.51**	0.21	59.83	**155.56**	0.26	61.33	**155.62**	0.32	62.33	**155.77**	0.47	140.83
NBSL2690	145.12	Control Elevation	149.50	Top of Bank	149.06	0.00	0.00	149.13	0.00	0.00	149.14	0.00	0.00	149.17	0.00	0.00	**149.78**	0.28	1.00
NBSL2700	142.77	Invert	147.90	Edge of Pavement	144.57	0.00	0.00	146.01	0.00	0.00	146.55	0.00	0.00	147.49	0.00	0.00	**148.90**	1.00	1.67
NBSL2710	146.62	Bottom Elevation	149.20	Top of Bank	148.20	0.00	0.00	148.25	0.00	0.00	148.27	0.00	0.00	148.30	0.00	0.00	148.56	0.00	0.00
NBSL2720	136.60	Bottom Elevation	148.30	Top of Bank	144.57	0.00	0.00	145.96	0.00	0.00	146.48	0.00	0.00	147.34	0.00	0.00	147.69	0.00	0.00
NBSL2730	144.6	Swale Bottom	147.70	Edge of Pavement	145.35	0.00	0.00	145.44	0.00	0.00	145.46	0.00	0.00	145.52	0.00	0.00	145.72	0.00	0.00
NBSL2740	141.77	Invert	146.60	Edge of Pavement	141.99	0.00	0.00	142.40	0.00	0.00	142.48	0.00	0.00	142.72	0.00	0.00	143.59	0.00	0.00
NBSL2750	139.88	Invert	145.00	Edge of Pavement	140.53	0.00	0.00	140.99	0.00	0.00	141.18	0.00	0.00	141.40	0.00	0.00	142.45	0.00	0.00
NBSL2760	138.93	Invert	144.00	Edge of Pavement	139.58	0.00	0.00	140.04	0.00	0.00	140.23	0.00	0.00	140.43	0.00	0.00	141.50	0.00	0.00
NBSL2770	137.78	Invert	143.70	Edge of Pavement	138.54	0.00	0.00	139.11	0.00	0.00	139.34	0.00	0.00	139.57	0.00	0.00	140.80	0.00	0.00
NBSL2790	142.00	Bottom Elevation	143.96	Control Elevation	**144.02**	0.06	62.67	**144.04**	0.08	64.00	**144.05**	0.09	64.17	**144.06**	0.10	64.67	**144.13**	0.16	162.83
NBSL2800	134.67	Invert	138.50	Edge of Pavement	135.79	0.00	0.00	136.30	0.00	0.00	136.64	0.00	0.00	136.95	0.00	0.00	**138.65**	0.15	0.33
NBSL2810	131.00	DEM Water Surface	135.00	Top of Bank	132.36	0.00	0.00	132.62	0.00	0.00	132.72	0.00	0.00	132.84	0.00	0.00	133.50	0.00	0.00
NBSL2820	127.00	DEM Water Surface	131.00	Top of Bank	127.66	0.00	0.00	127.86	0.00	0.00	127.93	0.00	0.00	128.00	0.00	0.00	128.43	0.00	0.00
NBSL2830	120.90	DEM Water Surface	128.00	Top of Bank	121.41	0.00	0.00	121.71	0.00	0.00	121.82	0.00	0.00	121.95	0.00	0.00	122.69	0.00	0.00
NBSL2840	118.00	DEM Water Surface	125.50	Top of Bank	118.87	0.00	0.00	119.27	0.00	0.00	119.42	0.00	0.00	119.61	0.00	0.00	120.91	0.00	0.00
NBSL2850	119.00	Structure Bottom	124.83	Top of Structure	123.88	0.00	0.00	**124.88**	0.05	0.83	**125.02**	0.19	1.83	**125.04**	0.21	2.83	**125.12**	0.29	1.83
NBSL2860	105.00	Bottom Elevation	108.00	Top of Bank	106.02	0.00	0.00	106.03	0.00	0.00	106.04	0.00	0.00	106.04	0.00	0.00	106.07	0.00	0.00
NBSL2870	104.00	Bottom Elevation	106.42	Grate Elevation	**106.51**	0.09	6.33	**106.60**	0.18	9.67	**106.87**	0.45	11.67	**107.06**	0.64	13.17	**107.18**	0.75	38.83
NBSL2880	104.00	Bottom Elevation	106.00	Edge of Pavement	105.01	0.00	0.00	**106.30**	0.30	3.33	**106.85**	0.85	6.00	**107.08**	1.08	7.50	**107.35**	1.35	7.00
NBSL2890	101.75	Invert	107.00	Top of Bank	103.84	0.00	0.00	106.30	0.00	0.00	106.85	0.00	0.00	**107.08**	0.08	1.67	**107.35**	0.35	1.76
NBSL2900	100.00	DEM Water Surface	105.50	Edge of Property	102.81	0.00	0.00	103.31	0.00	0.00	103.42	0.00	0.00	103.60	0.00	0.00	104.11	0.00	0.00
NBSL2910	104.00	Bottom Elevation	106.12	Top of Bank	106.00	0.00	0.00	106.02	0.00	0.00	106.12	0.00	0.00	**106.29**	0.17	3.17	**106.50**	0.38	2.83
NBSL2920	152.62	Control Elevation	155.50	Top of Bank	152.65	0.00	0.00	152.68	0.00	0.00	152.69	0.00	0.00	152.76	0.00	0.00	153.80	0.00	0.00
NBSL2930	149.47	Invert	155.10	Edge of Pavement	151.39	0.00	0.00	151.54	0.00	0.00	151.69	0.00	0.00	152.76	0.00	0.00	153.79	0.00	0.00
NBSL2931	148.5	Downstream Water Elevation	151.37	Grate Elevation	**151.39**	0.02	3.00	**151.54**	0.17	6.67	**151.69**	0.32	9.17	**152.76**	1.39	11.50	**153.79**	2.42	24.00
NBSL2932	148.8	Downstream Water Elevation	151.87	Grate Elevation	151.39	0.00	0.00	151.54	0.00	0.00	151.69	0.00	0.00	**152.76**	0.89	3.00	**153.79**	1.92	4.83
NBSL2940	148.80	Water Surface	153.00	Top of Bank	151.39	0.00	0.00	151.54	0.00	0.00	151.69	0.00	0.00	152.76	0.00	0.00	**153.79**	0.79	3.67
NBSL2950	149.86	Invert	154.50	Edge of Pavement	150.20	0.00	0.00	151.20	0.00	0.00	151.41	0.00	0.00	152.61	0.00	0.00	153.77	0.00	0.00
NBSL2960	152.00	Bottom Elevation	154.90	Top of Bank	153.06	0.00	0.00	154.11	0.00	0.00	154.39	0.00	0.00	154.84	0.00	0.00	**154.98**	0.08	4.17
NBSL2970	150.12	Invert	153.80	Edge of Pavement	150.70	0.00	0.00	151.16	0.00	0.00	151.33	0.00	0.00	152.57	0.00	0.00	153.78	0.00	0.00
NBSL2980	149.12	Invert	152.50	Edge of Pavement	150.09	0.00	0.00	151.13	0.00	0.00	151.31	0.00	0.00	**152.54**	0.04	0.67	**153.77**	1.27	3.00
NBSL2990	148.83	Invert	153.00	Top of Structure	150.05	0.00	0.00	150.81	0.00	0.00	150.94	0.00	0.00	152.31	0.00	0.00	**153.76**	0.76	2.33

Geosyntec consultants

APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL3000	146.45	Invert	152.80	Edge of Pavement	149.90	0.00	0.00	150.50	0.00	0.00	150.50	0.00	0.00	151.53	0.00	0.00	152.53	0.00	0.00
NBSL3010	147.33	Invert	150.10	Edge of Pavement	148.58	0.00	0.00	149.41	0.00	0.00	149.67	0.00	0.00	149.83	0.00	0.00	**150.17**	0.07	1.83
NBSL3020	145.41	Invert	149.52	Top of Structure	146.64	0.00	0.00	147.47	0.00	0.00	147.73	0.00	0.00	147.90	0.00	0.00	148.23	0.00	0.00
NBSL3024	137.91	Invert	145.70	Edge of Pavement	139.57	0.00	0.00	140.40	0.00	0.00	140.71	0.00	0.00	140.93	0.00	0.00	141.45	0.00	0.00
NBSL3026	137.58	Invert	145.00	Edge of Pavement	139.46	0.00	0.00	140.16	0.00	0.00	140.45	0.00	0.00	140.65	0.00	0.00	141.09	0.00	0.00
NBSL3030	142.00	Bottom Elevation	145.00	Top of Bank	144.84	0.00	0.00	**145.03**	0.03	0.83	**145.09**	0.09	1.83	**145.19**	0.19	2.67	**145.96**	0.96	1.83
NBSL3050	137.01	Invert	144.12	Top of Structure	139.44	0.00	0.00	139.98	0.00	0.00	140.22	0.00	0.00	140.68	0.00	0.00	141.64	0.00	0.00
NBSL3080	137.00	DEM Water Surface	145.00	Top of Bank	139.31	0.00	0.00	139.51	0.00	0.00	139.57	0.00	0.00	139.64	0.00	0.00	139.85	0.00	0.00
NBSL3090	132.93	Invert	139.00	Edge of Pavement	134.61	0.00	0.00	135.58	0.00	0.00	135.91	0.00	0.00	136.28	0.00	0.00	137.80	0.00	0.00
NBSL3100	137.00	Bottom Elevation	138.80	Edge of Pavement	137.62	0.00	0.00	137.66	0.00	0.00	137.67	0.00	0.00	137.69	0.00	0.00	137.90	0.00	0.00
NBSL3110	133.7	Invert	139.60	Edge of Pavement	133.91	0.00	0.00	134.08	0.00	0.00	134.13	0.00	0.00	134.22	0.00	0.00	134.61	0.00	0.00
NBSL3120	133.16	Invert	138.50	Edge of Pavement	133.74	0.00	0.00	133.90	0.00	0.00	133.95	0.00	0.00	134.04	0.00	0.00	134.39	0.00	0.00
NBSL3130	130.25	Invert	132.00	Top of Bank	130.71	0.00	0.00	131.02	0.00	0.00	131.07	0.00	0.00	131.13	0.00	0.00	131.27	0.00	0.00
NBSL3140	110.69	Invert	119.00	Edge of Pavement	112.28	0.00	0.00	113.22	0.00	0.00	113.40	0.00	0.00	113.57	0.00	0.00	114.07	0.00	0.00
NBSL3150	102.70	Control Elevation	107.00	Top of Bank	103.93	0.00	0.00	104.22	0.00	0.00	104.27	0.00	0.00	104.34	0.00	0.00	104.53	0.00	0.00
NBSL3160	136.00	Bottom Elevation	140.50	Edge of Pavement	139.56	0.00	0.00	139.71	0.00	0.00	139.73	0.00	0.00	139.79	0.00	0.00	140.01	0.00	0.00
NBSL3165	123.1	Invert	129.12	Grate Elevation	123.74	0.00	0.00	123.93	0.00	0.00	123.99	0.00	0.00	124.14	0.00	0.00	126.11	0.00	0.00
NBSL3200	122.00	Bottom Elevation	124.50	Edge of Pavement	123.74	0.00	0.00	123.89	0.00	0.00	123.94	0.00	0.00	124.03	0.00	0.00	124.43	0.00	0.00
NBSL3210	110.21	Invert	124.60	Edge of Pavement	110.41	0.00	0.00	111.00	0.00	0.00	111.14	0.00	0.00	111.45	0.00	0.00	112.18	0.00	0.00
NBSL3220	103.83	Invert	107.00	Edge of Pavement	104.08	0.00	0.00	104.88	0.00	0.00	105.57	0.00	0.00	105.74	0.00	0.00	**107.21**	0.21	0.17
NBSL3230	115.00	Bottom Elevation	118.00	Top of Bank	**118.17**	0.17	62.17	**118.30**	0.30	63.67	**118.33**	0.33	63.83	**118.38**	0.38	64.33	**118.55**	0.55	158.17
NBSL3240	102.70	Downstream Control Elevation	105.50	Top of Bank	103.96	0.00	0.00	104.86	0.00	0.00	**105.53**	0.03	0.67	**105.67**	0.17	5.00	**105.91**	0.41	4.33
NBSL3250	153.37	Control Elevation	158.00	Top of Bank	154.47	0.00	0.00	156.37	0.00	0.00	156.93	0.00	0.00	157.11	0.00	0.00	157.27	0.00	0.00
NBSL3260	152.53	Downstream Control Elevation	159.00	Edge of Pavement	154.48	0.00	0.00	156.20	0.00	0.00	156.92	0.00	0.00	157.11	0.00	0.00	157.27	0.00	0.00
NBSL3270	152.53	Downstream Control Elevation	160.10	Edge of Pavement	154.51	0.00	0.00	156.19	0.00	0.00	156.74	0.00	0.00	156.96	0.00	0.00	157.16	0.00	0.00
NBSL3280	152.53	Downstream Control Elevation	159.10	Edge of Pavement	154.53	0.00	0.00	156.19	0.00	0.00	156.68	0.00	0.00	156.90	0.00	0.00	157.12	0.00	0.00
NBSL3290	152.53	Downstream Control Elevation	159.00	Edge of Pavement	154.55	0.00	0.00	156.19	0.00	0.00	156.55	0.00	0.00	156.78	0.00	0.00	157.03	0.00	0.00
NBSL3300	152.53	Downstream Control Elevation	159.00	Edge of Pavement	154.57	0.00	0.00	156.20	0.00	0.00	156.50	0.00	0.00	156.73	0.00	0.00	157.00	0.00	0.00
NBSL3310	152.53	Downstream Control Elevation	159.00	Edge of Pavement	154.59	0.00	0.00	156.22	0.00	0.00	156.39	0.00	0.00	156.61	0.00	0.00	156.93	0.00	0.00
NBSL3320	152.53	Downstream Control Elevation	157.70	Edge of Pavement	154.62	0.00	0.00	156.24	0.00	0.00	156.36	0.00	0.00	156.52	0.00	0.00	156.88	0.00	0.00
NBSL3330	152.53	Downstream Control Elevation	157.00	Edge of Pavement	154.64	0.00	0.00	156.26	0.00	0.00	156.37	0.00	0.00	156.54	0.00	0.00	156.86	0.00	0.00
NBSL3340	152.53	Downstream Control Elevation	157.00	Edge of Pavement	154.65	0.00	0.00	156.27	0.00	0.00	156.38	0.00	0.00	156.55	0.00	0.00	156.86	0.00	0.00
NBSL3350	157.00	Bottom Elevation	158.50	Top of Bank	158.09	0.00	0.00	**159.02**	0.52	9.67	**159.03**	0.53	10.33	**159.04**	0.54	11.50	**159.05**	0.55	11.67
NBSL3360	153.37	Invert	156.66	Top of Structure	**157.25**	0.59	5.67	**158.39**	1.73	15.67	**158.42**	1.76	16.67	**158.45**	1.79	17.83	**158.48**	1.82	19.67
NBSL3370	154.00	DEM Water Surface	156.50	Top of Bank	**156.70**	0.19	8.83	**157.07**	0.57	16.00	**157.09**	0.59	16.83	**157.12**	0.62	18.17	**157.21**	0.71	31.50
NBSL3380	152.13	Invert	156.43	Grate Elevation	155.62	0.00	0.00	**156.99**	0.56	13.83	**157.04**	0.61	15.00	**157.10**	0.67	16.17	**157.20**	0.77	18.17
NBSL3390	152.66	Invert	156.31	Grate Elevation	155.01	0.00	0.00	**156.63**	0.32	11.50	**156.70**	0.39	13.67	**156.82**	0.51	15.67	**157.03**	0.72	16.17
NBSL3400	152.91	Invert	156.15	Grate Elevation	154.89	0.00	0.00	**156.50**	0.35	12.00	**156.59**	0.44	14.00	**156.73**	0.58	15.83	**156.97**	0.82	16.50
NBSL3410	152.53	Downstream Control Elevation	156.22	Grate Elevation	154.81	0.00	0.00	**156.39**	0.17	8.17	**156.49**	0.27	11.83	**156.64**	0.42	14.67	**156.92**	0.70	15.00
NBSL3420	153.12	Control Elevation	156.80	Top of Bank	155.00	0.00	0.00	156.45	0.00	0.00	**156.81**	0.01	1.00	**157.24**	0.44	8.33	**157.40**	0.60	10.00
NBSL3430	152.53	Downstream Control Elevation	157.80	Edge of Pavement	154.71	0.00	0.00	156.39	0.00	0.00	156.66	0.00	0.00	156.98	0.00	0.00	157.15	0.00	0.00
NBSL3440	152.53	Downstream Control Elevation	157.00	Edge of Pavement	154.69	0.00	0.00	156.35	0.00	0.00	156.57	0.00	0.00	156.82	0.00	0.00	157.00	0.00	0.00
NBSL3450	152.53	Downstream Control Elevation	157.00	Edge of Pavement	154.68	0.00	0.00	156.33	0.00	0.00	156.52	0.00	0.00	156.74	0.00	0.00	156.94	0.00	0.00
NBSL3460	152.53	Downstream Control Elevation	157.00	Edge of Pavement	154.66	0.00	0.00	156.29	0.00	0.00	156.43	0.00	0.00	156.61	0.00	0.00	156.88	0.00	0.00
NBSL3470	152.53	Control Elevation	156.80	Top of Bank	154.65	0.00	0.00	156.27	0.00	0.00	156.38	0.00	0.00	156.55	0.00	0.00	**156.86**	0.06	0.50
NBSL3480	149.84	Invert	156.00	Edge of Pavement	151.85	0.00	0.00	155.49	0.00	0.00	155.68	0.00	0.00	155.87	0.00	0.00	**156.20**	0.20	2.00
NBSL3490	149.86	Invert	156.40	Edge of Pavement	151.74	0.00	0.00	155.06	0.00	0.00	155.29	0.00	0.00	155.50	0.00	0.00	155.84	0.00	0.00
NBSL3500	149.44	Invert	156.10	Edge of Pavement	151.59	0.00	0.00	154.53	0.00	0.00	154.82	0.00	0.00	155.04	0.00	0.00	155.39	0.00	0.00
NBSL3510	148.84	Invert	153.28	Grate Elevation	151.24	0.00	0.00	**153.52**	0.24	6.33	**153.91**	0.63	9.33	**154.17**	0.89	12.00	**154.54**	1.26	13.33
NBSL3520	148.08	Downstream Control Elevation	155.00	Edge of Pavement	150.75	0.00	0.00	152.68	0.00	0.00	153.08	0.00	0.00	153.36	0.00	0.00	153.75	0.00	0.00
NBSL3530	148.08	Downstream Control Elevation	155.00	Edge of Pavement	150.42	0.00	0.00	152.14	0.00	0.00	152.52	0.00	0.00	152.82	0.00	0.00	153.22	0.00	0.00
NBSL3540	148.08	Control Elevation	152.50	Top of Bank	149.42	0.00	0.00	150.46	0.00	0.00	150.67	0.00	0.00	151.03	0.00	0.00	151.47	0.00	0.00
NBSL3550	142.93	Invert	148.36	Grate Elevation	145.22	0.00	0.00	**149.17**	0.81	4.83	**149.35**	0.99	7.33	**149.66**	1.30	8.33	**150.04**	1.68	10.33
NBSL3560	141.84	Invert	146.78	Grate Elevation	144.11	0.00	0.00	**147.86**	1.08	6.17	**148.01**	1.23	7.50	**148.28**	1.50	8.83	**148.60**	1.82	10.83
NBSL3570	140.39	Invert	146.48	Grate Elevation	142.68	0.00	0.00	**146.92**	0.44	3.67	**147.05**	0.57	7.00	**147.27**	0.79	8.17	**147.55**	1.07	9.83
NBSL3580	139.49	Invert	144.77	Grate Elevation	142.22	0.00	0.00	**145.84**	1.07	6.33	**145.95**	1.18	7.50	**146.13**	1.36	9.00	**146.36**	1.59	11.33
NBSL3590	138.49	Invert	144.03	Grate Elevation	142.03	0.00	0.00	**144.70**	0.67	6.33	**144.79**	0.76	7.50	**144.93**	0.90	8.67	**145.10**	1.07	11.17
NBSL3600	138.17	Invert	143.11	Grate Elevation	141.72	0.00	0.00	**143.81**	0.70	6.33	**143.87**	0.76	7.67	**143.98**	0.86	9.00	**144.11**	0.99	11.50
NBSL3610	137.75	Invert	142.47	Grate Elevation	141.37	0.00	0.00	**142.77**	0.30	6.17	**142.81**	0.34	7.50	**142.87**	0.40	8.67	**142.95**	0.48	11.00
NBSL3620	137.58	Invert	142.27	Grate Elevation	141.07	0.00	0.00	141.87	0.00	0.00	141.89	0.00	0.00	141.92	0.00	0.00	141.96	0.00	0.00
NBSL3630	137.46	Invert	141.80	Grate Elevation	139.65	0.00	0.00	140.45	0.00	0.00	140.45	0.00	0.00	140.45	0.00	0.00	140.69	0.00	0.00
NBSL3640	136.61	Control Elevation	141.00	Top of Bank	137.25	0.00	0.00	137.61	0.00	0.00	137.82	0.00	0.00	138.46	0.00	0.00	139.64	0.00	0.00
NBSL3650	132.09	Control Elevation	135.00	Top of Bank	133.66	0.00	0.00	**135.17**	0.17	6.50	**135.25**	0.25	7.67	**135.48**	0.48	9.33	**135.90**	0.90	14.17

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APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL3660	129.93	Invert	135.20	Edge of Pavement	132.55	0.00	0.00	133.34	0.00	0.00	133.38	0.00	0.00	133.51	0.00	0.00	133.73	0.00	0.00
NBSL3670	127.00	DEM Water Surface	133.00	Top of Bank	127.52	0.00	0.00	127.90	0.00	0.00	128.24	0.00	0.00	128.70	0.00	0.00	129.54	0.00	0.00
NBSL3680	119.21	Invert	126.38	Top of Structure	121.70	0.00	0.00	122.14	0.00	0.00	**128.07**	1.69	4.50	**128.38**	2.00	6.00	**128.84**	2.46	4.83
NBSL3690	109.32	Invert	116.00	Top of Bank	111.90	0.00	0.00	114.25	0.00	0.00	**116.12**	0.12	0.67	**117.36**	1.36	5.00	**119.40**	3.40	4.17
NBSL3700	106.40	Invert	116.00	Top of Bank	107.46	0.00	0.00	107.94	0.00	0.00	107.99	0.00	0.00	108.10	0.00	0.00	108.33	0.00	0.00
NBSL3710	102.40	Invert	106.00	Top of Bank	104.25	0.00	0.00	105.91	0.00	0.00	**106.05**	0.05	4.40	**106.47**	0.47	6.00	**107.14**	1.14	5.17
NBSL3720	103.00	Bottom Elevation	111.00	Top of Bank	107.94	0.00	0.00	108.32	0.00	0.00	108.37	0.00	0.00	108.51	0.00	0.00	108.75	0.00	0.00
NBSL3730	102.93	Invert	105.20	Edge of Pavement	102.97	0.00	0.00	103.19	0.00	0.00	103.22	0.00	0.00	103.34	0.00	0.00	104.78	0.00	0.00
NBSL3740	98.96	Invert	107.20	Edge of Pavement	100.72	0.00	0.00	102.53	0.00	0.00	102.87	0.00	0.00	103.26	0.00	0.00	104.77	0.00	0.00
NBSL3750	98.7	Invert	107.90	Edge of Pavement	100.56	0.00	0.00	102.25	0.00	0.00	102.40	0.00	0.00	102.54	0.00	0.00	103.26	0.00	0.00
NBSL3760	102.00	Bottom Elevation	108.50	Top of Bank	104.81	0.00	0.00	107.29	0.00	0.00	107.92	0.00	0.00	108.08	0.00	0.00	108.30	0.00	0.00
NBSL3770	102.21	Invert	108.90	Edge of Pavement	104.81	0.00	0.00	107.29	0.00	0.00	107.89	0.00	0.00	108.03	0.00	0.00	108.21	0.00	0.00
NBSL3780	101.1	Invert	109.00	Edge of Pavement	104.81	0.00	0.00	107.29	0.00	0.00	107.87	0.00	0.00	107.98	0.00	0.00	108.12	0.00	0.00
NBSL3790	97.16	Invert	109.00	Edge of Pavement	97.95	0.00	0.00	99.09	0.00	0.00	99.85	0.00	0.00	100.75	0.00	0.00	101.98	0.00	0.00
NBSL3810	131.00	DEM Water Surface	134.00	Top of Bank	133.31	0.00	0.00	133.68	0.00	0.00	133.74	0.00	0.00	133.81	0.00	0.00	**134.08**	0.08	0.67
NBSL3820	120.76	Invert	129.63	Top of Structure	120.76	0.00	0.00	121.81	0.00	0.00	126.28	0.00	0.00	126.86	0.00	0.00	128.78	0.00	0.00
NBSL3830	118.71	Invert	127.40	Edge of Pavement	118.71	0.00	0.00	119.88	0.00	0.00	126.23	0.00	0.00	126.77	0.00	0.00	**128.40**	1.00	1.17
NBSL3840	113.52	Invert	125.82	Top of Structure	114.27	0.00	0.00	119.00	0.00	0.00	**126.18**	0.36	1.10	**126.67**	0.85	2.67	**127.98**	2.16	3.00
NBSL3850	111.20	Invert	122.00	Edge of Pavement	111.91	0.00	0.00	116.13	0.00	0.00	**122.02**	0.02	0.23	**122.44**	0.44	2.17	**123.54**	1.54	2.50
NBSL3860	107.62	Invert	121.60	Edge of Pavement	108.38	0.00	0.00	113.52	0.00	0.00	118.23	0.00	0.00	118.57	0.00	0.00	119.48	0.00	0.00
NBSL3870	103.02	Invert	115.30	Edge of Pavement	103.78	0.00	0.00	108.38	0.00	0.00	110.77	0.00	0.00	110.97	0.00	0.00	111.50	0.00	0.00
NBSL3890	98.21	Invert	104.40	Edge of Pavement	98.95	0.00	0.00	103.55	0.00	0.00	**105.06**	0.66	1.62	**105.16**	0.75	3.00	**105.40**	1.00	2.67
NBSL3900	100.82	Control Elevation	105.50	Top of Bank	102.78	0.00	0.00	103.51	0.00	0.00	103.51	0.00	0.00	103.54	0.00	0.00	103.59	0.00	0.00
NBSL3910	100.82	Control Elevation	110.00	Top of Bank	101.56	0.00	0.00	102.27	0.00	0.00	102.51	0.00	0.00	102.93	0.00	0.00	103.48	0.00	0.00
NBSL3920	125.12	DEM Water Surface	138.10	Top of Bank	130.87	0.00	0.00	133.69	0.00	0.00	135.02	0.00	0.00	137.25	0.00	0.00	**140.01**	1.91	138.67
NBSL3930	125.12	DEM Water Surface	138.10	Top of Bank	126.48	0.00	0.00	133.69	0.00	0.00	135.02	0.00	0.00	137.25	0.00	0.00	**140.01**	1.91	138.50
NBSL3940	128.29	Invert	145.10	Edge of Pavement	135.89	0.00	0.00	137.25	0.00	0.00	137.46	0.00	0.00	137.73	0.00	0.00	139.02	0.00	0.00
NBSL3945	127.33	Invert	137.00	Top of Bank	135.89	0.00	0.00	**137.25**	0.25	3.50	**137.46**	0.46	4.67	**137.73**	0.73	5.67	**139.02**	2.02	7.17
NBSL3950	132.12	Bottom Elevation	137.00	Top of Bank	135.88	0.00	0.00	**137.23**	0.23	3.33	**137.41**	0.41	4.33	**137.61**	0.61	5.50	**138.29**	1.29	7.00
NBSL3960	127.00	DEM Water Surface	139.00	Edge of Pavement	135.88	0.00	0.00	137.21	0.00	0.00	137.37	0.00	0.00	137.57	0.00	0.00	138.21	0.00	0.00
NBSL3970	115.11	Bottom Elevation	128.00	Edge of Property	121.93	0.00	0.00	122.47	0.00	0.00	122.68	0.00	0.00	123.23	0.00	0.00	126.77	0.00	0.00
NBSL3980	132.00	Bottom Elevation	138.00	Top of Bank	136.44	0.00	0.00	136.55	0.00	0.00	136.58	0.00	0.00	136.64	0.00	0.00	136.99	0.00	0.00
NBSL3990	128.12	DEM Water Surface	134.00	Top of Bank	131.45	0.00	0.00	131.57	0.00	0.00	131.61	0.00	0.00	131.67	0.00	0.00	132.28	0.00	0.00
NBSL4000	120.32	Invert	131.70	Edge of Pavement	126.98	0.00	0.00	128.55	0.00	0.00	128.62	0.00	0.00	128.79	0.00	0.00	130.23	0.00	0.00
NBSL4010	120.12	Bottom Elevation	129.00	Top of Bank	126.98	0.00	0.00	128.53	0.00	0.00	128.56	0.00	0.00	128.58	0.00	0.00	128.65	0.00	0.00
NBSL4020	120.04	Invert	129.10	Edge of Pavement	126.98	0.00	0.00	128.54	0.00	0.00	128.56	0.00	0.00	128.60	0.00	0.00	128.72	0.00	0.00
NBSL4030	120.12	Bottom Elevation	129.00	Top of Bank	126.98	0.00	0.00	128.54	0.00	0.00	128.57	0.00	0.00	128.62	0.00	0.00	128.79	0.00	0.00
NBSL4040	113.51	Invert	127.80	Edge of Pavement	113.75	0.00	0.00	115.39	0.00	0.00	115.95	0.00	0.00	116.58	0.00	0.00	118.16	0.00	0.00
NBSL4050	97.16	Downstream Water Elevation	106.70	Edge of Pavement	97.95	0.00	0.00	99.23	0.00	0.00	99.90	0.00	0.00	100.63	0.00	0.00	102.27	0.00	0.00
NBSL4060	100.62	Control Elevation	108.50	Top of Bank	105.62	0.00	0.00	**108.56**	0.06	1.17	**109.34**	0.84	5.50	**109.58**	1.08	6.83	**109.93**	1.43	7.67
NBSL4070	100.12	Control Elevation	107.50	Top of Bank	104.91	0.00	0.00	105.62	0.00	0.00	106.21	0.00	0.00	106.96	0.00	0.00	**110.55**	3.05	1.83
NBSL4080	98.62	Control Elevation	106.40	Top of Bank	105.02	0.00	0.00	105.63	0.00	0.00	105.81	0.00	0.00	106.02	0.00	0.00	**106.43**	0.03	0.15
NBSL4090	107.12	Control Elevation	115.50	Top of Bank	108.46	0.00	0.00	110.33	0.00	0.00	111.04	0.00	0.00	112.27	0.00	0.00	113.03	0.00	0.00
NBSL4100	117.12	Control Elevation	123.00	Top of Bank	119.47	0.00	0.00	121.35	0.00	0.00	121.96	0.00	0.00	122.68	0.00	0.00	122.79	0.00	0.00
NBSL4110	106.00	Invert	115.00	Edge of Pavement	111.28	0.00	0.00	111.40	0.00	0.00	111.44	0.00	0.00	111.51	0.00	0.00	111.93	0.00	0.00
NBSL4120	102.5	Bottom Elevation	108.50	Top of Bank	104.53	0.00	0.00	105.29	0.00	0.00	105.54	0.00	0.00	105.97	0.00	0.00	106.47	0.00	0.00
NBSL4130	102.37	Invert	108.30	Edge of Pavement	103.76	0.00	0.00	103.84	0.00	0.00	103.84	0.00	0.00	104.94	0.00	0.00	107.72	0.00	0.00
NBSL4140	99.5	Invert	101.80	Edge of Pavement	100.89	0.00	0.00	101.48	0.00	0.00	101.48	0.00	0.00	101.73	0.00	0.00	**103.30**	1.50	1.50
NBSL4150	97.5	Invert	101.10	Edge of Pavement	98.65	0.00	0.00	99.22	0.00	0.00	99.28	0.00	0.00	100.01	0.00	0.00	**101.19**	0.09	8.33
NBSL4160	101.36	Invert	109.10	Top of Structure	101.79	0.00	0.00	101.97	0.00	0.00	102.03	0.00	0.00	102.13	0.00	0.00	103.03	0.00	0.00
NBSL4170	98.79	Control Elevation	100.50	Top of Bank	99.12	0.00	0.00	99.39	0.00	0.00	99.51	0.00	0.00	100.00	0.00	0.00	**101.18**	0.68	22.33
NBSL4175	97.16	Control Elevation	101.00	Top of Bank	97.95	0.00	0.00	98.89	0.00	0.00	99.28	0.00	0.00	100.00	0.00	0.00	**101.18**	0.18	11.50
NBSL4180	94.67	Control Elevation	103.00	Edge of Pavement	95.65	0.00	0.00	96.55	0.00	0.00	96.92	0.00	0.00	97.57	0.00	0.00	98.65	0.00	0.00
NBSL4190	94.54	Invert	101.50	Edge of Pavement	95.56	0.00	0.00	96.43	0.00	0.00	96.78	0.00	0.00	97.39	0.00	0.00	98.42	0.00	0.00
NBSL4200	94	Invert	103.70	Edge of Pavement	94.99	0.00	0.00	95.86	0.00	0.00	96.21	0.00	0.00	96.82	0.00	0.00	97.90	0.00	0.00
NBSL4210	137.00	DEM Water Surface	142.00	Top of Bank	137.27	0.00	0.00	137.64	0.00	0.00	137.78	0.00	0.00	138.04	0.00	0.00	138.48	0.00	0.00
NBSL4220	137.00	DEM Water Surface	142.00	Top of Bank	138.16	0.00	0.00	139.07	0.00	0.00	139.38	0.00	0.00	139.88	0.00	0.00	140.02	0.00	0.00
NBSL4230	130.00	Bottom Elevation	135.00	Top of Bank	132.11	0.00	0.00	132.66	0.00	0.00	133.39	0.00	0.00	134.06	0.00	0.00	134.29	0.00	0.00
NBSL4240	129.78	Invert	134.00	Top of Bank	133.09	0.00	0.00	133.16	0.00	0.00	133.17	0.00	0.00	133.95	0.00	0.00	**134.29**	0.29	1.00
NBSL4250	130.08	Invert	133.00	Edge of Pavement	**133.09**	0.09	38.50	**133.16**	0.16	26.00	**133.17**	0.17	26.50	**133.95**	0.95	41.33	**134.29**	1.29	59.00
NBSL4260	130.00	Bottom Elevation	133.50	Top of Bank	133.09	0.00	0.00	133.16	0.00	0.00	133.17	0.00	0.00	**133.95**	0.45	1.67	**134.29**	0.79	2.83
NBSL4270	127.26	Invert	132.00	Edge of Pavement	128.62	0.00	0.00	131.42	0.00	0.00	**132.44**	0.44	1.33	**133.94**	1.94	4.83	**134.28**	2.28	4.00
NBSL4280	126.63	Invert	131.91	Top of Structure	128.04	0.00	0.00	129.33	0.00	0.00	130.63	0.00	0.00	**132.14**	0.23	1.50	**132.65**	0.74	1.67

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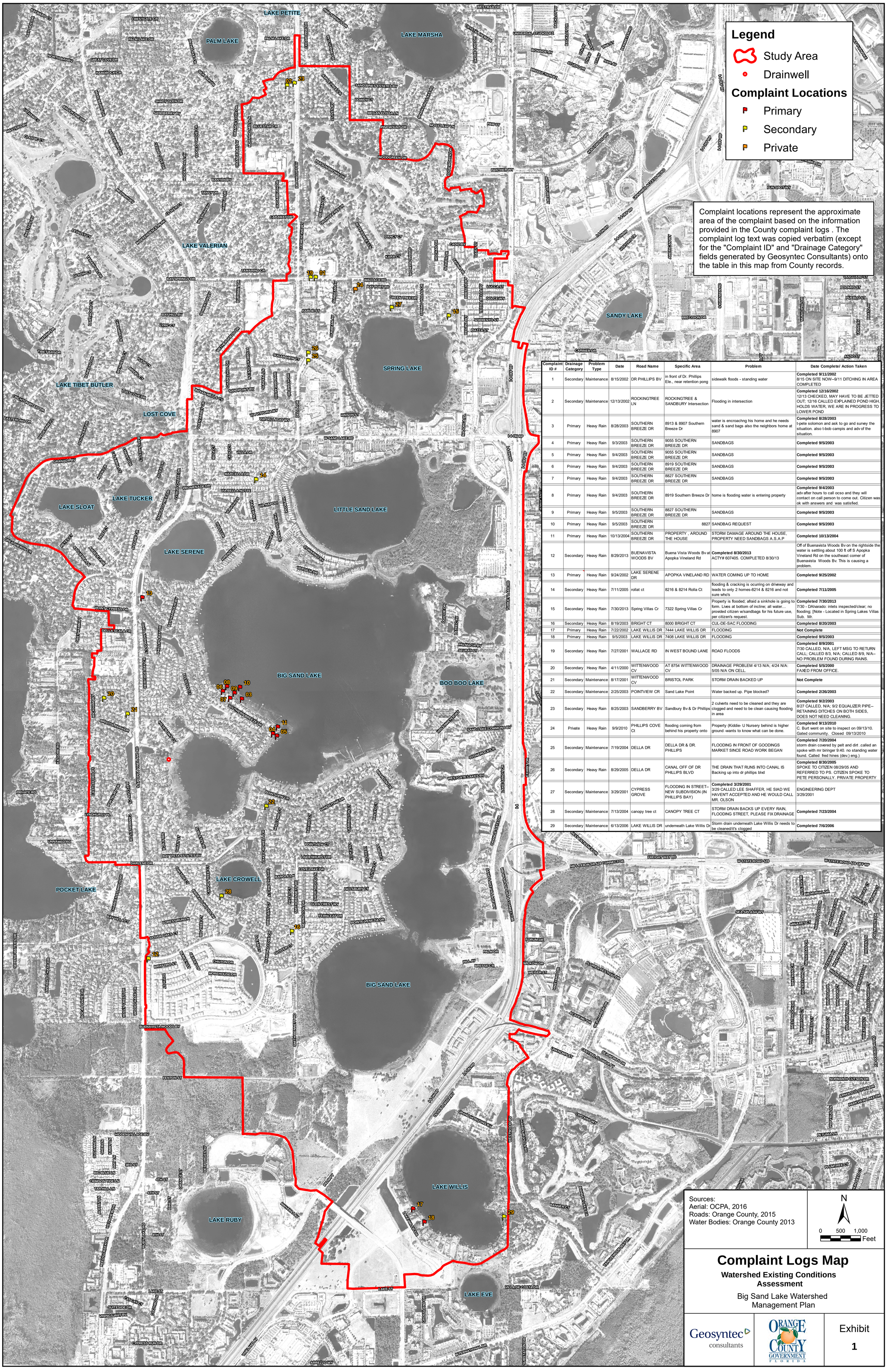
APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL4290	125.80	Invert	133.00	Edge of Pavement	127.31	0.00	0.00	128.62	0.00	0.00	129.60	0.00	0.00	131.17	0.00	0.00	131.86	0.00	0.00
NBSL4300	125.48	Invert	133.00	Edge of Pavement	126.82	0.00	0.00	127.96	0.00	0.00	128.61	0.00	0.00	130.24	0.00	0.00	131.09	0.00	0.00
NBSL4310	125.00	Invert	132.00	Edge of Pavement	126.35	0.00	0.00	127.38	0.00	0.00	127.73	0.00	0.00	129.37	0.00	0.00	130.38	0.00	0.00
NBSL4320	131.00	DEM Water Surface	135.50	Top of Bank	132.68	0.00	0.00	134.06	0.00	0.00	134.50	0.00	0.00	134.65	0.00	0.00	134.67	0.00	0.00
NBSL4330	127.62	Invert	137.00	Edge of Pavement	130.51	0.00	0.00	130.84	0.00	0.00	130.92	0.00	0.00	130.94	0.00	0.00	130.94	0.00	0.00
NBSL4340	126.12	Invert	132.90	Edge of Pavement	127.18	0.00	0.00	127.45	0.00	0.00	127.51	0.00	0.00	128.42	0.00	0.00	129.61	0.00	0.00
NBSL4350	123.72	Invert	132.00	Edge of Pavement	125.99	0.00	0.00	126.69	0.00	0.00	126.82	0.00	0.00	128.37	0.00	0.00	129.56	0.00	0.00
NBSL4360	124.04	Invert	131.00	Edge of Pavement	125.81	0.00	0.00	126.12	0.00	0.00	126.24	0.00	0.00	127.33	0.00	0.00	128.79	0.00	0.00
NBSL4370	122.60	Invert	129.00	Edge of Pavement	124.37	0.00	0.00	125.02	0.00	0.00	125.02	0.00	0.00	125.42	0.00	0.00	127.37	0.00	0.00
NBSL4380	125.02	Invert	128.82	Top of Structure	127.31	0.00	0.00	127.40	0.00	0.00	127.43	0.00	0.00	127.47	0.00	0.00	127.80	0.00	0.00
NBSL4390	123.12	Invert	128.40	Edge of Pavement	123.45	0.00	0.00	123.74	0.00	0.00	123.84	0.00	0.00	124.16	0.00	0.00	126.93	0.00	0.00
NBSL4400	121.92	Invert	127.20	Edge of Pavement	123.12	0.00	0.00	123.61	0.00	0.00	123.70	0.00	0.00	124.15	0.00	0.00	126.60	0.00	0.00
NBSL4410	120.71	Invert	127.00	Edge of Pavement	122.45	0.00	0.00	123.58	0.00	0.00	123.70	0.00	0.00	124.14	0.00	0.00	126.27	0.00	0.00
NBSL4420	125.00	Structure Bottom	129.34	Top of Structure	126.85	0.00	0.00	127.70	0.00	0.00	127.90	0.00	0.00	128.23	0.00	0.00	128.76	0.00	0.00
NBSL4430	122.82	Invert	128.00	Edge of Pavement	123.06	0.00	0.00	124.72	0.00	0.00	124.85	0.00	0.00	125.07	0.00	0.00	125.93	0.00	0.00
NBSL4440	121.12	Invert	124.30	Edge of Pavement	121.09	0.00	0.00	121.62	0.00	0.00	121.71	0.00	0.00	122.03	0.00	0.00	**124.82**	0.52	1.17
NBSL4450	119.62	Invert	124.00	Edge of Pavement	119.59	0.00	0.00	120.12	0.00	0.00	120.22	0.00	0.00	121.99	0.00	0.00	**124.37**	0.37	1.33
NBSL4460	112.37	Invert	122.79	Top of Structure	114.48	0.00	0.00	117.62	0.00	0.00	118.68	0.00	0.00	121.95	0.00	0.00	**124.15**	1.36	1.67
NBSL4470	111.60	Invert	122.70	Edge of Pavement	113.71	0.00	0.00	115.68	0.00	0.00	116.36	0.00	0.00	118.69	0.00	0.00	120.85	0.00	0.00
NBSL4480	111.23	Invert	121.60	Edge of Pavement	113.34	0.00	0.00	114.14	0.00	0.00	114.51	0.00	0.00	116.11	0.00	0.00	118.22	0.00	0.00
NBSL4490	109.80	Invert	118.00	Edge of Pavement	111.71	0.00	0.00	112.32	0.00	0.00	112.32	0.00	0.00	112.56	0.00	0.00	113.58	0.00	0.00
NBSL4500	100.43	Invert	115.00	Edge of Pavement	102.33	0.00	0.00	106.05	0.00	0.00	106.82	0.00	0.00	108.03	0.00	0.00	108.77	0.00	0.00
NBSL4510	99.33	Invert	106.60	Edge of Pavement	101.78	0.00	0.00	105.22	0.00	0.00	105.71	0.00	0.00	106.36	0.00	0.00	**107.08**	0.48	0.83
NBSL4520	105.62	Control Elevation	114.00	Top of Bank	113.46	0.00	0.00	113.88	0.00	0.00	**114.03**	0.03	0.33	**114.24**	0.24	2.00	**114.68**	0.68	1.83
NBSL4530	103.79	Invert	112.10	Edge of Pavement	106.62	0.00	0.00	109.30	0.00	0.00	111.13	0.00	0.00	111.66	0.00	0.00	112.00	0.00	0.00
NBSL4540	100.62	Invert	114.70	Edge of Pavement	105.52	0.00	0.00	107.76	0.00	0.00	108.99	0.00	0.00	109.40	0.00	0.00	109.65	0.00	0.00
NBSL4550	102	Invert	111.80	Edge of Pavement	104.79	0.00	0.00	106.95	0.00	0.00	108.05	0.00	0.00	108.50	0.00	0.00	108.85	0.00	0.00
NBSL4560	101.25	Invert	115.00	Edge of Pavement	104.04	0.00	0.00	106.29	0.00	0.00	107.14	0.00	0.00	107.59	0.00	0.00	108.04	0.00	0.00
NBSL4570	100.72	Invert	117.10	Edge of Pavement	103.47	0.00	0.00	105.70	0.00	0.00	106.34	0.00	0.00	106.77	0.00	0.00	107.30	0.00	0.00
NBSL4580	96.12	Invert	105.34	Top of Structure	101.77	0.00	0.00	105.07	0.00	0.00	**105.49**	0.15	1.17	**105.84**	0.50	2.33	**106.47**	1.13	2.50
NBSL4590	90.12	DEM Water Surface	111.50	Top of Bank	101.72	0.00	0.00	104.68	0.00	0.00	104.93	0.00	0.00	105.18	0.00	0.00	105.88	0.00	0.00
NBSL4600	96.80	Invert	104.30	Edge of Pavement	99.53	0.00	0.00	101.86	0.00	0.00	102.16	0.00	0.00	102.52	0.00	0.00	103.71	0.00	0.00
NBSL4610	100.00	Bottom Elevation	109.50	Top of Bank	103.02	0.00	0.00	105.06	0.00	0.00	105.70	0.00	0.00	106.32	0.00	0.00	106.40	0.00	0.00
NBSL4620	91.00	DEM Water Surface	104.00	Top of Bank	95.17	0.00	0.00	95.50	0.00	0.00	95.58	0.00	0.00	95.75	0.00	0.00	96.17	0.00	0.00
NBSL4630	98.47	Invert	107.20	Edge of Pavement	98.83	0.00	0.00	100.10	0.00	0.00	100.85	0.00	0.00	101.25	0.00	0.00	101.65	0.00	0.00
NBSL4640	124.00	DEM Water Surface	134.00	Top of Bank	130.40	0.00	0.00	133.29	0.00	0.00	133.89	0.00	0.00	**134.15**	0.15	39.33	**134.44**	0.44	40.67
NBSL4650	121.62	Control Elevation	125.00	Top of Bank	122.89	0.00	0.00	123.22	0.00	0.00	123.36	0.00	0.00	123.59	0.00	0.00	**125.74**	0.74	2.50
NBSL4660	120.98	Invert	127.00	Edge of Pavement	122.14	0.00	0.00	122.67	0.00	0.00	122.84	0.00	0.00	123.00	0.00	0.00	124.60	0.00	0.00
NBSL4670	120.42	Invert	126.30	Edge of Pavement	121.65	0.00	0.00	122.21	0.00	0.00	122.39	0.00	0.00	122.73	0.00	0.00	123.27	0.00	0.00
NBSL4680	120.32	Invert	126.30	Top of Bank	121.58	0.00	0.00	122.12	0.00	0.00	122.29	0.00	0.00	122.61	0.00	0.00	123.04	0.00	0.00
NBSL4690	118.12	Invert	124.50	Edge of Pavement	119.96	0.00	0.00	120.78	0.00	0.00	121.09	0.00	0.00	121.75	0.00	0.00	123.55	0.00	0.00
NBSL4700	118.12	Invert	125.00	Edge of Pavement	119.73	0.00	0.00	120.47	0.00	0.00	120.72	0.00	0.00	121.15	0.00	0.00	121.70	0.00	0.00
NBSL4710	115.92	Invert	125.10	Edge of Pavement	117.44	0.00	0.00	118.03	0.00	0.00	118.21	0.00	0.00	118.51	0.00	0.00	119.25	0.00	0.00
NBSL4720	114.05	Invert	117.50	Edge of Pavement	114.65	0.00	0.00	114.72	0.00	0.00	114.75	0.00	0.00	114.79	0.00	0.00	114.90	0.00	0.00
NBSL4730	108.12	Invert	113.80	Edge of Pavement	108.47	0.00	0.00	108.52	0.00	0.00	108.54	0.00	0.00	108.57	0.00	0.00	108.65	0.00	0.00
NBSL4740	104.21	Invert	111.40	Edge of Pavement	104.52	0.00	0.00	104.60	0.00	0.00	104.61	0.00	0.00	104.64	0.00	0.00	104.71	0.00	0.00
NBSL4750	100.99	Invert	105.00	Top of Bank	104.11	0.00	0.00	104.35	0.00	0.00	104.42	0.00	0.00	104.54	0.00	0.00	**105.34**	0.34	0.50
NBSL4760	95.00	DEM Water Surface	108.00	Edge of Pavement	95.71	0.00	0.00	96.62	0.00	0.00	97.08	0.00	0.00	97.85	0.00	0.00	99.08	0.00	0.00
NBSL4770	97.12	DEM Water Surface	119.00	Top of Bank	97.12	0.00	0.00	97.12	0.00	0.00	97.12	0.00	0.00	97.12	0.00	0.00	97.12	0.00	0.00
NBSL4780	97.12	DEM Water Surface	120.00	Top of Structure	105.28	0.00	0.00	108.28	0.00	0.00	108.77	0.00	0.00	109.89	0.00	0.00	111.79	0.00	0.00
NBSL4790	105.22	Invert	119.10	Edge of Pavement	105.22	0.00	0.00	105.73	0.00	0.00	106.02	0.00	0.00	106.53	0.00	0.00	108.54	0.00	0.00
NBSL4800	103.83	Invert	114.10	Edge of Pavement	103.83	0.00	0.00	104.34	0.00	0.00	104.83	0.00	0.00	104.94	0.00	0.00	105.83	0.00	0.00
NBSL4810	98.47	Invert	111.50	Edge of Pavement	99.55	0.00	0.00	100.08	0.00	0.00	100.48	0.00	0.00	101.47	0.00	0.00	102.67	0.00	0.00
NBSL4820	97.61	Invert	101.10	Edge of Pavement	99.55	0.00	0.00	100.06	0.00	0.00	100.22	0.00	0.00	100.54	0.00	0.00	100.90	0.00	0.00
NBSL4830	97.35	Invert	100.00	Top of Bank	99.55	0.00	0.00	**100.05**	0.05	56.17	**100.13**	0.13	59.33	**100.21**	0.21	61.33	**100.29**	0.28	149.83
NBSL4840	99.00	Bottom Elevation	100.00	Top of Bank	**100.03**	0.03	6.33	**100.04**	0.04	64.50	**100.05**	0.05	65.17	**100.06**	0.06	65.50	**100.12**	0.12	151.00
NBSL4870	102.79	Invert	114.00	Edge of Pavement	104.00	0.00	0.00	104.54	0.00	0.00	104.71	0.00	0.00	105.01	0.00	0.00	105.52	0.00	0.00
NBSL4880	100.44	Control Elevation	111.50	Top of Bank	103.09	0.00	0.00	103.82	0.00	0.00	103.98	0.00	0.00	104.25	0.00	0.00	104.69	0.00	0.00
NBSL4890	94.42	Invert	102.90	Edge of Pavement	95.07	0.00	0.00	96.23	0.00	0.00	96.37	0.00	0.00	96.83	0.00	0.00	99.46	0.00	0.00
NBSL4900	96.00	DEM Water Surface	103.12	Top of Structure	99.48	0.00	0.00	101.09	0.00	0.00	101.60	0.00	0.00	102.44	0.00	0.00	**103.61**	0.49	1.17
NBSL4905	91.12	Invert	101.00	Top of Bank	95.76	0.00	0.00	96.02	0.00	0.00	96.10	0.00	0.00	96.24	0.00	0.00	96.59	0.00	0.00
NBSL4910	109.00	Ground Elevation	116.00	Top of Bank	110.08	0.00	0.00	111.83	0.00	0.00	112.31	0.00	0.00	113.06	0.00	0.00	114.08	0.00	0.00
NBSL4920	103.12	Control Elevation	111.00	Top of Bank	108.10	0.00	0.00	109.63	0.00	0.00	109.67	0.00	0.00	109.74	0.00	0.00	109.97	0.00	0.00

APPENDIX A- NODE MAXIMUM CONDITIONS SUMMARY

	INITIAL STAGE		WARNING STAGE		MEAN ANNUAL / 24 HOUR			10 YEAR / 24 HOUR			25 YEAR / 24 HOUR			100 YEAR / 24 HOUR			100 YEAR / 72 HOUR		
NODE NAME	ELEVATION	DESCRIPTION	ELEVATION	DESCRIPTION	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)	PEAK STAGE (FT)	FLOOD DEPTH (FT)	FLOOD DURATION (HRS)
NBSL4930	96.12	Normal High Water Elevation	111.00	Edge of Property	96.79	0.00	0.00	97.52	0.00	0.00	97.78	0.00	0.00	98.07	0.00	0.00	98.30	0.00	0.00
NBSL4940	93.00	Bottom Elevation	97.00	Top of Bank	95.08	0.00	0.00	95.12	0.00	0.00	95.14	0.00	0.00	95.16	0.00	0.00	95.28	0.00	0.00
NBSL4950	96.00	Bottom Elevation	102.00	Top of Bank	97.05	0.00	0.00	97.42	0.00	0.00	97.61	0.00	0.00	97.95	0.00	0.00	99.40	0.00	0.00
NBSL4960	96.12	Bottom Elevation	103.00	Top of Bank	100.87	0.00	0.00	102.43	0.00	0.00	102.82	0.00	0.00	**103.02**	0.02	0.83	**103.13**	0.13	1.83
NBSL4970	95.12	Invert	101.10	Edge of Pavement	96.03	0.00	0.00	96.06	0.00	0.00	96.06	0.00	0.00	96.62	0.00	0.00	96.98	0.00	0.00
NBSL4980	95.12	Invert	103.00	Top of Bank	102.55	0.00	0.00	**103.33**	0.33	3.00	**103.47**	0.47	4.00	**103.56**	0.56	5.17	**103.67**	0.67	4.33
NBSL4990	99.00	Bottom Elevation	105.12	Top of Bank	101.02	0.00	0.00	102.57	0.00	0.00	102.93	0.00	0.00	103.49	0.00	0.00	104.44	0.00	0.00
NBSL5000	93.45	Invert	101.00	Edge of Pavement	93.42	0.00	0.00	93.73	0.00	0.00	93.86	0.00	0.00	94.25	0.00	0.00	95.41	0.00	0.00
NBSL5010	92.45	Invert	99.00	Edge of Pavement	93.07	0.00	0.00	93.50	0.00	0.00	93.69	0.00	0.00	94.22	0.00	0.00	95.41	0.00	0.00
NBSL5015	91.81	Invert	99.62	Top of Structure	93.07	0.00	0.00	93.50	0.00	0.00	93.69	0.00	0.00	94.22	0.00	0.00	95.41	0.00	0.00
NBSL5020	91.26	Invert	100.00	Edge of Pavement	93.07	0.00	0.00	93.50	0.00	0.00	93.69	0.00	0.00	94.21	0.00	0.00	95.41	0.00	0.00
NBSL5030	90.00	DEM Water Surface	97.00	Top of Bank	93.07	0.00	0.00	93.50	0.00	0.00	93.69	0.00	0.00	94.21	0.00	0.00	95.40	0.00	0.00
NBSL5060	97.00	DEM Water Surface	101.00	Top of Bank	98.94	0.00	0.00	99.09	0.00	0.00	99.14	0.00	0.00	99.49	0.00	0.00	100.15	0.00	0.00
NBSL5080	96.50	Control Elevation	101.00	Top of Bank	99.04	0.00	0.00	99.63	0.00	0.00	99.79	0.00	0.00	100.01	0.00	0.00	100.61	0.00	0.00
NBSL5090	97.00	Ground Elevation	100.00	Top of Bank	**100.03**	0.03	15.00	**100.06**	0.06	16.67	**100.06**	0.06	17.00	**100.07**	0.07	17.33	**100.15**	0.15	33.33
NBSL5100	102.12	Invert	117.00	Edge of Pavement	103.83	0.00	0.00	104.83	0.00	0.00	104.85	0.00	0.00	105.63	0.00	0.00	106.67	0.00	0.00
NBSL5110	95.52	Invert	100.40	Edge of Pavement	97.24	0.00	0.00	99.68	0.00	0.00	99.71	0.00	0.00	99.87	0.00	0.00	100.38	0.00	0.00
NBSL5120	91.73	Downstream Control Elevation	100.00	Edge of Pavement	93.40	0.00	0.00	95.80	0.00	0.00	95.81	0.00	0.00	96.08	0.00	0.00	96.80	0.00	0.00
NBSL5130	95.31	Control Elevation	99.50	Edge of Property	96.98	0.00	0.00	97.78	0.00	0.00	98.04	0.00	0.00	98.28	0.00	0.00	99.36	0.00	0.00
NBSL5140	99.92	Control Elevation	104.00	Top of Bank	101.81	0.00	0.00	102.61	0.00	0.00	102.77	0.00	0.00	103.00	0.00	0.00	103.68	0.00	0.00
NBSL5150	101.00	Bottom Elevation	104.50	Top of Bank	102.13	0.00	0.00	103.42	0.00	0.00	103.87	0.00	0.00	**104.62**	0.12	6.17	**105.24**	0.74	26.83
NBSL5155	92.10	Control Elevation	99.00	Edge of Property	92.88	0.00	0.00	93.73	0.00	0.00	94.02	0.00	0.00	94.52	0.00	0.00	95.31	0.00	0.00
NBSL5160	91.73	Drainwell Casing	95.00	Edge of Property	92.30	0.00	0.00	93.02	0.00	0.00	93.32	0.00	0.00	93.90	0.00	0.00	**95.05**	0.05	0.00
NBSL5161	90	N/A	101.20	Top of Structure	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NBSL5162	90	Drainwell Casing	101.20	Top of Structure	92.22	0.00	0.00	92.96	0.00	0.00	93.27	0.00	0.00	93.85	0.00	0.00	95.01	0.00	0.00
NBSL5164	89.5	N/A	101.40	Top of Structure	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NBSL5170	92.17	Invert	107.00	Edge of Pavement	94.42	0.00	0.00	95.19	0.00	0.00	95.48	0.00	0.00	96.04	0.00	0.00	97.32	0.00	0.00
NBSL5180	99.12	Control Elevation	102.50	Edge of Pavement	100.22	0.00	0.00	101.13	0.00	0.00	101.33	0.00	0.00	101.62	0.00	0.00	102.14	0.00	0.00
NBSL5190	94.63	Invert	102.00	Edge of Pavement	96.28	0.00	0.00	96.99	0.00	0.00	97.24	0.00	0.00	97.73	0.00	0.00	98.73	0.00	0.00
NBSL5200	111.92	Invert	117.50	Edge of Pavement	112.93	0.00	0.00	113.34	0.00	0.00	113.48	0.00	0.00	113.71	0.00	0.00	114.40	0.00	0.00
NBSL5210	111.22	Invert	115.50	Edge of Pavement	112.60	0.00	0.00	113.08	0.00	0.00	113.22	0.00	0.00	113.46	0.00	0.00	114.09	0.00	0.00
NBSL5220	98.82	Invert	101.62	Top of Structure	**102.06**	0.44	3.67	**102.12**	0.50	7.00	**102.14**	0.52	7.50	**102.18**	0.56	8.00	**102.29**	0.67	7.33
NBSL5230	98.78	Invert	102.10	Top of Structure	101.99	0.00	0.00	**102.36**	0.26	2.67	**102.68**	0.58	3.50	**103.49**	1.39	4.67	**107.45**	5.35	3.67
NBSL5240	98.62	Invert	103.00	Edge of Pavement	100.28	0.00	0.00	100.40	0.00	0.00	100.50	0.00	0.00	100.76	0.00	0.00	**103.49**	0.48	0.50
NBSL5250	95.32	Invert	101.50	Edge of Pavement	96.69	0.00	0.00	97.56	0.00	0.00	97.84	0.00	0.00	98.33	0.00	0.00	99.40	0.00	0.00
NBSL5260	94.82	Invert	123.50	Edge of Pavement	96.71	0.00	0.00	97.63	0.00	0.00	97.92	0.00	0.00	98.46	0.00	0.00	99.82	0.00	0.00
NBSL5270	96.20	Invert	102.00	Edge of Pavement	98.12	0.00	0.00	99.17	0.00	0.00	100.10	0.00	0.00	**102.19**	0.19	0.00	**102.42**	0.42	0.00
NBSL5280	96.13	Invert	102.30	Edge of Pavement	97.95	0.00	0.00	98.88	0.00	0.00	99.33	0.00	0.00	101.12	0.00	0.00	101.81	0.00	0.00
NBSL5290	95.53	Invert	103.00	Edge of Pavement	97.26	0.00	0.00	98.19	0.00	0.00	98.63	0.00	0.00	99.76	0.00	0.00	101.11	0.00	0.00
NBSL5300	94.87	Invert	106.92	Top of Structure	96.85	0.00	0.00	97.91	0.00	0.00	98.26	0.00	0.00	98.92	0.00	0.00	100.68	0.00	0.00
NBSL5310	105.00	Ground Elevation	108.00	Edge of Pavement	106.47	0.00	0.00	107.21	0.00	0.00	107.45	0.00	0.00	107.85	0.00	0.00	**108.05**	0.05	23.00
NBSL5320	100.52	Control Elevation	106.00	Top of Bank	104.81	0.00	0.00	104.95	0.00	0.00	104.98	0.00	0.00	105.03	0.00	0.00	105.40	0.00	0.00
NBSL5330	94.80	DEM Water Surface	106.00	Top of Bank	96.70	0.00	0.00	97.63	0.00	0.00	97.93	0.00	0.00	98.46	0.00	0.00	99.86	0.00	0.00
NBSL5340	94.80	Upstream Water Surface	112.00	Edge of Pavement	96.68	0.00	0.00	97.57	0.00	0.00	97.82	0.00	0.00	98.28	0.00	0.00	99.59	0.00	0.00
NBSL5350	94.53	Invert	107.60	Edge of Pavement	96.43	0.00	0.00	97.30	0.00	0.00	97.53	0.00	0.00	97.96	0.00	0.00	98.81	0.00	0.00
NBSL5360	93.90	Invert	111.70	Edge of Pavement	96.17	0.00	0.00	96.93	0.00	0.00	97.13	0.00	0.00	97.47	0.00	0.00	97.95	0.00	0.00
NBSL5370	92.46	Invert	112.00	Edge of Pavement	94.59	0.00	0.00	95.42	0.00	0.00	95.65	0.00	0.00	96.09	0.00	0.00	96.95	0.00	0.00
NBSL5380	92.02	Invert	111.20	Edge of Pavement	93.96	0.00	0.00	94.73	0.00	0.00	94.94	0.00	0.00	95.34	0.00	0.00	96.01	0.00	0.00
NBSL5390	91.45	Invert	107.60	Edge of Pavement	93.22	0.00	0.00	93.95	0.00	0.00	94.13	0.00	0.00	94.47	0.00	0.00	94.99	0.00	0.00
NBSL5400	88.88	Invert	99.00	Edge of Pavement	91.35	0.00	0.00	91.71	0.00	0.00	91.86	0.00	0.00	92.15	0.00	0.00	92.54	0.00	0.00
NBSL5410	84.89	Invert	96.00	Edge of Pavement	91.20	0.00	0.00	91.26	0.00	0.00	91.30	0.00	0.00	91.39	0.00	0.00	91.34	0.00	0.00
NBSL5420	91.12	N/A	94.00	Top of Bank	91.18	0.00	0.00	91.18	0.00	0.00	91.20	0.00	0.00	91.25	0.00	0.00	91.25	0.00	0.00

EXHIBITS



Complaint ID #	Drainage Category	Problem Type	Date	Road Name	Specific Area	Problem	Date Complete/ Action Taken
1	Secondary	Maintenance	8/15/2002	DR PHILLIPS BV	in front of Dr. Phillips Ele., near retention pong	sidewalk floods - standing water	**Completed 9/11/2002** 8/15 ON SITE NOW--9/11 DITCHING IN AREA COMPLETED
2	Secondary	Maintenance	12/13/2002	ROCKINGTREE LN	ROCKINGTREE & SANDBURY Intersection	Flooding in intersection	**Completed 12/16/2002** 12/13 CHECKED, MAY HAVE TO BE JETTED OUT; 12/16 CALLED EXPLAINED POND HIGH, HOLDS WATER, WE ARE IN PROGRESS TO LOWER POND
3	Primary	Heavy Rain	8/28/2003	SOUTHERN BREEZE DR	8913 & 8907 Southern Breeze Dr	water is encroachng his home and he needs sand & sand bags also the neighbors home at 8907	**Completed 8/28/2003** t-pete solomon and ask to go and survey the situation. also t-bob campis and adv of the situation.
4	Primary	Heavy Rain	9/3/2003	SOUTHERN BREEZE DR	9055 SOUTHERN BREEZE DR	SANDBAGS	**Completed 9/5/2003**
5	Primary	Heavy Rain	9/4/2003	SOUTHERN BREEZE DR	9055 SOUTHERN BREEZE DR	SANDBAGS	**Completed 9/5/2003**
6	Primary	Heavy Rain	9/4/2003	SOUTHERN BREEZE DR	8919 SOUTHERN BREEZE DR	SANDBAGS	**Completed 9/5/2003**
7	Primary	Heavy Rain	9/4/2003	SOUTHERN BREEZE DR	8827 SOUTHERN BREEZE DR	SANDBAGS	**Completed 9/5/2003**
8	Primary	Heavy Rain	9/4/2003	SOUTHERN BREEZE DR	8919 Southern Breeze Dr	home is flooding water is entering property	**Completed 9/4/2003** adv after hours to call ocso and they will contact on call person to come out. Citizen was ok with answers and was satisfied.
9	Primary	Heavy Rain	9/5/2003	SOUTHERN BREEZE DR	8827 SOUTHERN BREEZE DR	SANDBAGS	**Completed 9/5/2003**
10	Primary	Heavy Rain	9/5/2003	SOUTHERN BREEZE DR	8827	SANDBAG REQUEST	**Completed 9/5/2003**
11	Primary	Heavy Rain	10/13/2004	SOUTHERN BREEZE DR	PROPERTY , AROUND THE HOUSE	STORM DAMAGE AROUND THE HOUSE, PROPERTY NEED SANDBAGS A.S.A.P	**Completed 10/13/2004**
12	Secondary	Heavy Rain	8/29/2013	BUENAVISTA WOODS BV	Buena Vista Woods Bv at Apopka Vineland Rd	**Completed 8/30/2013** ACTY# 607405. COMPLETED 8/30/13	Off of Buenavista Woods Bv on the rightside the water is settling about 100 ft off S Apopka Vineland Rd on the southeast corner of Buenavista Woods Bv. This is causing a problem.
13	Primary	Heavy Rain	9/24/2002	LAKE SERENE DR	APOPKA VINELAND RD	WATER COMING UP TO HOME	**Completed 9/25/2002**
14	Secondary	Heavy Rain	7/11/2005	rollat ct	8216 & 8214 Rolla Ct	flooding & cracking is ocurring on driveway and leads to only 2 homes-8214 & 8216 and not sure who's	**Completed 7/11/2005**
15	Secondary	Heavy Rain	7/30/2013	Spring Villas Cr	7322 Spring Villas Cr	Property is flooded; afraid a sinkhole is going to form. Lives at bottom of incline; all water… provided citizen w/sandbags for his future use, per citizen's request.	**Completed 7/30/2013** 7/30 - DAlvarado: inlets inspected/clear; no flooding; [Note - Located in Spring Lakes Villas Sub. Mr.
16	Secondary	Heavy Rain	8/19/2003	BRIGHT CT	8000 BRIGHT CT	CUL-DE-SAC FLOODING	**Completed 8/20/2003**
17	Primary	Heavy Rain	7/22/2002	LAKE WILLIS DR	7444 LAKE WILLIS DR	FLOODING	**Not Complete**
18	Primary	Heavy Rain	9/5/2003	LAKE WILLIS DR	7408 LAKE WILLIS DR	FLOODING	**Completed 9/5/2003**
19	Secondary	Heavy Rain	7/27/2001	WALLACE RD	IN WEST BOUND LANE	ROAD FLOODS	**Completed 8/9/2001** 7/30 CALLED, N/A, LEFT MSG TO RETURN CALL; CALLED 8/3, N/A; CALLED 8/9, N/A-- NO PROBLEM FOUND DURING RAINS.
20	Secondary	Heavy Rain	4/11/2000	WITTENWOOD CV	AT 8754 WITTENWOOD CV	DRAINAGE PROBLEM 4/13 N/A; 4/24 N/A: 5/05 N/A ON CELL.	**Completed 5/5/2000** FAXED FROM OFFICE.
21	Secondary	Maintenance	8/17/2001	WITTENWOOD CV	BRISTOL PARK	STORM DRAIN BACKED UP	**Not Complete**
22	Secondary	Maintenance	2/25/2003	POINTVIEW CR	Sand Lake Point	Water backed up. Pipe blocked?	**Completed 2/26/2003**
23	Secondary	Heavy Rain	8/25/2003	SANDBERRY BV	Sandbury Bv & Dr Phillips	2 culverts need to be cleaned and they are clogged and need to be clean causing flooding in area	**Completed 9/2/2003** 8/27 CALLED, N/A; 9/2 EQUALIZER PIPE-- RETAINING DITCHES ON BOTH SIDES, DOES NOT NEED CLEANING.
24	Private	Heavy Rain	9/9/2010	PHILLIPS COVE Ct	flooding coming from behind his property onto	Property (Kiddie- U Nursery behind is higher ground -wants to know what can be done.	**Completed 9/13/2010** C. Burt went on site to inspect on 09/13/10. Gated community. Closed 09/13/2010
25	Secondary	Maintenance	7/19/2004	DELLA DR	DELLA DR & DR. PHILLIPS	FLOODING IN FRONT OF GOODINGS MARKET SINCE ROAD WORK BEGAN	**Completed 7/20/2004** storm drain covered by pelt and dirt .called an spoke with mr biringer 9:40. no standing water found. Called fred hines (dev.) eng.)
26	Secondary	Heavy Rain	8/29/2005	DELLA DR	CANAL OFF OF DR PHILLIPS BLVD	THE DRAIN THAT RUNS INTO CANAL IS Backing up into dr phillips blvd	**Completed 8/30/2005** SPOKE TO CITIZEN 08/29/05 AND REFERRED TO PS. CITIZEN SPOKE TO PETE PERSONALLY. PRIVATE PROPERTY
27	Secondary	Maintenance	3/29/2001	CYPRESS GROVE	FLOODING IN STREET--NEW SUBDIVISION (IN PHILLIPS BAY)	**Completed 3/29/2001** 3/29 CALLED LEE SHAFFER, HE SIAD WE HAVENT ACCEPTED AND HE WOULD CALL MR. OLSON	ENGINEERING DEPT 3/29/2001
28	Secondary	Maintenance	7/13/2004	canopy tree ct	CANOPY TREE CT	STORM DRAIN BACKS UP EVERY RAIN, FLOODING STREET, PLEASE FIX DRAINAGE	**Completed 7/23/2004**
29	Secondary	Maintenance	6/13/2006	LAKE WILLIS DR	underneath Lake Willis Dr	Storm drain underneath Lake Willis Dr needs to be cleaned/it's clogged	**Completed 7/6/2006**

Sources:
Aerial: OCPA, 2016
Roads: Orange County, 2015
Water Bodies: Orange County 2013

Complaint Logs Map

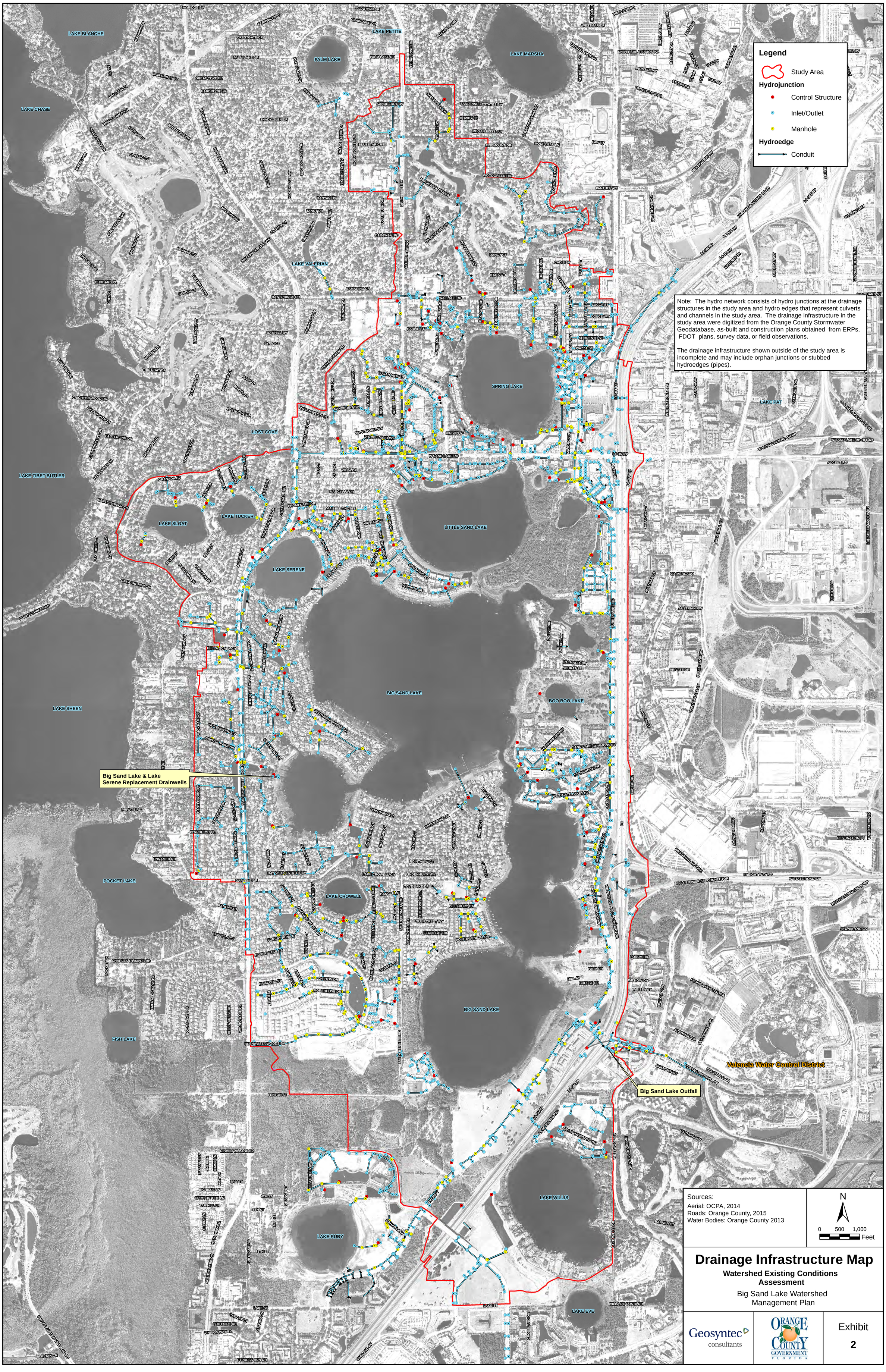
Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

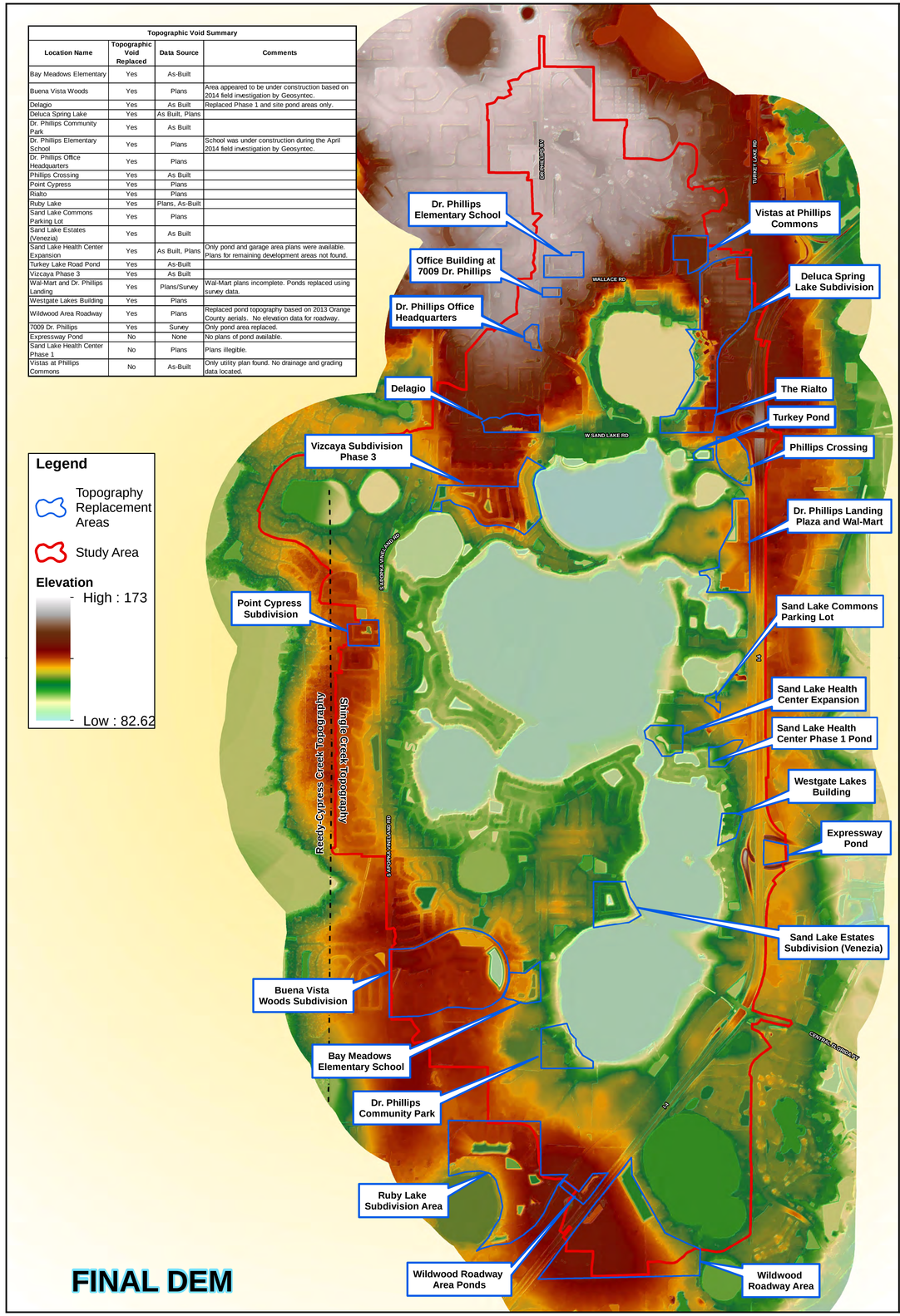
Geosyntec consultants

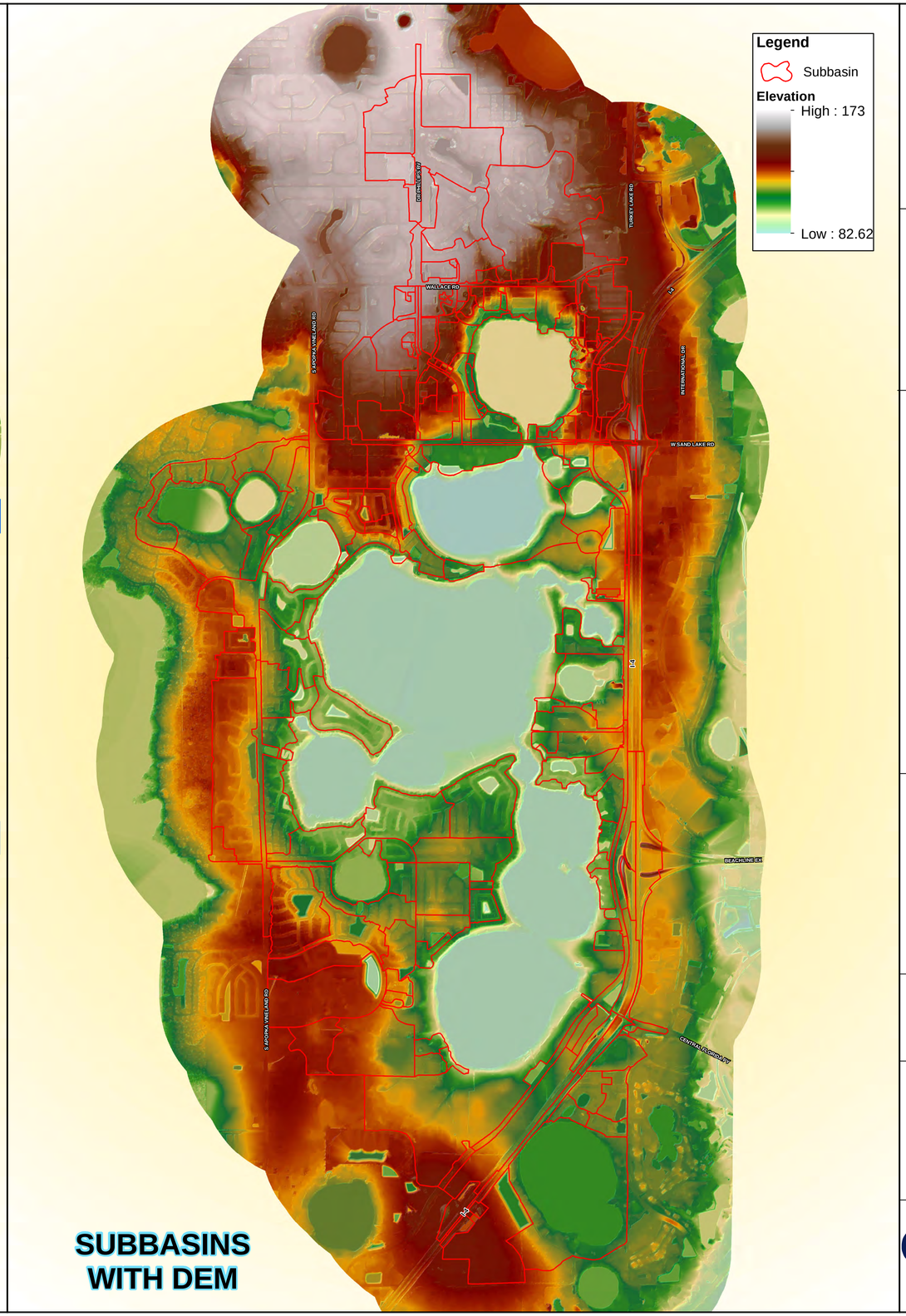
Orange County Government Florida

Exhibit 1


Legend
Study Area
Hydrojunction
Control Structure
Inlet/Outlet
Manhole
Hydroedge
Conduit
Note: The hydro network consists of hydro junctions at the drainage structures in the study area and hydro edges that represent culverts and channels in the study area. The drainage infrastructure in the study area were digitized from the Orange County Stormwater Geodatabase, as-built and construction plans obtained from ERPs, FDOT plans, survey data, or field observations.
The drainage infrastructure shown outside of the study area is incomplete and may include orphan junctions or stubbed hydroedges (pipes).
Big Sand Lake & Lake Serene Replacement Drainwells
Big Sand Lake Outfall
Valencia Water Control District
LAKE BLANCHE
LAKE CHASE
LAKE PETITE
PALM LAKE
LAKE MARSHA
LAKE VALERIAN
SPRING LAKE
LOST COVE
LAKE TIBET BUTLER
LAKE TUCKER
LAKE SLOAT
LAKE SERENE
LITTLE SAND LAKE
BIG SAND LAKE
BOO BOO LAKE
LAKE SHEEN
POCKET LAKE
LAKE CROWELL
FISH LAKE
LAKE RUBY
LAKE WILLIS
LAKE EVE
LAKE PAT
BAY RIDGE BV
OLD TOWN DR
CRAINDALE DR
FERNWICKE CT
CRESTGATE CR
PALM LAKE DR
CEDAR PINE DR
PITCH PINE DR
WESTMAR DR
VANELAND RD
CRYSTAL VIEW DR
SHORELINE DR
UNIVERSAL STUDIOS PZ
IRONSIDE AV
STUDIO DR
PRODUCTION PZ
BACKLOT DR
SOUTH ST
WEST ST
MAIN AV
NORTH BAY BV
GREAT COVE DR
HARDROCK CR
GALLEON CT
WINDJAMMER LN
LITTMAN CT
CLASSIC CT
BAYVIEW DR
OSPREY VIEW LN
BROOKLINE DR
RIDGEBERRY DR
MAJESTY DR
SHADY GLEN DR
SILK OAK DR
SANDBERRY BV
BLUESTAR CR
MORNING MIST LN
ORANGE COVE DR
ORANGE BAY AV
EDGE GROVE CR
CEDAR COVE DR
HIDDEN DALE AV
SAND PINES ESTATES BV
APPLE PINE CR
DOWDY CT
MEGAN ELISSA LN
SILVER LEAF DR
SPARKLING LAKE RD
PINEMOUNT DR
MOSS LEAF LN
PAW ST
WOODGREEN DR
PARSON BROWN DR
DR PHILLIPS BV
BANYAN BV
TANSY DR
PALMS DR
SUGARBUSH DR
CARAWAY DR
MERIMAN WY
CLOVER CT
VALERIAN BV
INDEPENDENCE PARK
CLEMENTINE AV
ORANGE TREE LN
PERSIAN CT
BITTERSWEET LN
DANCY CT
KARA CT
CADIZ BV
DAISY ST
HOCHO DR
SAVANNAH DR
SILVER LEAF DR
SPANISH VILLAS CR
BRESCIA WY
TERRABELLA BV
LUCCA ST
DOLCE WY
SORRENTO ST
PIAZZA ST
REGINA WY
PANTHER WY
HOLLYWOOD WY
MOSS LEAF LN
SKIRK
UNNAMED ACCESS ROAD
I-4 OFF RP
I-4 ON RP
FUN SPOT WY
AMERICAN WY
VISITORS CR
GRANDMOTION DR
MERIDIAN AV
MERRIMAC AV
ANDOVER AV
PEBBLE BEACH DR
FAIRWAY VALLEY DR
MASTERS BV
LEVALLY CT
LADYBETH DR
HUBBARD PL
CHES CT
TAZAWOOD DR
GLADIN CT
TAMARIND CR
BAY SPRINGS DR
WALLACE RD
HARLIE ST
SUNBEAM AV
BAYPORT RD
STONEHENGE DR
BURNWAY DR
SOMERTON LN
DAKEMOR CT
BAY HILL BV
LYRIC CT
GLENHILL CT
MASINA DR
TIBET BAY DR
BAYTONIA DR
CRICHTON WOOD DR
ISLESWORTH CT
EASTERLING DR
CYPRESS COVE DR
HIDDEN BAY LN
RIDGEMILL CT
SOUTH BAY DR
DANIELLE DR
WINTER CT
TULIP CT
BRIDAL CT
LOST COVE DR
VERMESSE LN CR
FERN ROOT LN
SUGAR VIEW CT
SUNDANCE LN
MISTY PINE CT
HIGH PINE RD
SANDPOINT BV
MIDIAN WELLS CT
GLEN ABBEY CR
VIA VITTORIA WY
VIA DELLAGIO WY
DELLA CR
HINSON ST
W SAND LAKE RD
GRANADA BV
GRANTHAM CT
GRANTHAM DR
BOLTON CT
BOLTON DR
GRUESBECK CT
HOOKER CR
JOZZE CR
BENTLEY PARK DR
CITRUS CHASE DR
PROMENADE DR
VIA BELLA NOTTE
VIA VILLA DR
VIA VERONA
VIA NAPOLI
VIA ROMA
THE ESPLANADE
TIVOLI CT
RICELLE LN
PADUA LN
GIAMBANO BV
VERSILIA DR
ANGELICA DR
ALESSE CR
LAGO CT
BELLES ST
ESQUIERA LN
GREAT HERON CR
LAKE TIBET CT
WILLOW TREE CT
POINT CYPRESS DR
DELLA SCALA CR
GREYHAWK PT
OAK HAMMOCK CT
BAYHARBOUR BV
PHILLIPS BAY DR
SOUTHERN BREEZE DR
WICKHAM WY
WITTENWOOD CV
BRISTOL PARK DR
WOODCHASE CR
CASTLEFORD PL
ROBERT DR
BAYCLIFF CT
CAMBERLEY CT
LYNDHURST PL
UNNAMED RD
POCKET LN
CHARLES E LIMPUS RD
EMERALD CREEK DR
BOCA POINTE DR
HOLLY CREST DR
WOODCHASER CR
BUENAVISTA WOODS BV
SMITH BENNETT RD
FENTON ST
SILK OAK CR
WATERGARDEN VINEYARD RD
CYPRESS RUN DR
HIDDEN VILLAGE BV
SUZANNE LN
SHERI LN
KIMMY LN
AMY LN
3RD ST
BIG BLUE LN
CRIMSON TIDE LN
TAR HILL LN
ALEX T LN
VISTA VIEW DR
REED CREEK DR
RUBY LAKE RD
4TH ST
5TH ST
6TH ST
PINE ST
ORANGE ST
DESFORGES AV
MCMAHAN AV
LAKE ST
CAT CAY CT
SUITESIDE DR
VININGS WAY BV
GOCONUT LN
VINELAND AV
LAKE WILLIS DR
GRAND HORIZONS BV
WEST WOOD BV
HARBOUR VILLAGE BLVD
CAPTAINS WY
CROSSLAND DR
VILLA DE COSTA DR
BANNER CT
LAKE LUCERNE DR
LAKE HURST DR
W SAND LAKE RD OFF RP
W SAND LAKE RD ON RP
GREENDRIVER PY
INTERNATIONAL DR
CANADA AV
ACCESS RD
LOCKHEED MARTIN BV
UNIVERSAL BV
JAMAICAN CT
VIA MERCADO
AUSTRIAN CT
AUSTRIAN RW
REMOTE RD
TURKEY LAKE RD
OCEANVIEW DR
LATREC AV
PALMACIA BV
SEURAT ST
PRIVATE DR
PLAZA ALMIRROW
PONTE PLAZA AV
SAMOAN CT
MILLSTONE VIEW WY
SAND LAKE COMMONS BV
STONEROCK CR
WESTGATE LAKES BV
LAKE SAND CR
ORANGE GATE DR
CONVENTION WY
HAYDEN CT
DESTINATION PY
TRADESHOW DR
WESTENTRANCE DR
FREIGHT WAY RD
NB I-4 EB W SR 528 CONNECTOR
W STATE ROAD 528
SEA SPLASH WY
FORUM DR
PALM DR
HILL AV
BRESSE CR
WILKOW DR
WEISER ST
VINEYARD DR
FLORIDA FESTIVAL DR
ACADEMIC DR
SEAWORLD DR
CENTRAL FLORIDA PY
UNKNOWN ST
I-4 ON RP
I-4 OFF RP
I-4 EB
I-4 WB
Sources:
Aerial: OCPA, 2014
Roads: Orange County, 2015
Water Bodies: Orange County 2013
N
0 500 1,000
Feet
Drainage Infrastructure Map
Watershed Existing Conditions Assessment
Big Sand Lake Watershed Management Plan
Geosyntec consultants
Orange County Government Florida
Exhibit
2

Topographic Void Summary			
Location Name	**Topographic Void Replaced**	**Data Source**	**Comments**
Bay Meadows Elementary	Yes	As-Built	
Buena Vista Woods	Yes	Plans	Area appeared to be under construction based on 2014 field investigation by Geosyntec.
Delagio	Yes	As Built	Replaced Phase 1 and site pond areas only.
Deluca Spring Lake	Yes	As Built, Plans	
Dr. Phillips Community Park	Yes	As Built	
Dr. Phillips Elementary School	Yes	Plans	School was under construction during the April 2014 field investigation by Geosyntec.
Dr. Phillips Office Headquarters	Yes	Plans	
Phillips Crossing	Yes	As Built	
Point Cypress	Yes	Plans	
Rialto	Yes	Plans	
Ruby Lake	Yes	Plans, As-Built	
Sand Lake Commons Parking Lot	Yes	Plans	
Sand Lake Estates (Venezia)	Yes	As Built	
Sand Lake Health Center Expansion	Yes	As Built, Plans	Only pond and garage area plans were available. Plans for remaining development areas not found.
Turkey Lake Road Pond	Yes	As-Built	
Vizcaya Phase 3	Yes	As Built	
Wal-Mart and Dr. Phillips Landing	Yes	Plans/Survey	Wal-Mart plans incomplete. Ponds replaced using survey data.
Westgate Lakes Building	Yes	Plans	
Wildwood Area Roadway	Yes	Plans	Replaced pond topography based on 2013 Orange County aerials. No elevation data for roadway.
7009 Dr. Phillips	Yes	Survey	Only pond area replaced.
Expressway Pond	No	None	No plans of pond available.
Sand Lake Health Center Phase 1	No	Plans	Plans illegible.
Vistas at Phillips Commons	No	As-Built	Only utility plan found. No drainage and grading data located.





ORANGE COUNTY GOVERNMENT FLORIDA

N

1,500 750 0 1,500 Feet

Notes:
Refer to Exhibit 5 for subbasin names.

DEM was generated from topographic data provided by Orange County.
DEM elevations within topographic replacement areas were generated from construction plan and survey data.

Orange County Topography Data:
Shingle Creek: ACA, 2002
Reedy-Cypress Creek: PSI, 2005.

Roads: Orange County, 2015

Exhibit

3

DEM and Subbasin Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

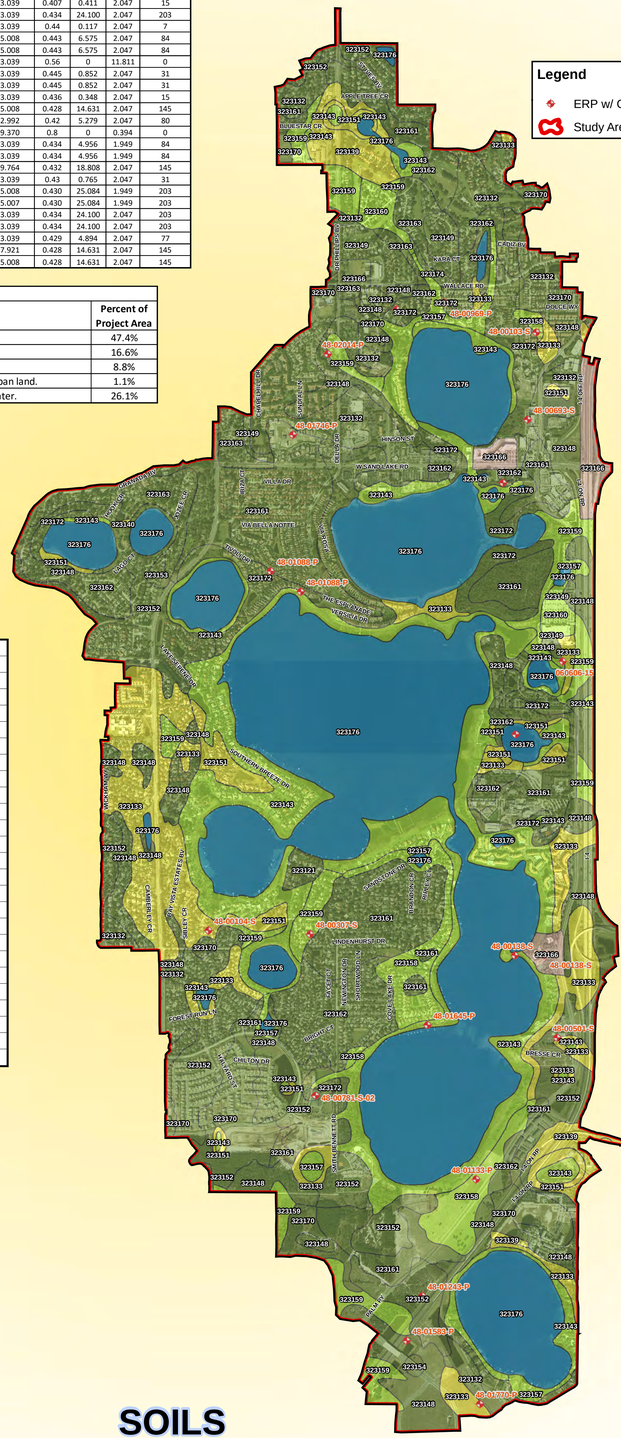
Soils Parameters Table							
MUKEY	Soil Name	Soil Hydrologic Class	Hydraulic Conductivity (in/hr)	Porosity	Soil Storage (in)	Soil Suction Head (in)	Annual Minimum Water Table Depth (cm)
323121	Arents - Nearly Level	A	13.039	0.43	3.951	2.165	69
323143	Basinger fine sand - depressional	A/D	13.039	0.407	0.411	2.047	15
323174	Candler fine sand - 5 to 12 percent slopes	A	13.039	0.434	24.100	2.047	203
323133	Immokalee fine sand	B/D	13.039	0.44	0.117	2.047	7
323149	Pomello-Urban land complex - 0 to 5 percent slopes	A	35.008	0.443	6.575	2.047	84
323148	Pomello fine sand - 0 to 5 percent slopes	A	35.008	0.443	6.575	2.047	84
323157	Sanibel muck	A/D	13.039	0.56	0	11.811	0
323160	Smyrna-Urban land complex	A/D	13.039	0.445	0.852	2.047	31
323159	Smyrna fine sand	A/D	13.039	0.445	0.852	2.047	31
323151	St. Johns fine sand	B/D	13.039	0.436	0.348	2.047	15
323163	Tavares-Urban land complex - 0 to 5 percent slopes	A	35.008	0.428	14.631	2.047	145
323166	Urban land	Urban Land	12.992	0.42	5.279	2.047	80
323176	Water	Water	39.370	0.8	0	0.394	0
323171	Zolfo-Urban land complex	A	13.039	0.434	4.956	1.949	84
323170	Zolfo Fine Sand	A	13.039	0.434	4.956	1.949	84
323132	Archbold sand - 0 to 5 percent slopes	A	29.764	0.432	18.808	2.047	145
323139	Ona Fine Sand	B/D	13.039	0.43	0.765	2.047	31
323152	St. Lucie fine sand - 0 to 5 percent slopes	A	35.008	0.430	25.084	1.949	203
323153	St. Lucie - Urban Land Complex, 0 to 5 percent slopes	A	35.007	0.430	25.084	1.949	203
323154	Candler fine sand - 0 to 5 percent slopes	A	13.039	0.434	24.100	2.047	203
323172	Candler and Apopka Fine Sands - 5 to 12 percent slopes	A	13.039	0.434	24.100	2.047	203
323158	Seffner Fine Sands	A/D	13.039	0.429	4.894	2.047	77
323161	Tavares fine sand - 0 to 5 percent slopes	A	27.921	0.428	14.631	2.047	145
323162	Tavares-Millhopper fine sands - 0 to 5 percent slopes	A	35.008	0.428	14.631	2.047	145

Soil Hydrologic Class Summary		
Soil Hydrologic Class	Hydrologic Class Description	Percent of Project Area
A	Well drained.	47.4%
A/D	Dual classification, well to poorly drained.	16.6%
B/D	Dual classification, moderately well to poorly drained.	8.8%
Urban Land	None, a hydrologic class is typically not assigned to urban land.	1.1%
Water	None, a hydrologic class is typically not assigned to water.	26.1%

Notes:
Soil Parameters Table: soils were compared to the SWFWMD soils lookup table which included additional soils data from the NRCS SSURGO and University of Florida IFAS databases. Soil parameters data referenced from SWFWMD lookup table.

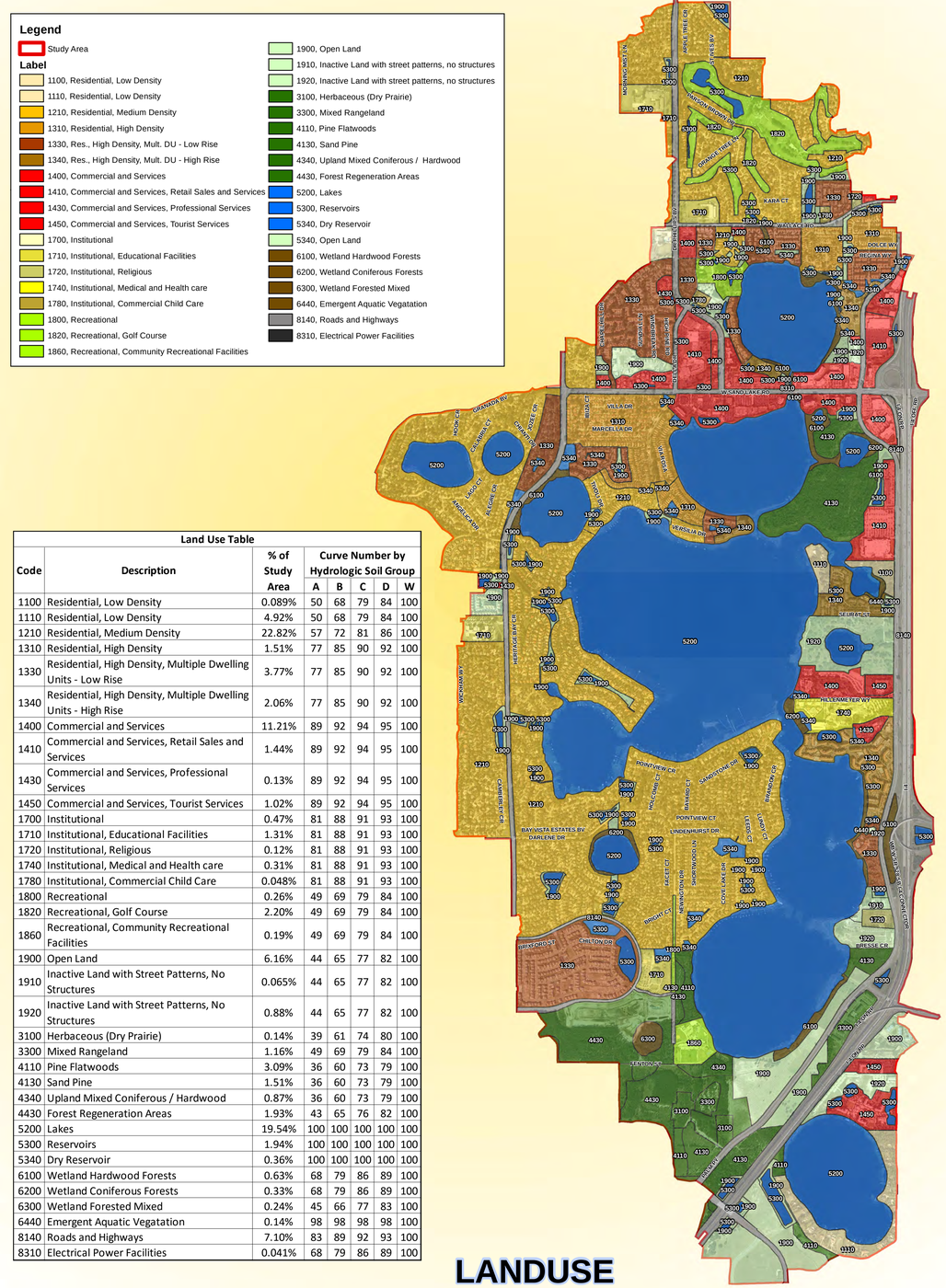
For runoff calculcation purposes Urban land soils (MUKEY 323166) and dual classification soils 'A/D' and 'B/D' would be assigned hydrologic class 'D'. MUKEY 323176 is for surface water and is not assigned a hydrologic class.

ERP Project with Geotechnical Data	
ERP Number	Project Name
060606-15	Turkey Lake Office Building
48-00103-S	Deluca Spring Lake
48-00103-S-03	Professional Office on Wallace Road
48-00104-S	Bay Vista Estates
48-00138-S	Westgate Lakes Fka Sand Lake Resort
48-00138-S	Westgate Lakes Phase IV
48-00307-S	Sand Lake Point Unit V
48-00501-S	Sand Lake Post Office Expansion
48-00558-S	Dr Phillips YMCA Building Expansion
48-00693-S	Turkey Lake Road Property
48-00781-S-02	Bay Meadows Elementary School Relief
48-00969-P	Phillips Bay
48-00993-P	Marbella Master Drainage Plan
48-00998-P	Eden Springs Resort
48-01088-P	Sand Lake Property AKA Vizcaya
48-01088-P	Vizcaya Townhomes Tract A Sand Lake Property
48-01133-P	Sand Lake Groves
48-01205-P-02	Phillips View Tower Building
48-01243-P	I-4 Auxillary Lane SR 535 to SR528
48-01583-P	Wildwood Area Roadway Network
48-01645-P	Sand Lake Estates Pd (Venezia)
48-01746-P	Dellagio Phase 3
48-01770-P	Vineland Point Condos
48-02014-P	Dr Phillips Office Building



SOILS

For project purposes, the landuse coverage provided by SFWMD was modified where necessary to provide a more detailed representation of land use within the study area.



Land Use Table							
Code	Description	% of Study Area	Curve Number by Hydrologic Soil Group				
			A	B	C	D	W
1100	Residential, Low Density	0.089%	50	68	79	84	100
1110	Residential, Low Density	4.92%	50	68	79	84	100
1210	Residential, Medium Density	22.82%	57	72	81	86	100
1310	Residential, High Density	1.51%	77	85	90	92	100
1330	Residential, High Density, Multiple Dwelling Units - Low Rise	3.77%	77	85	90	92	100
1340	Residential, High Density, Multiple Dwelling Units - High Rise	2.06%	77	85	90	92	100
1400	Commercial and Services	11.21%	89	92	94	95	100
1410	Commercial and Services, Retail Sales and Services	1.44%	89	92	94	95	100
1430	Commercial and Services, Professional Services	0.13%	89	92	94	95	100
1450	Commercial and Services, Tourist Services	1.02%	89	92	94	95	100
1700	Institutional	0.47%	81	88	91	93	100
1710	Institutional, Educational Facilities	1.31%	81	88	91	93	100
1720	Institutional, Religious	0.12%	81	88	91	93	100
1740	Institutional, Medical and Health care	0.31%	81	88	91	93	100
1780	Institutional, Commercial Child Care	0.048%	81	88	91	93	100
1800	Recreational	0.26%	49	69	79	84	100
1820	Recreational, Golf Course	2.20%	49	69	79	84	100
1860	Recreational, Community Recreational Facilities	0.19%	49	69	79	84	100
1900	Open Land	6.16%	44	65	77	82	100
1910	Inactive Land with Street Patterns, No Structures	0.065%	44	65	77	82	100
1920	Inactive Land with Street Patterns, No Structures	0.88%	44	65	77	82	100
3100	Herbaceous (Dry Prairie)	0.14%	39	61	74	80	100
3300	Mixed Rangeland	1.16%	49	69	79	84	100
4110	Pine Flatwoods	3.09%	36	60	73	79	100
4130	Sand Pine	1.51%	36	60	73	79	100
4340	Upland Mixed Coniferous / Hardwood	0.87%	36	60	73	79	100
4430	Forest Regeneration Areas	1.93%	43	65	76	82	100
5200	Lakes	19.54%	100	100	100	100	100
5300	Reservoirs	1.94%	100	100	100	100	100
5340	Dry Reservoir	0.36%	100	100	100	100	100
6100	Wetland Hardwood Forests	0.63%	68	79	86	89	100
6200	Wetland Coniferous Forests	0.33%	68	79	86	89	100
6300	Wetland Forested Mixed	0.24%	45	66	77	83	100
6440	Emergent Aquatic Vegatation	0.14%	98	98	98	98	100
8140	Roads and Highways	7.10%	83	89	92	93	100
8310	Electrical Power Facilities	0.041%	68	79	86	89	100

LANDUSE

ORANGE COUNTY GOVERNMENT FLORIDA

N

1,500 750 0 1,500 Feet

Sources:
Aerial: OCPA, 2016
Roads: Orange County, 2015
Landuse: SFWMD, 2008
Soils Features: Downloaded from NRCS web soil survey, websoilsurvey.sc.egov.usda.gov.

Exhibit

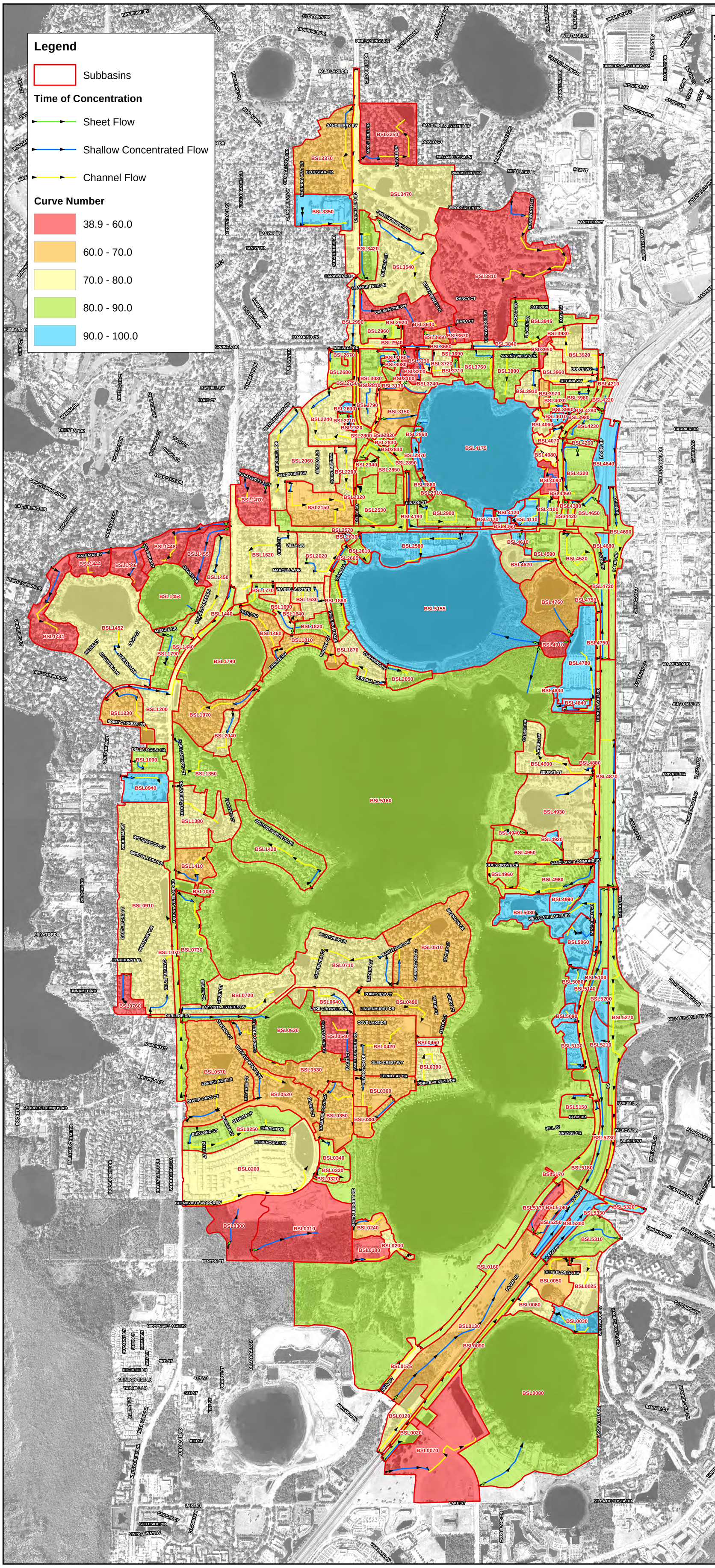
4

Soils and Landuse Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants



SUBBASIN DATA SUMMARY

Subbasin Name	Time of Concentration (min)	Curve Number	Area (Acres)	Subbasin Name	Time of Concentration (min)	Curve Number	Area (Acres)
BSL0020	12	8.29	83.5	BSL2940	17.9	1.74	81
BSL0030	10	27.93	81.4	BSL2960	15.1	8.26	81
BSL0050	10	16.22	69.7	BSL2990	32.2	12.11	75.2
BSL0060	10	9.25	77.3	BSL3030	19.3	10.42	85.3
BSL0070	39.7	77.31	58.2	BSL3080	15.3	4.73	82.1
BSL0080	25.2	208.37	88.7	BSL3100	27.1	1.09	55.8
BSL0090	24.7	14.29	81.7	BSL3130	10	2.23	65.7
BSL0120	12.8	12.68	79.4	BSL3150	25.6	17.94	65.9
BSL0130	56.9	65.48	61.7	BSL3160	16.1	2.41	57.1
BSL0160	10	17.31	85.7	BSL3200	16	3.50	52.6
BSL0175	10	5.63	76.8	BSL3230	10	2.93	74.3
BSL0180	22.4	9.04	48.8	BSL3240	12.8	6.92	80
BSL0200	12.8	3.72	74.7	BSL3250	45.1	37.63	59.5
BSL0240	15.8	7.20	64	BSL3350	44	20.17	90.1
BSL0250	30.9	34.70	80.3	BSL3370	37.3	44.02	65.6
BSL0260	10	85.45	79.4	BSL3420	40.4	12.59	85.1
BSL0300	28.9	26.90	49	BSL3470	11.1	79.70	78.3
BSL0310	28.1	70.43	52.3	BSL3540	46.4	46.22	73.3
BSL0320	10	1.61	81	BSL3640	44.2	29.13	58.3
BSL0330	10	4.28	81	BSL3650	12	3.84	67.2
BSL0340	13.5	7.14	81.8	BSL3670	16.1	2.85	59.4
BSL0350	21.5	21.74	61.8	BSL3680	14.8	3.99	75.9
BSL0360	21.3	18.10	62.3	BSL3690	10	0.52	89.4
BSL0380	14.6	8.13	66.1	BSL3710	10	1.46	89.4
BSL0390	17.5	12.60	77.9	BSL3720	10	5.76	79.3
BSL0420	28.6	40.79	63.4	BSL3760	14.8	13.05	82.9
BSL0460	27.3	3.06	80.5	BSL3810	34.8	137.65	55.9
BSL0490	19.5	40.54	64.5	BSL3840	12.7	6.64	74.4
BSL0510	20.9	63.99	66.9	BSL3900	15.6	18.77	83.4
BSL0520	14.6	27.71	67.3	BSL3910	12.3	7.75	74.1
BSL0530	19	32.79	63.8	BSL3920	18.5	15.72	77.2
BSL0540	24.4	13.77	57.9	BSL3930	10	1.31	73.2
BSL0570	25	61.79	64	BSL3945	15.5	22.90	80.7
BSL0630	35.9	45.44	88.5	BSL3950	18	3.38	60.8
BSL0640	18.5	13.63	75.6	BSL3960	22.8	11.96	79.3
BSL0710	23.5	56.09	70.4	BSL3970	32.6	3.50	66.6
BSL0720	22.2	35.76	79.3	BSL3980	17	6.76	86.6
BSL0730	26.2	34.92	84.1	BSL3990	10	0.38	98.7
BSL0760	37.8	8.37	57.3	BSL4010	25.3	2.86	90.8
BSL0910	31.7	114.25	72.9	BSL4030	37.9	5.60	88.3
BSL0940	20.8	14.48	92.7	BSL4060	10	3.88	74
BSL1070	17.5	27.65	82.4	BSL4070	10	4.15	76.4
BSL1080	10	1.73	88.8	BSL4080	17.7	4.27	78.7
BSL1090	38.4	10.29	81.1	BSL4090	23.3	5.55	60
BSL1200	14.5	25.26	70.5	BSL4100	35.1	6.68	81.6
BSL1230	30.2	18.57	60.8	BSL4110	19.6	5.99	94
BSL1350	16	36.88	79.9	BSL4120	15.1	3.38	94.5
BSL1380	15	33.60	80.2	BSL4160	10	1.24	95
BSL1410	20.5	13.14	66.9	BSL4170	10	1.97	94
BSL1420	30.5	40.28	86.1	BSL4175	10	139.09	95.8
BSL1440	10	6.16	86.6	BSL4190	42.5	7.91	86.5
BSL1441	37.8	24.84	57.6	BSL4210	10	1.13	69.5
BSL1444	18.7	10.37	57	BSL4220	10	2.38	86.8
BSL1446	23.3	12.17	58.4	BSL4230	10.4	8.25	88.9
BSL1448	28.8	17.04	57.7	BSL4260	41.5	2.31	89
BSL1450	25.2	23.57	77.9	BSL4280	21.3	5.85	84.4
BSL1452	33	92.87	74	BSL4320	86.9	17.71	89.7
BSL1454	12.2	33.18	81.5	BSL4380	11	1.04	88.2
BSL1455	34.9	15.96	58.7	BSL4420	22.6	2.30	88.5
BSL1460	18.7	12.94	65.2	BSL4460	18.3	7.04	83.5
BSL1470	20	18.07	57.2	BSL4520	10	16.46	89.9
BSL1620	25.6	48.23	79.1	BSL4590	10	14.62	84.9
BSL1630	22.9	10.82	75.3	BSL4610	10	2.56	90.4
BSL1640	10	2.64	65.6	BSL4620	13	14.96	70.3
BSL1690	35.3	9.23	78.9	BSL4640	19.9	17.70	91.3
BSL1770	17	8.13	80.7	BSL4650	14.8	9.94	84.5
BSL1790	23.8	73.16	87.8	BSL4680	10	2.68	91.8
BSL1810	18.8	12.50	60.4	BSL4690	25.2	18.72	89.8
BSL1820	34.7	7.07	82.5	BSL4720	32.7	15.57	87.6
BSL1870	22.7	18.33	76.6	BSL4750	10	4.36	85.2
BSL1880	22	9.53	89.7	BSL4760	27.6	35.92	64.7
BSL1970	39.2	25.19	60.6	BSL4780	10.3	31.19	93
BSL2040	25.3	8.59	78.5	BSL4830	10	0.88	91.4
BSL2050	12.7	8.14	83.9	BSL4840	18.2	4.30	92.8
BSL2060	26.4	46.59	74.9	BSL4870	89.5	38.90	87.1
BSL2150	41.3	26.29	64.7	BSL4880	10	11.13	86.9
BSL2200	25.5	9.76	75.8	BSL4900	10	21.13	79.9
BSL2240	26.9	24.84	77.5	BSL4910	22.1	6.72	38.9
BSL2320	10	1.87	83.1	BSL4920	10	1.78	90.6
BSL2340	10	4.91	89.2	BSL4930	15.9	58.47	78
BSL2530	10	21.71	88.9	BSL4940	18.2	4.27	89.3
BSL2570	10	14.01	83.6	BSL4950	10	21.33	89.3
BSL2580	10	30.24	91.6	BSL4960	10	6.81	82.3
BSL2610	10	3.08	89	BSL4980	44.3	24.34	82.3
BSL2620	18	21.53	77.3	BSL4990	22.4	7.18	90.9
BSL2630	10.6	0.75	94.4	BSL5030	10	32.32	91
BSL2665	13.8	2.91	81.8	BSL5060	25.9	14.67	90.2
BSL2670	22.6	1.95	81	BSL5080	10	7.26	91.1
BSL2680	24.6	7.15	81	BSL5090	10	3.95	90.2
BSL2690	13.5	1.64	92.5	BSL5100	44.2	19.52	83.6
BSL2710	13.2	1.57	89.8	BSL5130	10	8.61	91.9
BSL2720	10	0.79	94.4	BSL5140	10	10.05	86.3
BSL2750	10	4.16	84.9	BSL5150	13.4	8.06	80.6
BSL2790	10	7.22	79.4	BSL5155	23.5	210.43	91.3
BSL2800	10	6.23	87.7	BSL5160	24.3	1538.16	89.8
BSL2810	10	2.86	75.6	BSL5170	30.4	6.14	53.3
BSL2820	10	0.58	83.6	BSL5180	10	10.81	86.9
BSL2830	10	0.63	86.3	BSL5190	30.7	7.33	60.3
BSL2840	10	0.53	88.6	BSL5200	10	6.08	92.5
BSL2850	10	12.16	88.7	BSL5210	10	8.67	92.4
BSL2860	23.1	1.14	91.9	BSL5230	63.8	17.69	85
BSL2870	37.1	3.29	91.9	BSL5250	33.3	8.68	90.2
BSL2880	22.7	2.17	88	BSL5270	118.3	39.30	87.3
BSL2890	10	13.36	82.6	BSL5300	42.7	9.60	92.2
BSL2900	16.2	16.51	85.8	BSL5310	34.4	18.86	82.4
BSL2910	26.5	0.67	82.1	BSL5320	10	4.31	90.8
BSL2920	10	0.69	80.9	BSL5330	10	0.63	94.2

Sources:
Aerial: Orange County, 2016
Roads: Orange County, 2015

N

0 500 1,000 Feet

Subbasin Map

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

Orange County Government Florida

Exhibit

5

Legend

- Model Subbasins
- Possible 100 Year Structure Flooding

ICPR Node, Pass/Fail LOS

- Fail, 10 Year (12)
- Pass, 10 Year (162)
- Fail, 25 Year (53)
- Pass, 25 Year (316)
- Fail, 100 Year (3)
- Pass, 100 Year (6)
- N/A, Junction (3)
- Time-Stage (27)

ICPR Link

- Channel
- Drop Structure
- Percolation
- Pipe
- Rating Curve
- Weir
- Percolation Locations

HydroNetwork

- Hydroedge
- Hydrojunction

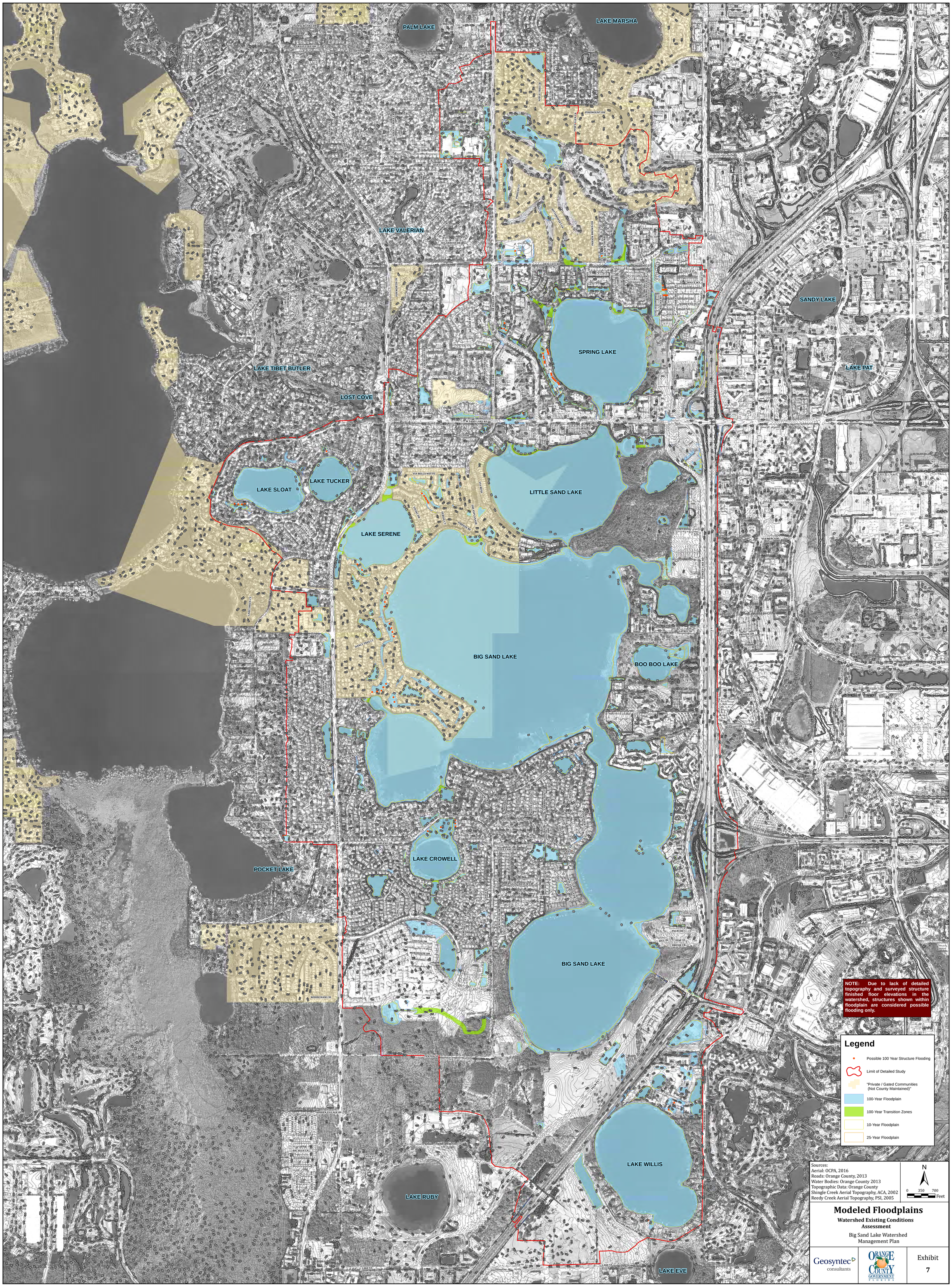
SUBBASIN DATA SUMMARY

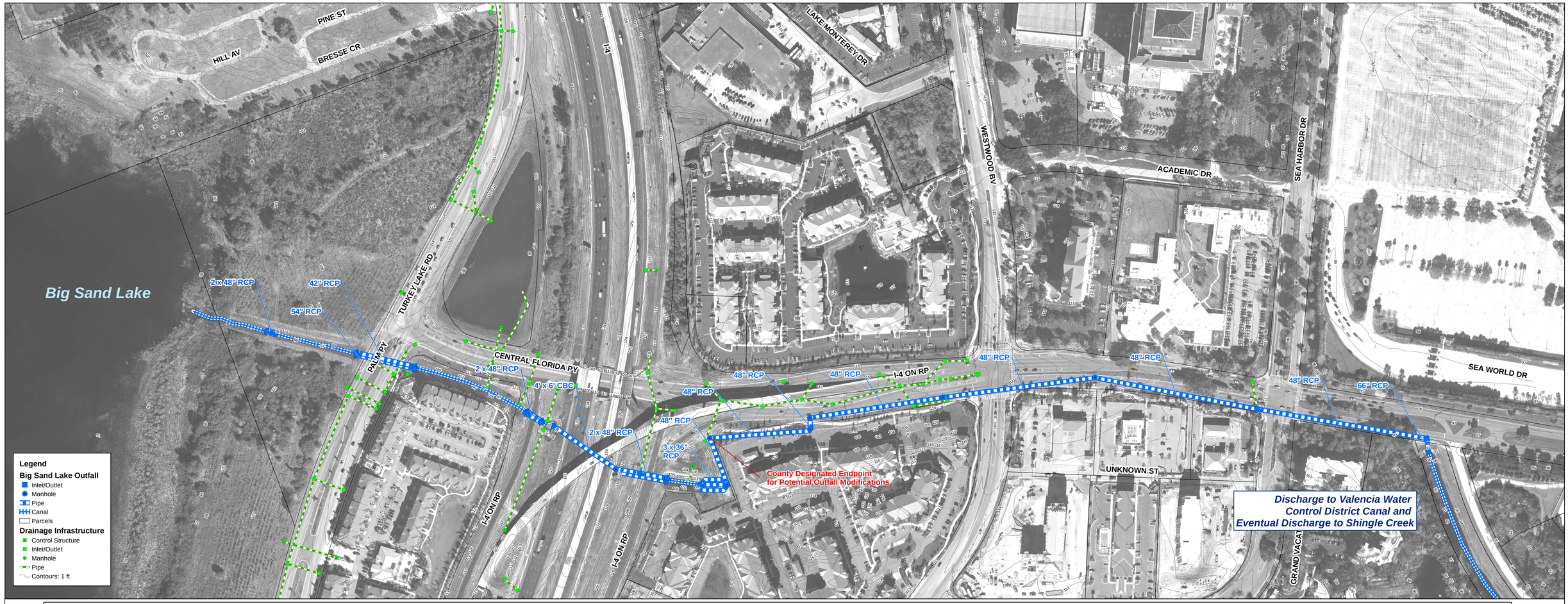
Subbasin Name	Time of Concentration (min)	Curve Number	Area (Acres)
BSL0020	12	83.5	8.29
BSL0030	10	81.4	27.93
BSL0050	10	69.7	16.22
BSL0060	10	77.3	9.25
BSL0070	39.7	58.2	77.31
BSL0080	25.2	88.7	208.37
BSL0090	24.7	81.7	14.29
BSL0120	12.8	79.4	12.68
BSL0130	56.9	61.7	65.48
BSL0160	10	85.7	17.31
BSL0175	10	76.8	5.63
BSL0180	22.4	48.8	9.04
BSL0200	12.8	74.7	3.72
BSL0240	15.8	64	7.20
BSL0250	30.9	80.3	34.70
BSL0260	10	79.4	85.45
BSL0300	28.9	49	26.90
BSL0310	28.1	52.3	70.43
BSL0320	10	81	1.61
BSL0330	10	81	4.28
BSL0340	13.5	81.8	7.14
BSL0350	21.5	61.8	21.74
BSL0360	21.3	62.3	18.10
BSL0380	14.6	66.1	8.13
BSL0390	17.5	77.9	12.60
BSL0420	28.6	63.4	40.79
BSL0460	27.3	80.5	3.06
BSL0400	19.5	64.5	40.54
BSL0510	20.9	66.9	63.99
BSL0520	14.6	67.3	27.71
BSL0530	19	63.8	32.79
BSL0540	24.4	57.9	13.77
BSL0480	25	64	61.79
BSL0630	35.9	88.5	45.44
BSL0640	18.5	75.6	13.63
BSL0710	23.5	70.4	56.09
BSL0720	22.2	79.3	35.76
BSL0730	26.2	84.1	34.92
BSL0760	37.8	57.3	8.37
BSL0910	31.7	72.9	114.25
BSL0940	20.8	92.7	14.48
BSL1070	17.5	82.4	27.65
BSL1080	10	88.8	1.73
BSL1090	38.4	81.1	10.29
BSL1200	14.5	70.5	25.26
BSL1230	30.2	60.8	18.57
BSL1350	16	79.9	36.88
BSL1380	15	80.2	33.60
BSL1410	20.5	68.8	14.58
BSL1420	30.5	86.1	40.28
BSL1440	10	86.6	6.16
BSL1441	37.8	57.6	24.84
BSL1444	18.7	57	10.37
BSL1446	23.3	58.4	12.17
BSL1448	28.8	57.7	17.04
BSL1450	25.2	77.9	23.57
BSL1452	33	74	92.87
BSL1454	12.2	81.5	33.18
BSL1455	34.9	58.7	15.96
BSL1460	18.7	65.2	12.94
BSL1470	20	57.2	18.07
BSL1620	25.6	79.1	48.23
BSL1630	22.9	75.3	10.82
BSL1640	10	65.6	2.64
BSL1690	35.3	78.9	9.23
BSL1770	17	80.7	8.13
BSL1790	23.8	87.8	73.16
BSL1810	18.8	60.4	12.50
BSL1820	34.7	82.5	7.07
BSL1870	22.7	76.6	18.33
BSL1880	22	89.7	9.53
BSL1970	39.2	60.6	25.19
BSL2040	25.3	78.5	8.59
BSL2050	12.7	83.9	8.14
BSL2060	26.4	74.9	46.59
BSL2150	41.3	64.7	26.29
BSL2200	25.5	75.8	9.76
BSL2240	26.9	77.5	24.84
BSL2320	10	83.1	1.87
BSL2340	10	89.2	4.91
BSL2530	10	88.9	21.71
BSL2570	10	83.6	14.01
BSL2580	10	91.6	30.24
BSL2610	10	89	3.08
BSL2620	18	77.3	21.53
BSL2630	10.6	94.4	0.75
BSL2665	13.8	81.8	2.91
BSL2670	22.6	81	1.95
BSL2680	24.6	81	7.15
BSL2690	13.5	92.5	1.64
BSL2710	13.2	89.8	1.57
BSL2720	10	94.4	0.79
BSL2750	10	84.9	4.16
BSL2790	10	79.4	7.22
BSL2800	10	87.7	6.23
BSL2810	10	75.6	2.86
BSL2820	10	83.6	0.58
BSL2830	10	86.3	0.63
BSL2840	10	88.6	0.53
BSL2850	10	88.7	12.16
BSL2860	23.1	91.9	1.14
BSL2870	37.1	91.9	3.29
BSL2880	22.7	88	2.17
BSL2890	10	82.6	13.36
BSL2900	16.2	85.8	16.51
BSL2910	26.5	82.1	0.67213
BSL2920	10	80.9	0.6865
BSL2940	17.9	81	1.74283
BSL2960	15.1	81	8.25663
BSL2990	32.2	75.2	12.1056
BSL3030	19.3	85.3	10.4222
BSL3080	15.3	82.1	4.73171
BSL3100	27.1	55.8	1.08956
BSL3130	10	65.7	2.22616
BSL3150	25.6	65.9	17.9373
BSL3160	16.1	57.1	2.41494
BSL3200	16	52.6	3.49564
BSL3230	10	74.3	2.9295
BSL3240	12.8	80	6.9238
BSL3250	45.1	59.5	37.6256
BSL3350	44	90.1	20.1714
BSL3370	37.3	65.6	44.018
BSL3420	40.4	85.1	12.5858
BSL3470	11.1	78.3	79.6961
BSL3540	46.4	73.3	46.2168
BSL3640	44.2	58.3	29.1296
BSL3650	12	67.2	3.84121
BSL3670	16.1	59.4	2.85271
BSL3680	14.8	75.9	3.98744
BSL3690	10	89.4	0.52259
BSL3710	10	89.4	1.46137
BSL3720	10	79.3	5.75801
BSL3760	14.8	82.9	13.0481
BSL3810	34.8	55.9	137.646
BSL3840	12.7	74.4	6.6376
BSL3900	15.6	83.4	18.7222
BSL3910	12.3	74.1	7.75322
BSL3920	18.5	77.2	15.7234
BSL3930	10	73.2	1.31385
BSL3945	15.5	80.7	22.8962
BSL3950	18	60.8	3.37837
BSL3960	22.8	79.3	11.9568
BSL3970	32.6	66.6	3.50043
BSL3980	17	86.6	6.75503
BSL3990	10	98.7	0.37739
BSL4010	25.3	90.8	2.85591
BSL4030	37.9	88.3	5.59539
BSL4060	10	74	3.87803
BSL4070	10	76.4	4.15432
BSL4080	17.7	78.7	4.27359
BSL4090	23.3	60	5.54819
BSL4100	35.1	81.6	6.67949
BSL4110	19.6	94	5.98689
BSL4120	15.1	94.5	3.38228
BSL4160	10	95	1.24363
BSL4170	10	94	1.96845
BSL4175	10	95.8	139.087
BSL4190	42.5	86.5	7.90653
BSL4210	10	69.5	1.13261
BSL4220	10	86.8	2.37911
BSL4230	10.4	88.9	8.25236
BSL4260	41.5	89	2.30953
BSL4280	21.3	84.4	5.85384
BSL4320	86.9	89.7	17.7124
BSL4380	11	88.2	1.03671
BSL4420	22.6	88.5	2.29863
BSL4460	18.3	83.5	7.03712
BSL4520	10	89.9	15.8033
BSL4590	10	84.9	14.6209
BSL4610	10	90.4	2.56117
BSL4620	13	70.3	14.9632
BSL4640	19.9	91.3	17.6972
BSL4650	14.8	84.5	9.93887
BSL4680	10	91.8	2.6789
BSL4690	25.2	89.8	18.7218
BSL4720	32.7	87.7	16.2334
BSL4750	10	85.2	4.35903
BSL4760	27.6	64.7	35.9204
BSL4780	10.3	93	31.1928
BSL4830	10	91.4	0.87951
BSL4840	18.2	92.8	4.30176
BSL4870	89.5	87.1	38.9008
BSL4880	10	86.9	11.1287
BSL4900	10	79.9	21.1338
BSL4910	22.1	38.9	6.71727
BSL4920	10	90.6	1.77699
BSL4930	15.9	78	58.4728
BSL4940	18.2	89.3	4.27072
BSL4950	10	89.3	21.3335
BSL4960	10	82.3	6.81462
BSL4980	44.3	82.3	24.3388
BSL4990	22.4	90.9	7.18017
BSL5030	10	91	32.3154
BSL5060	25.9	90.2	14.6713
BSL5080	10	91.1	7.2563
BSL5090	10	90.2	3.95072
BSL5100	44.2	83.6	19.5214
BSL5130	10	91.9	8.61301
BSL5140	10	86.3	10.0543
BSL5150	13.4	80.6	8.0575
BSL5155	23.5	91.3	210.433
BSL5160	24.3	89.8	1534.91
BSL5170	30.4	53.3	6.14324
BSL5180	10	86.9	10.807
BSL5190	30.7	60.3	7.32817
BSL5200	10	92.5	6.07752
BSL5210	10	92.4	8.6715
BSL5230	63.8	85	17.6903
BSL5250	33.3	90.2	8.68492
BSL5270	203.7	87.3	39.2968
BSL5300	42.7	92.2	9.59522
BSL5310	34.4	82.4	18.862
BSL5320	10	90.8	4.30878
BSL5330	10	94.2	0.63092

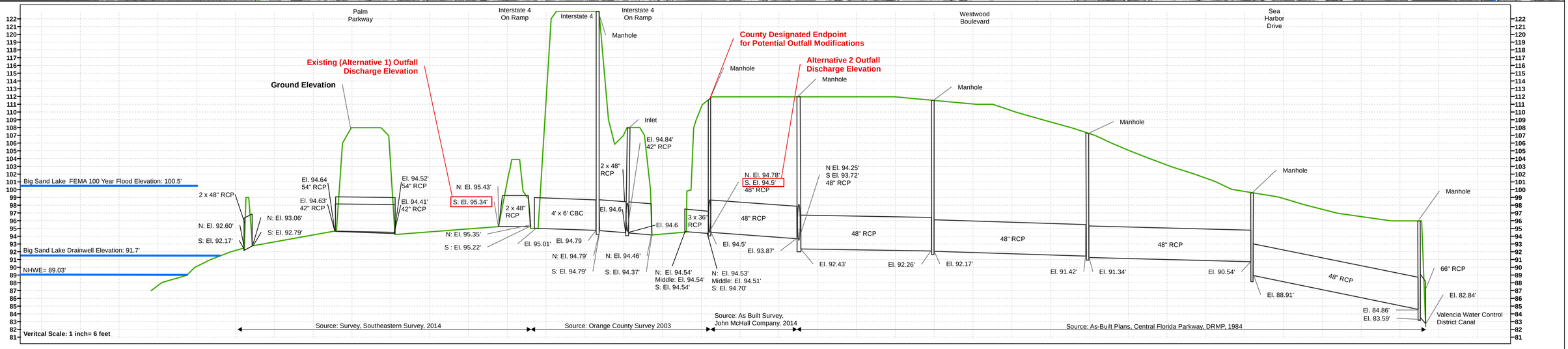
LINK CONNECTIVITY TABLE

NAME	FROM NODE	TO NODE
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PBSL0080	NBSL0080	NBSL0090
PBSL0090	NBSL0090	NBSL0100
PBSL0100	NBSL0100	NBSL0110
PBSL0110	NBSL0110	NBSL0130
PBSL0130	NBSL0130	NBSL0140
PBSL0140	NBSL0140	NBSL0150
PBSL0150	NBSL0150	NBSL0170
PBSL0170	NBSL0170	NBSL5160
PBSL0190	NBSL0190	NBSL0200
PBSL0210	NBSL0210	NBSL0200
PBSL0220	NBSL0220	NBSL0210
PBSL0230	NBSL0230	NBSL0220
PBSL0240	NBSL0240	NBSL0230
PBSL0250	NBSL0250	NBSL0260
PBSL0270	NBSL0270	NBSL0280
PBSL0280	NBSL0280	NBSL0290
PBSL0290	NBSL0290	NBSL0310
PBSL0310	NBSL0310	NBSL5160
PBSL0321	NBSL0321	NBSL0322
PBSL0322	NBSL0322	NBSL0330
PBSL0365	NBSL0365	NBSL0370
PBSL0370	NBSL0370	NBSL0375
PBSL0375	NBSL0375	NBSL0380
PBSL0400	NBSL0400	NBSL0405
PBSL0405	NBSL0405	NBSL0410
PBSL0410	NBSL0410	NBSL5160
PBSL0430	NBSL0430	NBSL0440
PBSL0440	NBSL0440	NBSL0450
PBSL0450	NBSL0450	NBSL0470
PBSL0470	NBSL0470	NBSL0480
PBSL0480	NBSL0480	NBSL5160
PBSL0500	NBSL0500	NBSL5160
PBSL0550	NBSL0550	NBSL0560
PBSL0560	NBSL0560	NBSL0630
PBSL0580	NBSL0580	NBSL0590
PBSL0590	NBSL0590	NBSL0600
PBSL0600	NBSL0600	NBSL0610
PBSL0610	NBSL0610	NBSL0620
PBSL0620	NBSL0620	NBSL0630
PBSL0649	NBSL0649	NBSL0650
PBSL0650	NBSL0650	NBSL0670
PBSL0660A	NBSL0660	NBSL0720
PBSL0660B	NBSL0660	NBSL0670
PBSL0670	NBSL0670	NBSL0680
PBSL0680	NBSL0680	NBSL0690
PBSL0690	NBSL0690	NBSL0700
PBSL0700	NBSL0700	NBSL0710
PBSL0740	NBSL0740	NBSL0750
PBSL0750	NBSL0750	NBSL5160
PBSL0770	NBSL0770	NBSL0780
PBSL0780	NBSL0780	NBSL0790
PBSL0790	NBSL0790	NBSL0800
PBSL0800	NBSL0800	NBSL0810
PBSL0810	NBSL0810	NBSL0820
PBSL0820	NBSL0820	NBSL0830
PBSL0830	NBSL0830	NBSL0840
PBSL0840	NBSL0840	NBSL0850
PBSL0850	NBSL0850	NBSL0860
PBSL0860	NBSL0860	NBSL0870
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PBSL0890	NBSL0890	NBSL0900
PBSL0900	NBSL0900	NBSL0910
PBSL0920	NBSL0920	NBSL0930
PBSL0930	NBSL0930	NBSL1040
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PBSL0960	NBSL0960	NBSL0970
PBSL0970	NBSL0970	NBSL0980
PBSL0980	NBSL0980	NBSL0990
PBSL0990	NBSL0990	NBSL1000
PBSL1000	NBSL1000	NBSL1010
PBSL1010	NBSL1010	NBSL1020
PBSL1020	NBSL1020	NBSL1030
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PBSL1040	NBSL1040	NBSL1050
PBSL1050	NBSL1050	NBSL1060
PBSL1060	NBSL1060	NBSL1070
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PBSL1100	NBSL1100	NBSL1110
PBSL1110	NBSL1110	NBSL1120
PBSL1120	NBSL1120	NBSL1130
PBSL1130	NBSL1130	NBSL1140
PBSL1140	NBSL1140	NBSL1150
PBSL1150	NBSL1150	NBSL1160
PBSL1160	NBSL1160	NBSL1170
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PBSL1180	NBSL1180	NBSL1190
PBSL1190	NBSL1190	NBSL1200
PBSL1210	NBSL1210	NBSL1220
PBSL1220	NBSL1220	NBSL1790
PBSL1240	NBSL1240	NBSL1250
PBSL1250	NBSL1250	NBSL1260
PBSL1260	NBSL1260	NBSL1270
PBSL1270	NBSL1270	NBSL1280
PBSL1280	NBSL1280	NBSL1290
PBSL1290	NBSL1290	NBSL1300
PBSL1300	NBSL1300	NBSL1310
PBSL1310	NBSL1310	NBSL1320
PBSL1320	NBSL1320	NBSL1330
PBSL1330	NBSL1330	NBSL1340
PBSL1340	NBSL1340	NBSL1350
PBSL1360	NBSL1360	NBSL1370
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PBSL1400	NBSL1400	NBSL5160
PBSL1430	NBSL1430	NBSL5160
PBSL1442	NBSL1442	NBSL1443
PBSL1443	NBSL1443	NBSL1452
PBSL1445	NBSL1445	NBSL1452
PBSL1447	NBSL1447	NBSL1452
PBSL1449	NBSL1449	NBSL1454
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PBSL1490	NBSL1490	NBSL1500
PBSL1500	NBSL1500	NBSL1510
PBSL1510	NBSL1510	NBSL1520
PBSL1520	NBSL1520	NBSL1530
PBSL1530	NBSL1530	NBSL1540
PBSL1540	NBSL1540	NBSL1550
PBSL1550	NBSL1550	NBSL1560
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PBSL1590	NBSL1590	NBSL1600
PBSL1600	NBSL1600	NBSL1610
PBSL1610	NBSL1610	NBSL1620
PBSL1650	NBSL1650	NBSL1660
PBSL1660	NBSL1660	NBSL1670
PBSL1670	NBSL1670	NBSL1680
PBSL1680	NBSL1680	NBSL1690
PBSL1700	NBSL1700	NBSL1710
PBSL1710	NBSL1710	NBSL1720
PBSL1720	NBSL1720	NBSL1730
PBSL1730	NBSL1730	NBSL1740
PBSL1740	NBSL1740	NBSL1750
PBSL1750	NBSL1750	NBSL1760
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PBSL1800	NBSL1800	NBSL5160
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PBSL1860	NBSL1860	NBSL1870
PBSL1890	NBSL1890	NBSL5155
PBSL1900	NBSL1900	NBSL1910
PBSL1910	NBSL1910	NBSL1920
PBSL1920	NBSL1920	NBSL1930
PBSL1930	NBSL1930	NBSL1940
PBSL1940	NBSL1940	NBSL1950
PBSL1950	NBSL1950	NBSL1960
PBSL1960	NBSL1960	NBSL1970
PBSL1980	NBSL1980	NBSL1990
PBSL1990	NBSL1990	NBSL2000
PBSL2000	NBSL2000	NBSL2010
PBSL2010	NBSL2010	NBSL2020
PBSL2020	NBSL2020	NBSL2030
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PBSL2070	NBSL2070	NBSL2080
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PBSL2130	NBSL2130	NBSL2140
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PBSL2170	NBSL2170	NBSL2180
PBSL2180	NBSL2180	NBSL2190
PBSL2190	NBSL2190	NBSL2320
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PBSL2320	NBSL2320	NBSL2330
PBSL2330	NBSL2330	NBSL2550
PBSL2350	NBSL2350	NBSL2360
PBSL2360	NBSL2360	NBSL2370
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PBSL2400	NBSL2400	NBSL2500
PBSL2500	NBSL2500	NBSL2510
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PBSL2520	NBSL2520	NBSL2530
PBSL2540	NBSL2540	NBSL2550
PBSL2550A	NBSL2550	NBSL2570
PBSL2550B	NBSL2550	NBSL2560
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PBSL2650	NBSL2650	NBSL2660
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PBSL3000	NBSL3000	NBSL3010
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PBSL3026	NBSL3026	NBSL3080
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PBSL3165	NBSL3165	NBSL3200
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PBSL3300	NBSL3300	NBSL3310
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PBSL3560	NBSL3560	NBSL3570
PBSL3570	NBSL3570	NBSL3580
PBSL3580	NBSL3580	NBSL3590

NAME	FROM NODE	TO NODE
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PBSL3610	NBSL3610	NBSL3620
PBSL3620	NBSL3620	NBSL3630
PBSL3630	NBSL3630	NBSL3640
PBSL3640	NBSL3640	NBSL3650
PBSL3680	NBSL3680	NBSL3690
PBSL3690	NBSL3690	NBSL3700
PBSL3710	NBSL3710	NBSL3740
PBSL3730	NBSL3730	NBSL3740
PBSL3740	NBSL3740	NBSL3750
PBSL3750	NBSL3750	NBSL3790
PBSL3760	NBSL3760	NBSL3770
PBSL3770	NBSL3770	NBSL3780
PBSL3790	NBSL3790	NBSL4175
PBSL3820	NBSL3820	NBSL3830
PBSL3830	NBSL3830	NBSL3840
PBSL3840	NBSL3840	NBSL3850
PBSL3850	NBSL3850	NBSL3860
PBSL3860	NBSL3860	NBSL3870
PBSL3870	NBSL3870	NBSL3890
PBSL3890	NBSL3890	NBSL4175
PBSL3920	NBSL3920	NBSL3930
PBSL3940	NBSL3940	NBSL3945
PBSL4000	NBSL4000	NBSL4010
PBSL4010	NBSL4010	NBSL4020
PBSL4020	NBSL4020	NBSL4030
PBSL4040	NBSL4040	NBSL4050
PBSL4050	NBSL4050	NBSL4175
PBSL4130	NBSL4130	NBSL4140
PBSL4140	NBSL4140	NBSL4150
PBSL4150	NBSL4150	NBSL4175
PBSL4180A	NBSL4180	NBSL5155
PBSL4180B	NBSL4180	NBSL4190
PBSL4190	NBSL4190	NBSL4200
PBSL4200	NBSL4200	NBSL5155
PBSL4240	NBSL4240	NBSL4250
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PBSL4270	NBSL4270	NBSL4280
PBSL4280	NBSL4280	NBSL4290
PBSL4290	NBSL4290	NBSL4300
PBSL4300	NBSL4300	NBSL4310
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PBSL4330	NBSL4330	NBSL4340
PBSL4340	NBSL4340	NBSL4350
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PBSL4390	NBSL4390	NBSL4400
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PBSL4660	NBSL4660	NBSL4670
PBSL4670	NBSL4670	NBSL4680
PBSL4680	NBSL4680	NBSL4720
PBSL4690	NBSL4690	NBSL4700
PBSL4700	NBSL4700	NBSL4710
PBSL4710	NBSL4710	NBSL4720
PBSL4720	NBSL4720	NBSL4730
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PBSL4790	NBSL4790	NBSL4800
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PBSL4810	NBSL4810	NBSL4820
PBSL4820	NBSL4820	NBSL4830
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PBSL4890	NBSL4890	NBSL5160
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PBSL5110	NBSL5110	NBSL5120
PBSL5120	NBSL5120	NBSL5160
PBSL5160A	NBSL5160	NBSL5170
PBSL5160B	NBSL5160	NBSL5170
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PBSL5200B	NBSL5200	NBSL5210
PBSL5210	NBSL5210	NBSL5220
PBSL5220	NBSL5220	NBSL5230
PBSL5230	NBSL5230	NBSL5240
PBSL5240	NBSL5240	NBSL5190
PBSL5250	NBSL5250	NBSL5260
PBSL5260A	NBSL5260	NBSL5330
PBSL5260B	NBSL5260	NBSL5300
PBSL5270	NBSL5270	NBSL5280
PBSL5280	NBSL5280	NBSL5290
PBSL5290	NBSL5290	NBSL5300
PBSL5300	NBSL5300	NBSL5330
PBSL5330A	NBSL5330	NBSL5340
PBSL5330B	NBSL5330	NBSL5340
PBSL5330C	NBSL5330	NBSL5340
P


PALM LAKE
LAKE MARSHA
LAKE VALERIAN
SANDY LAKE
SPRING LAKE
LAKE TIBET BUTLER
LOST COVE
LAKE PAT
LAKE SLOAT
LAKE TUCKER
LITTLE SAND LAKE
LAKE SERENE
BIG SAND LAKE
BOO BOO LAKE
POCKET LAKE
LAKE CROWELL
LAKE RUBY
LAKE WILLIS
LAKE EVE
NOTE: Due to lack of detailed topography and surveyed structure finished floor elevations in the watershed, structures shown within floodplain are considered possible flooding only.
Legend
Possible 100 Year Structure Flooding
Limit of Detailed Study
"Private / Gated Communities (Not County Maintained)"
100-Year Floodplain
100-Year Transition Zones
10-Year Floodplain
25-Year Floodplain
Sources:
Aerial: OCPA, 2016
Roads: Orange County, 2013
Water Bodies: Orange County 2013
Topographic Data: Orange County
Shingle Creek Aerial Topography, ACA, 2002
Reedy Creek Aerial Topography, PSI, 2005
N
0 350 700 Feet
Modeled Floodplains
Watershed Existing Conditions Assessment
Big Sand Lake Watershed Management Plan
Geosyntec consultants
Orange County Government Florida
Exhibit 7





Notes
Aerial: OCPA, 2016
Elevation: NAVD88

0 75 150 Feet

Big Sand Lake Outfall Plan and Profile

Big Sand Lake Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

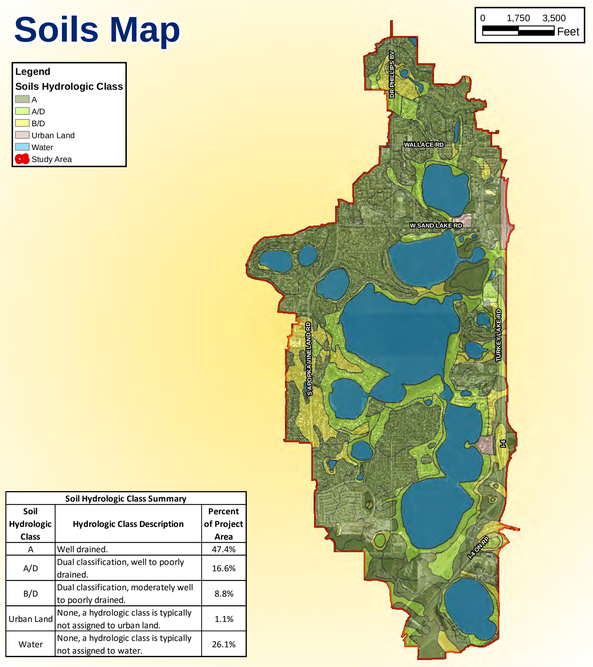
Orange County Government Florida

Exhibit

8

Big Sand Lake Watershed Existing Conditions Assessment

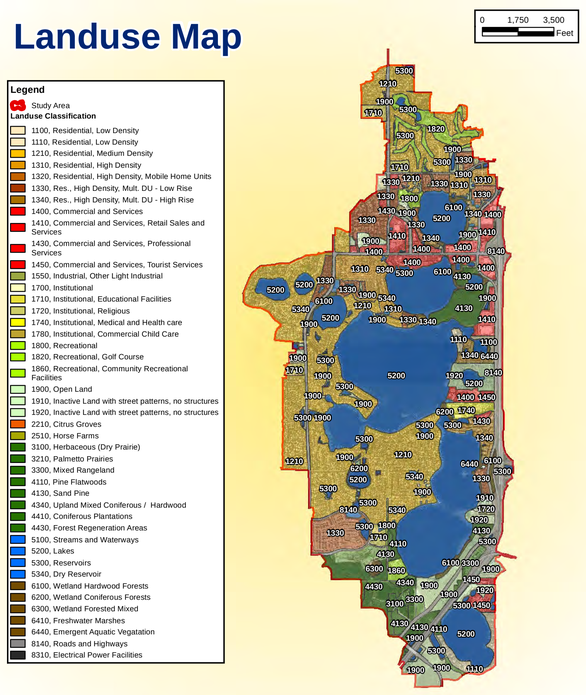
Soils Map



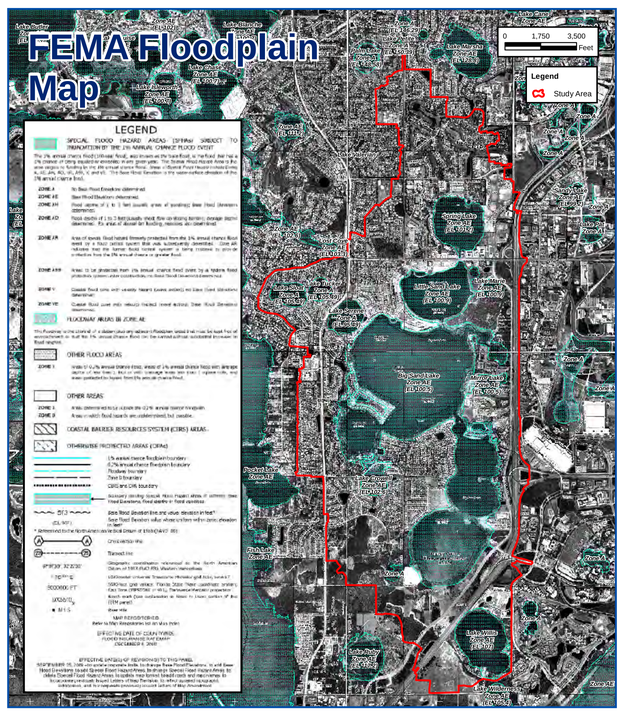
Soil Hydrologic Class Summary

Soil Hydrologic Class	Hydrologic Class Description	Percent of Project Area
A	Well drained.	47.4%
A/D	Dual classification, well to poorly drained.	16.6%
B/D	Dual classification, moderately well to poorly drained.	8.8%
Urban Land	None, a hydrologic class is typically not assigned to urban land.	1.1%
Water	None, a hydrologic class is typically not assigned to water.	26.1%

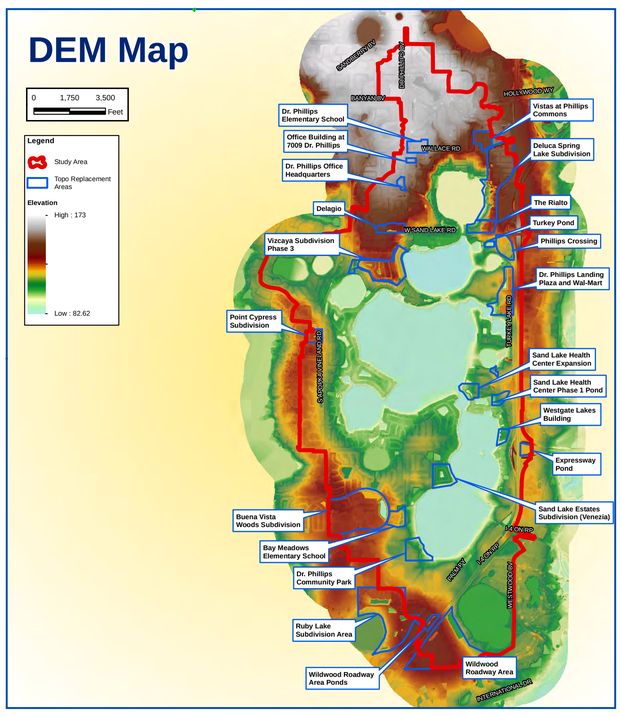
Landuse Map

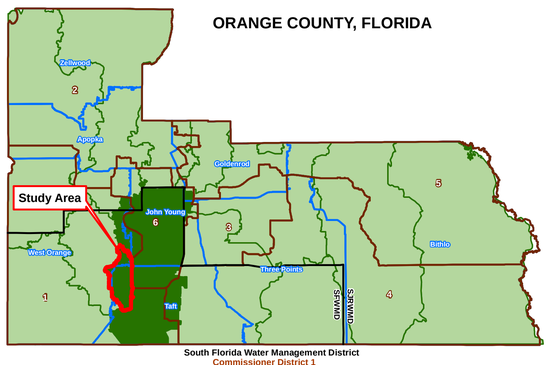


FEMA Floodplain Map

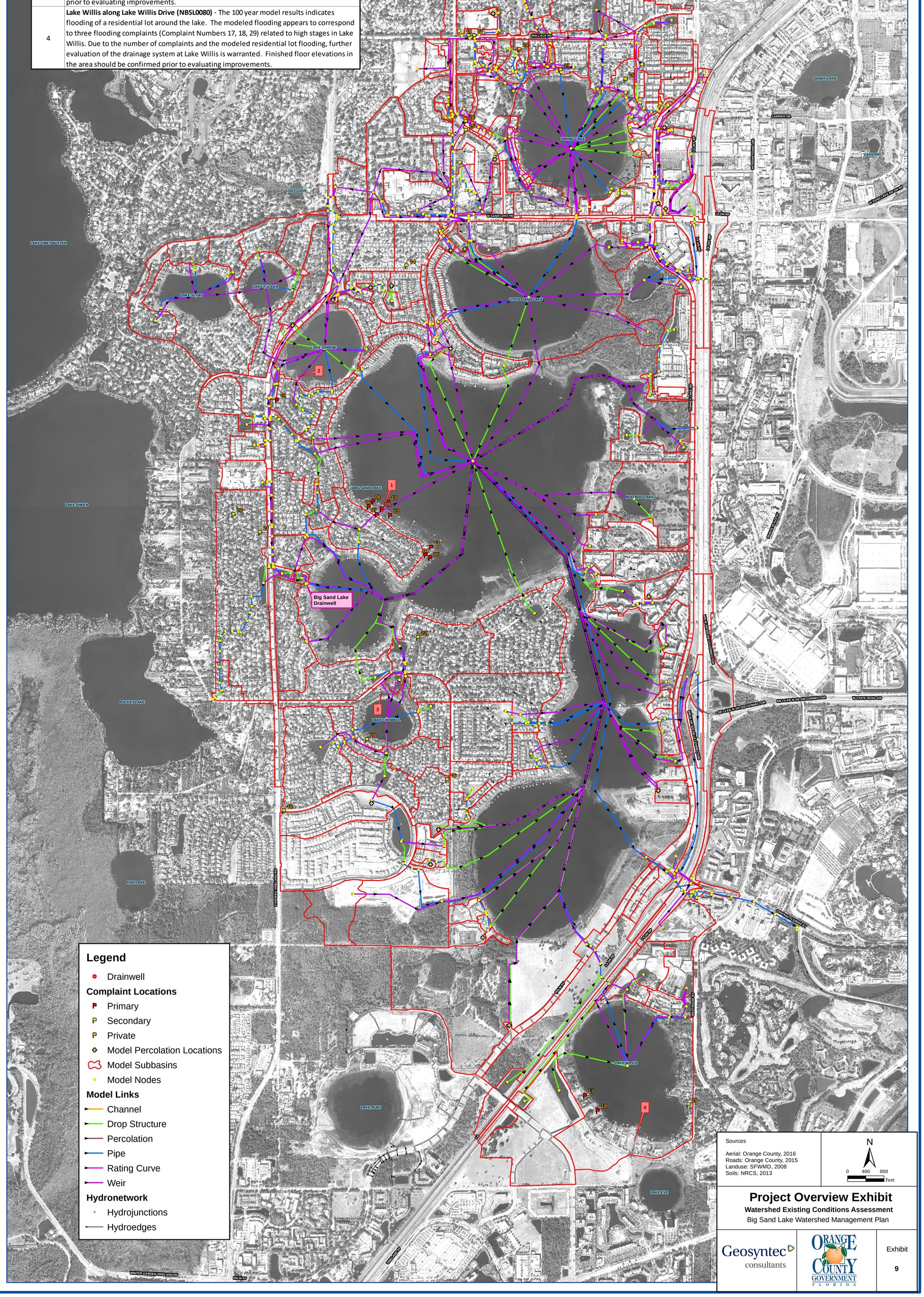


DEM Map





Primary Drainage Deficiencies, Action Warranted	
1	**Big Sand Lake and Southern Breeze Drive (NBSL5160)** - The model indicates that lake stages would encroach on the back yards of numerous residential properties during the 100 year / 72 hour event. Also, the stages appear close to several residential structures. Due to the large size of the lake, it is possible that structures could be impacted by wave action during high winds. Several complaints describe problems with high stages in Big Sand Lake threatening homes that border Big Sand Lake on Southern Breeze Drive and Elliots Court. Due to impacts to residential lots and the flooding complaints, further action to evaluate improvement alternatives appears warranted. Finished floor elevations in the area should be confirmed prior to evaluating improvements.
2	**Bay Harbour subdivision / Lake Serene Drive (NBSL1950, NBSL1790) -** Water from Lake Serene encroaches on residential lots beginning during the 10 year / 24 hour event. Six residential lots on the southwest side of Lake Serene appeared to flood during the 100 year / 72 hour event. No related flooding issues were identified in the complaint logs. Due to the impact to residential lots, further action to evaluate improvement alternatives appears warranted. Finished floor elevations in the area should be confirmed prior to evaluating improvements.
3	**Lake Crowell and Darlene Drive (MSBU Pond 7311) Pond (NBSL0630, NBSL0640, NBSL0649, NBSL0650)** - The model indicates Lake Crowell overtops its top of bank beginning during the 10 year / 24 hour event. During the 100 year / 72 hour event, the model indicated possible structure flooding due to high lake stages at 5 residential lots. The model also indicated possible structure flooding from the pond at Darlene Drive at one residential lot starting during the mean annual event. No related flooding issues were identified in the complaint logs. Due to the impact to residential lots, further action to evaluate improvement alternatives appears warranted. Finished floor elevations in the area should be confirmed prior to evaluating improvements.
4	**Lake Willis along Lake Willis Drive (NBSL0080)** - The 100 year model results indicates flooding of a residential lot around the lake. The modeled flooding appears to correspond to three flooding complaints (Complaint Numbers 17, 18, 29) related to high stages in Lake Willis. Due to the number of complaints and the modeled residential lot flooding, further evaluation of the drainage system at Lake Willis is warranted. Finished floor elevations in the area should be confirmed prior to evaluating improvements.



Sources

Aerial: Orange County, 2016
Roads: Orange County, 2015
Landuse: SFWMD, 2008
Soils: NRCS, 2013

N

0 400 800 Feet

Project Overview Exhibit

Watershed Existing Conditions Assessment

Big Sand Lake Watershed Management Plan

Geosyntec consultants

Orange County Government Florida

Exhibit 9

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Geosyntec is a specialized consulting and engineering firm that works with private and public sector clients to address their new ventures and complex problems involving the environment, our natural resources, and our civil infrastructure. Geosyntec has a staff of over 1,000 engineers, scientists, and related technical and project support staff located in more than 70 offices throughout the U.S. and in Canada, Malaysia, and the United Kingdom.

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