WINTER HAVEN WATERSHED MANAGEMENT PLAN

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1 Introduction

The Winter Haven Stormwater Assessment and Improvement Project (SAIP) was initiated by the City of Winter Haven and was funded by a Legislative Appropriation, administered by the Florida Department of Environmental Protection (FDEP). The plan incorporates Digital Topographic Information, Stormwater Inventory Mapping, and Hydrologic and Hydraulic Analysis to assess current conditions and the capacity of the City's stormwater infrastructure as well as develop a range of improvement concepts to further improve flood protection and the water quality of discharged stormwater. This report outlines the methods and results of this effort.

1.1 Project Location

The watershed is in northern Polk County, along US Highway 17, just south of US Highway 92. The 12,856-acre watershed encompasses, including 23 named Lakes. The watershed eventually discharges to the Peace Creek Canal.

It should be noted, that the project analysis is primarily focused on the urban core of the City but contributing areas outside the urban core are included though to a lesser level of detail. A watershed location map is included as **Figure 1** and **Figure 2** identifies the watershed's boundary and major waterbody drainage areas.

1.2 Purpose and Objectives

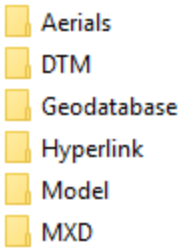
The primary goal of this project is to develop management tools that can guide flood mitigation measures and improve water quality within the watershed. This will be accomplished by completing the following three objectives:

- Develop a GIS inventory of the primary drainage infrastructure throughout the watershed. This effort will evaluate the maintenance condition of structures owned and/or maintained by the City.
- Develop a detailed hydrologic and hydraulic (H&H) model to characterize runoff responses throughout the watershed and develop pollutant loading estimates and hot spot analysis to identify area with opportunity to address water quality concerns.
- Develop potential improvement concepts to improve flood protection and water quality.

This report outlines the methods and a brief summary of the findings and datasets created. This report along with the digital files/attachments provide the deliverables for the SAIP.

1.3 Digital Deliverables

During development of the watershed evaluation, various digital files were obtained and/or created. The digital files have been organized according to the SWFWMD digital deliverable format, as shown below:



2 Watershed Inventory

The first step in developing the WMP involves gathering pertinent information to quantitatively describe the watershed landform and key elements that influence the flow of surface runoff. This study performs this task by characterizing the landform through creation of a digital terrain model. Factors that influence surface runoff characteristics are developed by gathering watershed data such as soils and land use, and then inventorying hydrologic and hydraulic features. A brief summary of these activities is described below.

2.1 Digital Terrain Model Development

The variations in land elevation from place to place cause the movement of surface water following a rain event, so the first step in the WMP is to characterize those topographic changes. Topographic information of the watershed was collected by SWFWMD and the City in 2017 using Light Detection and Ranging (LiDAR) technology. Using GIS tools, a Digital Terrain Model (DTM) was derived from LiDAR data points and supplemental three-dimensional breaklines. The DTM provided a three-dimensional representation of the watersheds. **Figure 3** shows the watershed DTM elevations range from 120 to 180 within the watershed.

The vertical datum selected for use in the current study is NAVD88. All LiDAR data are in NAVD88 however majority of the compiled as-built dataset and ERPs are currently in National Geodetic Vertical Datum of 1929 (NGVD29). Thus, the specified elevation in as-builts and ERPs will have to be converted from NGVD29 to NAVD88. Elevations reported in NGVD29 were converted to NAVD88 by subtracting approximately 1-foot from locations within the watershed. The conversion factor was calculated using the U.S. Army Corps of Engineers (USACE) CORPSCON software. Horizontal Datum will be referenced to Florida State Plane Coordinate System, West Zone (0902), Units US Survey Feet, North American Datum of 1983 HARN (2007) including the most recent NSRS adjustment.

2.2 Hydrologic Inventory

2.2.1 Subbasin Delineation Process

Although the hydrologic and hydraulic model to be used for this project will utilize the two-dimensional (2-D) elements of ICPR v4, the subbasin draining to each major outfall was delineated which will act as break lines during development of the 2-D model and allow accumulation of pollutant loads to each outfall. **Figure 4** shows the 271 subbasins which were delineated.

2.2.2 Land Use Characterization

Land use/land cover is a dominant factor in stormwater runoff. As development or other changes to the landform occur the volume, rate, and pollutant concentrations of discharge can be affected. To account for this the SWFWMD 2010 GIS land-use coverage which is based on the Florida Land Use and Cover Classification System (FLUCCS) was obtained. The 2010 coverage was updated using the 2017 aerial imagery to incorporate changes associated with new development and to provide a more detailed and accurate coverage. Furthermore, the impervious areas delineated as part of the LiDAR data collection was incorporated. The FLUCCS land cover types were re-classified/simplified to facilitate pollutant loading and hydraulic roughness characterization. The resulting land coverage is shown in **Figure 5** and **Table 1** provides a breakdown of land cover types within the watershed.

Table 1: Land Cover Breakdown

Land Use Type	Parking	Pervious	Roads	Rooftops	Water	Total	
	Area (Acres)						Percent
COMMERCIAL	427.4	595.8	0.8	216.1	-	**1240.0**	**10%**
CROPLAND	-	16.6	-	-	-	**16.6**	**0%**
INDUSTRIAL	77.3	115.4	-	36.5	-	**229.2**	**2%**
INSTITUTIONAL	97.8	388.3	-	77.5	-	**563.6**	**4%**
NURSERY	0.3	34.8	-	0.1	-	**35.3**	**0%**
OPEN WATER	-	-	-	-	3674.1	**3674.1**	**29%**
PASTURE	0.2	11.4	-	-	-	**11.7**	**0%**
RECREATIONAL	8.2	116.8	-	2.8	-	**127.8**	**1%**
RESIDENTIAL HIGH DENSITY	61.1	349.6	1.6	132.5	-	**544.8**	**4%**
RESIDENTIAL LOW DENSITY	39.3	683.4	0.1	126.0	-	**848.7**	**7%**
RESIDENTIAL MED DENSITY	193.3	2304.3	0.2	482.8	-	**2980.6**	**23%**
ROADWAYS	-	-	765.1	-	-	**765.1**	**6%**
UPLAND BRUSH	-	23.6	-	-	-	**23.6**	**0%**
UPLAND FOREST	0.1	519.1	0.1	0.3	-	**519.6**	**4%**
UPLAND GRASS	0.1	640.8	-	-	-	**640.9**	**5%**
UTILITIES	65.1	77.8	-	9.1	-	**151.9**	**1%**
WETLAND BRUSH	-	188.9	-	-	-	**188.9**	**1%**
WETLAND FOREST	-	138.2	-	-	-	**138.2**	**1%**
WETLAND GRASS	-	156.1	-	-	-	**156.1**	**1%**
TOTAL	**970.4**	**6360.8**	**767.8**	**1083.7**	**3674.1**	**12856.8**	**100%**
PERCENT OF TOTAL	**8%**	**49%**	**6%**	**8%**	**29%**		

2.2.3 Soil Characterization

In addition to land use, the soils that comprise the watershed have a strong influence on the interaction of surface water and groundwater as well as their respective movements. The soils coverage used for this analysis was obtained from the United States Department of Agriculture – Natural Resource Conservation Service (formerly USDA/SCS) Soil Survey Geodatabase (SSURGO). The soil coverage was collected as a GIS shapefile (polygons) with the associated Map Unit Key (MUKEY). The MUKEY is used to relate each unique soil type to the soil characterization in the SSURGO database, which is

used to define the associated hydrologic parameters. **Figure 6** shows the soil coverage and **Table 2** provides a breakdown using the Hydrologic Soil Groups (HSG) classification for reference.

Table 2: Hydrologic Soil Breakdown

MUKEY	NAME	HSG	ACRES	PERCENT OF TOTAL
1425021	Adamsville fine sand 0 to 2 percent slopes	A/D	409.6	3.2%
1425038	Adamsville-Urban land complex	A	462.0	3.6%
1425024	Anclote mucky fine sand depressional 0 to 1 percent slopes	A/D	32.4	0.3%
1424994	Apopka fine sand 0 to 5 percent slopes	A	85.1	0.7%
1425048	Arents organic substratum-Urban land complex	A	130.9	1.0%
1425047	Arents sandy	A	13.8	0.1%
1425046	Arents-Urban land complex 0 to 5 percent slopes	A	164.9	1.3%
1425026	Basinger mucky fine sand depressional	A/D	29.1	0.2%
1424995	Candler sand 0 to 5 percent slopes	A	1031.1	8.0%
1424996	Candler sand 5 to 8 percent slopes	A	18.5	0.1%
1425039	Candler-Urban land complex 0 to 5 percent slopes	A	2247.0	17.5%
1425032	Felda fine sand	A/D	9.7	0.1%
1425052	Fort Meade-Urban land complex 0 to 5 percent slopes	A	17.1	0.1%
1425025	Hontoon muck frequently ponded 0 to 1 percent slopes	A/D	229.7	1.8%
1425012	Immokalee sand	B/D	107.0	0.8%
1425022	Kaliga muck frequently ponded 0 to 1 percent slopes	C/D	19.2	0.1%
1425017	Lochloosa fine sand	C	37.5	0.3%
1425041	Myakka-Immokolee-Urban land complex	A/D	451.5	3.5%
1425033	Oldsmar fine sand	A/D	11.6	0.1%
1425014	Ona-Ona wet fine sand 0 to 2 percent slopes	B/D	26.3	0.2%
1425016	Placid and Myakka fine sands depressional	A/D	102.3	0.8%
1425013	Pomello fine sand	A	95.5	0.7%
1425042	Pomello-Urban land complex	A	165.1	1.3%
1424999	Pomona fine sand	A/D	164.7	1.3%
1425040	Pomona-Urban land complex	A/D	40.9	0.3%
1425020	Pompano fine sand	A/D	6.0	0.0%
1425005	Samsula muck frequently ponded 0 to 1 percent slopes	A/D	126.3	1.0%
1425009	Smyrna and Myakka fine sands	A/D	320.9	2.5%
1425006	Sparr sand 0 to 5 percent slopes	A/D	409.3	3.2%
1425043	Sparr-Urban land complex 0 to 5 percent slopes	A/D	635.6	4.9%
1425019	St. Lucie fine sand 0 to 5 percent slopes	A	74.7	0.6%
1425007	Tavares fine sand 0 to 5 percent slopes	A	237.3	1.8%
1425050	Tavares-Urban land complex	A	450.9	3.5%
1425008	Urban land	A	910.9	7.1%
1454702	Water	W	3549.1	27.6%
1425030	Wauchula fine sand	C/D	2.8	0.0%
1425036	Zolfo fine sand 0 to 2 percent slopes	A	30.6	0.2%
		Total	**12,856**	**100%**

2.2.4 Rainfall Data

The fundamental driver of stormwater flow is rainfall. Rainfall depths for the series of design storm simulations **(Table 3)** were obtained from the SWFWMD ERP handbook. Additionally, a 1-inch/1-hour storm event was evaluated to quantify potential water quality impacts/improvements and a 3-inch/1-hour storm event was included to evaluate roadway flooding.

Table 3: Design Storm Rainfall Depths

Event	Rainfall Distribution	Rainfall Depth (inches)
1 inch/1-hour	FDOT 1-hour	1.0
3 inch/1-hour	FDOT 1-hour	3.0
2.33-year/24-hour	Florida Modified	4.0
10-year/24-hour	Florida Modified	6.0
25-year/24-hour	Florida Modified	7.0
100-year/24-hour	Florida Modified	10.0

2.2.5 Environmental Resource Permit (ERP) Plans

ERP as-built plans were used to supplement existing hydraulic parameters for major conveyance features and topographic void areas. A total of 65 ERP as-built plan sets were collected from the SWFWMD. Their location is shown on **Figure 7** and **Table 4** provides a description of each.

Table 4: ERP Summary

ID	ERP Number	Project Name	Area (Acres)
1	028071000	Buckey Ridge	50.6
2	028306000	Lake Hartridge STRMWTR TRTMNT	8.7
3	028667000	Buckeye Trace	30.4
4	028846000	Normandy Heights	47.8
5	021396000	Island Lakes s/d	22.0
6	025246000	Buckeye Pointe	25.6
7	025800001	Lake Rochelle Estates	19.4
8	027534000	Twin Lake Hills s/d	88.7
9	028977000	Lake Smart Estates	26.6
10	028885000	Central Pointe	33.9
11	029799000	Dundee Station	20.5
12	019809000	HURST CHAPEL A.M.E.	5.6
13	014135000	VIGORO	50.6
14	015965001	SR 655 US 17 TO COLEMAN RD	8.8
15	007003000	CHURCH OF GOD & TRUE HOLINESS	30.5
16	015749000	WINTER HAVEN, CITY OF-POLK COMM. COLLEGE	47.8
17	007973000	WINTER HAVEN, CITY OF-FAIRFAX WATER PLT.	22.0
18	000615006	WAL-MART SUPERCENTER #968-01 EXPANSION	25.6
19	009633000	DOT-S.R. 655, RECKER HIGHWAY WIDENING	19.4
20	015965000	DOT-STATE ROAD 655 #16120-3504	88.7
21	002769000	KINGS POND	26.7
22	002769001	KINGS POND PH 2	33.9
23	007994000	WINTER HAVEN, CITY OF-WWTP #2 IMPR.	20.5
24	011706000	WINN DIXIE STORE #4911-WINTERWOOD PLAZA	5.7
25	001522006	LIFE CARE CENTER OF WINTER HAVEN	20.3
26	020442000	LAKE HARTRIDGE LK CONINE LOCK SYSTEM	10.1

ID	ERP Number	Project Name	Area (Acres)
27	031554000	ST JAMES CROSSING	6.4
28	009134000	WINTER RIDGE CONDOS (LK SMART VILLAGE)	12.0
29	017859000	Cypress Woods Blvd. FDOT plans	10.5
30	032142000	PDG Evergreen	35.8
31	028333001	DOT-SR555 US17 RDWY APPROACH LAKE CONINE	4.4
32	040239000	Greater Works Ministries	29.3
33	002778002	WINTER HAVEN MUNIC. AIRPORT RUNWAY 4-22	16.6
34	034803000	Winter Haven Downtown Trailhead	18.4
35	040889000	The Landings Winter Haven - Phase One	29.9
36	007477001	Spring Lake Rehabilitation Center	10.7
37	006046005	St Joseph Cath Church- Pond Expansion	9.5
38	033252001	Havendale Shoppes & Offices	0.4
39	032141000	WINTER HAVEN RETAIL CENTER	46.2
40	002778001	WINTER HAVEN, CITY OF-T-HANGAR	36.5
41	002778006	WINTER HAVEN MUNICIPAL AIRPORT	47.3
42	025108000	Winter Haven Walgreens/Blockbuster	7.8
43	025286000	Park Lake Condominiums	7.0
44	035045001	Cypress Cove Apartments	4.2
45	001522000	LAKE OTIS SUBDIVISION	87.1
46	010091001	Dollar General - Winter Haven	15.7
47	007477003	Spring Lake Rehabilitation Center	4.9
48	002778005	Winter Haven Mun Airport-T-Hangar Taxi	6.8
49	027596000	Lakeridge Estates	4.5
50	001522004	INTERLOCHEN SUBDIVISION-LOTS 9 & 10	5.3
51	033909000	WINTER HAVEN BAPTIST CHURCH	2.3
52	041267000	FDOT SR 542 from 1st St to Buckeye Loop Rd	5.0
53	010709001	AT&T-BUILDING ADDITION	74.0
54	015749001	PSC-Berm Construction	2.1
55	040605000	Dr. Edwin Moore Estates	16.6
56	015749002	Polk State College Soccer Complex	11.5
57	041741000	O'Reilly Auto Parts Winter Haven	54.1
58	013625005	Holiday Inn - Winter Haven	1.2
59	009828005	POLK CO-GARNER ELEMENTARY SCHOOL	6.8
60	033252002	SOCIAL SECURITY ADMIN BUILDING	4.2
61	033909001	Winter Haven Baptist Church	19.9
62	032804000	Lakeside Terrace Apartments	47.4
63	035074000	Inman Park	9.2
64	015882001	Lake Silver Stormwater Treatment Project	20.9
65	017888001	Borden 5th St Truck Trailer Parking	6.3

2.2.6 FEMA Flood Hazard Area

The Federal Emergency Management Agency (FEMA) Special Flood Hazard Area coverage was collected to identify area of special flood risk and facilitate development of model boundary conditions. **Figure 8** shows the effective flood hazard areas which were based on the results of the Peace Creek Watershed Management Plan (PCWMP). The PCWMP regional in nature and established Base Flood Elevations (BFE) for all the major lakes and some local flooding areas.

2.2.7 Water Level Data

This study area includes the 23 named lakes shown on **Figure 9** and **Table 5**. Each lake is treated as a constant stage boundary condition for the H&H analysis. The boundary stage for each lake is generally based on the 75% exceedance level using monitoring data collected by the USGS and/or SWFWMD.

Table 5: Lake Stage Data

Lake Name	Starting Water Level (NAVD 1988)
Lake Buckeye	128.1
Lake Cannon	131.5
Lake Conine	128.4
Lake Deer	139.7
Lake Elbert	133.8
Lake Hartridge	131.5
Lake Howard	131.5
Lake Ida	134.2
Lake Idyl	132.5
Lake Idylwild	131.5
Lake Jessie	131.5
Lake Link	126.6
Lake Lulu	131.5
Lake Martha	141.3
Lake Maude	139.6
Lake May	131.5
Lake Mirror	131.5
Lake Otis	126.1
Lake Pansy	128.6
Lake Roy	131.5
Lake Shipp	131.5
Lake Silver	145.2
Lake Spring	131.5

2.3 Hydraulic Inventory

The hydraulic model features (Control Structures, Pipes, Channels, and Weirs) are based on the latest stormwater inventory coverage. The inventory was updated as part of this project using ERP as-built plans, field measurement data collected, and some structure parameters were estimated. The current inventory includes 49 Control Structures, 3,932 Pipes, 769 Manholes, 3,686 1-D/2-D Interface Nodes (Curb Inlets, Grate Inlets, Mitered Ends, and Projecting Ends). Location of the hydraulic structures is shown on **Figure 10.**

3 Hydrologic Parameterization

The Interconnected Channel and Pond Routing Version 4 (ICPRv4) model will be used to analyze the hydrology of the watershed. The above-mentioned land use and soil coverages will be employed for hydrologic parameterization using the Green-Ampt method to calculate runoff in ICPRv4.

3.1 Impervious/DCIA Parameters

The Green-Ampt hydrologic method of ICPR v4 requires an Impervious Area (IA) coverage to prevent infiltration and evapotranspiration over impervious areas. The Land Cover layer was utilized for this analysis. **Table 6** provides the IA and Directly Connected Impervious Area (DCIA) values used for each land cover type.

Table 6: Impervious/DCIA Lookup Table

Land Cover Type	% Impervious	% DCIA	% Direct	Initial Abstraction Impervious (in)	Initial Abstraction Pervious (in)
Parking	98	98	0	0.05	0.1
Roads	98	98	0	0.05	0.1
Rooftops	98	98	0	0.05	0.1
Upland Brush	0	0	0	0.05	0.1
Upland Forest	0	0	0	0.05	0.1
Upland Grass	0	0	0	0.05	0.1
Wetland Brush	98	98	0	0.05	0.1
Wetland Forest	98	98	0	0.05	0.1
Wetland Grass	98	98	0	0.05	0.1
Water	98	98	0	0.05	0.1

3.2 Green-Ampt (GA) Parameterization

The hydrologic rainfall abstraction method used was the GA equation, as incorporated in the ICPR v.4 software. In general, the GA values were established using the USDA/NRCS Soil Survey Geographic (SSURGO) database. **Table 7** provides the GA parameters used for this analysis. The following section is a description of the required parameters and how each was calculated using the SURRGO information (based on ICPR v4 Manual).

Saturated Hydraulic Conductivity ("Kv Sat") – This parameter was populated with values as listed in the SSURGO database.

Saturated Moisture Content ("MC Sat") – It was estimated from the bulk density of the soil as follows:

$$\varphi = f\ \text{air}\ (1.0 - \rho\ \text{bulk}\ -\ /\ 2.65)$$

Where:

φ - porosity or saturated moisture content (volume fraction)

f air - multiplier, usually 0.93

ρ bulk - bulk density of the soil (gm/cm^3)

Bulk soil density used value as listed in the SSURGO database.

Residual Moisture Content ("MC Res") – The following regression equation was used to estimate the residual moisture content. Percentages of clay and sands values were obtained from the SSURGO database.

$$\Theta_r = (-0.018+0.009(S) + 0.005(C) + 0.029(\varphi) - 0.0002(C^2) - 0.001(S)(\varphi) -0.0002(C^2)(\varphi^2) + 0.0003(C^2)(\varphi)-0.002(\varphi^2)(C))$$

Where:

Θ_r - residual moisture content (volume fraction)

C - % clay

S - % sand

φ - porosity or saturated moisture content (volume fraction)

Source: Rawls, W.J., "Pedotransfer Functions for the United States", Developments in Soil Science, Volume 30, 2004.

Field Moisture Content ("MC Field") – This is the moisture content by volume fraction at field capacity. Field capacity is the amount of water remaining in the soil after free (gravitational) drainage has ceased and occurs at matric potentials between -1/10 bar and 1/3 bar. These values were obtained from the SSURGO database.

Wilting Moisture Content ("MC Wilting") – This is the moisture content by volume fraction when most plants wilt and fail to recover their turgor upon rewetting. The matric potential at this soil moisture condition was estimated at -15 bar. These values were obtained from the SSURGO database. This value should always be greater than MC Residual and less than MC Field.

Initial Moisture Content ("MC Initial") – This is the initial moisture content by volume fraction and is typically set to MC Field for normal antecedent conditions.

Pore Size Index – The following regression equation was be used to estimate the pore size index. Percentages of clay and sands values were obtained from the Soil Survey Geographic (SSURGO) database.

$$\lambda = \exp\ (-0.784+0.018(S) – 1.062(\varphi) – 0.00005(S^2) – 0.003(C^2) + 1.111(\varphi^2) - 0.031(S)(\varphi) + 0.0003(SC)(\varphi^2) - 0.006\ (C^2)(\varphi^2) – 0.000002(S^2)(C)\ (0.008)(C^2)(\varphi) – 0.007(\varphi^2)C)$$

Where:

λ - Brooks-Corey pore size index

C - % clay

S - % sand

φ - porosity or saturated moisture content (volume fraction)

Source: Rawls, W.J., "Pedotransfer Functions for the United States", Developments in Soil Science, Volume 30, 2004.

Bubble Pressure – The following regression equation was be used to estimate the soil bubble pressure. Percentages of clay and sands values were obtained from the SSURGO database.

$$h_b = \exp(5.340 + 0.185(C) - 2.484(\varphi) - 0.002(C^2) - 0.044(S)(\varphi) + 0.617(C)(\varphi)$$
$$+0.001(S^2)(\varphi 2) + 0.009(C^C)(\varphi^2) - 0.00001(S^2)(C) - 0.009(C^2)(\varphi)$$
$$-0.0007(S^2)(\varphi) - 0.000005(C^2)(S) + 0.500(\varphi^2)C)$$

Where:

h_b- bubble pressure (in)
C - % clay
S - % sand
φ - porosity or saturated moisture content (volume fraction)

Source: Rawls, W.J., "Pedotransfer Functions for the United States", Developments in Soil Science, Volume 30, 2004.

Table 7: Green-Ampt Parameters

Name	Kv-sat (ft/day)	MC Saturated	MC Residual	MC Initial	MC Field	MC Wilting	Pore Size Index	Bubble Pressure (in)	Depth to Water Table (ft)
Apopka fine sand 0 to 5 percent slopes	21.5	0.408	0.016	0.072	0.072	0.031	0.48	1.6	3.3
Candler sand 0 to 5 percent slopes	37.7	0.37	0.009	0.072	0.072	0.018	0.6	1.9	4.9
Candler sand 5 to 8 percent slopes	27.3	0.416	0.006	0.034	0.034	0.011	0.56	1.4	4.8
Pomona fine sand	15	0.415	0.019	0.096	0.096	0.037	0.48	1.4	0.9
Samsula muck frequently ponded 0 to 1 percent slopes	25.5	0.497	0.047	0.251	0.251	0.094	0.52	0.9	0.3
Sparr sand 0 to 5 percent slopes	22	0.392	0.032	0.126	0.126	0.064	0.48	1.7	2.1
Tavares fine sand 0 to 5 percent slopes	26.1	0.411	0.008	0.068	0.068	0.016	0.57	1.5	4.6
Urban land	21.5	0.408	0.016	0.072	0.072	0.031	0.48	1.6	3.3
Smyrna and Myakka fine sands	22.1	0.426	0.014	0.083	0.083	0.028	0.55	1.3	0.9
Immokalee sand	17.5	0.414	0.012	0.076	0.076	0.023	0.56	1.5	1
Pomello fine sand	49.8	0.413	0.008	0.05	0.05	0.015	0.58	1.5	2.9
Ona-Ona wet fine sand 0 to 2 percent slopes	23.8	0.405	0.017	0.095	0.095	0.033	0.57	1.5	1
Placid and Myakka fine sands depressional	24.5	0.443	0.014	0.082	0.082	0.027	0.54	1.1	0
Lochloosa fine sand	11	0.427	0.036	0.146	0.146	0.071	0.38	1.5	3.7
St. Lucie fine sand 0 to 5 percent slopes	67	0.404	0.006	0.057	0.057	0.011	0.59	1.5	3.1
Pompano fine sand	26.1	0.446	0.011	0.05	0.05	0.022	0.55	1.1	0.3
Adamsville fine sand 0 to 2 percent slopes	26	0.386	0.005	0.034	0.034	0.009	0.61	1.8	1.6
Kaliga muck frequently ponded 0 to 1 percent slopes	15.8	0.51	0.059	0.307	0.307	0.134	0.35	5	0
Anclote mucky fine sand depressional 0 to 1 percent slopes	25.6	0.404	0.024	0.109	0.109	0.048	0.55	1.5	0
Hontoon muck frequently ponded 0 to 1 percent slopes	26.1	0.592	0.007	0.491	0.491	0.16	0.36	13.6	0

Name	Kv-sat (ft/day)	MC Saturated	MC Residual	MC Initial	MC Field	MC Wilting	Pore Size Index	Bubble Pressure (in)	Depth to Water Table (ft)
Basinger mucky fine sand depressional	25.7	0.415	0.015	0.073	0.073	0.029	0.57	1.4	0
Wauchula fine sand	10.4	0.418	0.036	0.147	0.147	0.072	0.41	1.5	0.9
Felda fine sand	17.7	0.43	0.037	0.149	0.149	0.074	0.4	1.9	0.5
Oldsmar fine sand	13.5	0.416	0.028	0.127	0.127	0.056	0.46	1.4	0.9
Zolfo fine sand 0 to 2 percent slopes	18.6	0.393	0.009	0.07	0.07	0.017	0.58	1.8	2.8
Adamsville-Urban land complex	29.2	0.413	0.004	0.025	0.025	0.007	0.58	1.4	2.9
Candler-Urban land complex 0 to 5 percent slopes	26.1	0.414	0.003	0.017	0.017	0.005	0.57	1.5	6.6
Pomona-Urban land complex	14.9	0.404	0.014	0.068	0.068	0.027	0.49	1.6	4
Myakka-Immokolee-Urban land complex	21.3	0.412	0.01	0.06	0.06	0.02	0.57	1.5	4
Pomello-Urban land complex	45.7	0.412	0.006	0.039	0.039	0.012	0.58	1.5	4
Sparr-Urban land complex 0 to 5 percent slopes	20.1	0.394	0.013	0.062	0.062	0.026	0.49	1.6	4
Udorthents excavated	21.6	0.48	0.002	0.009	0.009	0.004	0.47	0.9	3.8
Arents-Urban land complex 0 to 5 percent slopes	26.1	0.437	0.01	0.05	0.05	0.019	0.53	1.3	2.3
Arents sandy	70	0.43	0.017	0.091	0.091	0.033	0.54	1.4	3
Arents organic substratum-Urban land complex	26.1	0.571	0.038	0.223	0.223	0.108	0.54	0.8	2.5
Tavares-Urban land complex	26.1	0.398	0.005	0.031	0.031	0.009	0.58	1.6	4.8
Fort Meade-Urban land complex 0 to 5 percent slopes	26.1	0.439	0.004	0.024	0.024	0.007	0.51	1.4	6.6
Water	26.1	0.592	0.007	0.491	0.491	0.16	0.36	13.6	0

4 Hydraulic Data Development

4.1 Surface Water Hydraulic Features

The H&H model hydraulic features (Structures, Pipes, Channels, and Weirs) discussed previously were imported into the ICPR v4 model.

4.2 Boundary Areas

Boundary (time-stage) data was based on an estimated SHWL elevation for each of the name lakes discussed previously. The boundary lake areas were treated as an exclusion area which eliminated hydrologic and hydraulic elements within the boundary area.

4.3 2-D Surface Water Mesh Development

The 2-D surface mesh was developed using a series of breaklines and breakpoints. The breaklines were developed using the outfall basin boundaries and roadway centerlines provided by the City. Additional breaklines were developed based on preliminary model results to further refine the 2-D surface flow patterns.

Breakpoints were provided to supplement the breaklines. The breakpoints were provided using ICPR v4 to provide a triangular pattern with a 20-foot spacing. Additional breakpoints were added as needed based on preliminary model results.

4.4 Node Storage Characterization

Node stage storage relationships were extracted from the project DTM for each element of the ICPRv4 2-D surface mesh.

4.5 Roughness Parameters

Surface roughness parameters within the 2-D surface water model area are based on the previously discussed land use coverage categories. For each category shallow and deep Manning's values were developed based on available literature values. Coefficients are shown in **Table 8**.

Table 8: Manning's Roughness Values

Land Cover Type	Shallow N	Deep N	Depth Range	Damping Threshold	Area Reduction
COMMERCIAL	0.15	0.05	2	0	1
GOLF COURSE	0.125	0.05	2	0	1
INDUSTRIAL	0.1	0.05	2	0	1
INSTITUTIONAL	0.1	0.05	2	0	1
OPEN WATER	0.1	0.05	2	0	1
RESIDENTIAL HIGH DENSITY	0.1	0.05	2	0	1
RESIDENTIAL LOW DENSITY	0.15	0.05	2	0	1
RESIDENTIAL MED DENSITY	0.1	0.05	2	0	1
TRANSPORTATION	0.04	0.04	2	0	1

Land Cover Type	Shallow N	Deep N	Depth Range	Damping Threshold	Area Reduction
TREE CROPS	0.17	0.05	2	0	0.95
UPLAND BRUSH	0.3	0.05	2	0	0.95
UPLAND FOREST	0.2	0.1	2	0	0.95
UPLAND GRASS	0.3	0.05	2	0	0.95
WETLAND BRUSH	0.2	0.05	2	0	0.95
WETLAND FOREST	0.2	0.1	2	0	0.95
WETLAND GRASS	0.3	0.05	2	0	0.95

5 Hydrologic and Hydraulic Model Development, Stabilization, and Results

5.1 H&H Model Development

Using the above referenced data sets, a series of ICPR Version 4 models were developed. The Analysis area was subdivided into 11 individual areas. The model areas were delineated by combining neighboring Lake drainage areas. **Figure 11** shows the location and extent of each model area and **Table 9** outlines the associated Lakes and area.

Table 9: Model Area Summary

Model ID	Associated Lakes	Area (acre)
1	Lake Buckeye, Lake Fannie, Lake Gem, Lake Idyl	612
2	Lake Elbert, Lake Martha, Peace Creek	1,278
3	Lake Link, Lake Lulu, Lake Otis, Lake Roy	2,043
4	Citrus Lake, Lake Conine, Lake Ida, Lake Smart, Swan Lake	1,063
5	Lake Shipp	912
6	Lake Howard, Lake May, Lake Silver	2,385
7	Lake Hartridge, Lake Pansy	1,170
8	Lake Mirror, Spring Lake	404
9	Lake Cannon, Lake Deer	1,411
10	Lake Jessie, Lake Idylwild	1,190
11	Lake Maude	384

5.2 Model Stabilization

Model stabilization aims to reduce the model run time by eliminating abrupt changes in node stages or link flow rates. For this project, the ICPR v4 animation tool was used to animate flow direction arrows which highlight changes in flow direction. Issues primarily occur where hydraulic features create initial flow or in flat depressional areas where surface water begins to “Slosh”. Initial flows were resolved by establishing initial water levels at the hydraulic control elevation. Sloshing issues were resolved by delineating “Simplification” features in ICPR v4 which consolidate multiple 2-D surface nodes into a single 1-D area.

5.3 Model Results

The models were simulated for the range of design storms previously outlined. The max elevation surface was exported from ICPR v4. The max elevation surface provides an interpolation between each model node. The max elevation surface was imported into GIS then a raster was created to identify areas where the max elevation surface was 0.25 feet higher than the topographic surface. The resulting raster is converted into a flood inundation polygon feature class. **Figure 12, 13, 14, 15, 16, and 17** show the resulting inundation areas for the 1-inch/1-hour, 3-inch/1-hour, 2.33-year/24-hour, 10-year/24-hour, 25-year/24-hour, and 100-year/24-hour, respectively. Further, the inundation areas are provided in digital format for more detailed review.

6 Pollutant Load Calculation Method

An Event Mean Concentration (EMC) based method for estimating the quantity of pollutants carried downstream by stormwater runoff was utilized for these analyses. The method is used to identify where pollutant loads are being produced. The loading estimated were calculated on an average annual basis for Total Nitrogen (TN), Total Phosphorous (TP), and Total Suspended Solids. The pollutant loading estimate data development, parameterization and calculations were conducted using GIS and MS Access to facilitate reporting and reproducibility of calculations.

The following sections describe the input parameters and equations utilized to calculate the average yearly gross and net pollutant loads in the study area.

6.1 Rainfall/Runoff

EMC based pollutant loading estimates are highly dependent on the amount of runoff produced over the drainage area. The annual rainfall depth was interpolated from the isopleth map obtained from "Evaluation of Current Stormwater Design Criteria within Florida" (Harper 2007) (shown below). The annual rainfall depth of 50-inches is then converted to a runoff depth. Based on the land use/soil combination, a non-Directly Connected Impervious Area (NDCIA) Curve Number (CN) and DCIA percentage is selected using **Table 10**. The NDCIA-CN/DCIA combination is converted to a runoff coefficient (C) using **Table 11.** A 10% initial abstraction value was used based on standard literature.

The following formula was applied to calculate the annual runoff depth:

*Annual Runoff (in) = 0.9 * Runoff Coefficient (C) * Annual Rainfall (in)*

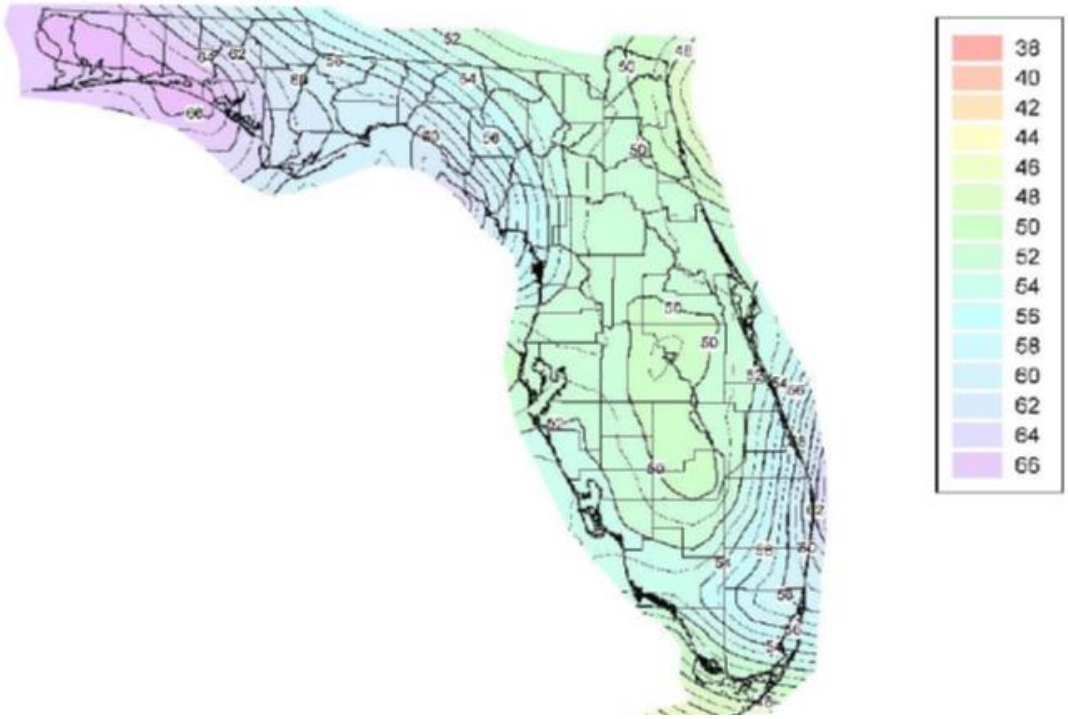


Table 10 - CN and DCIA Lookup Table (FLUCC Based)

Land Use Description	A	A/D	B	B/D	C	C/D	D	W	DCIA
COMMERCIAL	39	60	60	70	74	77	80	98	75
CROPLAND	39	60	60	70	74	77	80	98	2
INDUSTRIAL	39	60	60	70	74	77	80	98	75
INSTITUTIONAL	39	60	60	70	74	77	80	98	60
NURSERY	39	60	60	70	74	77	80	98	15
OPEN WATER	39	60	60	70	74	77	80	98	98
PASTURE	39	60	60	70	74	77	80	98	5
RECREATIONAL	39	60	60	70	74	77	80	98	10
RESIDENTIAL HIGH DENSITY	39	60	60	70	74	77	80	98	75
RESIDENTIAL LOW DENSITY	39	60	60	70	74	77	80	98	30
RESIDENTIAL MED DENSITY	39	60	60	70	74	77	80	98	60
ROADWAYS	39	60	60	70	74	77	80	98	80
UPLAND BRUSH	39	60	60	70	74	77	80	98	5
UPLAND FOREST	39	60	60	70	74	77	80	98	5
UPLAND GRASS	39	60	60	70	74	77	80	98	5
UTILITIES	39	60	60	70	74	77	80	98	15
WETLAND BRUSH	39	60	60	70	74	77	80	98	98
WETLAND FOREST	39	60	60	70	74	77	80	98	98
WETLAND GRASS	39	60	60	70	74	77	80	98	98

Table 11 - Mean Annual Runoff Coefficients as a Function of CN and DCIA (Harper 2007)

Zone 2
Mean Annual Runoff Coefficients (C Values) as a Function
of DCIA Percentage and Non-DCIA Curve Number (CN)

NDCIA	Percent DCIA																				
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	0.002	0.043	0.083	0.123	0.164	0.204	0.244	0.285	0.325	0.366	0.406	0.446	0.487	0.527	0.567	0.608	0.648	0.688	0.729	0.769	0.809
35	0.004	0.044	0.085	0.125	0.165	0.205	0.246	0.286	0.326	0.366	0.407	0.447	0.487	0.528	0.568	0.608	0.648	0.689	0.729	0.769	0.809
40	0.007	0.047	0.087	0.127	0.167	0.207	0.248	0.288	0.328	0.368	0.408	0.448	0.488	0.528	0.569	0.609	0.649	0.689	0.729	0.769	0.809
45	0.010	0.050	0.090	0.130	0.170	0.210	0.250	0.290	0.330	0.370	0.410	0.450	0.490	0.530	0.570	0.610	0.650	0.690	0.729	0.769	0.809
50	0.015	0.055	0.095	0.134	0.174	0.214	0.254	0.293	0.333	0.373	0.412	0.452	0.492	0.531	0.571	0.611	0.651	0.690	0.730	0.770	0.809
55	0.022	0.061	0.101	0.140	0.179	0.219	0.258	0.298	0.337	0.376	0.416	0.455	0.494	0.534	0.573	0.613	0.652	0.691	0.731	0.770	0.809
60	0.030	0.069	0.108	0.147	0.186	0.225	0.264	0.303	0.342	0.381	0.420	0.459	0.498	0.537	0.576	0.615	0.654	0.693	0.731	0.770	0.809
65	0.042	0.080	0.119	0.157	0.195	0.234	0.272	0.311	0.349	0.387	0.426	0.464	0.502	0.541	0.579	0.618	0.656	0.694	0.733	0.771	0.809
70	0.057	0.095	0.133	0.170	0.208	0.245	0.283	0.321	0.358	0.396	0.433	0.471	0.509	0.546	0.584	0.621	0.659	0.697	0.734	0.772	0.809
75	0.079	0.116	0.152	0.189	0.225	0.262	0.298	0.335	0.371	0.408	0.444	0.481	0.517	0.554	0.590	0.627	0.663	0.700	0.736	0.773	0.809
80	0.111	0.146	0.181	0.216	0.251	0.285	0.320	0.355	0.390	0.425	0.460	0.495	0.530	0.565	0.600	0.635	0.670	0.705	0.740	0.774	0.809
85	0.160	0.192	0.225	0.257	0.290	0.322	0.355	0.387	0.420	0.452	0.485	0.517	0.550	0.582	0.614	0.647	0.679	0.712	0.744	0.777	0.809
90	0.242	0.270	0.299	0.327	0.355	0.384	0.412	0.440	0.469	0.497	0.526	0.554	0.582	0.611	0.639	0.667	0.696	0.724	0.753	0.781	0.809
95	0.404	0.424	0.444	0.464	0.485	0.505	0.525	0.546	0.566	0.586	0.606	0.627	0.647	0.667	0.688	0.708	0.728	0.749	0.769	0.789	0.809
98	0.595	0.605	0.616	0.627	0.638	0.648	0.659	0.670	0.680	0.691	0.702	0.713	0.723	0.734	0.745	0.756	0.766	0.777	0.788	0.799	0.809

6.2 Event Mean Concentrations

The concentration of pollutant loads is specific to the type of land use, where the runoff is being produced. Monitoring and field measurement of the pollutant concentrations from runoff produced by various Florida land use types has been compiled and converted to standardized EMC values, expressed in milligrams/liter (mg/L). The EMC values are multiplied by the annual runoff volume to calculate a mass of pollutants, expressed as pounds/year (lb./year). The land use specific EMC values utilized for this project are a combination of those obtained by Polk County and UCF's BMP Trains software and included as **Table 12**.

Table 12 - Event Mean Concentration Input Values

	Event Mean Concentration (mg/L)		
Land Use Description	**TN**	**TP**	**TSS**
COMMERCIAL	1.2	0.19	60
CROPLAND	2.5	0.51	20
INDUSTRIAL	1.2	0.26	60
INSTITUTIONAL	1.1	0.19	60
NURSERY	2.5	0.51	60
OPEN WATER	0	0	0
PASTURE	3.5	0.68	23
RECREATIONAL	2.1	0.33	40
RESIDENTIAL HIGH DENSITY	2.3	0.52	23
RESIDENTIAL LOW DENSITY	1.7	0.26	40
RESIDENTIAL MED DENSITY	2.1	0.33	30
ROADWAYS	1.5	0.2	60
UPLAND BRUSH	1.1	0.03	8
UPLAND FOREST	1.7	0.16	8
UPLAND GRASS	1.1	0.06	23
UTILITIES	1.1	0.06	23
WETLAND BRUSH	1.6	0.16	11
WETLAND FOREST	1.2	0.02	11
WETLAND GRASS	1.1	0.02	11

6.3 Pollutant Loading Calculations

The annual pollutant load is calculated for each unique land use/soil area, using the above referenced monthly rainfall, monthly runoff, and EMC values by spatially intersecting the land use and soil coverage. The annual pollutant load produced by each unique area is accumulated, to express the gross average annual pollutant load, for the watershed areas.

The following formula was applied to estimate the gross average monthly pollutant load:

*Gross Average Annual Load (lbs.) = 0.226 * Annual Runoff (in) * EMC (mg/L) * Area (Ac)*

6.4 Stormwater Best Management Practices Treatment Areas

A GIS coverage was developed to identify portions of the drainage area which are treated by a stormwater management system using best management practices (BMP). The SWFWMD's ERP GIS coverage and input by the City were used to identify potential treatment systems. **Figure 18** shows the identified BMP treatment areas and **Table 13** provides a summary of each BMP type. These are areas where drainage retrofits have been constructed in order to mitigate for otherwise untreated stormwater runoff. The lack of stormwater treatment over the majority of the drainage area is primarily due to much of the basin being undeveloped or agricultural land use. Approximately 2,066 acres (16%) of the drainage area is estimated to be treated by a stormwater management system, prior to discharging into a surface water feature.

Table 13 - BMP Treatment Summary

Treatment	Area (Acres)	Percent Total (%)
DRY_RETENTION	1,096.4	8.5%
EXFILTRATION	19.8	0.15%
NO_TREATMENT	10,788.9	83.9%
RAIN_GARDEN	4.6	0.04%
WET_DETENTION	945.4	7.4%
Total	12,855	100.%

6.5 BMP Treatment Reductions

To calculate pollutant load reduction associated with currently implemented stormwater Best Management Practices (BMP), the SWFWMD ERP coverage was used to identify permitted stormwater projects which provide a reduction of pollutant loads. Each project pollutant load reduction percentages were obtained from Polk County and assigned the project BMP coverage.

The following formula was applied to estimate pollutant load reductions associated with the identified BMPs:

*Net Average Monthly Load = Gross Average Monthly Load * (1 – BMP Removal)*

6.6 Pollutant Loading Hot Spots

Pollutant loading calculations were discretized for each unique land use, soil, and BMP polygon. Each individual polygon is assigned an annual loading as well as an areal (lbs./acre/year) loading. The areal loadings were spatially plotted using GIS to provide a "Hot Spot" map, provided for TN, TP and TSS as **Figure 19, 20, and 21**, respectively.

6.7 Outfall Pollutant Loading Totals

The discretized pollutant loading calculations were summarized for each outfall on an areal basis to identify outfalls with the highest concentration loadings. **Table 14** provides the total average annual loadings for each outfall and is sorted by the highest to lowest areal TP loading. The areal loading rates were spatially plotted for each outfall for TN, TP and TSS as **Figure 22, 23, and 24**, respectively.

Table 14 – Outfall Loading Summary

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Outfall_ID	ACRES	TN	TP	TSS	TN	TP	TSS
Citrus Lake_Direct_Runoff	11.4195	46.63	6.94	2016.86	4.08	0.61	176.62
Lake Buckeye_Direct_Runoff	173.9266	930.78	143.08	12642.89	5.35	0.82	72.69
Lake Cannon_Direct_Runoff	851.9482	3130.12	487.21	85246.61	3.67	0.57	100.06
Lake Conine_Direct_Runoff	430.2829	1808.47	212.07	26984.78	4.2	0.49	62.71
Lake Deer_Direct_Runoff	344.7156	1408.69	244.75	33335.51	4.09	0.71	96.7
Lake Elbert_Direct_Runoff	217.2649	218.93	28.91	3829.57	1.01	0.13	17.63
Lake Gem_Direct_Runoff	19.9142	132.94	19.71	2359.28	6.68	0.99	118.47
Lake Hartridge_Direct_Runoff	847.1697	2982.67	474.81	63493.06	3.52	0.56	74.95
Lake Howard_Direct_Runoff	678.806	409.84	59.16	8937.84	0.6	0.09	13.17
Lake Ida_Direct_Runoff	44.2936	185.58	26.65	5135.24	4.19	0.6	115.94
Lake Idyl_Direct_Runoff	89.6661	539.02	90.28	7746.69	6.01	1.01	86.39
Lake Idylwild_Direct_Runoff	221.9904	1113.3	186.31	21061.85	5.02	0.84	94.88
Lake Jessie_Direct_Runoff	969.5853	5301.67	817.62	112483.3	5.47	0.84	116.01

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Outfall_ID	ACRES	TN	TP	TSS	TN	TP	TSS
Lake Link_Direct_Runoff	56.81	323.45	50.32	5174.28	5.69	0.89	91.08
Lake Lulu_Direct_Runoff	684.9692	3060.79	272.01	31599.07	4.47	0.4	46.13
Lake Martha_Direct_Runoff	119.5531	351.45	54.35	5257.02	2.94	0.45	43.97
Lake Maude_Direct_Runoff	125.7086	538.94	69.38	8993.87	4.29	0.55	71.55
Lake May_Direct_Runoff	144.3473	704.54	95.56	17061.25	4.88	0.66	118.2
Lake Mirror_Direct_Runoff	187.9528	594.44	89.38	9412.61	3.16	0.48	50.08
Lake Otis_Direct_Runoff	253.4183	1057.39	159.97	17871.44	4.17	0.63	70.52
Lake Pansy_Direct_Runoff	243.8147	560.83	64.78	8824.87	2.3	0.27	36.19
Lake Roy_Direct_Runoff	201.0554	1134.83	158.71	20067.62	5.64	0.79	99.81
Lake Shipp_Direct_Runoff	408.0801	1077.85	179.81	28704.63	2.64	0.44	70.34
Lake Silver_Direct_Runoff	69.1546	124.92	19.73	5829.65	1.81	0.29	84.3
No Name 1_Direct_Runoff	17.4643	159.22	29.09	2175.7	9.12	1.67	124.58
No Name 2_Direct_Runoff	23.5011	283.64	49.71	3919.43	12.07	2.12	166.78
No Name 3_Direct_Runoff	12.0429	99.54	13.65	2001.94	8.27	1.13	166.23
No Name 4_Direct_Runoff	43.9167	107.82	12.96	2483.35	2.46	0.3	56.55
No Name 5_Direct_Runoff	34.6736	308.6	43.96	5315.94	8.9	1.27	153.31
No Name 6_Direct_Runoff	5.3356	24.78	3.66	379.64	4.64	0.69	71.15
Spring Lake_Direct_Runoff	37.2866	78.42	13.85	1307.15	2.1	0.37	35.06
STRUCTURE-1211	17.5346	64.49	10.17	3176.95	3.68	0.58	181.18
STRUCTURE-2382	10.4258	118.17	18.16	2130.28	11.33	1.74	204.33
STRUCTURE-2409	170.8306	1468.27	252.46	41022.12	8.59	1.48	240.13
STRUCTURE-2430	149.9964	987.36	141.46	38039.2	6.58	0.94	253.6
STRUCTURE-2431	3.4646	27.17	3.63	1057.23	7.84	1.05	305.15
STRUCTURE-2495	47.2488	303.12	19.67	4000.19	6.42	0.42	84.66
STRUCTURE-2612	73.1011	631.07	94.48	22665.09	8.63	1.29	310.05
STRUCTURE-3000	1.7642	15.6	2.37	739.61	8.84	1.34	419.23
STRUCTURE-3062	12.559	89.57	13.74	4301.08	7.13	1.09	342.47
STRUCTURE-3077	4.1138	57.88	12.21	960.67	14.07	2.97	233.52
STRUCTURE-3080	23.7689	261.82	40.61	5121.2	11.02	1.71	215.46
STRUCTURE-3672	6.9862	18.77	2.84	457.57	2.69	0.41	65.5
STRUCTURE-3673	3.392	7.26	1.14	138.34	2.14	0.34	40.78
STRUCTURE-3674	1.1835	2.62	0.41	49.89	2.21	0.35	42.16
STRUCTURE-3675	3.1437	7.1	1.12	135.2	2.26	0.35	43.01
STRUCTURE-3676	39.7176	378.63	60.6	14524.67	9.53	1.53	365.7
STRUCTURE-3880	8.541	52.23	8.11	2529.95	6.12	0.95	296.21
STRUCTURE-4060	6.5789	64.01	9.63	1460.44	9.73	1.46	221.99
STRUCTURE-4090	110.9924	923.04	140.88	40262.21	8.32	1.27	362.75
STRUCTURE-4092	4.8728	41.41	6.44	2026.19	8.5	1.32	415.82
STRUCTURE-4118	24.8638	240.25	38.15	8547.47	9.66	1.53	343.77
STRUCTURE-4119	4.4784	50.8	7.84	881.53	11.34	1.75	196.84
STRUCTURE-4120	2.2545	25.58	3.95	444.44	11.34	1.75	197.13
STRUCTURE-4121	2.1985	24.96	3.86	420.59	11.35	1.76	191.31
STRUCTURE-4184	7.6336	68.9	10.61	1245.94	9.03	1.39	163.22
STRUCTURE-4186	19.5741	135.2	13.45	2322.7	6.91	0.69	118.66
STRUCTURE-4193	6.3574	72.14	11.15	1234.73	11.35	1.75	194.22
STRUCTURE-4194	1.9312	21.89	3.37	392.47	11.34	1.74	203.22
STRUCTURE-4200	55.6343	619.87	95.98	11182.33	11.14	1.73	201
STRUCTURE-4204	10.1538	115.01	17.69	2062.63	11.33	1.74	203.14
STRUCTURE-4205	22.2427	244.4	37.86	4628.59	10.99	1.7	208.09
STRUCTURE-4387	16.731	182.38	29.06	4034.71	10.9	1.74	241.15
STRUCTURE-4393	26.383	131.2	20.2	6120.14	4.97	0.77	231.97

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Outfall_ID	ACRES	TN	TP	TSS	TN	TP	TSS
STRUCTURE-4408	3.4864	39.42	5.99	783.55	11.31	1.72	224.74
STRUCTURE-4560	5.4054	14.44	2.19	340.76	2.67	0.41	63.04
STRUCTURE-4568	4.3655	49.38	7.58	903.95	11.31	1.74	207.07
STRUCTURE-4579 & STRUCTURE-6888	17.5267	134.97	20.18	4886.79	7.7	1.15	278.82
STRUCTURE-4586	2.8955	31.75	5.18	666.93	10.96	1.79	230.33
STRUCTURE-4587	0.8989	13.84	3.04	166.22	15.4	3.39	184.91
STRUCTURE-4588	2.0939	17.77	2.77	870.48	8.49	1.32	415.72
STRUCTURE-4589	1.8467	16.15	2.47	772.37	8.74	1.34	418.24
STRUCTURE-4590	2.9296	28.91	4.39	988.84	9.87	1.5	337.54
STRUCTURE-4591	5.2177	53.76	8.18	1565.71	10.3	1.57	300.08
STRUCTURE-4592 & STRUCTURE-5941 & STRUCTURE-6442	9.341	81.26	12.4	3874.02	8.7	1.33	414.73
STRUCTURE-4593	24.9146	230.42	35.4	8911.18	9.25	1.42	357.67
STRUCTURE-4594	1.9661	17.54	2.65	825.77	8.92	1.35	420.01
STRUCTURE-4619	45.9379	432.44	67.18	13793.04	9.41	1.46	300.25
STRUCTURE-4663	8.1164	20.3	3.03	540.88	2.5	0.37	66.64
STRUCTURE-4876	4.263	33.65	5.1	577.07	7.89	1.2	135.37
STRUCTURE-4877	20.9432	128.39	19.21	2104.27	6.13	0.92	100.47
STRUCTURE-5045	1.9019	9.95	1.49	257.46	5.23	0.78	135.37
STRUCTURE-5051	18.2559	198.33	30.32	3751.99	10.86	1.66	205.52
STRUCTURE-5126	2.7399	29.78	4.47	765.02	10.87	1.63	279.21
STRUCTURE-5130	25.9946	294.71	45.52	5074.13	11.34	1.75	195.2
STRUCTURE-5132	14.1346	129.55	20.07	2867.83	9.17	1.42	202.89
STRUCTURE-5133	30.6702	303.16	50.12	5493.54	9.88	1.63	179.12
STRUCTURE-5135	0.7836	8.89	1.37	152.94	11.35	1.75	195.18
STRUCTURE-5184	0.3787	4.27	0.64	92.7	11.28	1.7	244.78
STRUCTURE-5185	1.4916	16.86	2.56	337.75	11.3	1.72	226.44
STRUCTURE-5186	2.9657	33.69	5.22	556.55	11.36	1.76	187.66
STRUCTURE-5188	16.8446	180.06	27.82	3744.46	10.69	1.65	222.29
STRUCTURE-5189	4.6996	53.19	8.24	888.46	11.32	1.75	189.05
STRUCTURE-5190 & STRUCTURE-5191	20.7188	211.42	32.73	3582.91	10.2	1.58	172.93
STRUCTURE-5193	9.3291	105.81	16.3	1854.37	11.34	1.75	198.77
STRUCTURE-5194	80.7678	446.24	50.26	13312.12	5.53	0.62	164.82
STRUCTURE-5196	1.6218	18.38	2.82	332.51	11.33	1.74	205.02
STRUCTURE-5197	1.3676	15.54	2.41	251.81	11.36	1.77	184.12
STRUCTURE-5198	6.6755	75.63	11.6	1389.37	11.33	1.74	208.13
STRUCTURE-5213	22.7968	254.38	39.16	4915.93	11.16	1.72	215.64
STRUCTURE-5216	54.9831	359.59	59.66	11574.57	6.54	1.08	210.51
STRUCTURE-5222	34.0908	302.74	47.14	11456.07	8.88	1.38	336.05
STRUCTURE-5223	2.4106	18.2	2.86	886.13	7.55	1.19	367.6
STRUCTURE-5224	9.1493	98.11	15.18	2043.89	10.72	1.66	223.39
STRUCTURE-5225	4.3346	49.31	7.7	755.69	11.38	1.78	174.34
STRUCTURE-5226	5.3322	60.64	9.46	937.04	11.37	1.78	175.73
STRUCTURE-5227	5.863	66.44	10.21	1204.18	11.33	1.74	205.39
STRUCTURE-5228	2.9871	33.86	5.2	610.96	11.33	1.74	204.53
STRUCTURE-5229	2.7949	31.67	4.86	578.15	11.33	1.74	206.86
STRUCTURE-5230	1.4508	16.41	2.5	322.44	11.31	1.72	222.25
STRUCTURE-5231	6.5679	74.3	11.32	1449.62	11.31	1.72	220.71
STRUCTURE-5232	21.0526	234.31	36.23	4345.83	11.13	1.72	206.43
STRUCTURE-5233	1.951	22.16	3.44	359.11	11.36	1.77	184.06
STRUCTURE-5234	5.397	61.52	9.53	1109.53	11.4	1.77	205.58

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Outfall_ID	ACRES	TN	TP	TSS	TN	TP	TSS
STRUCTURE-5236	4.3231	24.17	3.58	667.19	5.59	0.83	154.33
STRUCTURE-5237	5.0055	26.88	4.01	714.43	5.37	0.8	142.73
STRUCTURE-5238	613.9805	4342.96	540.12	90669.64	7.07	0.88	147.68
STRUCTURE-5239	115.0465	739.86	89.76	10687.12	6.43	0.78	92.89
STRUCTURE-5257	275.9142	1739.23	280.25	27917.94	6.3	1.02	101.18
STRUCTURE-5258	5.7403	65.04	9.98	1188.53	11.33	1.74	207.05
STRUCTURE-5259	4.9624	56.35	8.73	937.55	11.36	1.76	188.93
STRUCTURE-5260	2.9056	33.04	5.15	515.33	11.37	1.77	177.36
STRUCTURE-5261	3.6688	40.47	6.17	767.18	11.03	1.68	209.11
STRUCTURE-5264	1.5208	13.06	2.02	633.69	8.59	1.33	416.68
STRUCTURE-5265	0.0597	0.67	0.09	25.58	11.24	1.52	428.39
STRUCTURE-5267	29.0456	301.14	46.68	4921.24	10.37	1.61	169.43
STRUCTURE-5303	21.2681	249.95	38.44	4434.4	11.75	1.81	208.5
STRUCTURE-5307	61.7268	555.14	85.44	12632.56	8.99	1.38	204.65
STRUCTURE-5308	6.9353	76.35	11.73	1375.44	11.01	1.69	198.32
STRUCTURE-5309	2.6334	30.28	4.74	450.6	11.5	1.8	171.11
STRUCTURE-5320	61.2587	540.43	87.29	10479.36	8.82	1.42	171.07
STRUCTURE-5322	3.6686	40.3	6.14	770	10.99	1.67	209.89
STRUCTURE-5325	17.2701	167.04	28.09	6076.11	9.67	1.63	351.83
STRUCTURE-5330	4.1646	32.97	6.54	1585.28	7.92	1.57	380.66
STRUCTURE-5331	5.0013	37.34	6.7	1819.54	7.47	1.34	363.81
STRUCTURE-5333	15.3547	90.73	13.76	4263.92	5.91	0.9	277.69
STRUCTURE-5339	12.2842	46.2	7.31	2309.96	3.76	0.59	188.04
STRUCTURE-5342	3.5696	42.03	6.48	738.53	11.77	1.81	206.9
STRUCTURE-5343	3.4985	41.18	6.34	727.03	11.77	1.81	207.81
STRUCTURE-5346	14.5924	134.23	25.09	4943.81	9.2	1.72	338.79
STRUCTURE-5356	1.0237	11.46	1.74	229.1	11.19	1.7	223.8
STRUCTURE-5357	0.3203	3.62	0.55	74.01	11.3	1.71	231.06
STRUCTURE-5358	1.5357	17.43	2.7	294.14	11.35	1.76	191.54
STRUCTURE-5359	0.2504	2.83	0.43	56.62	11.31	1.72	226.11
STRUCTURE-5360	2.0454	23.23	3.6	380.25	11.36	1.76	185.9
STRUCTURE-5361	2.71	29.62	4.5	581.86	10.93	1.66	214.71
STRUCTURE-5362	6.0966	68.63	10.48	1310.82	11.26	1.72	215.01
STRUCTURE-5363	1.6566	16.84	2.53	463.01	10.16	1.53	279.5
STRUCTURE-5364	3.7783	32.59	5.2	1087.55	8.62	1.38	287.84
STRUCTURE-5365	2.3483	26.49	4.09	450.29	11.28	1.74	191.75
STRUCTURE-5366	7.2523	60.82	9.92	1961.31	8.39	1.37	270.44
STRUCTURE-5372	0.4107	4.67	0.73	73.03	11.37	1.78	177.81
STRUCTURE-5373	6.0246	68.4	10.61	1199.78	11.35	1.76	199.15
STRUCTURE-5397	7.27	81.96	12.73	1326.25	11.27	1.75	182.43
STRUCTURE-5398	9.8758	73.96	11.69	1802.19	7.49	1.18	182.49
STRUCTURE-5399	5.6458	63.02	9.82	982.31	11.16	1.74	173.99
STRUCTURE-5400	0.3632	3.86	0.59	71.86	10.64	1.63	197.85
STRUCTURE-5401	1.2894	14.21	2.2	237.82	11.02	1.71	184.45
STRUCTURE-5403	2.0048	22.46	3.49	362.67	11.21	1.74	180.9
STRUCTURE-5404	21.1594	138.6	21.54	2233.89	6.55	1.02	105.57
STRUCTURE-5405	16.6258	188.69	29.17	3217.3	11.35	1.75	193.51
STRUCTURE-5406	1.6615	18.87	2.92	313.22	11.35	1.76	188.52
STRUCTURE-5408 & STRUCTURE-5409	31.5046	249.92	41.58	10161.46	7.93	1.32	322.54
STRUCTURE-5424	20.0931	157.43	28.37	7079.53	7.83	1.41	352.34
STRUCTURE-5430	15.7042	133.03	22.38	4831.02	8.47	1.43	307.63

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Outfall_ID	ACRES	TN	TP	TSS	TN	TP	TSS
STRUCTURE-5441	1.3418	15.21	2.34	270.68	11.34	1.74	201.73
STRUCTURE-5442	3.4843	39.59	6.16	635.74	11.36	1.77	182.46
STRUCTURE-5443	4.3778	49.77	7.75	783.88	11.37	1.77	179.06
STRUCTURE-5444	3.9128	44.45	6.9	727	11.36	1.76	185.8
STRUCTURE-5445	3.7363	42.4	6.55	726.61	11.35	1.75	194.47
STRUCTURE-5446	0.5801	6.55	0.99	135.93	11.3	1.71	234.31
STRUCTURE-5447	10.3729	48.64	6.33	1401.17	4.69	0.61	135.08
STRUCTURE-5449	4.4975	21.38	2.54	996.66	4.75	0.57	221.6
STRUCTURE-5450	6.3559	72.12	11.17	1207.69	11.35	1.76	190.01
STRUCTURE-5451	5.5201	58.96	9.04	1059.31	10.68	1.64	191.9
STRUCTURE-5452	2.9544	33.44	5.11	636.11	11.32	1.73	215.31
STRUCTURE-5453	0.6773	7.67	1.17	143.99	11.32	1.73	212.59
STRUCTURE-5456	10.5017	118.59	18.27	2088.65	11.29	1.74	198.89
STRUCTURE-5457	36.8291	124.13	20.36	5901.07	3.37	0.55	160.23
STRUCTURE-5461	4.7207	14	2.35	738.66	2.97	0.5	156.47
STRUCTURE-5462	3.9441	25.01	3.82	554.82	6.34	0.97	140.67
STRUCTURE-5464	4.7204	28.56	4.9	1536.8	6.05	1.04	325.57
STRUCTURE-5465	10.0513	114.01	17.58	1992.31	11.34	1.75	198.21
STRUCTURE-5467	5.6174	53.3	8.22	927.89	9.49	1.46	165.18
STRUCTURE-5469	5.0356	36.13	6.5	1849.31	7.17	1.29	367.25
STRUCTURE-5472	44.7132	342.42	67.73	16615.85	7.66	1.51	371.61
STRUCTURE-5473	123.6921	1101.12	174.61	43511.48	8.9	1.41	351.77
STRUCTURE-5480 & STRUCTURE-5487	128.672	1127.51	177.18	35103.54	8.76	1.38	272.81
STRUCTURE-5492	7.8969	89.35	13.78	1546.07	11.31	1.75	195.78
STRUCTURE-5493	8.3567	79.5	12.28	2077.66	9.51	1.47	248.62
STRUCTURE-5494	1.3262	15.05	2.32	260.08	11.35	1.75	196.11
STRUCTURE-5495	0.0244	0.28	0.04	4.67	11.35	1.76	191.23
STRUCTURE-5496	48.5202	394.6	60.85	13530.78	8.13	1.25	278.87
STRUCTURE-5497	1.0122	7.72	1.23	309.73	7.63	1.22	305.99
STRUCTURE-5725	4.8762	55.33	8.54	950.04	11.35	1.75	194.83
STRUCTURE-5726	5.2556	55.79	8.59	1266.66	10.61	1.63	241.01
STRUCTURE-5727	17.1928	156.39	24.47	5978.72	9.1	1.42	347.75
STRUCTURE-5728	7.4632	81.9	12.67	1658.31	10.97	1.7	222.2
STRUCTURE-5729	4.4953	51.04	7.9	853.76	11.35	1.76	189.92
STRUCTURE-5730	3.4285	38.91	6.01	663.85	11.35	1.75	193.63
STRUCTURE-5731	16.9539	192.68	29.97	3081.69	11.36	1.77	181.77
STRUCTURE-5732	65.4011	476.31	58.08	15037.88	7.28	0.89	229.93
STRUCTURE-5733	6.1983	70.17	10.82	1196.41	11.32	1.75	193.02
STRUCTURE-5736	9.276	35.85	5.71	1641.03	3.86	0.62	176.91
STRUCTURE-5737	20.9074	107.32	7.96	2646.45	5.13	0.38	126.58
STRUCTURE-5738	5.9253	20.87	2.17	673.63	3.52	0.37	113.69
STRUCTURE-5739	21.9632	210.43	37.48	3730.08	9.58	1.71	169.83
STRUCTURE-5751 & STRUCTURE-5752	70.0915	616.33	96.16	14355.07	8.79	1.37	204.8
STRUCTURE-5771	6.306	65.74	10.28	1401.38	10.42	1.63	222.23
STRUCTURE-5820	26.9121	151.84	22.44	4224.65	5.64	0.83	156.98
STRUCTURE-5826	19.5988	104.88	15.67	2778.1	5.35	0.8	141.75
STRUCTURE-5827	12.9182	82.75	13.92	1937.71	6.41	1.08	150
STRUCTURE-5829	9.8036	20.25	2.17	295.27	2.07	0.22	30.12
STRUCTURE-5832	12.4685	145.68	30.11	2162.09	11.68	2.41	173.4
STRUCTURE-5834	8.8567	73.72	14.1	1279.78	8.32	1.59	144.5
STRUCTURE-5839	3.6478	41.35	6.35	743.29	11.34	1.74	203.76

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Outfall_ID	ACRES	TN	TP	TSS	TN	TP	TSS
STRUCTURE-5841	1.0141	11.49	1.77	206.66	11.33	1.74	203.78
STRUCTURE-5846	5.4991	62.33	9.58	1123.73	11.33	1.74	204.35
STRUCTURE-5852	4.6081	52.13	7.93	1023.7	11.31	1.72	222.15
STRUCTURE-5862	10.4691	115.54	17.95	2211.24	11.04	1.71	211.22
STRUCTURE-5872	5.6772	53.08	10.26	1034.29	9.35	1.81	182.18
STRUCTURE-5875	8.072	104.51	22.12	1612.01	12.95	2.74	199.7
STRUCTURE-5878	3.3011	21.29	3.15	566.25	6.45	0.96	171.53
STRUCTURE-5882	0.4866	5.45	0.79	148.65	11.2	1.63	305.48
STRUCTURE-5885	0.2594	2.89	0.41	90.08	11.14	1.58	347.26
STRUCTURE-5898	1.286	14.57	2.24	266.24	11.33	1.74	207.03
STRUCTURE-5910	12.3564	140.23	21.67	2396.27	11.35	1.75	193.93
STRUCTURE-5940	10.0854	44.86	6.97	2190.31	4.45	0.69	217.18
STRUCTURE-6082	7.7991	62.09	9.48	2196.22	7.96	1.22	281.6
STRUCTURE-6088	3.1803	17.65	2.6	306.34	5.55	0.82	96.32
STRUCTURE-6089	8.6995	80.91	12.44	1326.87	9.3	1.43	152.52
STRUCTURE-6099	18.3253	164.37	25.03	3618.87	8.97	1.37	197.48
STRUCTURE-6105	6.0133	65.38	10.14	1357.9	10.87	1.69	225.82
STRUCTURE-6106	19.5894	222.82	34.43	3812.55	11.37	1.76	194.62
STRUCTURE-6292	366.0971	3342.94	377.83	49025.01	9.13	1.03	133.91
STRUCTURE-6449	1.9268	15.94	2.52	796.88	8.27	1.31	413.58
STRUCTURE-6510	6.771	76.88	11.9	1286.88	11.35	1.76	190.06
STRUCTURE-6513	125.4491	1175.74	186.25	24545.97	9.37	1.48	195.66
STRUCTURE-6561	3.9161	44.4	6.84	787	11.34	1.75	200.97
STRUCTURE-6564	33.0089	182.77	27.12	5001.05	5.54	0.82	151.51
STRUCTURE-6566	8.7358	48.5	7.19	1330.09	5.55	0.82	152.26
STRUCTURE-6567	23.1275	125.67	18.72	3378.03	5.43	0.81	146.06
STRUCTURE-6580	40.4747	323.84	35.72	4141.25	8	0.88	102.32
STRUCTURE-6589	65.0454	470.79	74.38	14371.06	7.24	1.14	220.94
STRUCTURE-6709	13.741	51.5	8.16	2574.78	3.75	0.59	187.38
STRUCTURE-6815	48.0385	489.41	75.51	21659.94	10.19	1.57	450.89
STRUCTURE-6828	27.5573	151.01	23.42	2482.81	5.48	0.85	90.1
STRUCTURE-6832	7.4205	32.36	3.24	263.23	4.36	0.44	35.47
STRUCTURE-6861	24.1422	195.11	41.1	9637.11	8.08	1.7	399.18
STRUCTURE-6865	11.4744	103.78	9.96	825.95	9.04	0.87	71.98
STRUCTURE-6871	2.67	7.77	1.07	310.01	2.91	0.4	116.11
STRUCTURE-6887	0.1315	1.34	0.19	56.58	10.23	1.41	430.29
Swan Lake_Direct_Runoff	11.7775	87.26	13.46	1208.41	7.41	1.14	102.6
Unidentified Outfall_1	3.5265	40.49	6.3	666.27	11.48	1.79	188.93
Unidentified Outfall_2	30.4669	330.32	50.99	5895.64	10.84	1.67	193.51
Unidentified Outfall_3	172.882	1117.46	181.21	25846.44	6.46	1.05	149.5
Unidentified Outfall_4	35.5585	95.13	15.04	3081.33	2.68	0.42	86.66
Unidentified Outfall_5	7.1592	36.55	6.32	1993.87	5.11	0.88	278.5
Unidentified Outfall_6	28.4669	287.03	44.71	5847.28	10.08	1.57	205.41
Unidentified Outfall_7	13.0151	129.86	20.14	2837.71	9.98	1.55	218.03
Unidentified Outfall_8	3.4894	2.37	0.24	77.12	0.68	0.07	22.1
Unidentified Outfall_9	4.1353	3.43	0.39	100.39	0.83	0.1	24.28
Unidentified Outfall_10	6.9745	79.81	12.32	1379.82	11.44	1.77	197.84
Unidentified Outfall_11	154.4883	1244.4	212.73	60183.97	8.05	1.38	389.57
Unidentified Outfall_12	8.0101	57.86	8.91	2791.66	7.22	1.11	348.52
Unidentified Outfall_13	61.2279	366.56	37.83	4255.22	5.99	0.62	69.5
Unidentified Outfall_14	4.6192	13.96	2.16	664.7	3.02	0.47	143.9

6.8 Lake Pollutant Loading Totals

The discretized pollutant loading calculations were summarized for each Surface Water on an areal basis to identify outfalls with the highest concentration loadings. **Table 15** provides the total average annual loadings for each Surface Water and is sorted by the highest to lowest areal TP loading. The areal loading rates were spatially plotted for each outfall for TN, TP and TSS as **Figure 25, 26, and 27**, respectively.

Table 15 Lake Loading Summary

		Annual Loading (lbs./year)			Areal Loading (lbs./acre/year)		
Surface Water Name	**ACRES**	**TN**	**TP**	**TSS**	**TN**	**TP**	**TSS**
Citrus Lake	65.5	296	46	13582	4.5	0.7	207
Lake Buckeye	265.0	1533	209	21663	5.8	0.79	82
Lake Cannon	1033.4	4478	688	130034	4.3	0.67	126
Lake Conine	796.7	4580	652	97699	5.8	0.82	123
Lake Deer	377.7	1591	272	38337	4.2	0.72	101
Lake Elbert	599.9	3749	576	91069	6.3	0.96	152
Lake Fannie	40.5	324	36	4141	8.0	0.88	102
Lake Gem	67.2	376	58	10349	5.6	0.87	154
Lake Hartridge	920.3	3614	569	86158	3.9	0.62	94
Lake Howard	1869.5	9414	1311	226069	5.0	0.7	121
Lake Ida	98.7	600	93	20441	6.1	0.94	207
Lake Idyl	154.7	1010	165	22118	6.5	1.06	143
Lake Idylwild	225.5	1140	190	22119	5.1	0.84	98
Lake Jessie	969.6	5302	818	112483	5.5	0.84	116
Lake Link	95.5	749	116	13267	7.8	1.22	139
Lake Lulu	1006.7	5860	708	105959	5.8	0.7	105
Lake Martha	307.6	1854	269	40843	6.0	0.87	133
Lake Maude	386.0	2888	439	61440	7.5	1.14	159
Lake May	353.6	2475	395	90948	7.0	1.12	257
Lake Mirror	282.6	1524	233	28581	5.4	0.82	101
Lake Otis	552.3	3921	608	75840	7.1	1.1	137
Lake Pansy	243.8	561	65	8825	2.3	0.27	36
Lake Roy	318.3	2055	298	43785	6.5	0.94	138
Lake Shipp	911.6	4792	801	138487	5.3	0.88	152
Lake Silver	164.2	893	139	36459	5.4	0.85	222
Lake Smart	61.2	367	38	4255	6.0	0.62	70
No Name 1	17.5	159	29	2176	9.1	1.67	125
No Name 2	23.5	284	50	3919	12.1	2.12	167
No Name 3	35.6	215	23	4958	6.0	0.64	139
No Name 4	43.9	108	13	2483	2.5	0.3	57
No Name 5	34.7	309	44	5316	8.9	1.27	153
No Name 6	5.3	25	4	380	4.6	0.69	71
Peace Creek	366.1	3343	378	49025	9.1	1.03	134
Spring Lake	120.2	662	109	25580	5.5	0.91	213
Swan Lake	40.7	290	44	4660	7.1	1.08	115
Citrus Lake	65.5	296	46	13582	4.5	0.7	207
Lake Buckeye	265.0	1533	209	21663	5.8	0.79	82
Lake Cannon	1033.4	4478	688	130034	4.3	0.67	126
Lake Conine	796.7	4580	652	97699	5.8	0.82	123
Lake Deer	377.7	1591	272	38337	4.2	0.72	101
Lake Elbert	599.9	3749	576	91069	6.3	0.96	152
Lake Fannie	40.5	324	36	4141	8.0	0.88	102

7 Problem Area Identification

7.1 Flooding Problem Areas

Based on the resulting flooding inundation areas, eighty (80) flooding problem area were identified through visual inspection within the City limits. The polygons were delineated where inundation of roadways (full lane inundation) and/or buildings was identified for the design storms in excess of the 3-inch/1-hour event. Generally, privately owned neighborhoods and commercial parcels were excluded since this effort is intended to focus primarily on City infrastructure. **Figure 28** shows the location and extent of the identified flooding problem areas.

7.2 Problem Area Ranking

The problem areas were further prioritized based on the following ranking criteria, the results of which are provided as **Table 16**:

- Roadway Type: The roadway type was determined using the Polk Transportation Planning Organization (TPO) and the City's roadway GIS layers. Each flooding problem area roadway type was classified as
  - Local (1 point),
  - Collector (2 points), or
  - Arterial (3 points).
- Pollutant Loading: The Total Phosphorous (TP) Hot Spot map, previously discussed, was used to generally quantify the intensity of TP loadings in the vicinity of the problem area. The Hot Spot map was classified using the following criteria:
  - 0-0.75 lb./ac/yr. as low,
  - 0.75-1.5 lb./ac/yr. as medium, and
  - 1.5 to 5.0 lb./ac/yr. as high.

  Then each area was visually inspected to estimate the loading intensity as:
  - Low (1 point),
  - Medium (2 points), or
  - High (3 points).
- Flooding Frequency: The flood inundation GIS layer was used to classify each problem area based on the minimum design storm which was expected to cause lane closure. The following point system was used:
  - 100-yr (1 point),
  - 25-yr (2 points), or
  - 2.33-yr (3 points).
- Existing Collection System: Each problem area was classified based on the current existence of stormwater drainage elements using the following point system:
  - Yes (1 point),
  - Limited (2 points), or
  - No (3 points).
- Impairment Status: If the problem area discharged to a nutrient impaired water body then 3 points were assigned. Otherwise, 0 points were assigned if no impairment.
- Size: To incorporate an element of area magnitude, the following point criteria was used based on the delineated problem area acreage:

- 0-1 acres (1 point),
- 1-2 acres (2 points), or
- >2 acres (3 points).

Table 16 Problem Area Ranking

Problem Area ID	Receiving Water Body	Acres	Nutrient Impairment	Road Type	Flood Frequency	PL Intensity	Existing System	Area Points	Impairment Points	Type Points	Frequency Points	PL Points	Ex System Points	Total Points
1	Lake Howard	0.5	Yes	LOCAL	25-YR	LOW	YES	1	3	1	2	1	1	9
2	Lake Cannon	0.7	Yes	LOCAL	100-YR	MEDIUM	YES	1	3	1	1	2	1	9
3	Lake Howard	0.7	Yes	LOCAL	2-YR	LOW	YES	1	3	1	3	1	1	10
4	Lake Cannon	1.3	Yes	LOCAL	25-YR	LOW	YES	2	3	1	2	1	1	10
5	Lake Howard	1.1	Yes	LOCAL	25-YR	LOW	NO	2	3	1	2	1	3	12
6	Lake Shipp	7	Yes	LOCAL	25-YR	LOW	NO	3	3	1	2	1	3	13
7	Lake Howard	4.4	Yes	LOCAL	25-YR	LOW	LIMITED	3	3	1	2	1	2	12
8	Lake Howard	1.9	Yes	LOCAL	2-YR	LOW	NO	2	3	1	3	1	3	13
9	Lake Howard	2	Yes	LOCAL	2-YR	LOW	NO	3	3	1	3	1	3	14
10	Lake Howard	1.4	Yes	LOCAL	2-YR	LOW	LIMITED	2	3	1	3	1	2	12
11	Lake Howard	0.5	Yes	LOCAL	25-YR	MEDIUM	YES	1	3	1	2	2	1	10
12	Lake Hartridge	4.3	Yes	LOCAL	25-YR	MEDIUM	YES	3	3	1	2	2	1	12
13	Lake Shipp	4	Yes	LOCAL	2-YR	HIGH	LIMITED	3	3	1	3	3	2	15
14	Lake Howard	7.7	Yes	LOCAL	2-YR	MEDIUM	LIMITED	3	3	1	3	2	2	14
15	Lake Howard	18	Yes	LOCAL	25-YR	MEDIUM	LIMITED	3	3	1	2	2	2	13
16	Lake Shipp	1.3	Yes	COLLECTOR	100-YR	HIGH	YES	2	3	2	1	3	1	12
17	Lake Shipp	0.3	Yes	LOCAL	2-YR	HIGH	NO	1	3	1	3	3	3	14
18	Lake Howard	13	Yes	LOCAL	2-YR	HIGH	YES	3	3	1	3	3	1	14
19	Lake Mirror	0.5	No	LOCAL	2-YR	HIGH	NO	1	0	1	3	3	3	11
20	Lake Howard	0.9	Yes	COLLECTOR	2-YR	HIGH	NO	1	3	2	3	3	3	15
21	Lake Hartridge	20	Yes	ARTERIAL	25-YR	MEDIUM	YES	3	3	3	2	2	1	14
22	Lake Mirror	6.8	No	LOCAL	100-YR	HIGH	LIMITED	3	0	1	1	3	2	10
23	Lake Shipp	1.1	Yes	COLLECTOR	2-YR	MEDIUM	NO	2	3	2	3	2	3	15
24	Lake May	0.7	Yes	LOCAL	25-YR	MEDIUM	YES	1	3	1	2	2	1	10
25	Lake Howard & Lake May	21	Yes	LOCAL	2-YR	HIGH	LIMITED	3	3	1	3	3	2	15
26	Lake Shipp	1.6	Yes	LOCAL	2-YR	HIGH	YES	2	3	1	3	3	1	13
27	Lake Howard	1.3	Yes	LOCAL	100-YR	MEDIUM	YES	2	3	1	1	2	1	10
28	Lake May	0.7	Yes	COLLECTOR	25-YR	HIGH	YES	1	3	2	2	3	1	12
29	Lake Howard	0.4	Yes	LOCAL	25-YR	MEDIUM	YES	1	3	1	2	2	1	10
30	Lake Howard	2.9	Yes	ARTERIAL	2-YR	MEDIUM	YES	3	3	3	3	2	1	15
31	Lake Shipp	0.5	Yes	LOCAL	2-YR	HIGH	LIMITED	1	3	1	3	3	2	13
32	Citrus Lake	1.4	No	LOCAL	25-YR	MEDIUM	YES	2	0	1	2	2	1	8
33	Lake Shipp	1.3	Yes	ARTERIAL	2-YR	HIGH	YES	2	3	3	3	3	1	15
34	Lake Maude	0.3	No	LOCAL	25-YR	LOW	NO	1	0	1	2	1	3	8
35	Lake Shipp	11	Yes	ARTERIAL	2-YR	MEDIUM	YES	3	3	3	3	2	1	15
36	Lake May	0.9	Yes	LOCAL	2-YR	MEDIUM	NO	1	3	1	3	2	3	13
37	Lake Silver	6.5	No	LOCAL	2-YR	MEDIUM	LIMITED	3	0	1	3	2	2	11
38	Lake Howard	1.2	Yes	COLLECTOR	2-YR	MEDIUM	YES	2	3	2	3	2	1	13
39	Lake Maude	1.2	No	LOCAL	25-YR	LOW	YES	2	0	1	2	1	1	7
40	Lake Silver	0.7	No	LOCAL	25-YR	MEDIUM	YES	1	0	1	2	2	1	7
41	Lake May	3.9	Yes	LOCAL	2-YR	MEDIUM	LIMITED	3	3	1	3	2	2	14
42	Lake Howard	5.9	Yes	LOCAL	25-YR	MEDIUM	YES	3	3	1	2	2	1	12
43	Lake Howard	7.4	Yes	LOCAL	2-YR	MEDIUM	YES	3	3	1	3	2	1	13
44	Lake Lulu	1.3	Yes	ARTERIAL	25-YR	MEDIUM	YES	2	3	3	2	2	1	13
45	Lake Conine	2.5	Yes	LOCAL	25-YR	HIGH	YES	3	3	1	2	3	1	13

Problem Area ID	Receiving Water Body	Acres	Nutrient Impairment	Road Type	Flood Frequency	PL Intensity	Existing System	Area Points	Impairment Points	Type Points	Frequency Points	PL Points	Ex System Points	Total Points
46	Lake Silver	1.9	No	LOCAL	25-YR	MEDIUM	YES	2	0	1	2	2	1	8
47	Lake Conine	1	Yes	LOCAL	100-YR	MEDIUM	NO	2	3	1	1	2	3	12
48	Lake Lulu	11	Yes	ARTERIAL	25-YR	MEDIUM	YES	3	3	3	2	2	1	14
49	Lake Lulu	0.8	Yes	ARTERIAL	25-YR	MEDIUM	YES	1	3	3	2	2	1	12
50	Lake Elbert	1.3	No	COLLECTOR	25-YR	MEDIUM	YES	2	0	2	2	2	1	9
51	Lake Martha	0.4	No	LOCAL	100-YR	MEDIUM	YES	1	0	1	1	2	1	6
52	Lake Lulu	1.3	Yes	LOCAL	2-YR	MEDIUM	YES	2	3	1	3	2	1	12
53	Lake Otis & Lake Lulu	5.6	Yes	LOCAL	2-YR	HIGH	NO	3	3	1	3	3	3	16
54	Lake Elbert	3.3	No	LOCAL	2-YR	MEDIUM	YES	3	0	1	3	2	1	10
55	Lake Maude	0.6	No	LOCAL	2-YR	HIGH	YES	1	0	1	3	3	1	9
56	Lake Lulu	2.5	Yes	ARTERIAL	25-YR	MEDIUM	YES	3	3	3	2	2	1	14
57	Lake Martha	0.9	No	LOCAL	2-YR	HIGH	NO	1	0	1	3	3	3	11
58	Lake Otis & Lake Lulu	6.4	Yes	COLLECTOR	2-YR	MEDIUM	NO	3	3	2	3	2	3	16
59	Lake Otis	4.4	No	LOCAL	25-YR	MEDIUM	LIMITED	3	0	1	2	2	2	10
60	Lake Elbert	2.2	No	COLLECTOR	2-YR	HIGH	LIMITED	3	0	2	3	3	2	13
61	Lake Elbert	1.2	No	LOCAL	2-YR	HIGH	NO	2	0	1	3	3	3	12
62	Lake Martha	1.6	No	LOCAL	100-YR	MEDIUM	YES	2	0	1	1	2	1	7
63	Lake Martha	1.1	No	LOCAL	2-YR	HIGH	YES	2	0	1	3	3	1	10
64	Lake Idyl	0.2	Yes	LOCAL	25-YR	MEDIUM	YES	1	3	1	2	2	1	10
65	Swan Lake	1.9	No	LOCAL	2-YR	HIGH	YES	2	0	1	3	3	1	10
66	Lake Otis & Lake Roy	43	No	LOCAL	25-YR	HIGH	NO	3	0	1	2	3	3	12
67	Lake Lulu	2.2	Yes	LOCAL	2-YR	MEDIUM	LIMITED	3	3	1	3	2	2	14
68	Swan Lake	1	No	LOCAL	25-YR	HIGH	YES	2	0	1	2	3	1	9
69	Lake Roy	0.8	No	ARTERIAL	25-YR	MEDIUM	YES	1	0	3	2	2	1	9
70	Swan Lake	1	No	LOCAL	2-YR	HIGH	NO	2	0	1	3	3	3	12
71	Lake Elbert	1.6	No	LOCAL	2-YR	HIGH	NO	2	0	1	3	3	3	12
72	Lake Elbert	0.6	No	LOCAL	2-YR	HIGH	NO	1	0	1	3	3	3	11
73	Lake Idyl	23	Yes	LOCAL	2-YR	HIGH	LIMITED	3	3	1	3	3	2	15
74	Lake Elbert	0.9	No	ARTERIAL	2-YR	HIGH	LIMITED	1	0	3	3	3	2	12
75	Lake Roy	6.7	No	LOCAL	2-YR	LOW	NO	3	0	1	3	1	3	11
76	Lake Elbert	9.3	No	LOCAL	2-YR	HIGH	YES	3	0	1	3	3	1	11
77	Lake Link	13	No	LOCAL	2-YR	HIGH	YES	3	0	1	3	3	1	11
78	Lake Elbert	1	No	LOCAL	2-YR	HIGH	NO	2	0	1	3	3	3	12
79	Lake Elbert	0.9	No	LOCAL	2-YR	HIGH	NO	1	0	1	3	3	3	11
80	Lake Elbert	1.4	No	COLLECTOR	2-YR	HIGH	YES	2	0	2	3	3	1	11

7.3 Priority Problem Areas

Using the above ranking system and coordination with City Staff, 5 problem areas were selected as priority problem areas. The priority areas will be used for the subsequent task of evaluating potential improvement alternatives. **Figure 29** shows the location of the priority problem areas and **Table 17** provides a summary of each problem area. The priority problem areas are further described in the following section.

Table 17 Priority Problem Area Summary

Priority Area ID	Receiving Water Body	Acres	Road Type	Flood Frequency	PL Intensity	Existing System
1	Lake Idyl	24	LOCAL	2.33-YR	HIGH	LIMITED
2	Lake Mirror	17	LOCAL	100-YR	HIGH	YES
3	Lake Elbert, Lulu & Otis	166	LOCAL	100-YR	HIGH	LIMITED
4	Lake Otis & Roy	72	LOCAL	25-YR	HIGH	LIMITED
5	Lake Howard & Shipp	19	LOCAL	2.33-YR	LOW	LIMITED
6	Lake Howard	17	LOCAL	2.33-YR	HIGH	YES

7.3.1 Priority Problem Area 1

Priority Problem Area 1 encompasses a 24-acre neighborhood, located between Ware Avenue NE (North), Avenue T NE (South), 9th Lane NE (East), and 9th Street NE (West), as shown on **Figure 30**. The neighborhood is drained to Lake Idyl (Nutrient Impaired) through a limited drainage system, connected to Avenue T NE drainage system, with no treatment of stormwater runoff. Although roadway flooding is anticipated in some location for storms in excess of the 2.33-year storm, this flooding is not considered significant. However, the high pollutant loading discharge to an impaired lake makes this priority area ideal for stormwater improvements which expand the existing drainage system while providing treatment of stormwater runoff.

7.3.2 Priority Problem Area 2

Priority Problem Area 2 encompasses a 17-acre neighborhood, located between Mirror Terrace NW (North West), 7th Street NW (East), and Perrin Avenue NW (South West) as shown on **Figure 31**. The neighborhood is drained to Lake Mirror through a complete drainage system, with no treatment of stormwater runoff. Although roadway flooding is anticipated in some location for storms in excess of the 100-year storm, this flooding is not considered significant. However, the high pollutant loading discharge directly to Lake Mirror makes this priority area ideal for stormwater improvements which provide treatment of stormwater runoff.

7.3.3 Priority Problem Area 3

Priority Problem Area 3 encompasses a 166-acre neighborhood, located between Avenue C SE (North), Avenue C SE (South), 6th Street SE (East), and 1st Street S (West) as shown on **Figure 32**. The neighborhood is drained to Lakes Elbert, Lulu (Nutrient Impaired) and Otis through a limited drainage system, with no treatment of stormwater runoff. Although roadway flooding is anticipated in some location for storms in excess of the 100-year storm, this flooding is not considered significant. However, the high pollutant loading discharge to the lakes makes this priority area ideal for stormwater improvements which expand the current drainage system while providing treatment of stormwater runoff.

7.3.4 Priority Problem Area 4

Priority Problem Area 4 encompasses a 72-acre neighborhood, located between Avenue K SE (North), Avenue Q SE (South), 8th Street SE (East), and 6st Street SE (West) as shown on **Figure 33**. The neighborhood is drained to Lakes Otis and Roy through a limited drainage system, with no treatment of stormwater runoff. Although roadway flooding is anticipated in some location for storms in excess of the 25-year storm, this flooding is not considered significant. However, the high pollutant loading discharge to the lakes makes this priority area ideal for stormwater improvements which expand the current drainage system while providing treatment of stormwater runoff.

7.3.5 Priority Problem Area 5

Priority Problem Area 5 encompasses a 19-acre neighborhood, located between High Point Avenue SW (North), Winter Lake Road SW (South), Marshall Road SW (East), and the neighborhood property limits (West) as shown on **Figure 34**. The neighborhood is drained to Lakes Howard (Nutrient Impaired) and Shipp (Nutrient Impaired) through a limited drainage system, with limited treatment of stormwater runoff. Significant roadway flooding is anticipated for storms in excess of the 2.33-year storm, due to the lack of an adequate discharge system. The significant flooding makes this priority area ideal for stormwater improvements which expand the current drainage system to provide adequate discharge capacity.

7.3.6 Priority Problem Area 6

Priority Problem Area 6 encompasses a 17-acre neighborhood, located on south side of Lake Howard Drive, just west of 15th Street SW as shown on **Figure 35**. The neighborhood is drained to Lakes Howard (Nutrient Impaired), with no treatment of stormwater runoff. Significant roadway flooding is anticipated for storms in excess of the 2.33-year storm, due to a backwater effect from Lake Howard on the existing drainage system. The significant flooding makes this priority area ideal for stormwater improvements which increase the systems discharge capacity.

8 BMP Analysis

The following sections outline proposed improvement concepts for each of the six (6) problem areas outlined above. Each concept utilizes various stormwater Best Management Practices (BMPs) to capture, route, and/or treat local stormwater runoff to reduce flood risk to local infrastructure and/or reduce discharge of pollutants to nearby surface water bodies. The primary BMPs proposed as part of this project include:

- Exfiltration Pipe Systems
- Surface Retention Areas/Rain Gardens
- Nutrient Separating Baffle Boxes
- Traditional Drainage Pipes and Structures
- Stromwater Pump Systems

8.1 Priority Problem Area 1 – Concept Analysis

The improvement concept for Priority Area 1, as shown on **Figure 36**, expands the existing stormwater collection system to increase capture, retention, and infiltration of stormwater runoff using approximately 1,300 LF of exfiltration pipe. Additionally, a baffle box is proposed at the system's outfall, prior to discharge to Lake Idyl.

The concept has been evaluated in three (3) phases outlined below:

- Phase 1A – Construction of ~1,000 LF of 36" exfiltration pipe and associated structures along 9th Street NE, 9th Court NE, and Avenue V NE. The proposed exfiltration system will connect into the existing drainage pipe running south along 9th Street NE to Avenue T NE.
- Phase 1B – Construction of ~300 LF of 36" exfiltration pipe and associated structures along the northern portion of 9th Lane NE. The proposed exfiltration system will connect into the existing drainage pipe running along Avenue T NE through a proposed 350 LF drainage pipe.
- Phase 1C – Construction of a nutrient separating baffle box at Avenue T NE. just before the outfall to Lake Idyl.

Drainage basins were delineated for each phase, as shown on **Figure 37**, to evaluate the system's capacity to capture, retain, and infiltrate stormwater and calculate the potential pollutant loading reductions associated with each phase. The pollutant loading rates were calculated using the approach previously outlined, in conjunction with the BMPTrains software, developed by the University of Central Florida (UCF), to estimate the potential reductions. **Table 18** provides a summary of the estimated loading calculations. A preliminary estimation of construction costs was developed as part of **Appendix A**.

Table 18 Concept 1 Pollutant Loading Estimates

Phase	Treatment Feature	Acres Treated	Existing Runoff (ac-ft/yr)	Existing TN (lb/yr)	Existing TP (lb/yr)	Runoff Reduction (%)	TN Reduction (%)	TP Reduction (%)	Runoff Captured (ac-ft/yr)	TN Captured (lb/yr)	TP Captured (lb/yr)
1A	Exfiltration Pipes	7.3	15.3	83.2	13.0	66%	66%	66%	10.1	54.9	8.6
1B	Exfiltration Pipes	2.1	4.6	23.3	3.5	67%	67%	67%	3.1	15.6	2.4
1C	Baffle Box	47.4	86.9	353.5	51.9	0%	15%	20%	0.0	53.0	10.4
Overall	**Treatment Train**	56.8	106.8	460.0	68.4	12%	31%	33%	13.2	142.6	22.6

8.2 Priority Problem Area 2 – Concept Analysis

The improvement concept for Priority Area 2, as shown on **Figure 38**, expands the existing stormwater collection system to increase capture, retention, and infiltration of stormwater runoff using approximately 1,700 LF of exfiltration pipe prior to outfall to Lake Mirror.

The concept has been evaluated in three (3) phases outlined below:

- Phase 2A – Construction of ~750 LF of 36" exfiltration pipe and associated structures along 8th Street NW. The proposed exfiltration system will connect into the existing drainage pipe running west along Avenue L NW.
- Phase 2B – Construction of ~400 LF of 36" exfiltration pipe and associated structures along Thompson Circle NW. The proposed exfiltration system will connect into the existing drainage pipe running northwest to Mirror Terrace NW.
- Phase 2C – Construction of ~550 LF of 36" exfiltration pipe and associated structures along Mirror Terrace NW. The proposed exfiltration system outfalls to Lake Mirror.

Drainage basins were delineated for each phase, as shown on **Figure 39**, to evaluate the system's capacity to capture, retain, and infiltrate stormwater and calculate the potential pollutant loading reductions associated with each phase. The pollutant loading rates were calculated using the approach previously outlined, in conjunction with the BMPTrains software, developed by the University of Central Florida (UCF), to estimate the potential reductions. **Table 19** provides a summary of the estimated loading calculations. A preliminary estimation of construction costs was developed and as part of **Appendix A**.

Table 19 Concept 2 Pollutant Loading Estimates

Phase	Treatment Feature	Acres Treated	Existing Runoff (ac-ft/yr)	Existing TN (lb/yr)	Existing TP (lb/yr)	Runoff Reduction (%)	TN Reduction (%)	TP Reduction (%)	Runoff Captured (ac-ft/yr)	TN Captured (lb/yr)	TP Captured (lb/yr)
2A	Exfiltration Pipes	6.8	15.0	73.1	11.4	52%	52%	52%	7.8	38.0	5.9
2B	Exfiltration Pipes	5.8	12.0	68.2	10.4	39%	39%	39%	4.7	26.6	4.1
2C	Exfiltration Pipes	17.3	36.9	200.2	31.0	18%	18%	18%	6.7	36.5	5.7
Overall	**Treatment Train**	**29.9**	**63.8**	**341.5**	**52.8**	**39%**	**39%**	**39%**	**24.9**	**133.2**	**20.6**

8.3 Priority Problem Area 3 – Concept Analysis

The improvement concept for Priority Area 3, as shown on **Figure 40**, expands the existing stormwater collection system to increase capture, retention, and infiltration of stormwater runoff using approximately 6,900 LF of exfiltration pipe prior to outfall to Lakes Otis and Lulu.

The concept has been evaluated in six (6) phases outlined below. Phases A, B, and C run in Series to Lake Otis; Phases D, and E run separately in series to Lake Otis; and Phase F outfalls to Lake Lulu:

- Phase 3A – Construction of ~300 LF of 36" exfiltration pipe and associated structures along 2nd Street SE. The proposed exfiltration system will connect into the existing drainage pipe running east along Avenue E SE.
- Phase 3B – Construction of ~700 LF of 36" exfiltration pipe and associated structures along 4th Street SE. The proposed exfiltration system will connect into the existing drainage pipe running east along Avenue E SE.
- Phase 3C – Construction of ~1,200 LF of 36" exfiltration pipe and associated structures along 4th Street SE and Avenue I SE. The proposed exfiltration system will connect into the existing drainage pipe running east along 6th Street SE.
- Phase 3D – Construction of ~400 LF of 36" exfiltration pipe and associated structures along Thompson Circle NW. The proposed exfiltration system will connect into the existing drainage pipe running northwest to Mirror Terrace NW.
- Phase 3E – Construction of ~1,700 LF of 36" exfiltration pipe and associated structures along 5th Street SE. The proposed exfiltration system will connect into the existing drainage pipe running east along 6th Street SE and eventually outfalls to Lake Otis.
- Phase 3F – Construction of ~2,600 LF of 36" exfiltration pipe and associated structures along 2nd Street SE and Avenue K SE. The proposed exfiltration system will connect into the existing drainage pipe running east along 1st Street S and eventually outfalls to Lake Lulu.

Drainage basins were delineated for each phase, as shown on **Figure 41**, to evaluate the system's capacity to capture, retain, and infiltrate stormwater and calculate the potential pollutant loading reductions associated with each phase. The pollutant loading rates were calculated using the approach previously outlined, in conjunction with the BMPTrains software, developed by the University of Central Florida (UCF), to estimate the potential reductions. **Table 20** provides a summary of the estimated loading calculations. A preliminary estimation of construction costs was developed and as part of **Appendix A**.

Table 20 Concept 3 Pollutant Loading Estimates

Phase	Treatment Feature	Acres Treated	Existing Runoff (ac-ft/yr)	Existing TN (lb/yr)	Existing TP (lb/yr)	Runoff Reduction (%)	TN Reduction (%)	TP Reduction (%)	Runoff Captured (ac-ft/yr)	TN Captured (lb/yr)	TP Captured (lb/yr)
3A	Exfiltration Pipes	7.9	16.9	86.9	13.3	23%	23%	23%	3.9	20.0	3.1
3B	Exfiltration Pipes	26.8	56.3	290.0	45.8	15%	15%	15%	8.4	43.5	6.9
3C	Exfiltration Pipes	5.1	11.2	57.9	8.8	62%	62%	62%	7.0	35.9	5.5
3A-3C Overall	**Treatment Train**	**39.8**	**84.4**	**434.7**	**67.9**	**38%**	**38%**	**38%**	**32.1**	**165.2**	**25.8**
3D	Exfiltration Pipes	7.5	16.0	86.9	13.5	66%	66%	66%	10.6	57.4	8.9
3E	Exfiltration Pipes	23.1	50.8	262.0	40.0	40%	40%	40%	20.3	104.8	16.0
3D-3E Overall	**Treatment Train**	**30.6**	**66.8**	**348.9**	**53.5**	**50%**	**50%**	**50%**	**33.4**	**174.5**	**26.8**
3F	**Exfiltration Pipes**	**22.2**	**49.6**	**242.0**	**38.9**	**45%**	**45%**	**45%**	**22.3**	**108.9**	**17.5**

8.4 Priority Problem Area 4 – Concept Analysis

The improvement concept for Priority Area 4, as shown on **Figure 42**, expands the existing stormwater collection system to increase capture, retention, and infiltration of stormwater runoff using approximately 4,900 LF of exfiltration pipe prior to outfall to Lakes Otis and Roy.

The concept has been evaluated in six (6) phases outlined below:

- Phase 4A – Construction of ~2,300 LF of 36" exfiltration pipe and associated structures along 7th Street SE. The proposed exfiltration system will connect into the existing drainage pipe running along Oleander Drive SE and Avenue K SE.
- Phase 4B – Construction of ~2,600 LF of 36" exfiltration pipe and associated structures along 8th Street SE. The proposed exfiltration system will connect into the existing drainage pipe running along Cypress Gardens Boulevard to Lake Roy and Avenue K SE to Lake Otis.

Drainage basins were delineated for each phase, as shown on **Figure 43**, to evaluate the system's capacity to capture, retain, and infiltrate stormwater and calculate the potential pollutant loading reductions associated with each phase. The pollutant loading rates were calculated using the approach previously outlined, in conjunction with the BMPTrains software, developed by the University of Central Florida (UCF), to estimate the potential reductions. **Table 21** provides a summary of the estimated loading calculations. A preliminary estimation of construction costs was developed and as part of **Appendix A**.

Table 21 Concept 4 Pollutant Loading Estimates

Phase	Treatment Feature	Acres Treated	Existing Runoff (ac-ft/yr)	Existing TN (lb/yr)	Existing TP (lb/yr)	Runoff Reduction (%)	TN Reduction (%)	TP Reduction (%)	Runoff Captured (ac-ft/yr)	TN Captured (lb/yr)	TP Captured (lb/yr)
1A	Exfiltration Pipes	49.5	108.9	561.4	85.6	27%	27%	27%	29.6	152.4	23.2
1B	Exfiltration Pipes	39.6	83.1	428.6	67.5	38%	38%	38%	31.3	161.6	25.5
Overall	**Treatment Train**	**89.1**	**192.0**	**990.0**	**153.1**	**39%**	**39%**	**39%**	**74.9**	**386.1**	**59.7**

8.5 Priority Problem Area 5 – Concept Analysis

The improvement concept for Priority Area 5, as shown on **Figure 44**, expands the existing stormwater collection system along Sandalwood Court SW and High Point Court SW to re-route the neighborhoods to a proposed 1.25-acre retention pond.

Drainage basins were delineated for each phase, as shown on **Figure 45**, to evaluate the system's capacity to capture, retain, and infiltrate stormwater and calculate the potential pollutant loading reductions associated with each phase. The pollutant loading rates were calculated using the approach previously outlined, in conjunction with the BMPTrains software, developed by the University of Central Florida (UCF), to estimate the potential reductions. **Table 22** provides a summary of the estimated loading calculations. A preliminary estimation of construction costs was developed and as part of **Appendix A**.

Table 22 Concept 5 Pollutant Loading Estimates

Phase	Treatment Feature	Acres Treated	Existing Runoff (ac-ft/yr)	Existing TN (lb/yr)	Existing TP (lb/yr)	Runoff Reduction (%)	TN Reduction (%)	TP Reduction (%)	Runoff Captured (ac-ft/yr)	TN Captured (lb/yr)	TP Captured (lb/yr)
5A	Retention Pond	22.7	43.6	224.8	35.4	79%	79%	79%	34.5	177.6	28.0

8.6 Priority Problem Area 6 – Concept Analysis

The improvement concept for Priority Area 6, as shown on **Figure 46**, expands the existing stormwater collection system along Fox Ridge Run SW to re-route the existing drainage system to a proposed pump system. The pump would outfall to the South Lake Howard Nature Park. Additionally, flap gates are proposed on the existing outfalls to prevent backwater from Lake Howard. It should be noted that this concept does not include elements to reduce discharge of nutrient loads.

Figure 47 shows the 12-acre drainage basin to be served by the proposed pump system. Based on this drainage area, **Table 23** shows the peak runoff rate for each design storm. Although a more detailed design process is needed to determine the most effective pump size, a 5 MGD pump was used for the purposes of evaluating the concept from a preliminary cost-benefit perspective. The 5 MGD pump would convey most of the 10-year/24-hour peak runoff rate.

A preliminary estimation of construction costs was developed and as part of **Appendix A**. Until a more detailed design of the proposed pump station is completed, a unit cost of $200,000 per MGD of pump capacity was used.

Table 23 Concept 6 Drainage Area Runoff Rates

Design Storm	Rainfall Depth (in)	Peak Runoff Rate (CFS)	Peak Runoff Rate (MGD)
2.33-year/24-hour	4.0	2.35	1.5
10-year/24-hour	6.0	12.05	7.8
25-year/24-hour	7.0	17.81	11.5
100-year/24-hour	10.0	41.2	26.6

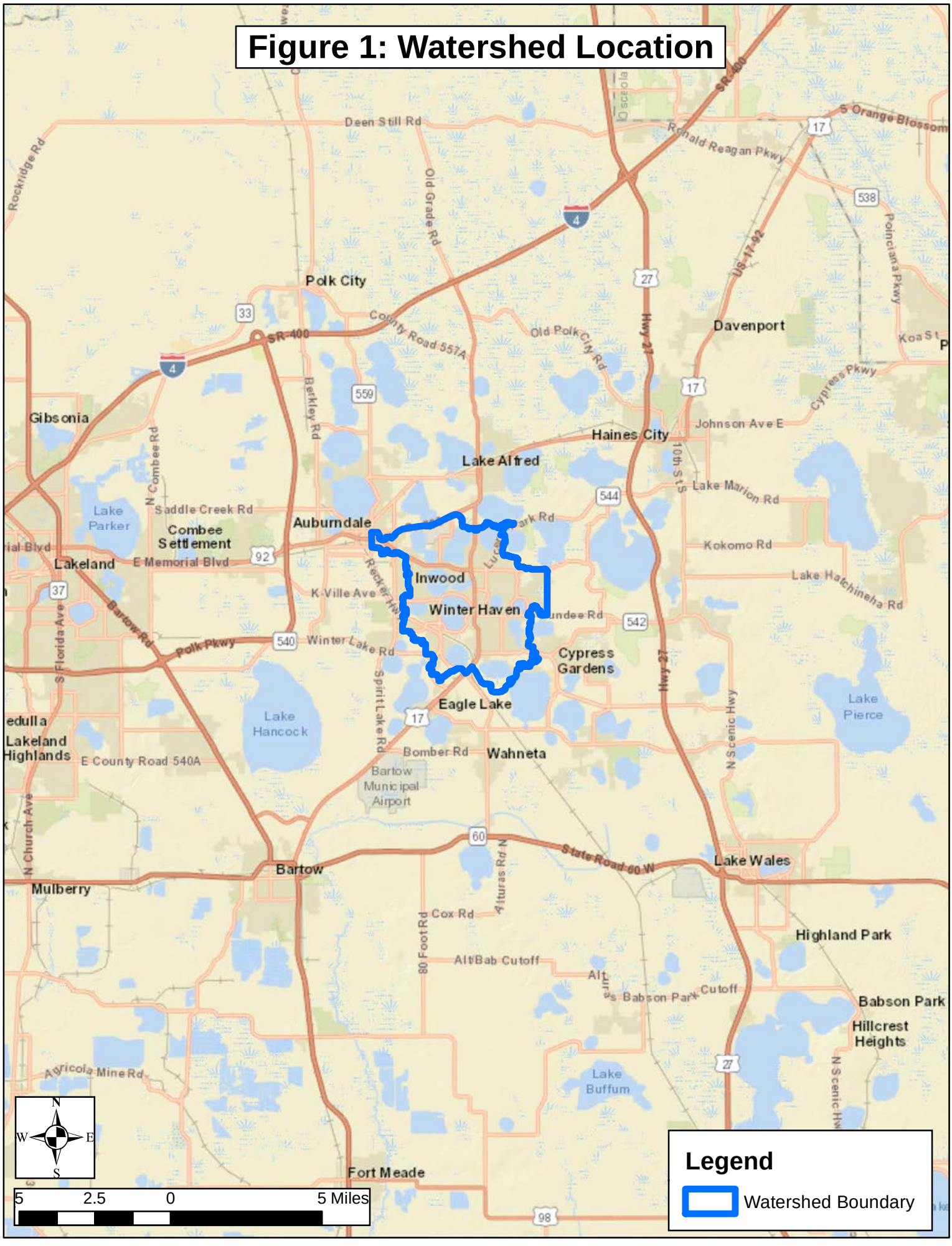
8.7 Cost-Benefit Summary (Water Quality)

The concepts described above provide a variety of benefits including improved flood protection, reduced discharge of pollutant loads, and increased infiltration. **Table 24** was developed to offer a summary comparison of the cost-benefits for the various concepts. The table focuses on benefits associated with water quality improvements based on SWFWMD's current pollutant loading reduction metrics.

Table 24 Cost-Benefit Summary (Water Quality/Infiltration)

		Treated Area (Acres/20-years)			Infiltration (Ac-Ft/20-years)			Total Nitrogen (Lbs/20-years)			Total Phosphorous (Lbs/20-years)			SWFWMD Maximum Effective Cost (Minimum of TN, TP and Acres Treated)	% SWFWMD Potential Reimbursment
Phase	Estimated Cost	Phase Total	Phase Unit Cost	SWFWMD Highly Effective Unit Cost	Phase Total	Phase Unit Cost	SWFWMD Highly Effective Unit Cost	Phase Total	Phase Unit Cost	SWFWMD Highly Effective Unit Cost	Phase Total	Phase Unit Cost	SWFWMD Highly Effective Unit Cost		
1A	$634,442	146	$4,345	$8,050	202	$3,141	-	1,098	$578	$176	171	$3,703	$1,498	$96,599	15%
1B	$348,097	42	$8,288	$8,050	62	$5,647	-	312	$1,114	$176	47	$7,380	$1,498	$27,499	8%
1C	$536,407	948	$566	$8,050	0	-	-	1,061	$506	$176	208	$2,583	$1,498	$93,335	17%
Overall 1	*$1,518,946*	*1,136*	*$1,337*	*$8,050*	*264*	*$5,762*	-	*2,852*	*$533*	*$176*	*452*	*$3,364*	*$1,498*	*$250,987*	*17%*
2A	$453,918	136	$3,338	$8,050	156	$2,918	-	760	$597	$176	118	$3,845	$1,498	$66,864	15%
2B	$290,534	116	$2,505	$8,050	93	$3,109	-	532	$546	$176	81	$3,579	$1,498	$46,812	16%
2C	$395,361	346	$1,143	$8,050	134	$2,940	-	730	$542	$176	113	$3,495	$1,498	$64,206	16%
Overall 2	*$1,139,814*	*598*	*$1,906*	*$8,050*	*498*	*$2,289*	-	*2,664*	*$428*	*$176*	*412*	*$2,768*	*$1,498*	*$234,393*	*21%*
3A	$381,433	158	$2,414	$8,050	78	$4,907	-	400	$955	$176	61	$6,251	$1,498	$35,159	9%
3B	$503,463	536	$939	$8,050	169	$2,982	-	870	$579	$176	137	$3,664	$1,498	$76,549	15%
3C	$428,087	102	$4,197	$8,050	139	$3,077	-	717	$597	$176	109	$3,913	$1,498	$63,137	15%
3 (A-C)	*$1,312,983*	*796*	*$1,649*	*$8,050*	*641*	*$2,047*	-	*3,304*	*$397*	*$176*	*516*	*$2,545*	*$1,498*	*$290,711*	*22%*
3D	$762,744	150	$5,085	$8,050	211	$3,614	-	1,147	$665	$176	178	$4,292	$1,498	$100,943	13%
3E	$1,335,278	462	$2,890	$8,050	406	$3,286	-	2,096	$637	$176	320	$4,169	$1,498	$184,462	14%
3 (D-E)	*$2,098,022*	*612*	*$3,428*	*$8,050*	*668*	*$3,141*	-	*3,489*	*$601*	*$176*	*535*	*$3,921*	*$1,498*	*$307,050*	*15%*
3F	$1,520,427	444	$3,424	$8,050	446	$3,406	-	2,178	$698	$176	350	$4,338	$1,498	$191,664	13%
Overall 3	*$4,931,432*	*1,852*	*$2,663*	*$8,050*	*1,756*	*$2,809*	-	*8,971*	*$550*	*$176*	*1,401*	*$3,519*	*$1,498*	*$789,425*	*16%*
4A	$1,716,711	990	$1,734	$8,050	591	$2,904	-	3,047	$563	$176	465	$3,696	$1,498	$268,180	16%
4B	$1,766,140	792	$2,230	$8,050	627	$2,817	-	3,231	$547	$176	509	$3,468	$1,498	$284,358	16%
Overall 4	*$3,482,852*	*1,782*	*$1,954*	*$8,050*	*1,498*	*$2,325*	-	*7,722*	*$451*	*$176*	*1,194*	*$2,916*	*$1,498*	*$679,536*	*20%*
5A	$997,444	454	$2,197	$8,050	689	$1,448	-	3,552	$281	$176	560	$1,782	$1,498	$312,618	31%
6A	$2,636,033	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 1: Watershed Location



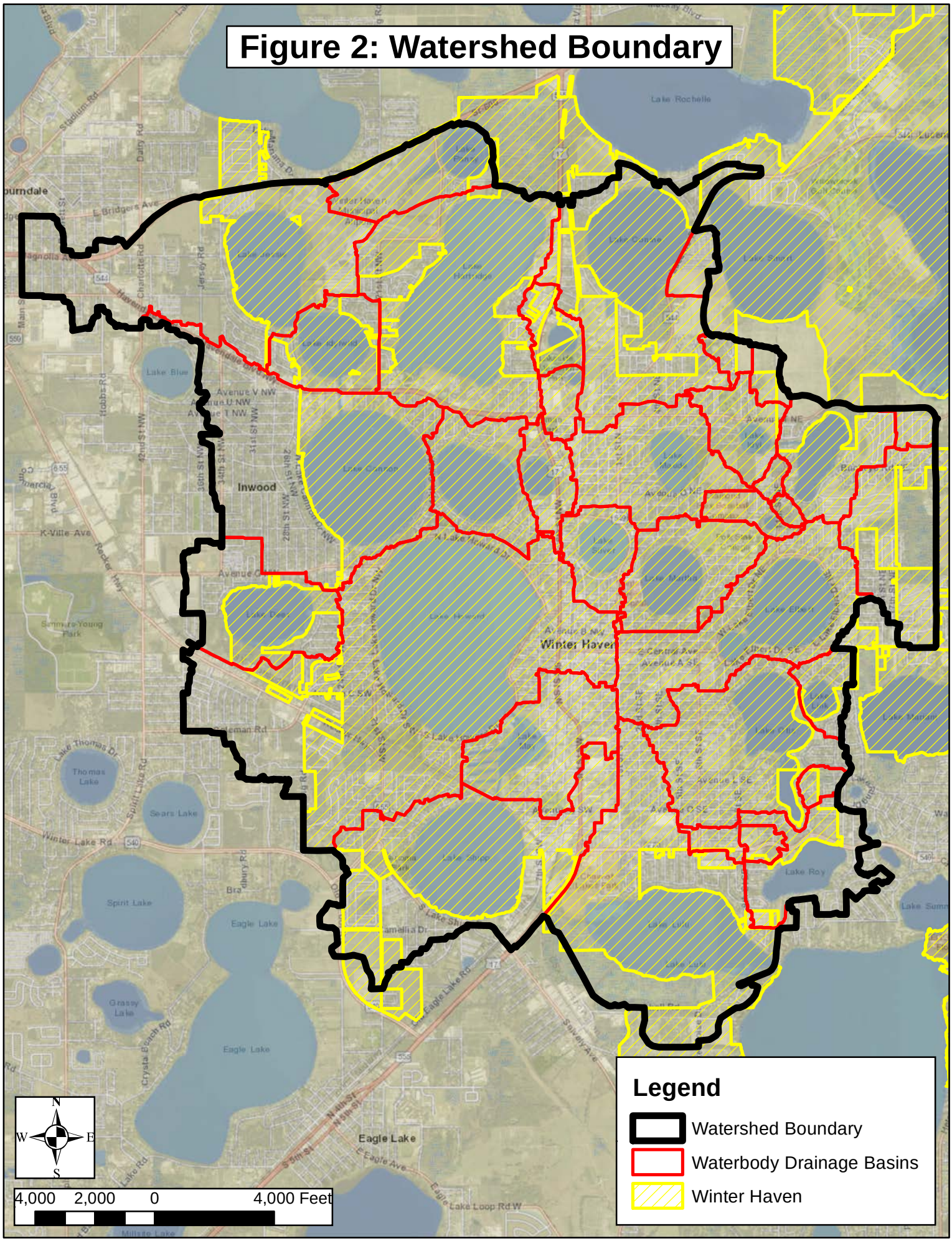


Figure 2: Watershed Boundary
Lake Rochelle
Lake Blue
Inwood
Winter Haven
Lake Howard
Lake Thomas
Thomas Lake
Sears Lake
Spirit Lake
Eagle Lake
Grassy Lake
Lake Roy
Lake Summit
Eagle Lake
Legend
Watershed Boundary
Waterbody Drainage Basins
Winter Haven
N
W
E
S
4,000 2,000 0 4,000 Feet

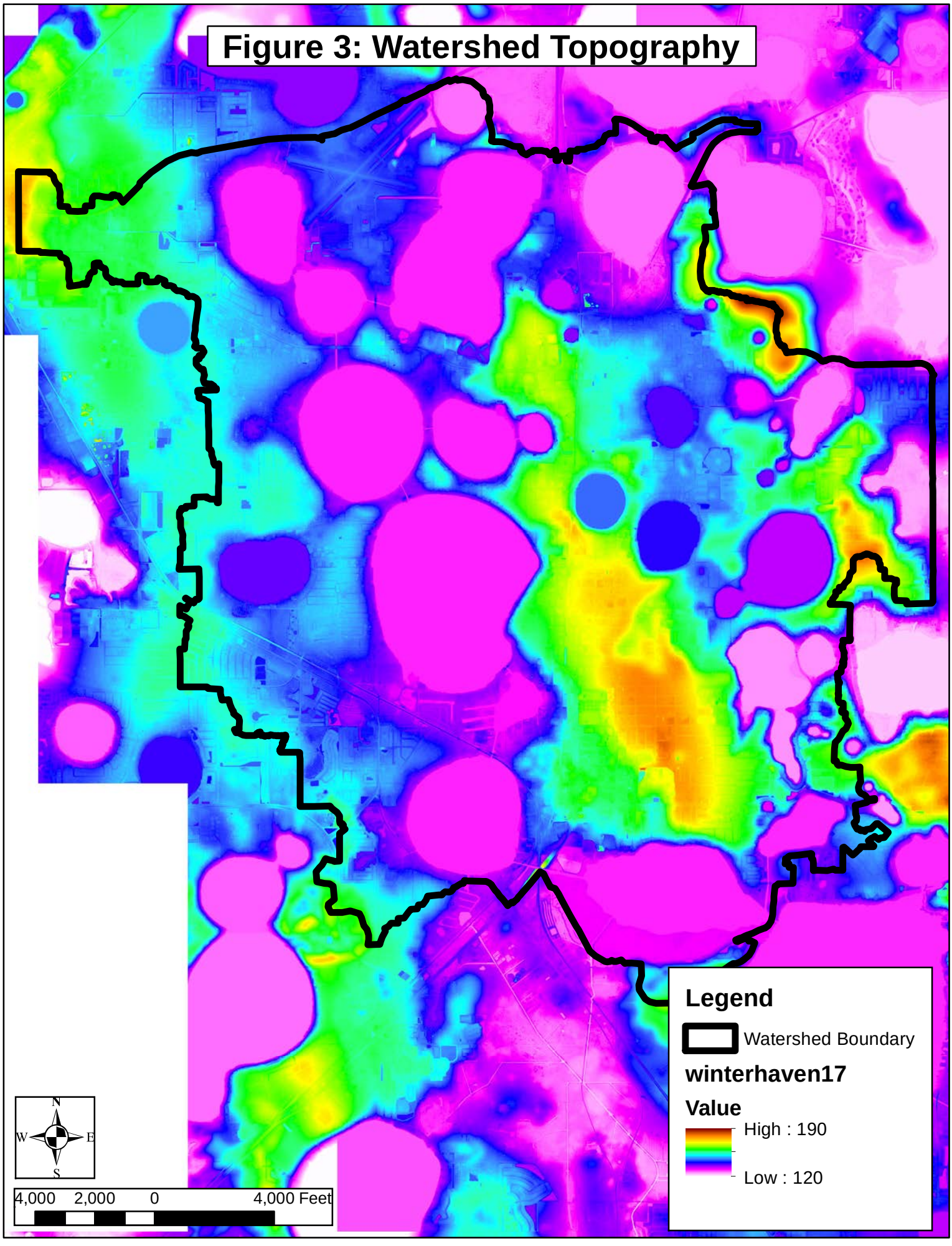


Figure 3: Watershed Topography
Legend
Watershed Boundary
winterhaven17
Value
High : 190
Low : 120
N
W
E
S
4,000 2,000 0 4,000 Feet

Figure 4: Subbasin Delineation

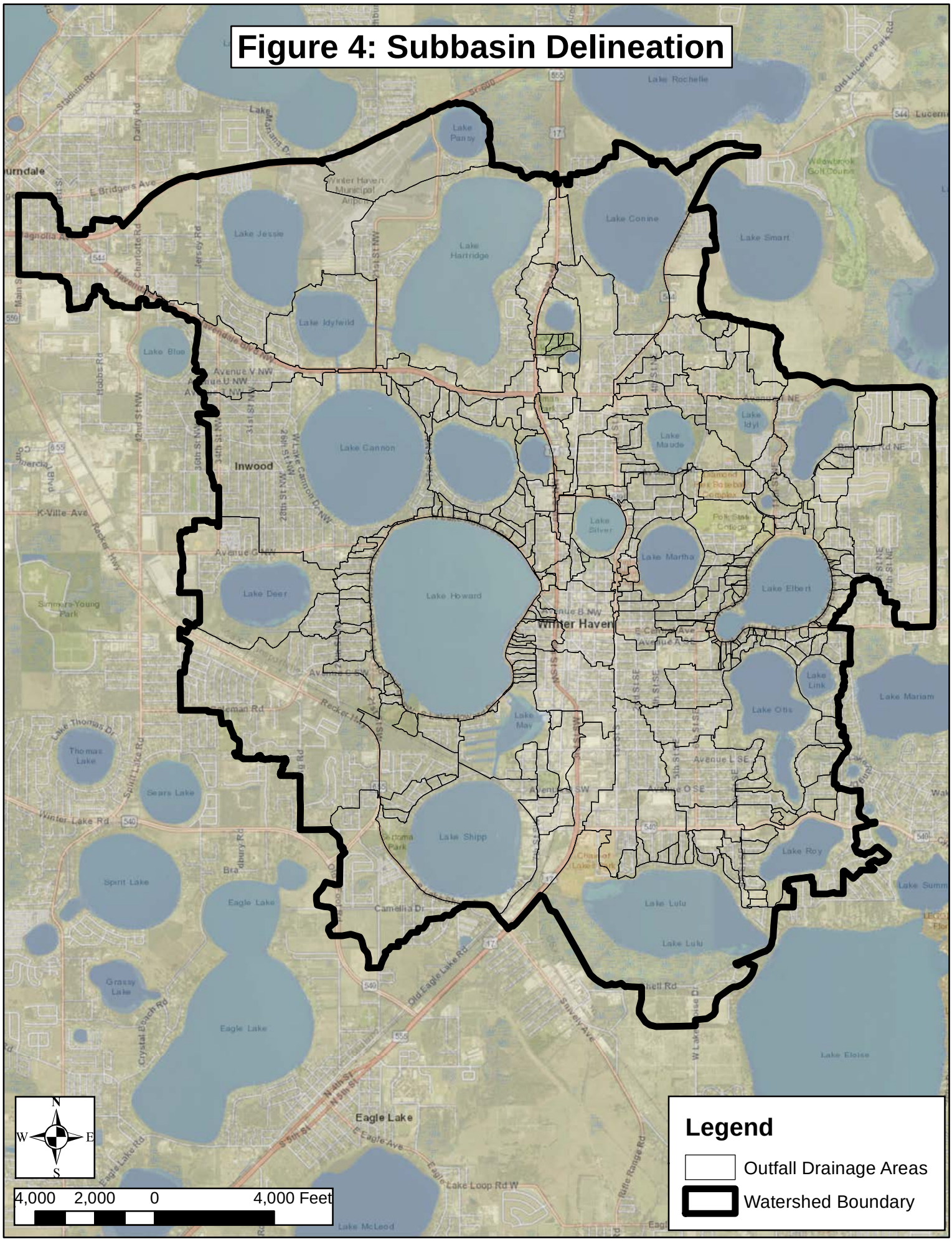


Figure 5: Landuse Coverage

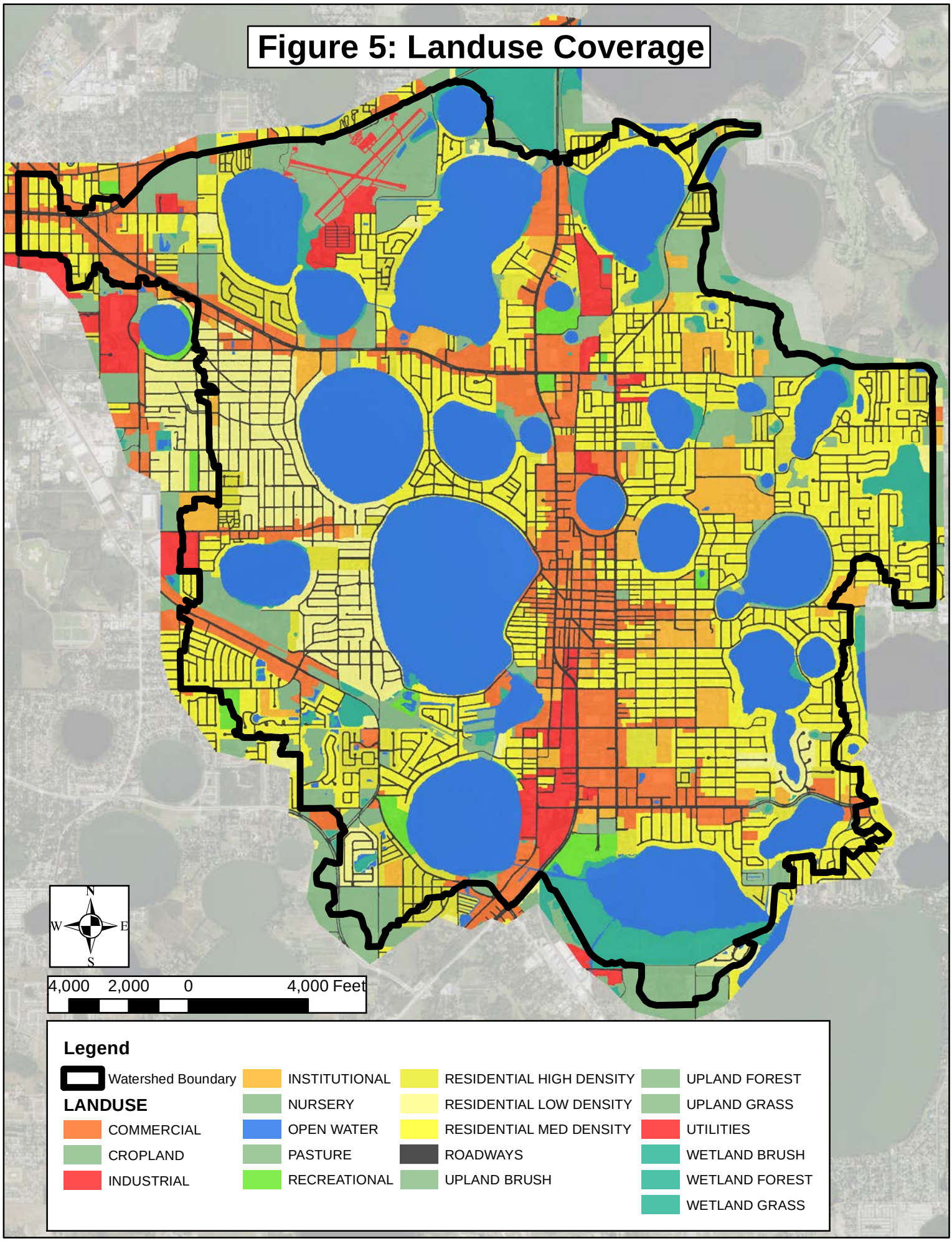


Figure 6: Hydrologic Soil Coverage

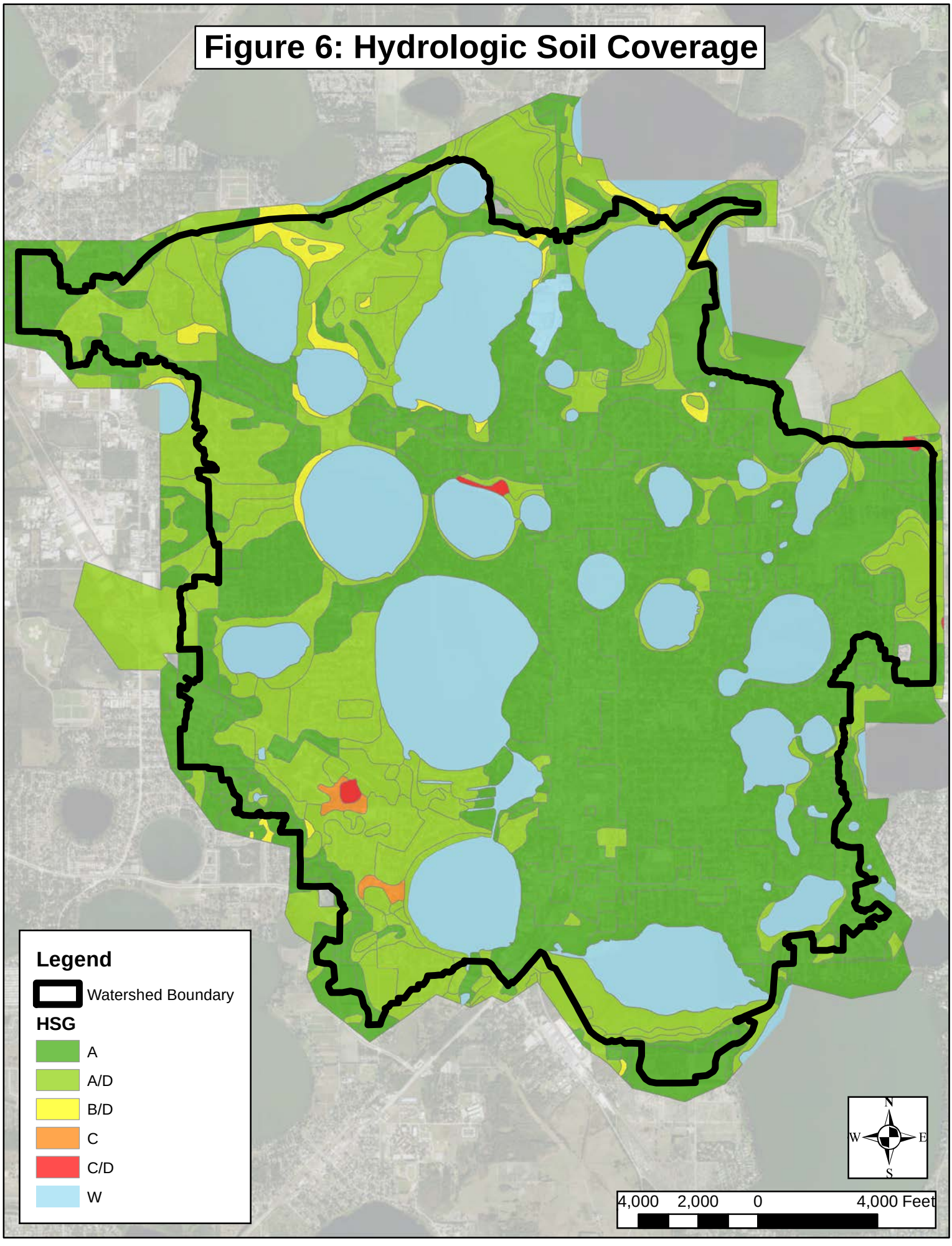


Figure 7: ERP Coverage

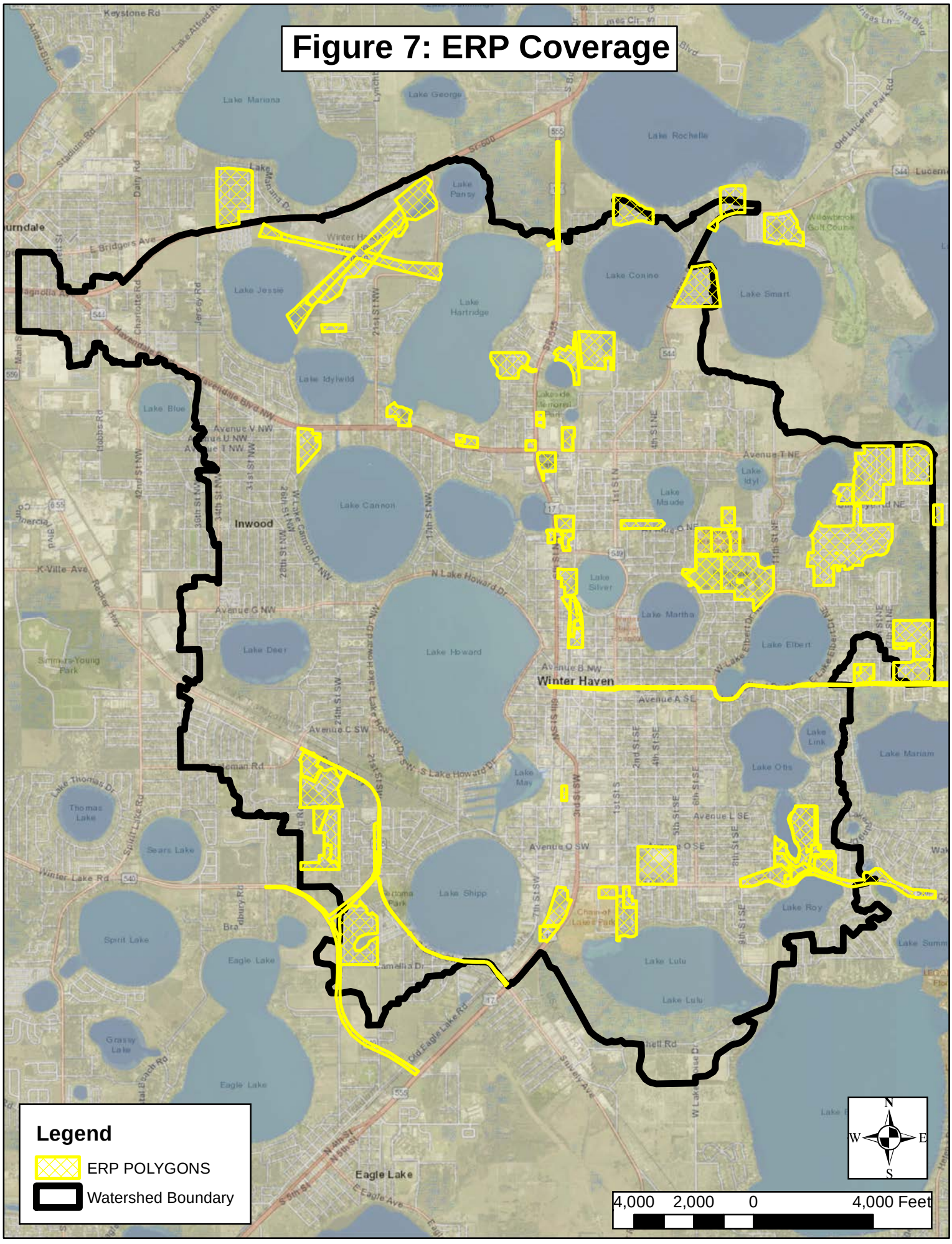


Figure 8: FEMA Coverage

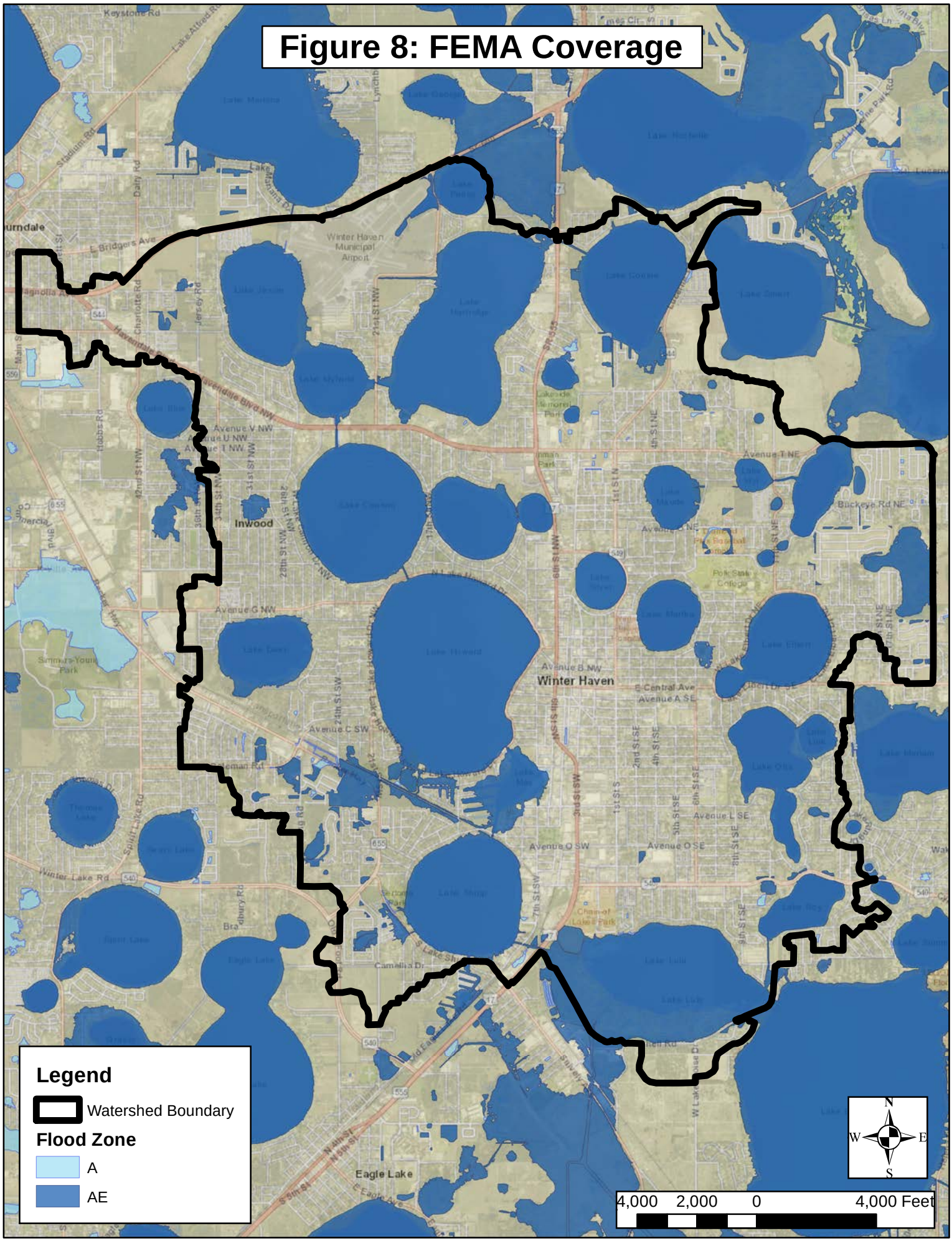

Legend
Watershed Boundary
Flood Zone
A
AE
N
W
E
S
4,000 2,000 0 4,000 Feet
Winter Haven
Inwood
Eagle Lake
Winter Haven Municipal Airport
Lake Howard
Lake Conine
Lake Hamilton
Lake Jessie
Lake Eloise
Lake Shipp
Lake Lulu
Lake Maude
Lake Silver
Lake Ellen
Lake Otis
Lake Miriam
Lake Mariana
Lake Alfred Rd
Keystone Rd
Stadium Rd
Dairy Rd
E Bridgers Ave
Havendale Blvd NW
Avenue V NW
Avenue U NW
Avenue T NW
Avenue G NW
Avenue C SW
Avenue B NW
Avenue T NE
Avenue A SE
Avenue L SE
Avenue O SW
Avenue O SE
Buckeye Rd NE
Winter Lake Rd
Camellia Dr
Old Eagle Lake Rd
Polk State College
Summers-Young Park
Chain of Lakes Park
Lakeside Memorial Park
Inman Park
Jersey Rd
Charlotte Rd
Hobbs Rd
Lake Hwy
Lake Rochelle
Lake Gibson
Lake Smart
Lake Merlin
Lake Parker
Lake Garfield
Lake Swan
Lake Ethel
Lake Hartridge
Lake Cannon
Lake Eva
Lake Dexter
Lake Roy
Lake Juno
Lake Eagle
Lake Lily
Lake Idylwild
Lake Blue
Lake Myrtle
Lake Lena
Lake Mirror
Lake Rochelle
Lake Howard
Lake Shipp
Lake Lulu
Lake Lily
Lake Eloise
Lake Jessie
Lake Hamilton
Lake Conine
Lake Gibson
Lake Smart
Lake Parker
Lake Garfield
Lake Swan
Lake Ethel
Lake Miriam
Lake Otis

Figure 9: Waterbodies

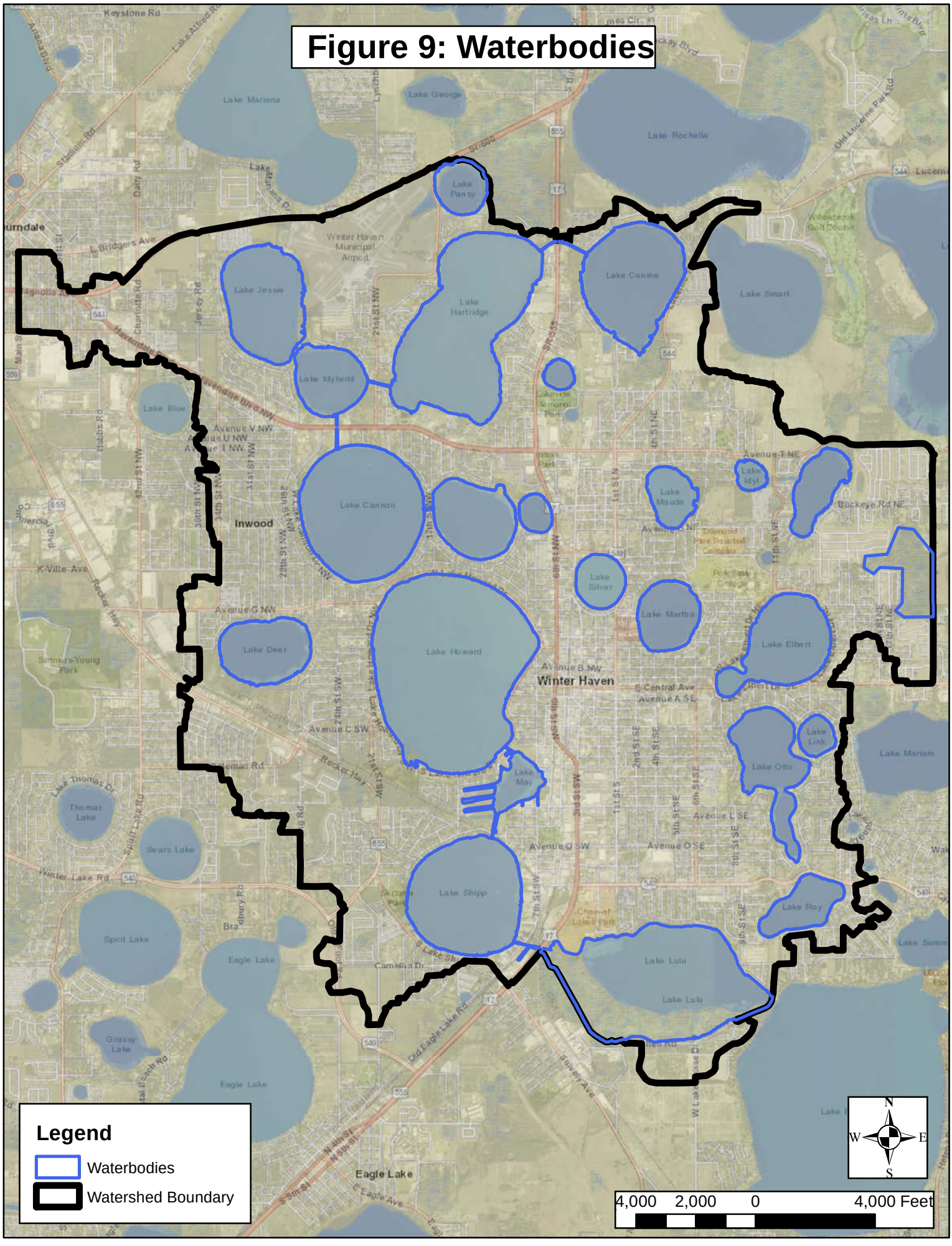


Figure 10: Hydraulic Network

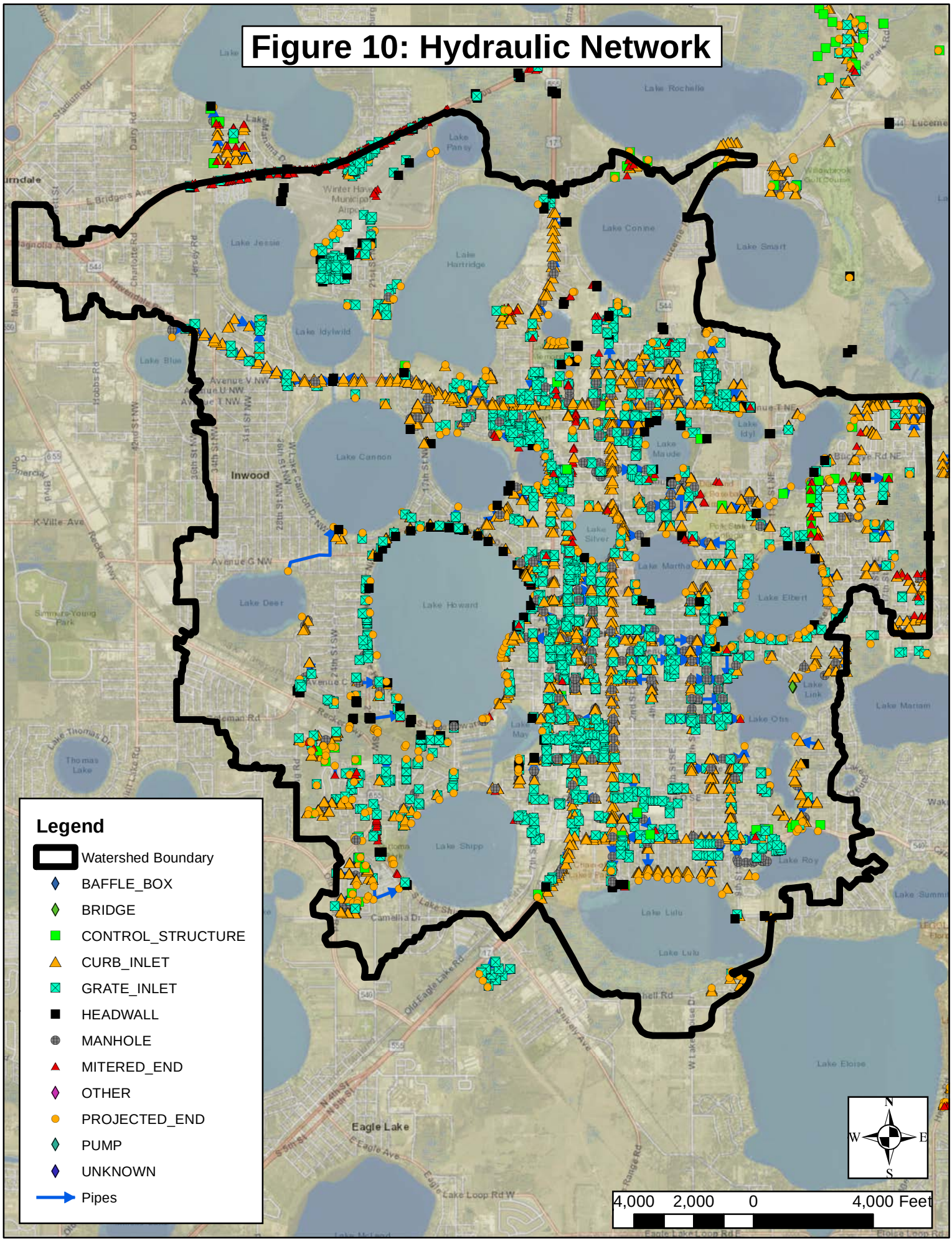


Figure 11: Model Areas

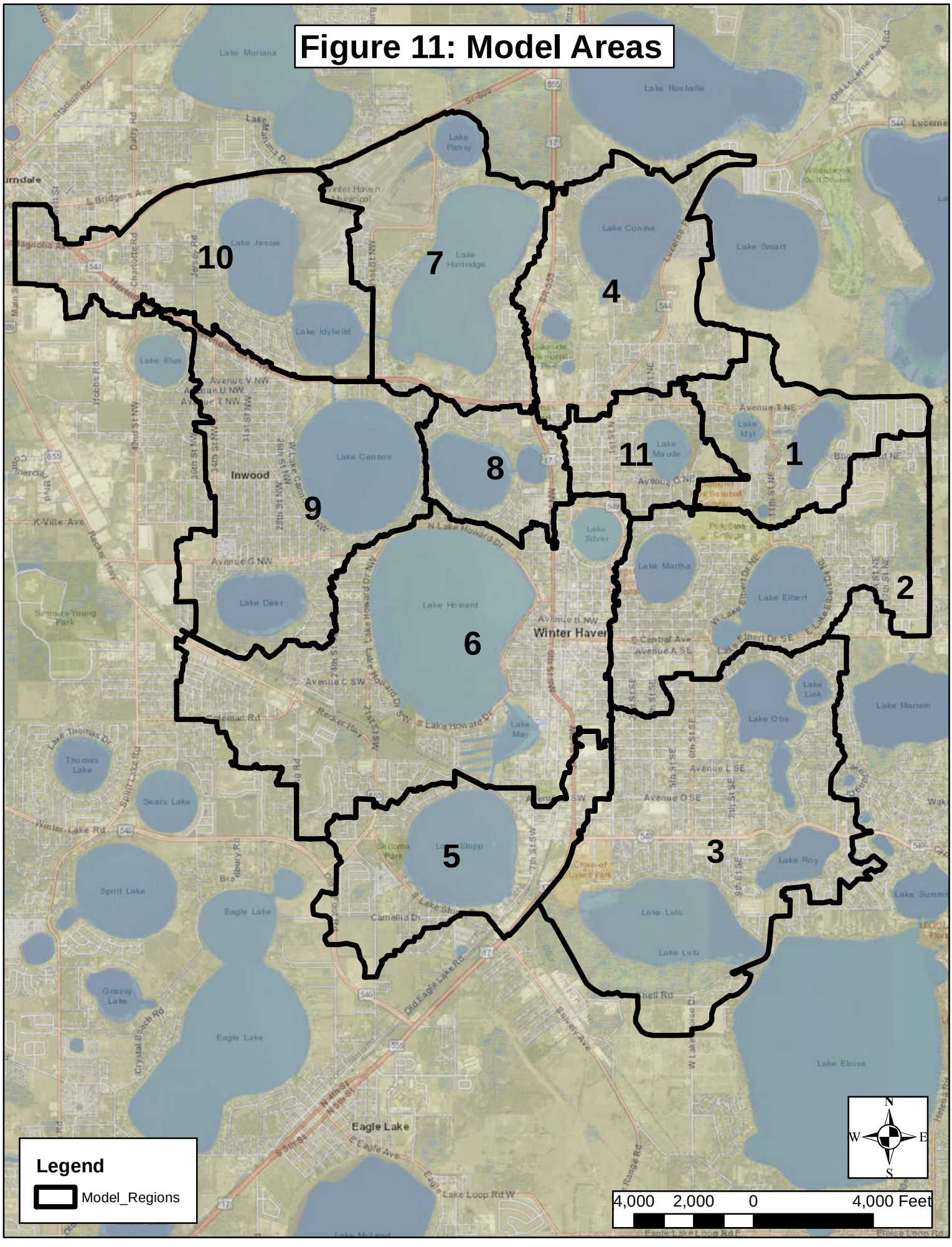


Figure 12: Inundation (1-in/1-hr Storm)

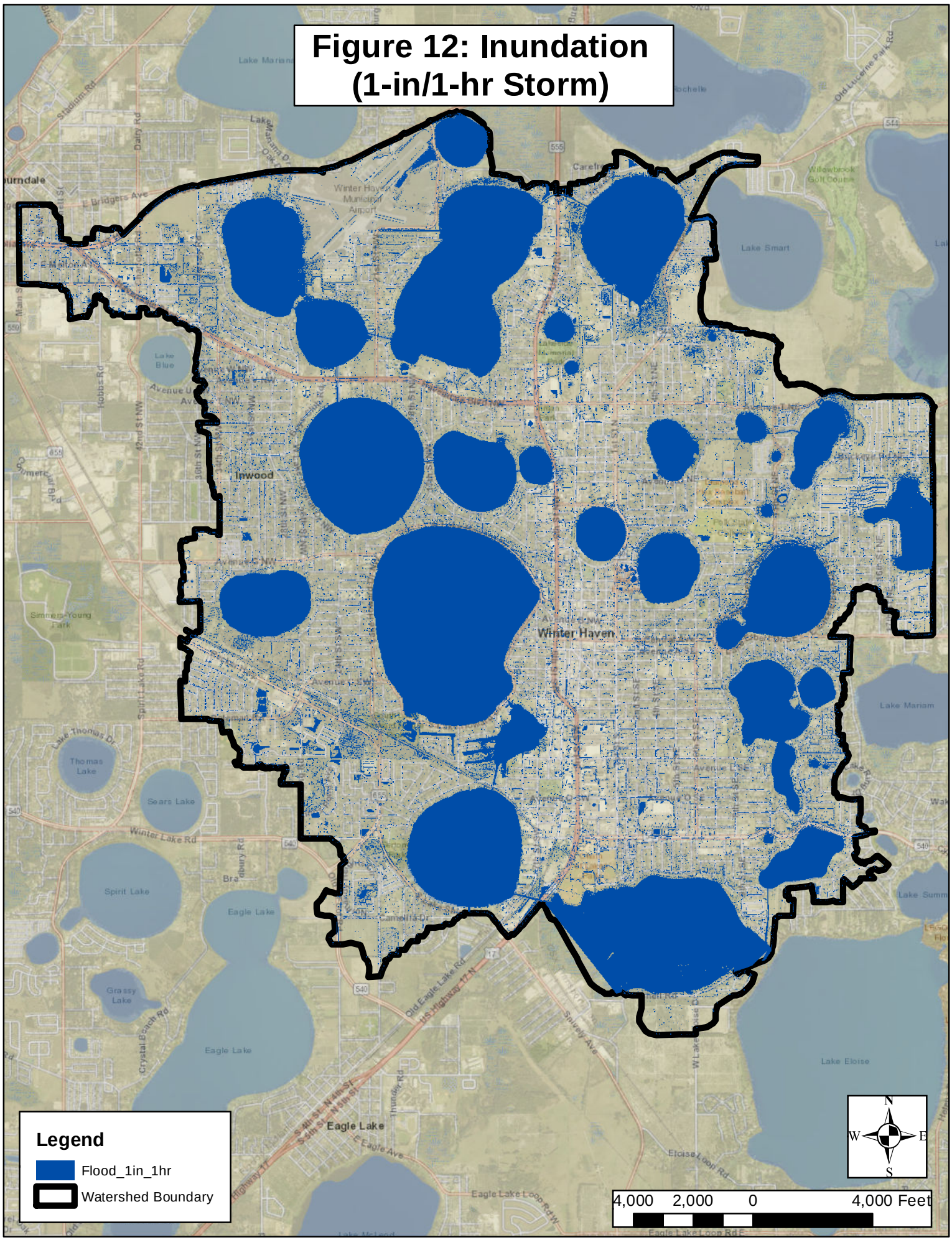


Figure 13: Inundation (3-in/1-hr Storm)

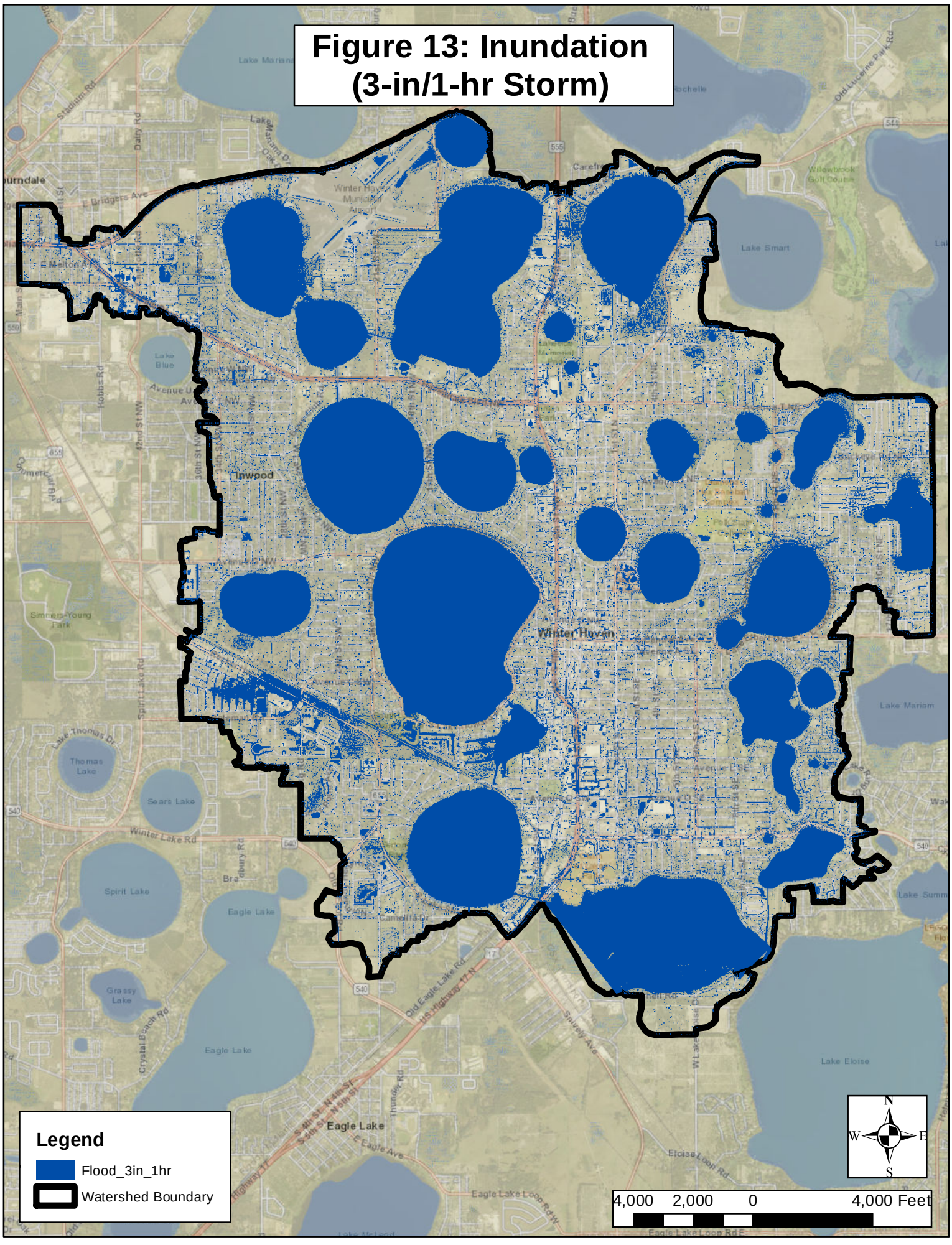


Figure 14: Inundation (2.33-yr/24-hr Storm)

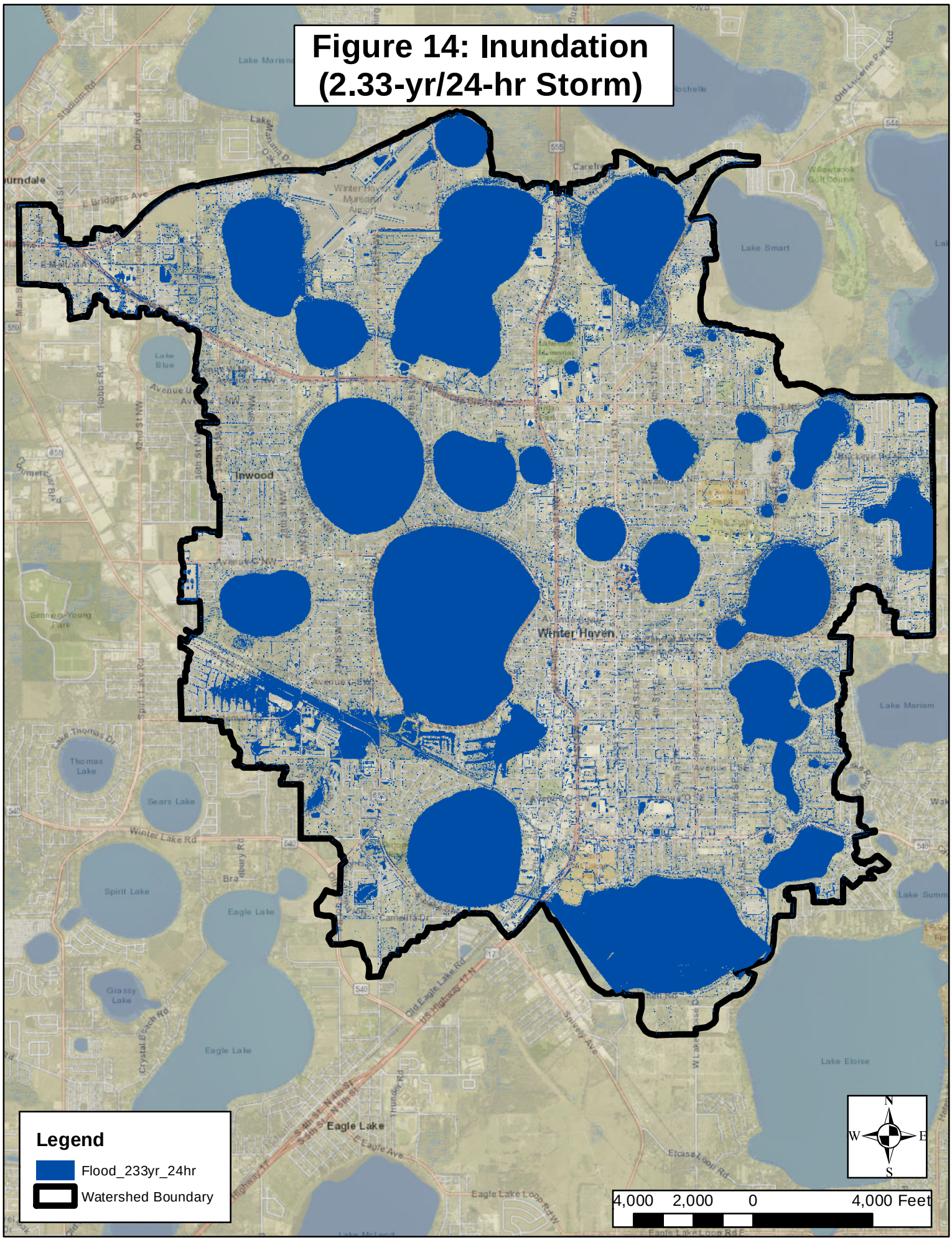


Figure 15: Inundation (10-yr/24-hr Storm)

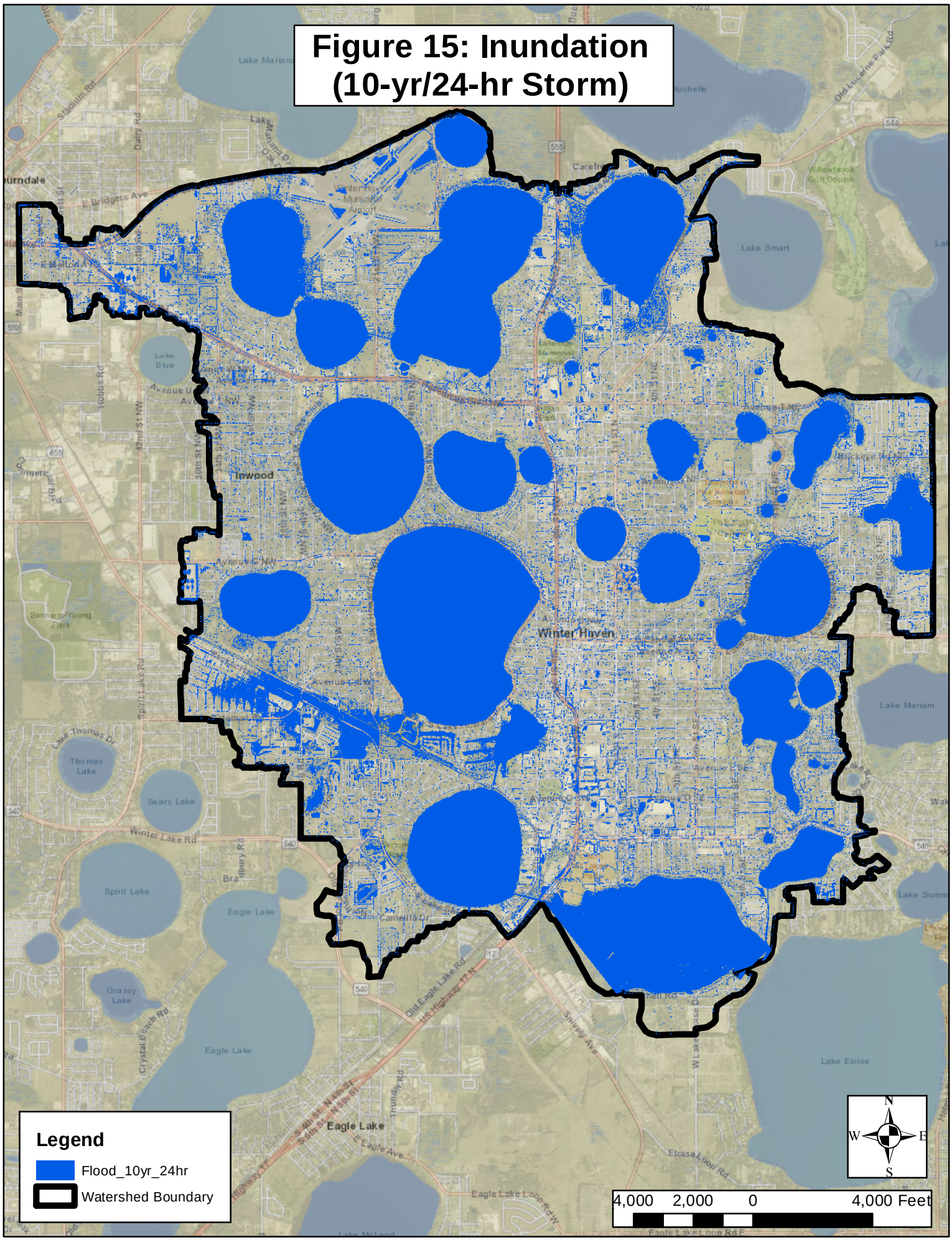


Figure 16: Inundation (25-yr/24-hr Storm)

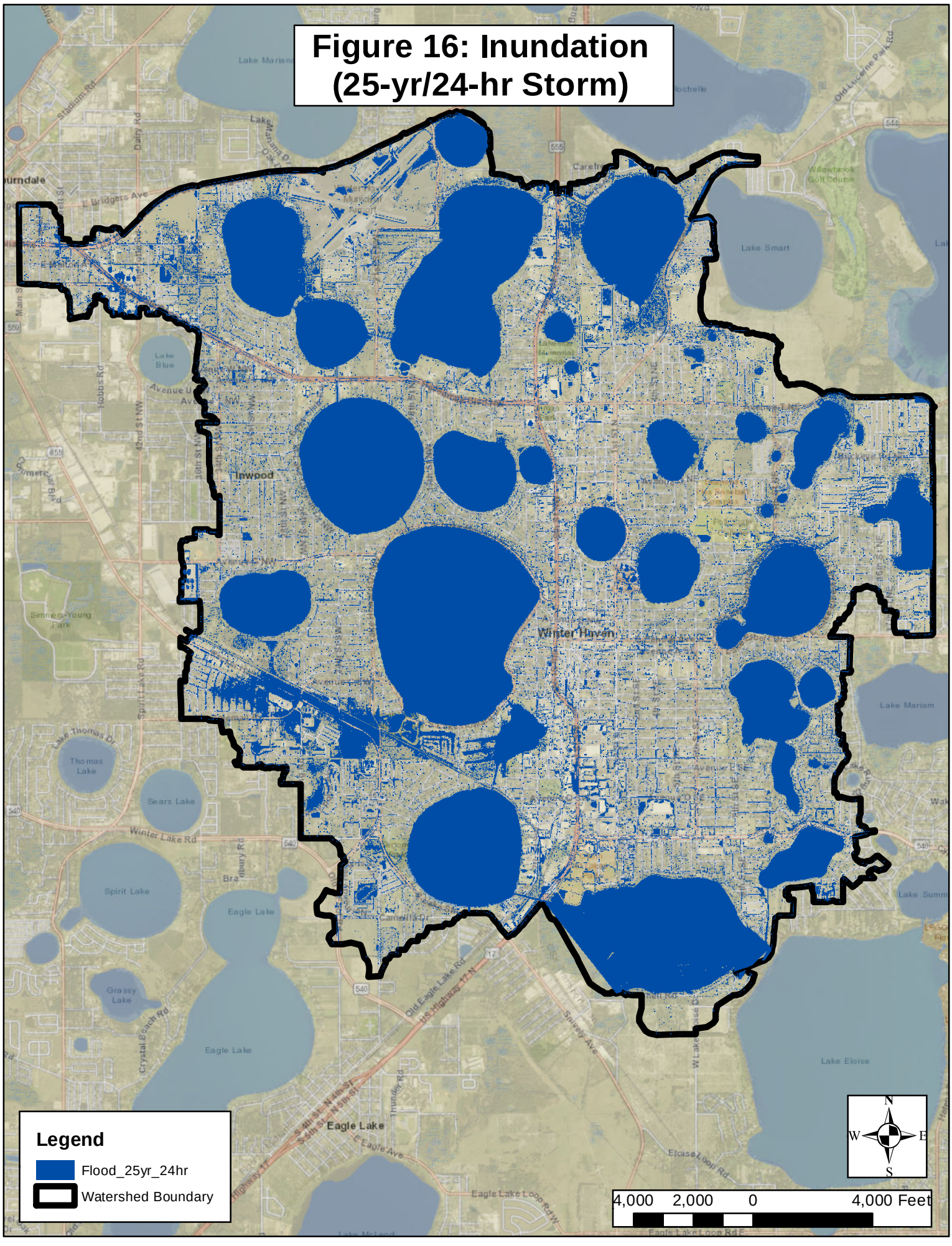


Figure 17: Inundation (100-yr/24-hr Storm)

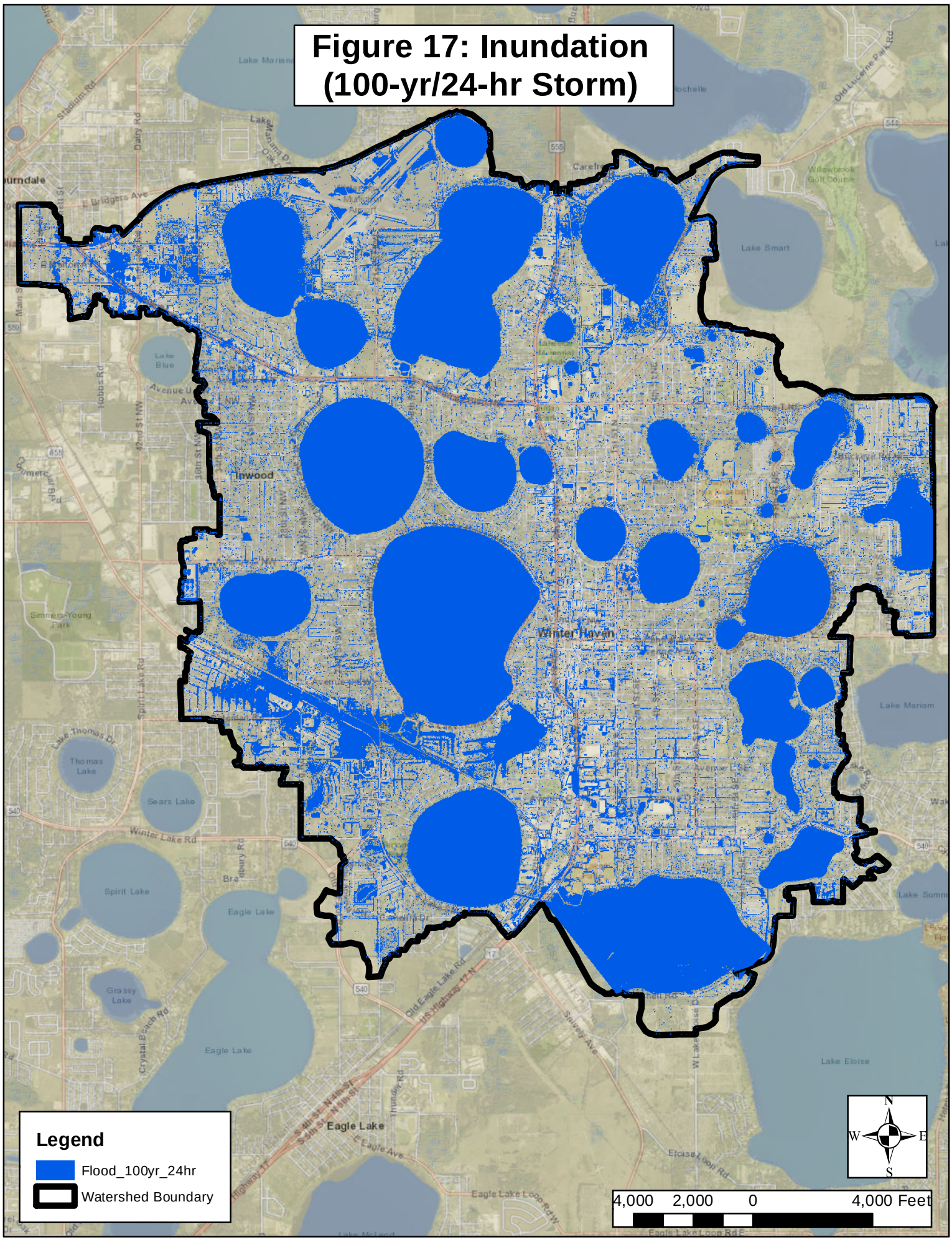


Figure 18: BMP Areas

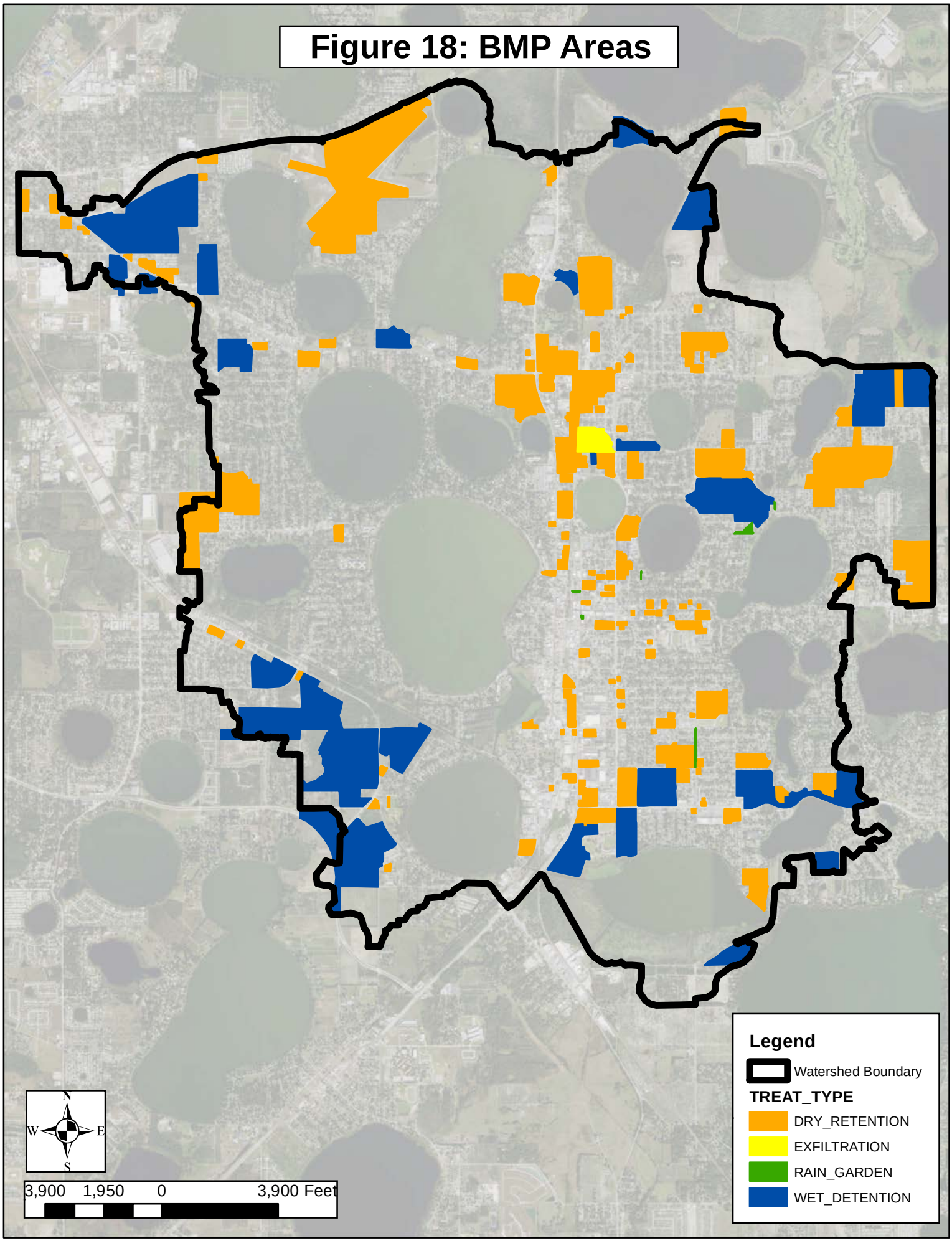


Figure 19: TN Hot Spots

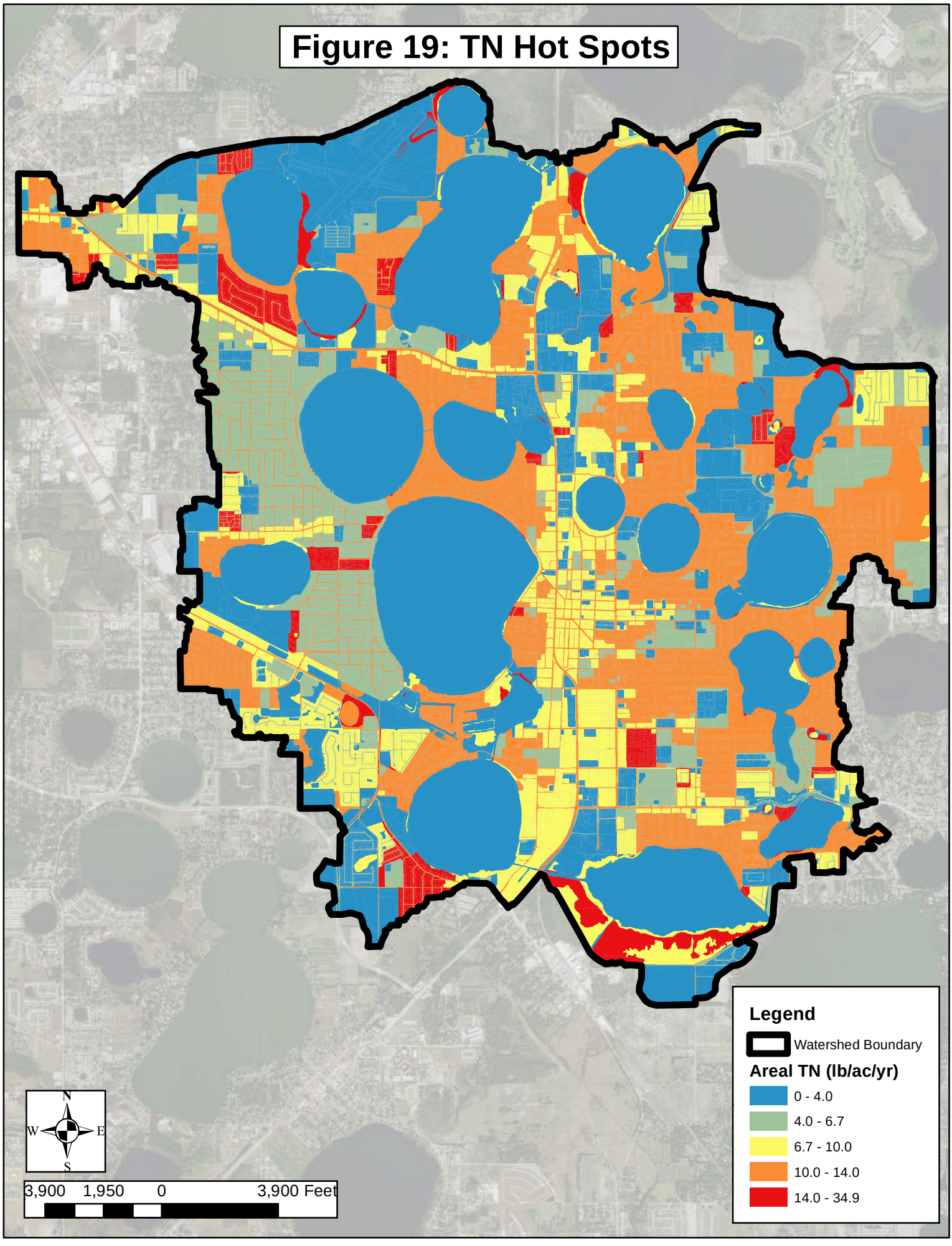


Figure 20: TP Hot Spots

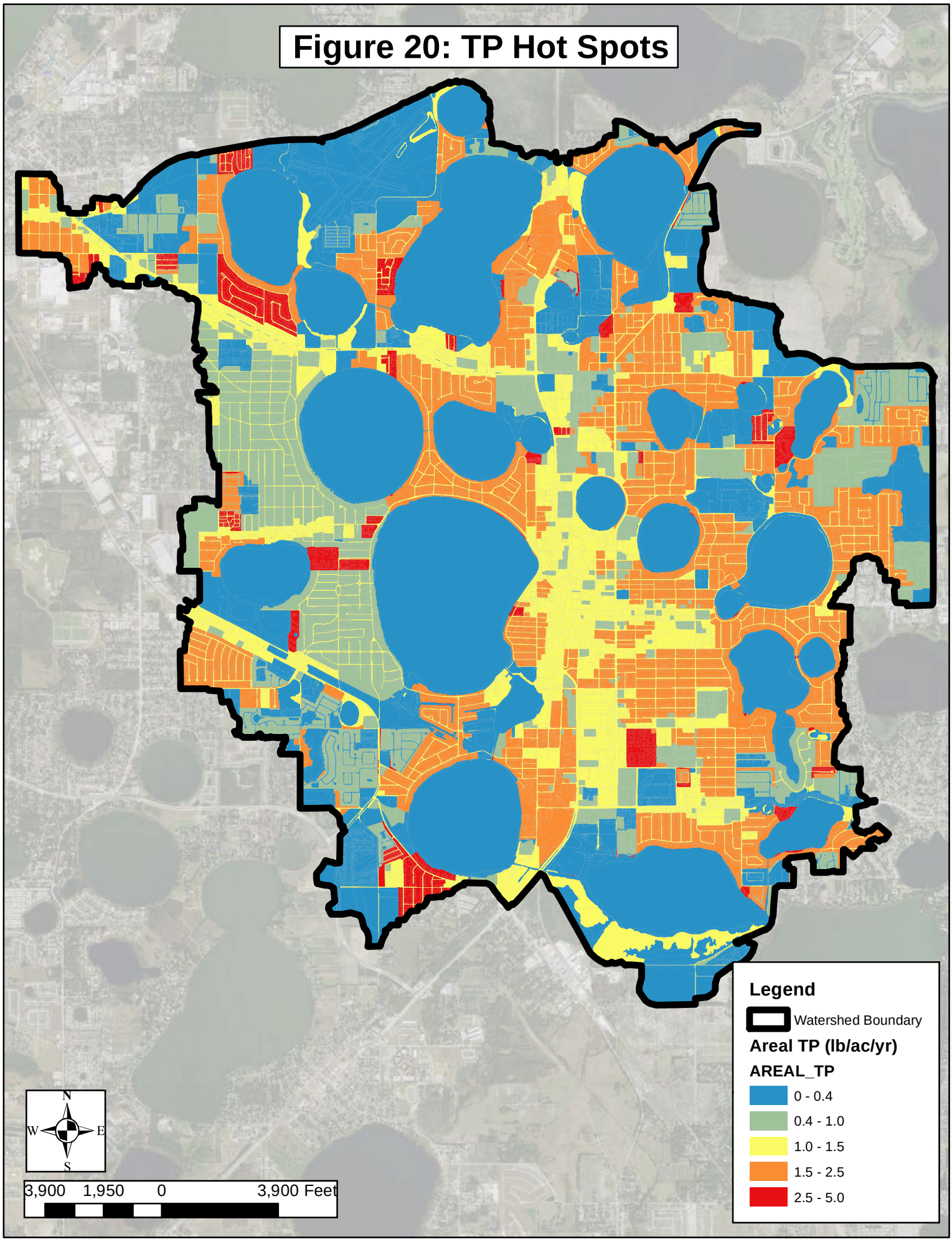


Figure 21: TSS Hot Spots

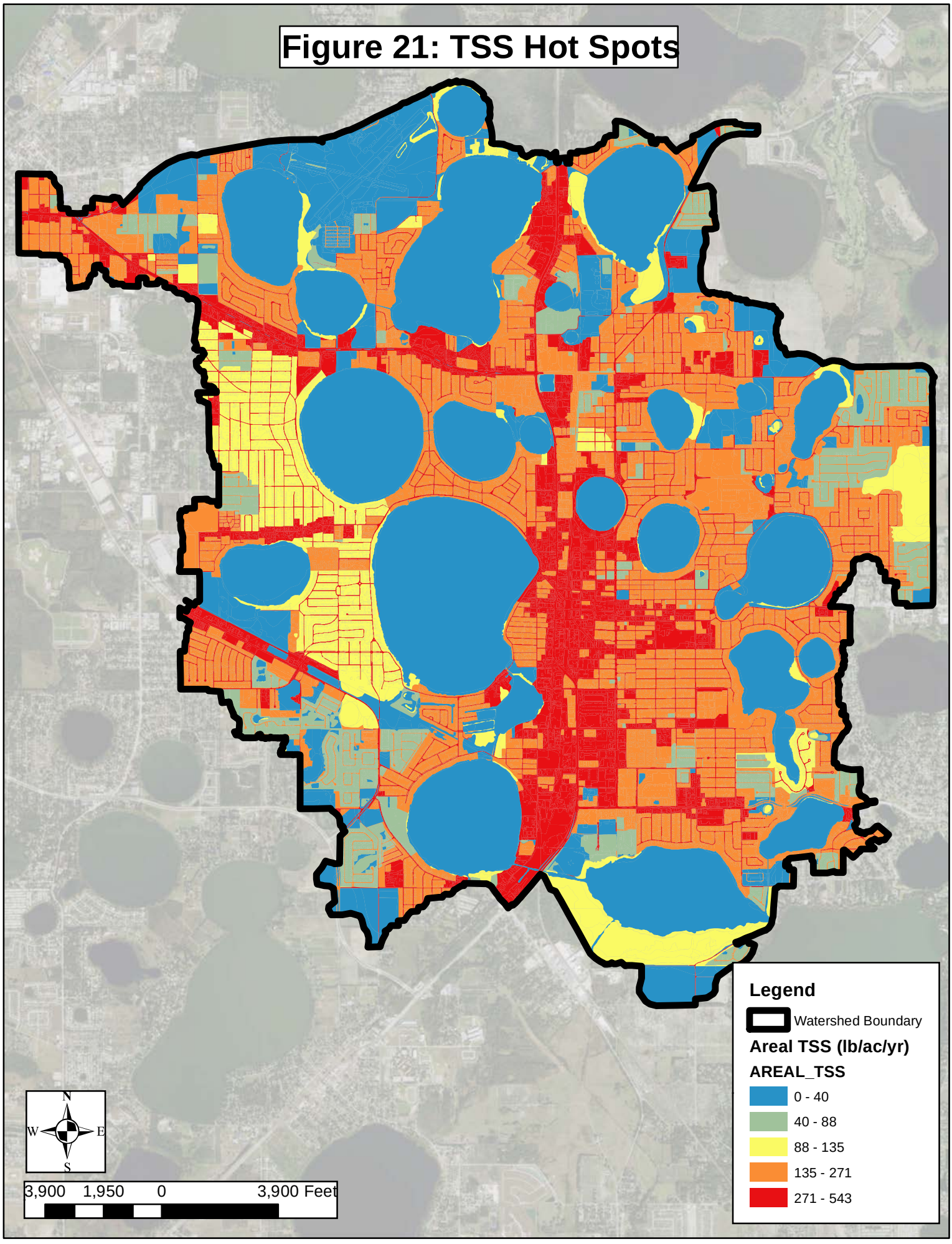


Figure 22: TN Outfalls

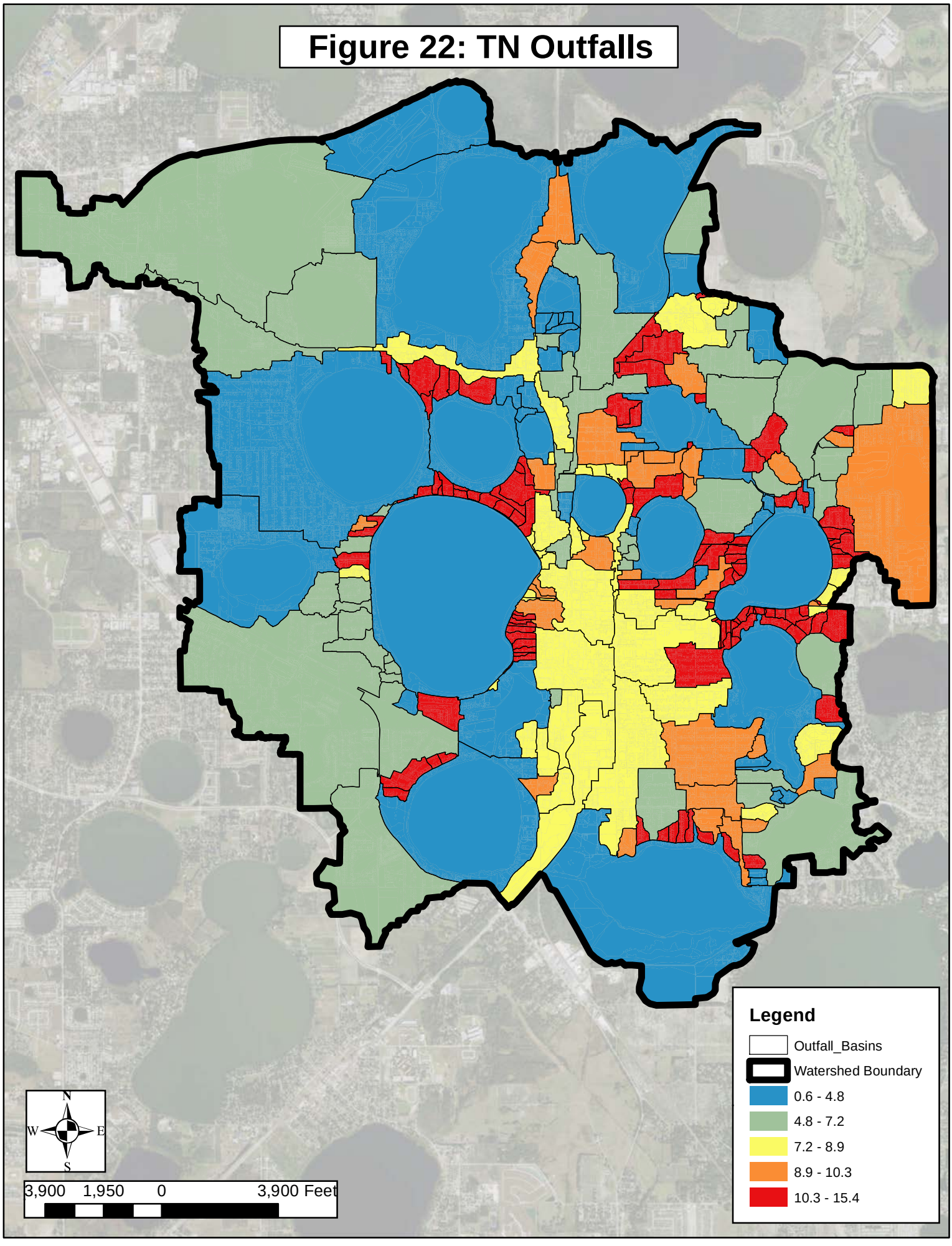


Figure 23: TP Outfalls

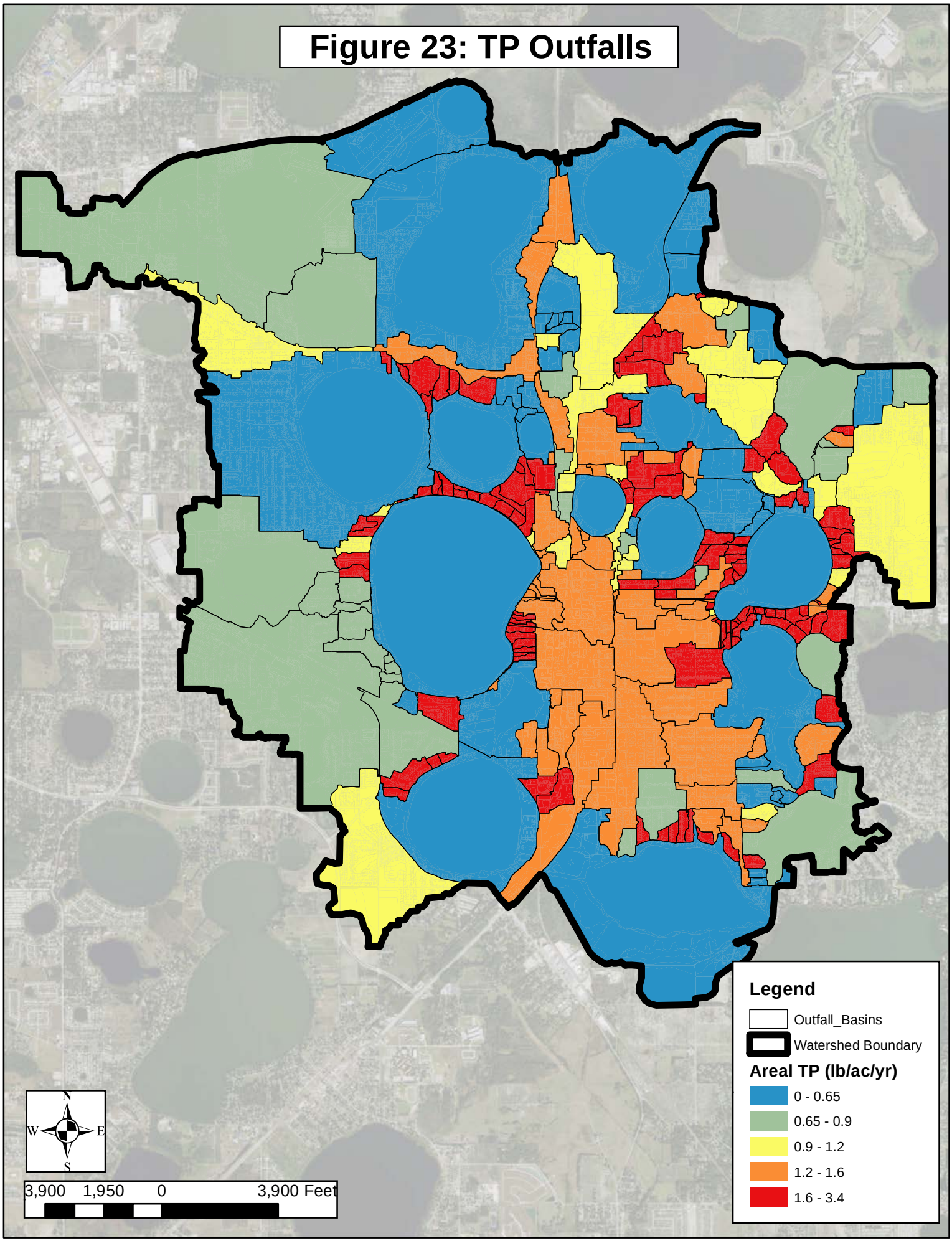


Figure 24: TSS Outfalls

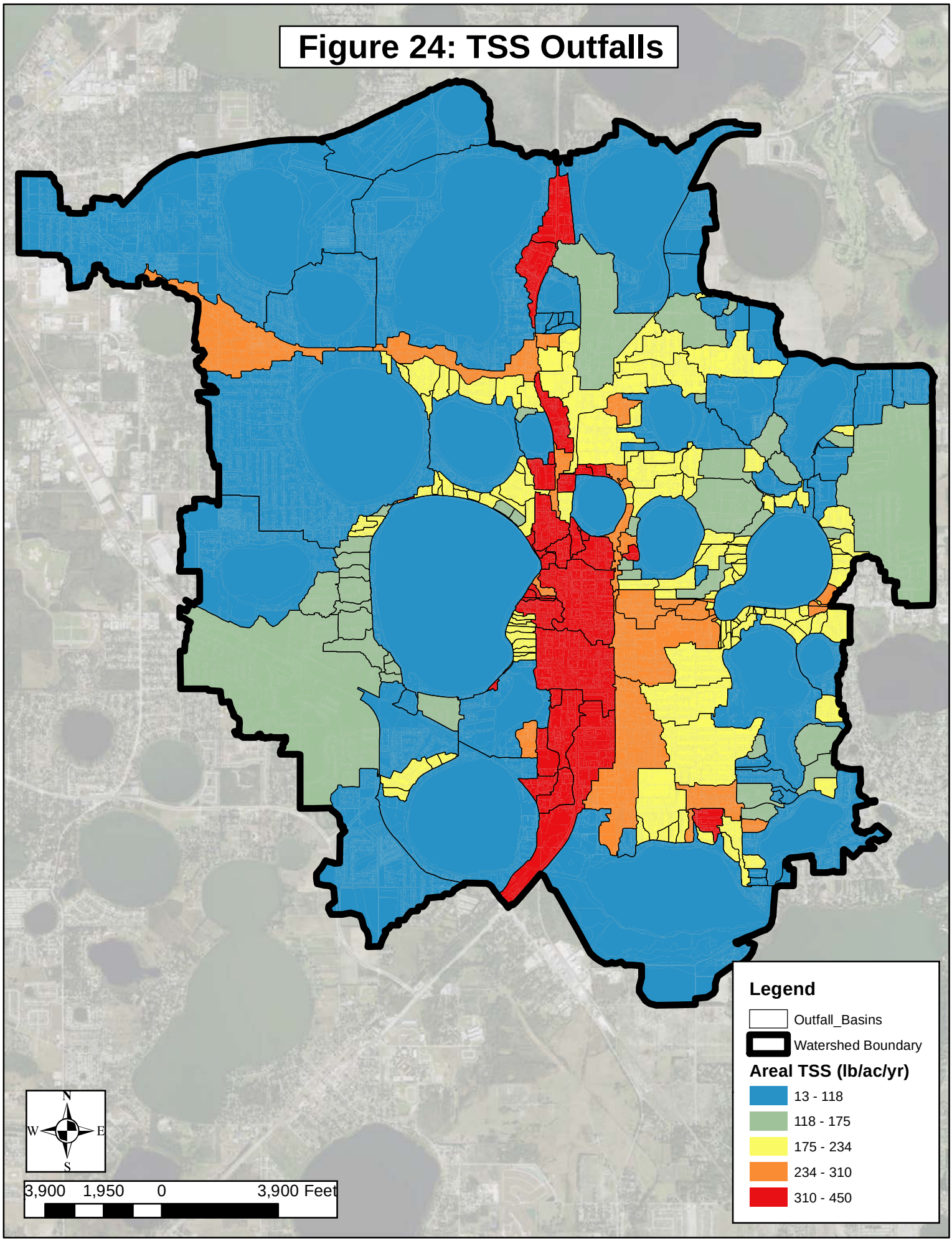


Figure 25: TN Lakes

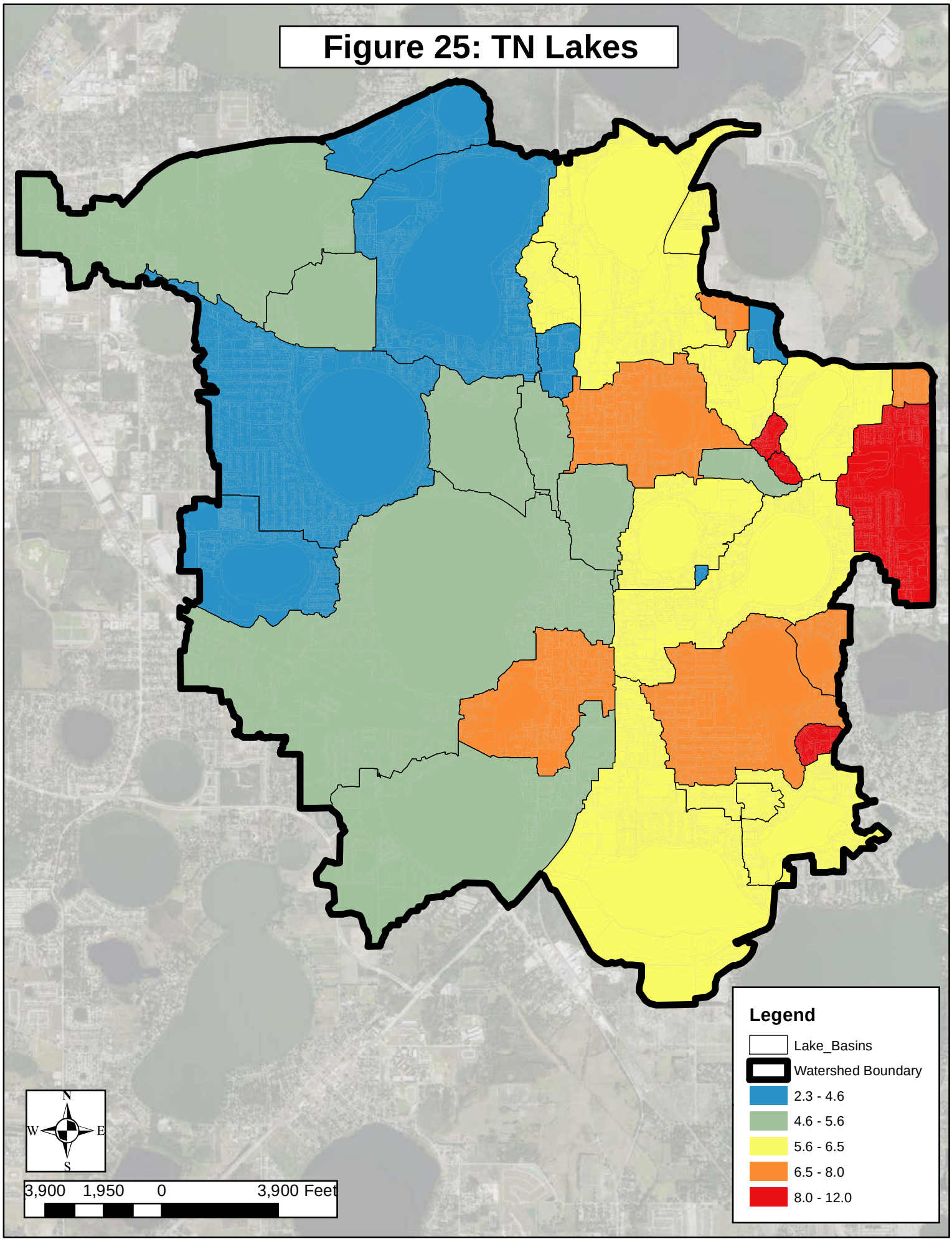


Figure 26: TP Lakes

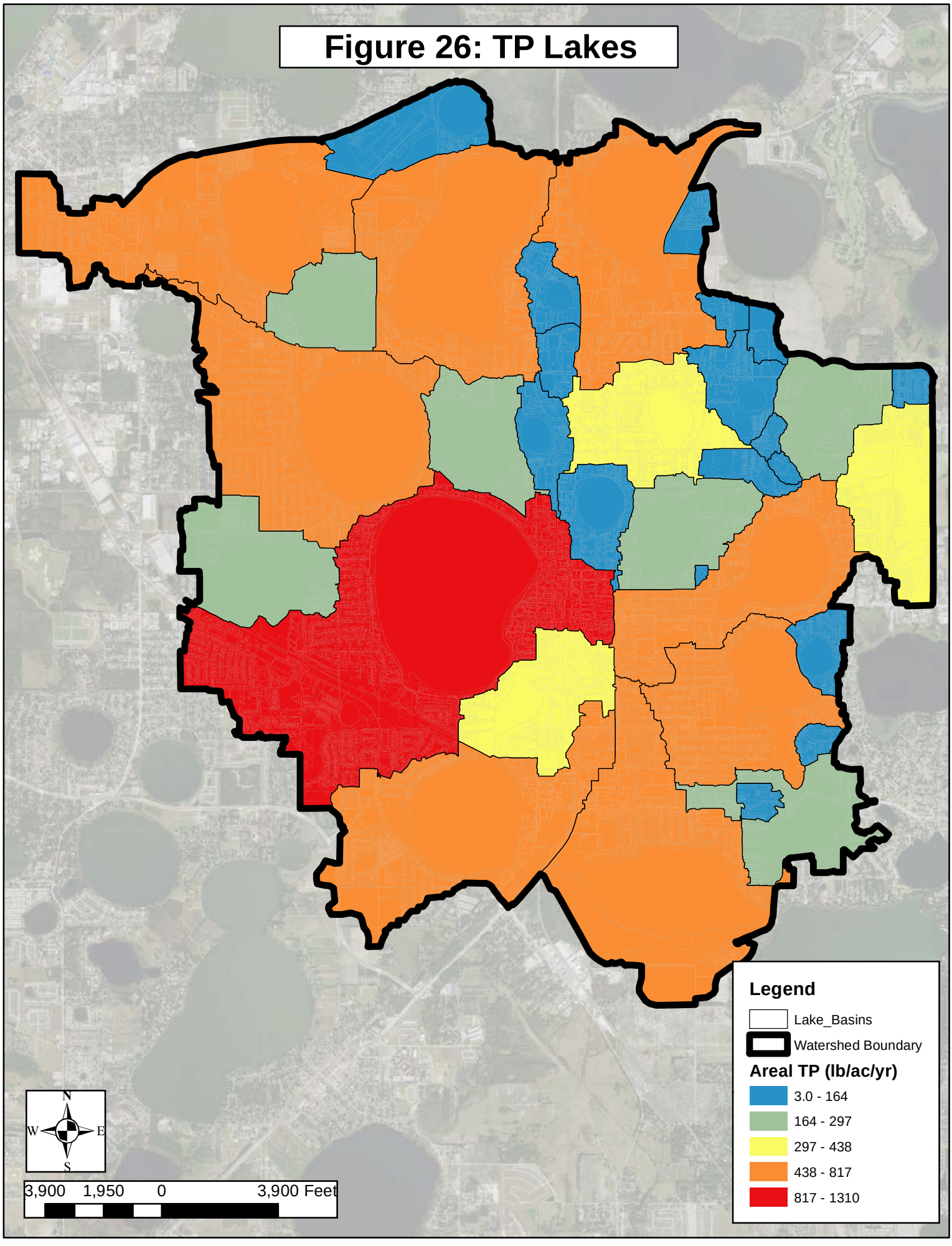


Figure 27: TSS Lakes

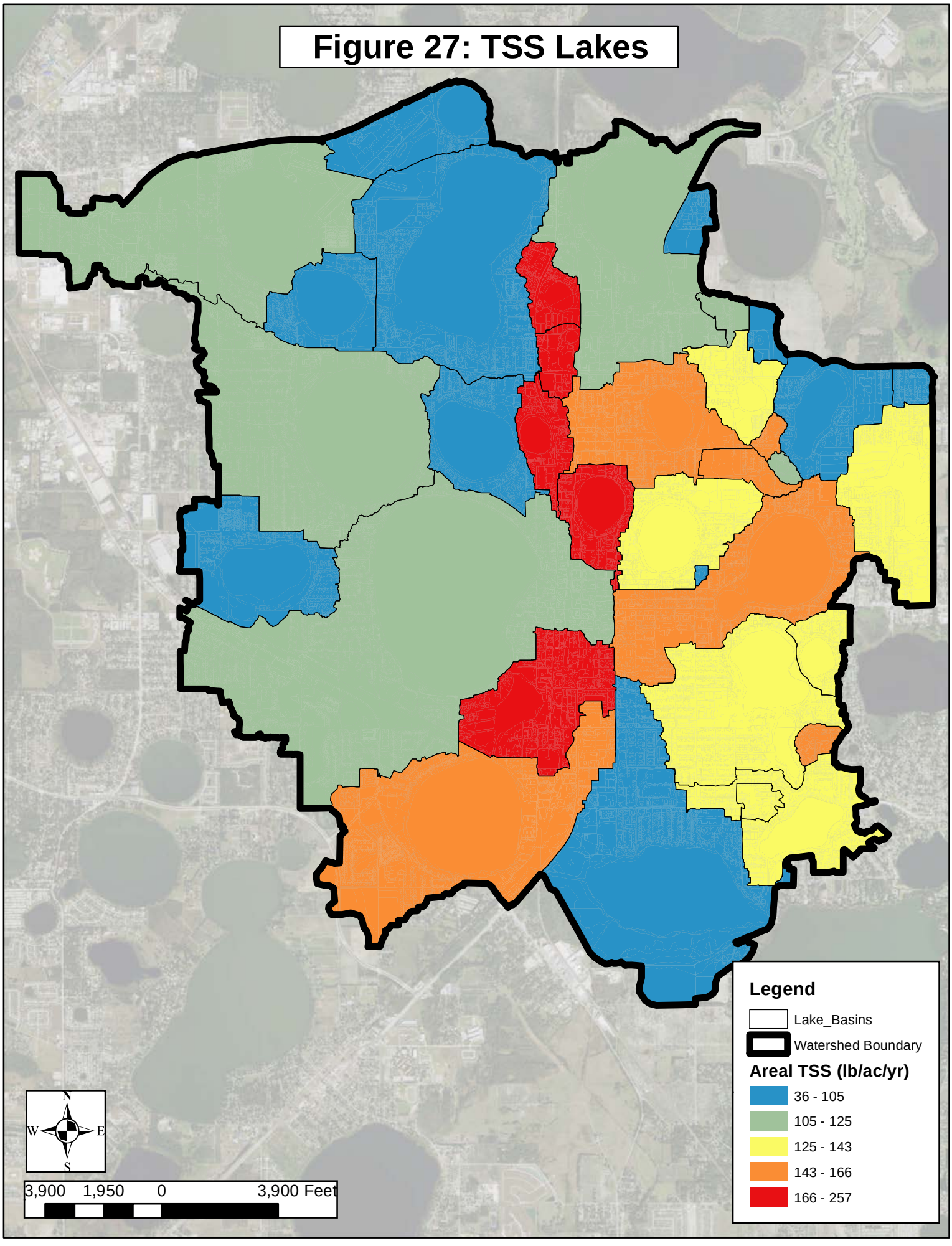


Figure 28: Flooding Problem Areas

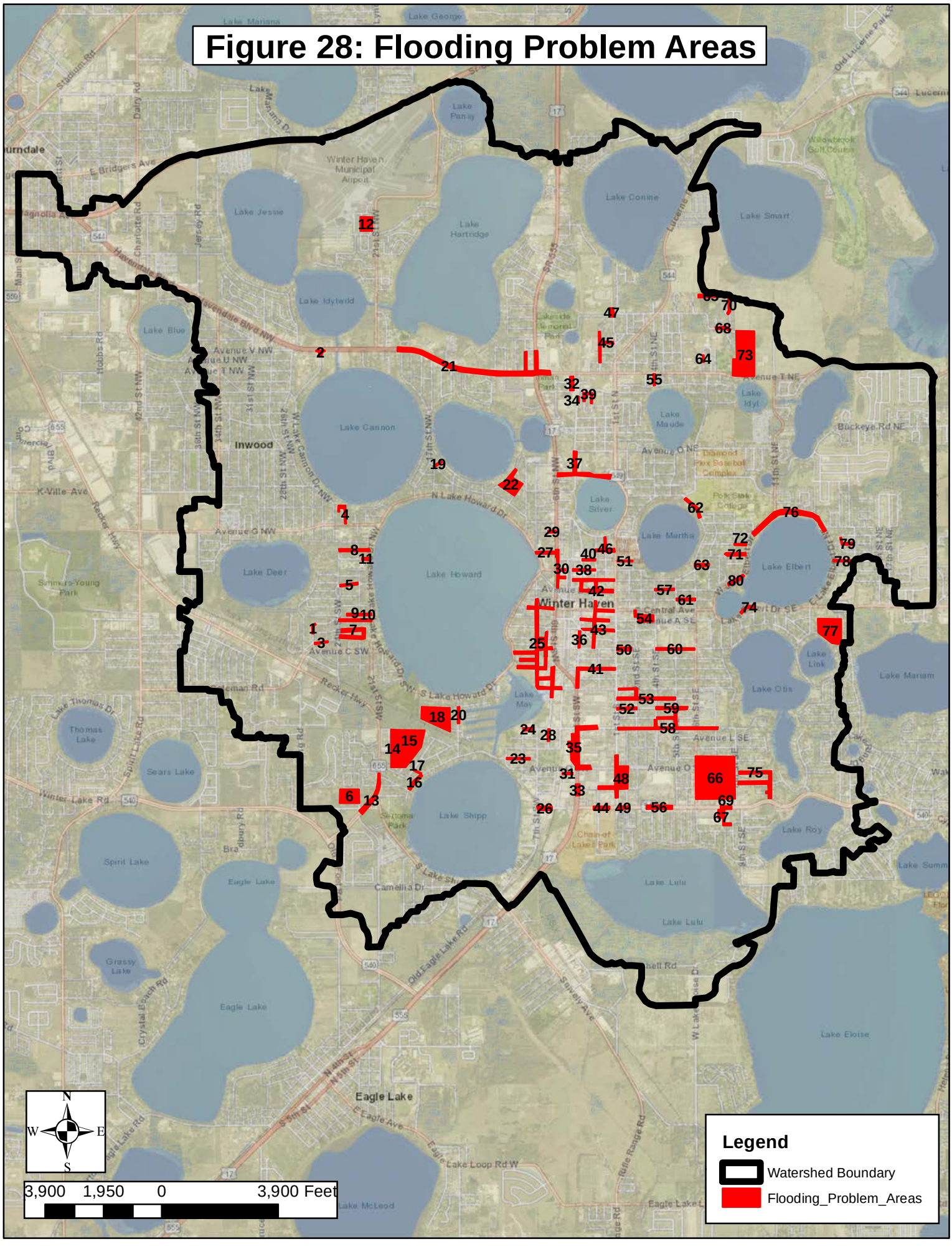
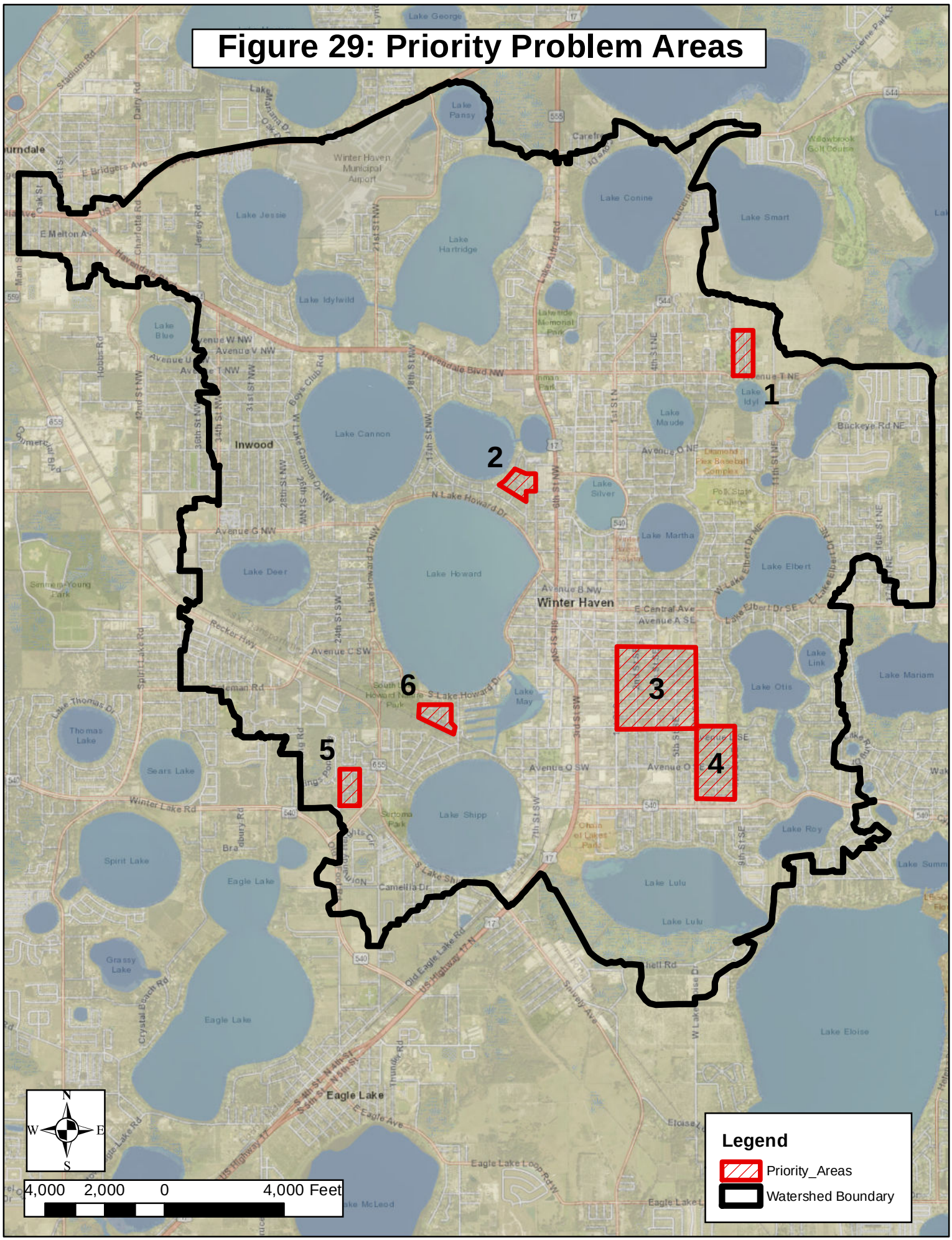


Figure 29: Priority Problem Areas



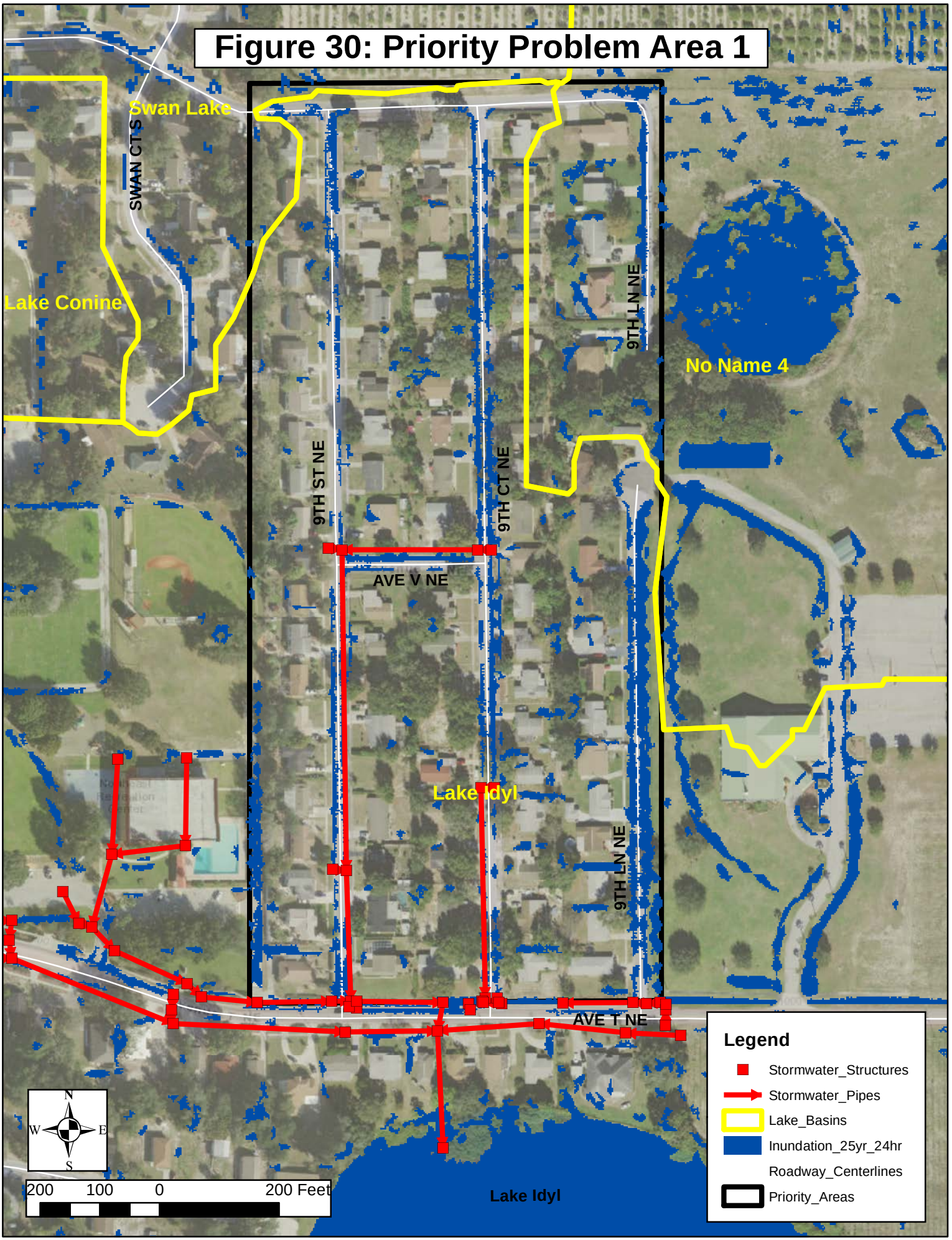


Figure 30: Priority Problem Area 1
Swan Lake
SWAN CT S
Lake Conine
9TH ST NE
9TH CT NE
9TH LN NE
No Name 4
AVE V NE
Lake Idyl
9TH LN NE
AVE T NE
Lake Idyl
N
W
E
S
200 100 0 200 Feet
Legend
Stormwater_Structures
Stormwater_Pipes
Lake_Basins
Inundation_25yr_24hr
Roadway_Centerlines
Priority_Areas

Figure 31: Priority Problem Area 2
Lake Mirror
MIRROR TER NW
Spring Lake
THOMPSON CIR NW
Lake Mirror
PERRIN AVE NW
AVE L NW
8TH ST NW
AVE B SW
N
W
E
S
200 100 0 200 Feet
Legend
Stormwater_Structures
Stormwater_Pipes
Lake_Basins
Priority_Areas
Inundation_25yr_24hr
Roadway_Centerlines

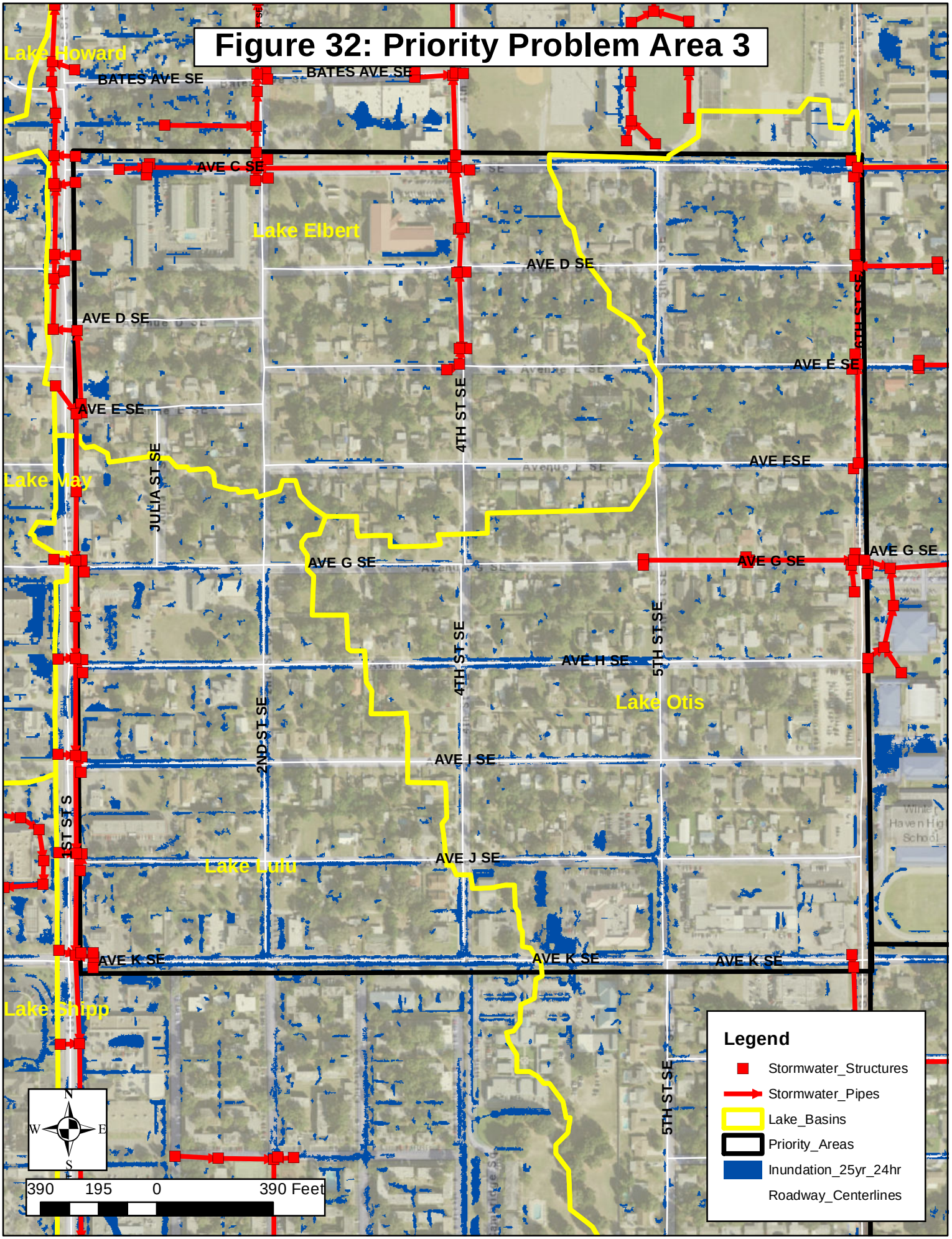
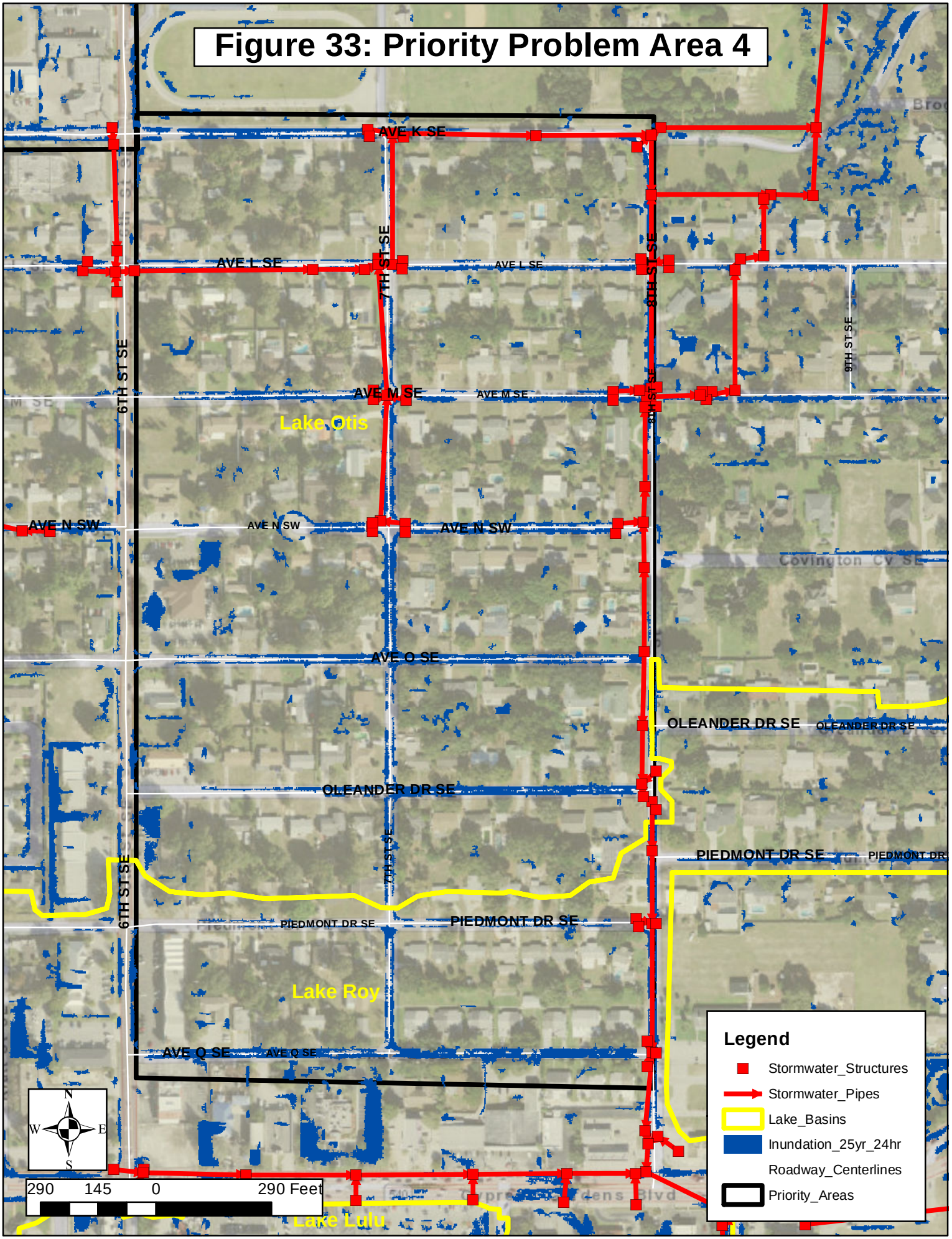


Figure 32: Priority Problem Area 3
Lake Howard
BATES AVE SE
BATES AVE SE
AVE C SE
Lake Elbert
AVE D SE
AVE D SE
6TH ST SE
AVE E SE
AVE E SE
4TH ST SE
JULIA ST SE
Lake May
AVE F SE
AVE G SE
AVE G SE
AVE G SE
5TH ST SE
4TH ST SE
AVE H SE
Lake Otis
2ND ST SE
AVE I SE
1ST ST S
Lake Lulu
AVE J SE
AVE K SE
AVE K SE
AVE K SE
Lake Shipp
5TH ST SE
White Haven Hig School
Legend
Stormwater_Structures
Stormwater_Pipes
Lake_Basins
Priority_Areas
Inundation_25yr_24hr
Roadway_Centerlines
N
W
E
S
390 195 0 390 Feet

Figure 33: Priority Problem Area 4



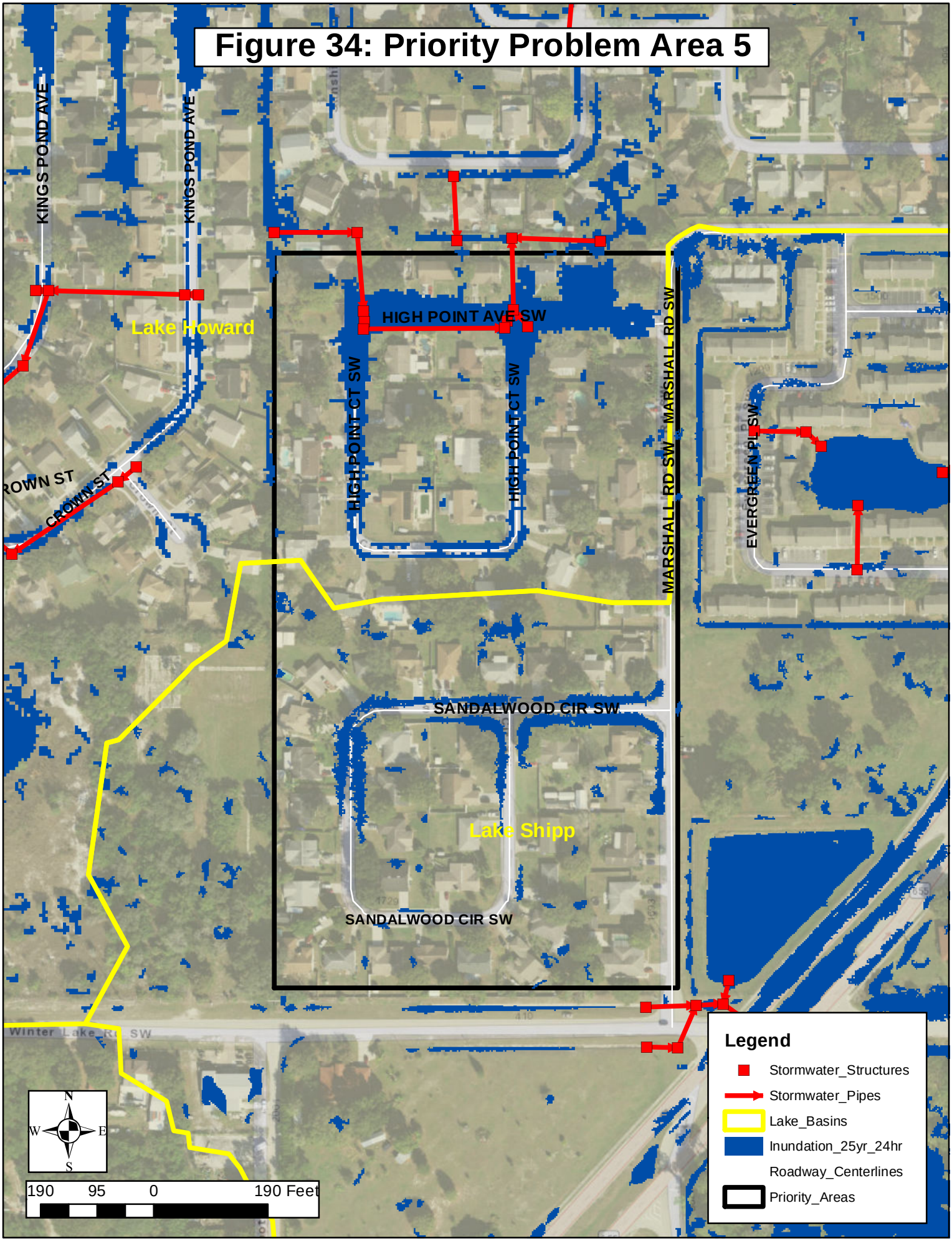


Figure 34: Priority Problem Area 5
KINGS POND AVE
KINGS POND AVE
Lake Howard
HIGH POINT AVE SW
HIGH POINT CT SW
HIGH POINT CT SW
MARSHALL RD SW
MARSHALL RD SW
EVERGREEN PL SW
CROWN ST
SANDALWOOD CIR SW
Lake Shipp
SANDALWOOD CIR SW
Winter Lake Rd SW
N
W
E
S
190 95 0 190 Feet
Legend
Stormwater_Structures
Stormwater_Pipes
Lake_Basins
Inundation_25yr_24hr
Roadway_Centerlines
Priority_Areas

Figure 35: Priority Problem Area 6
LAKE HOWARD DR S
LAKE HOWARD DR S
15TH ST SW
Lake May
FOX RIDGE RUN SW
Lake Howard
FOXBORO LN SW
FOX RIDGE RUN SW
AVE I SW
Lake May
T SW
CAMELOT CT SW
NOTTINGHAM ST SW
KENWOOD AVE SW
SHERIDAN ST SW
KENWOOD AVE SW
N
W
E
S
190
95
0
190 Feet
Legend
Stormwater_Structures
Stormwater_Pipes
Lake_Basins
Priority_Areas
Inundation_25yr_24hr
Roadway_Centerlines

Figure 36: Priority Area 1 Concept

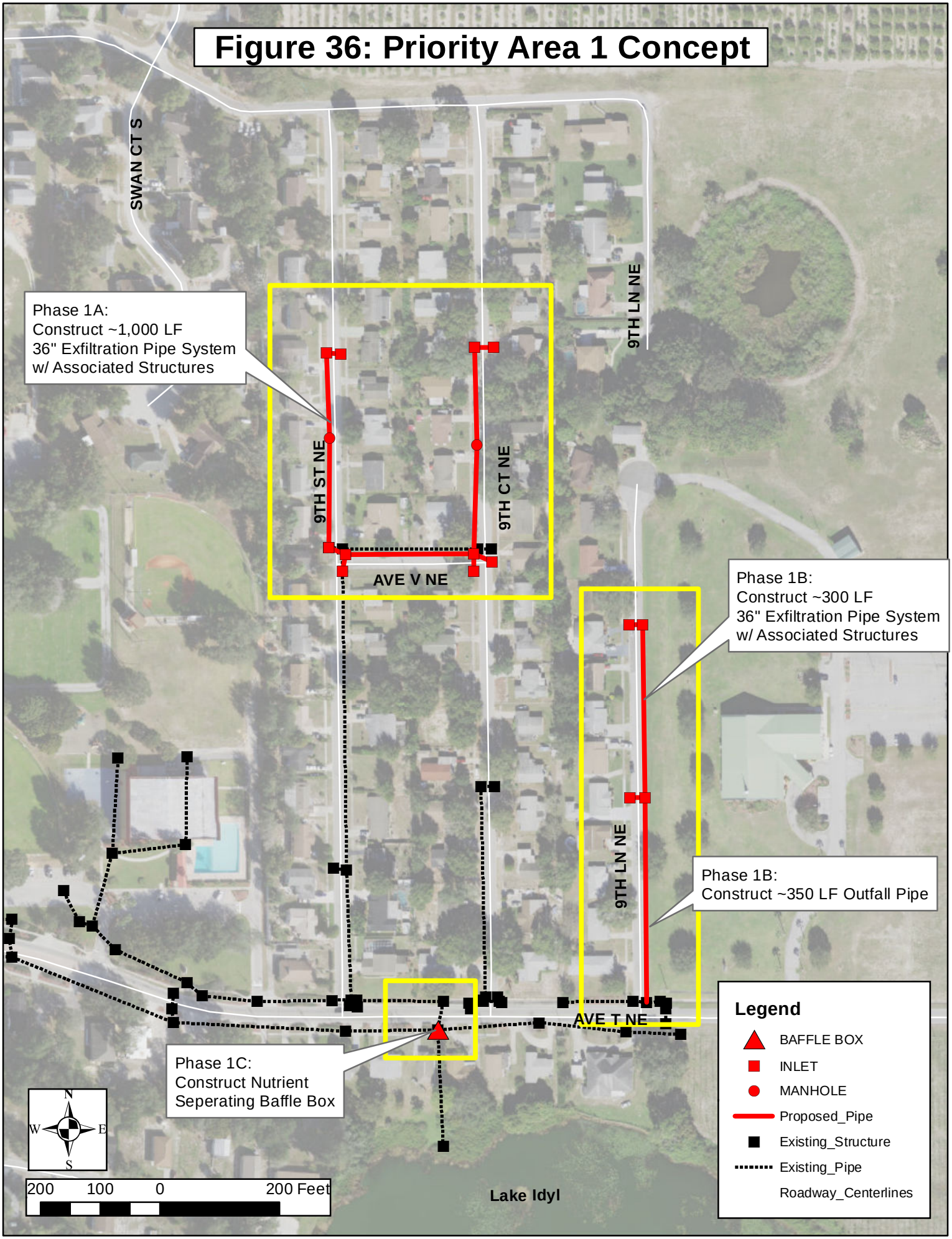


Figure 37: Priority Area 1 - Drainage Area

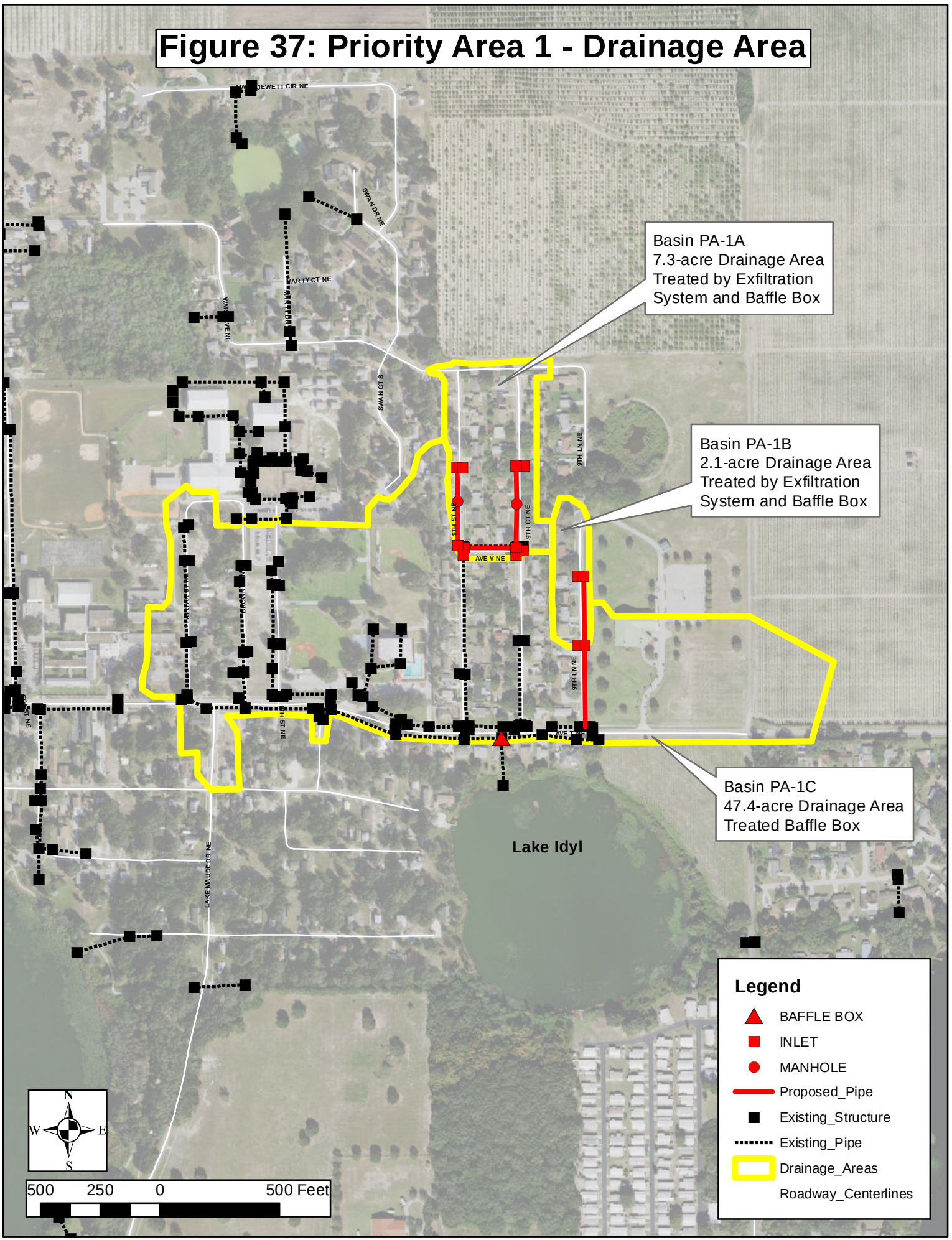


Figure 38: Priority Area 2 Concept

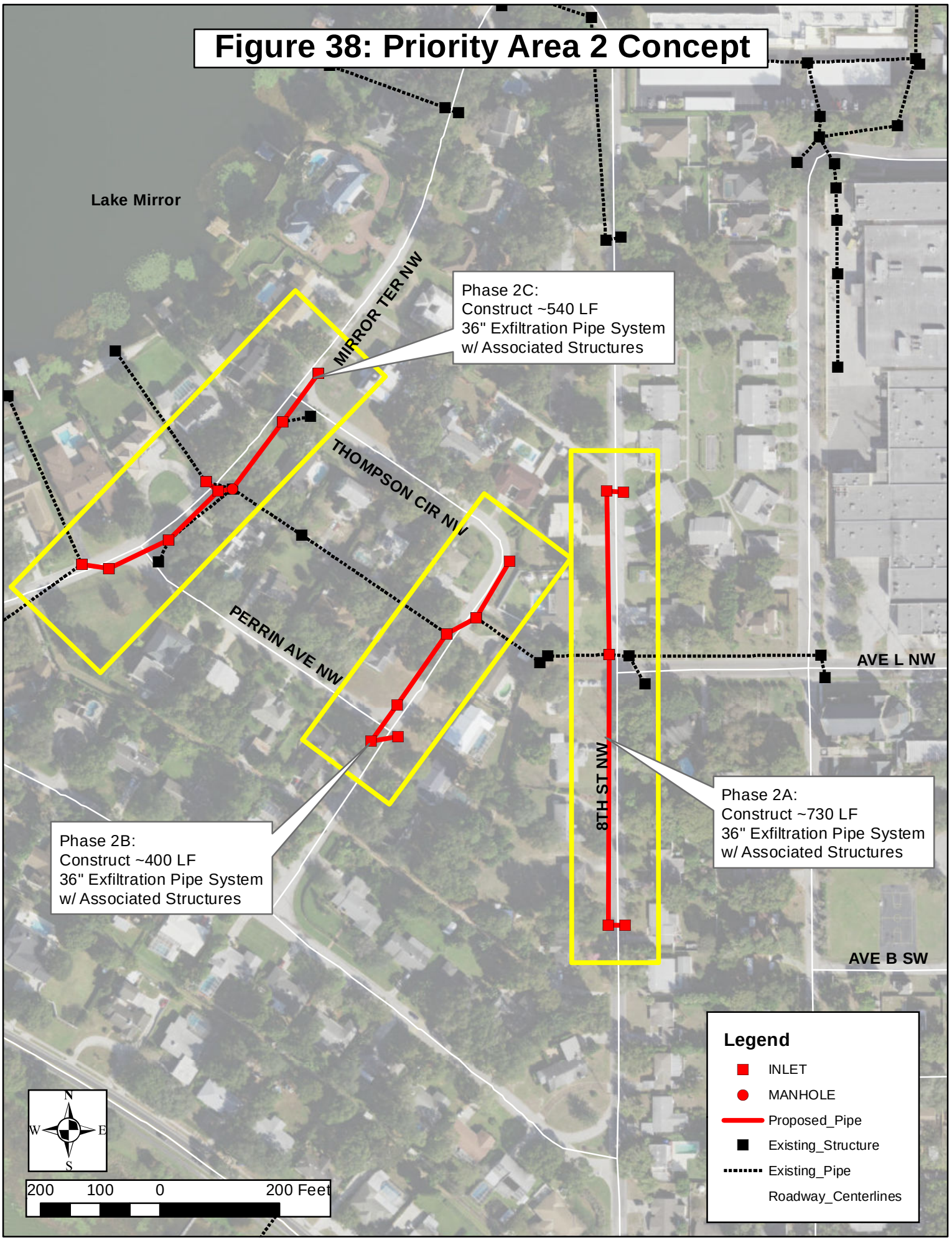


Figure 39: Priority Area 2 - Drainage Area

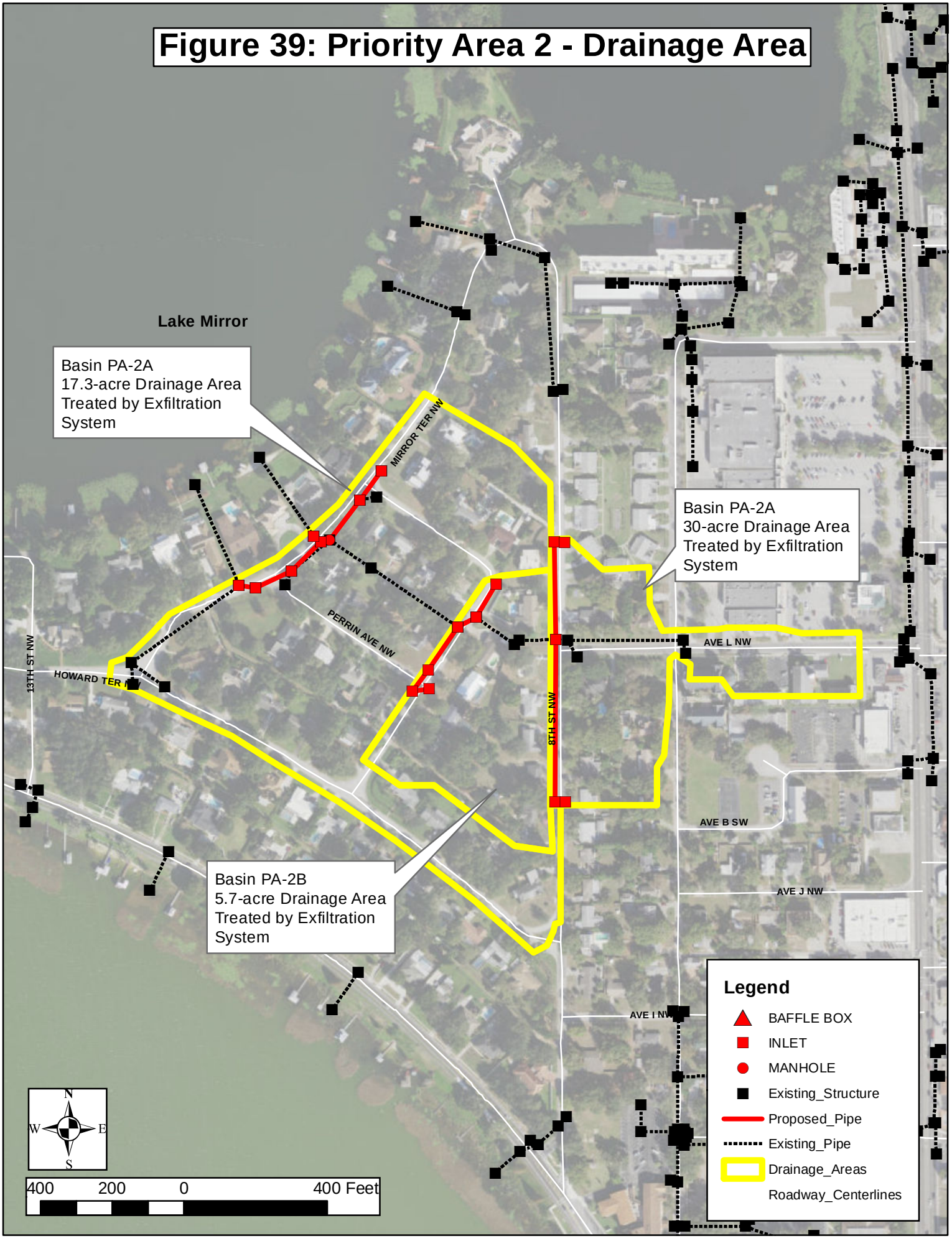
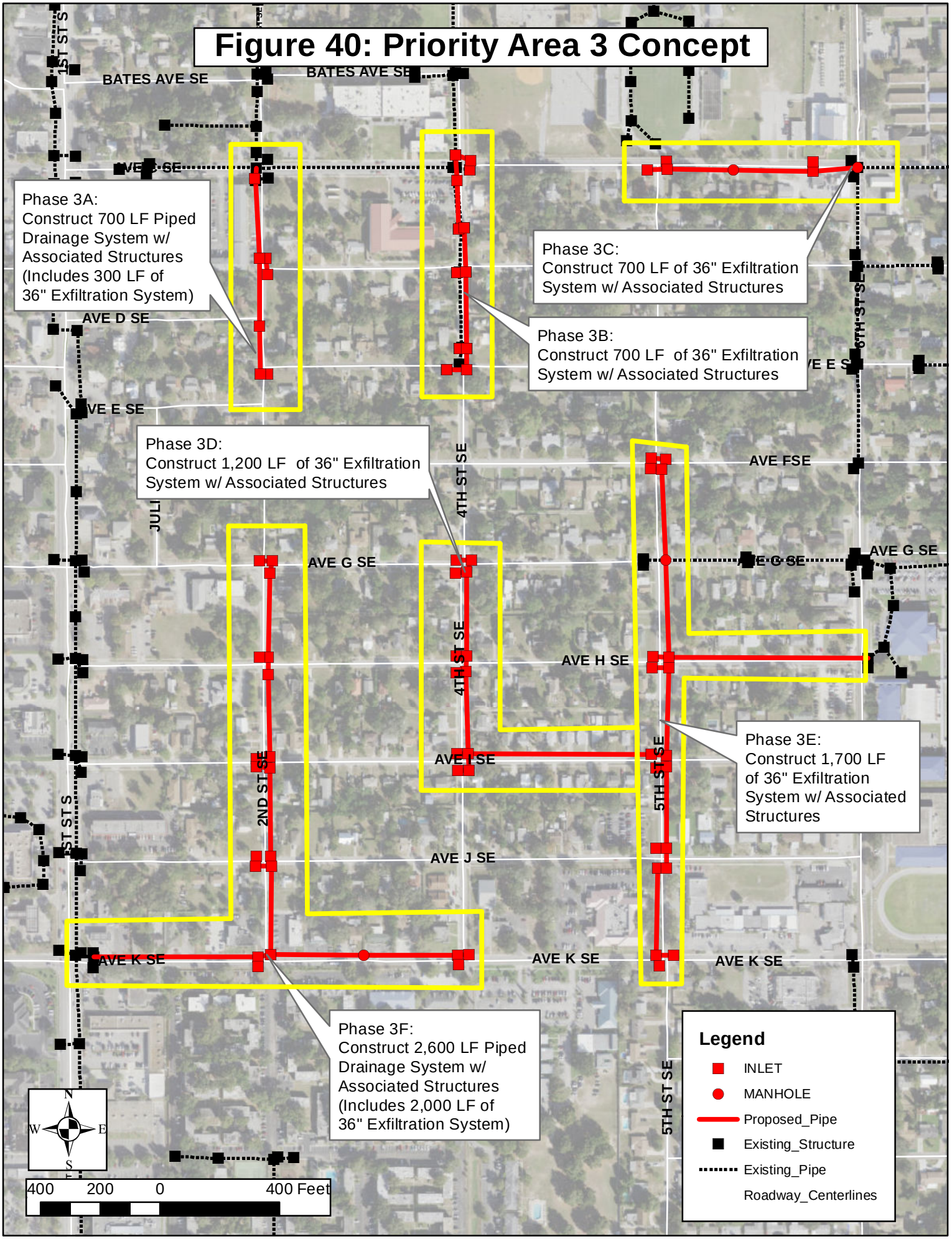


Figure 40: Priority Area 3 Concept



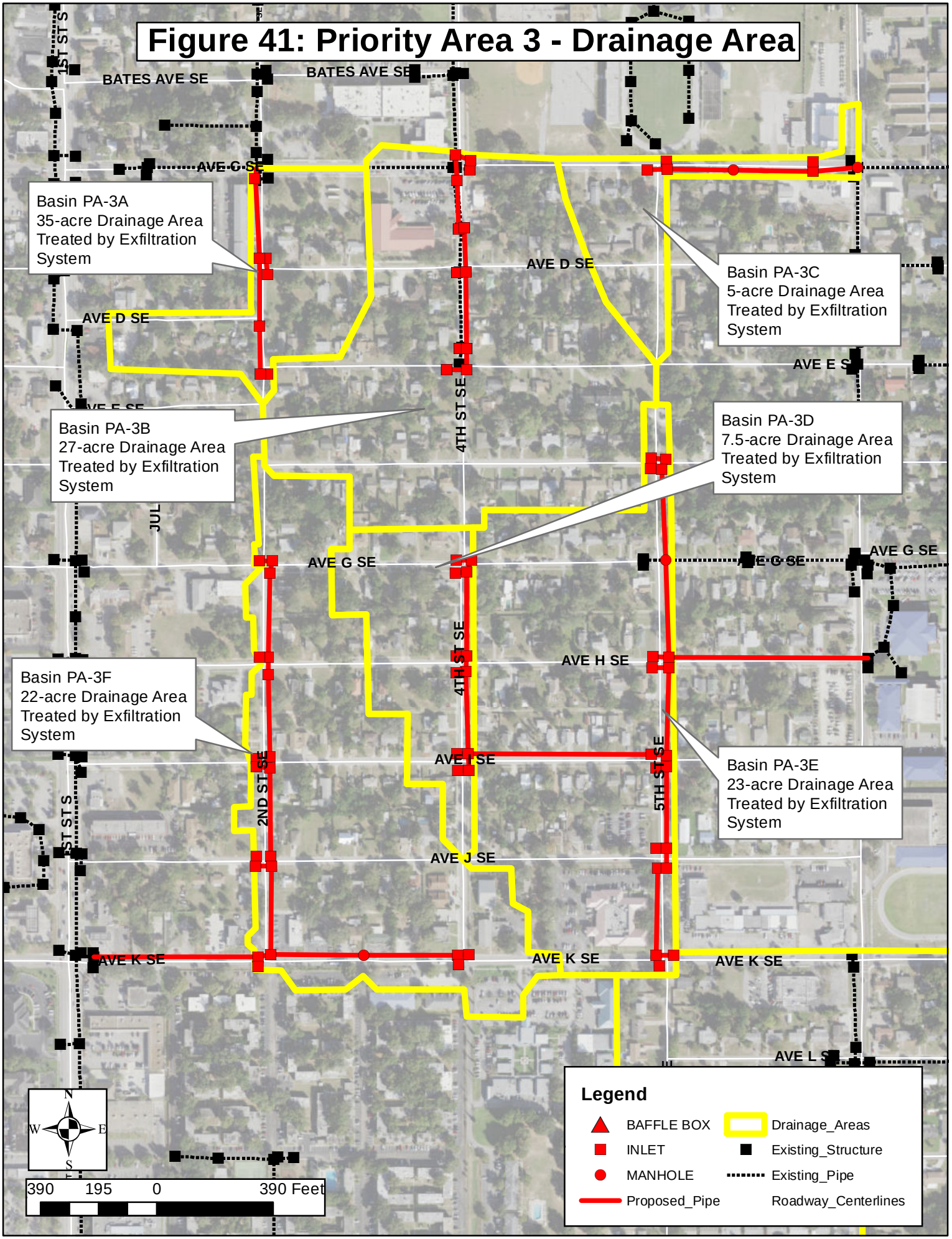
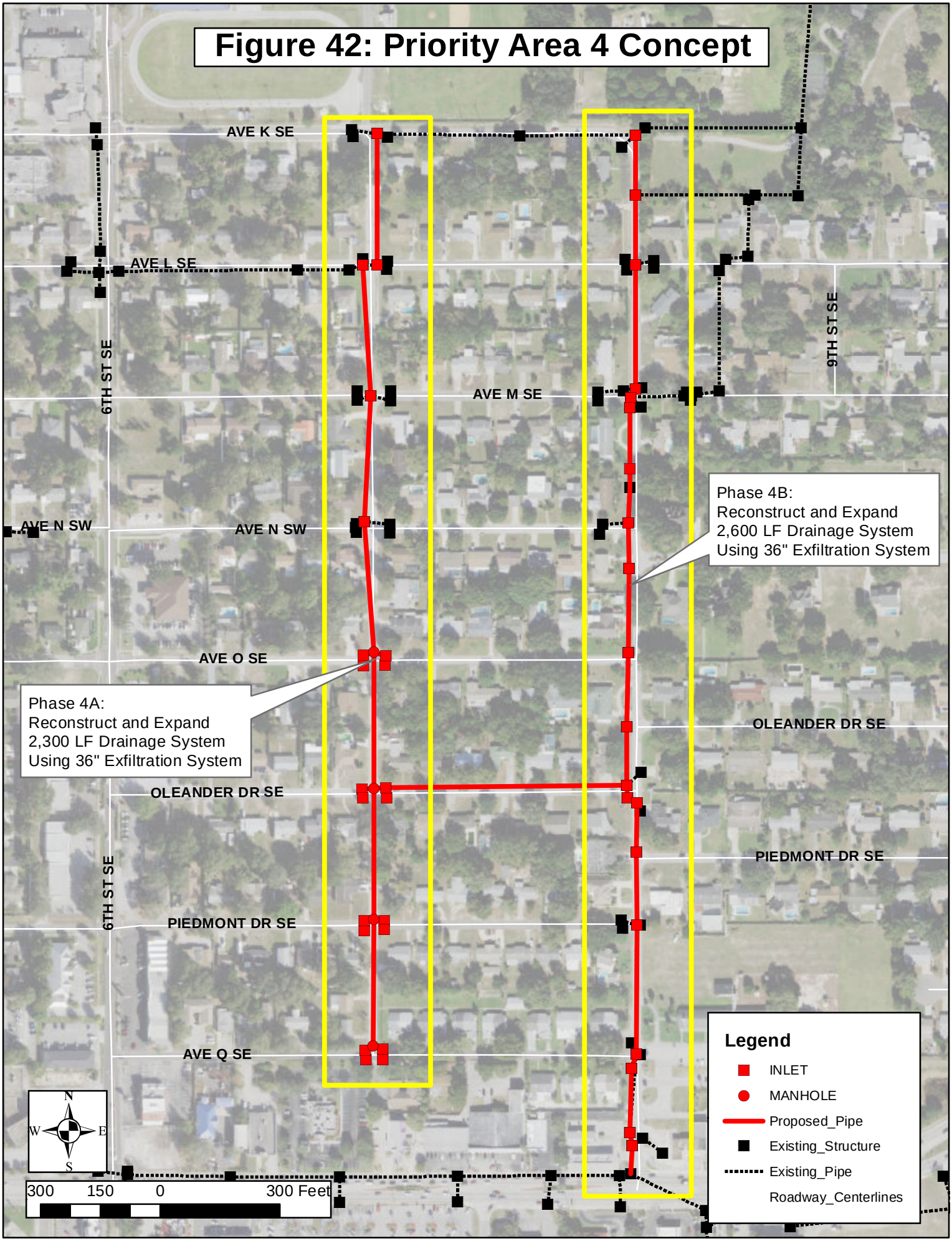


Figure 41: Priority Area 3 - Drainage Area
BATES AVE SE
BATES AVE SE
AVE G SE
AVE D SE
AVE D SE
AVE E SE
4TH ST SE
AVE G SE
AVE G SE
AVE G SE
4TH ST SE
AVE H SE
AVE I SE
2ND ST SE
5TH ST SE
AVE J SE
AVE K SE
AVE K SE
AVE K SE
AVE L SE
Basin PA-3A
35-acre Drainage Area
Treated by Exfiltration
System
Basin PA-3B
27-acre Drainage Area
Treated by Exfiltration
System
Basin PA-3C
5-acre Drainage Area
Treated by Exfiltration
System
Basin PA-3D
7.5-acre Drainage Area
Treated by Exfiltration
System
Basin PA-3E
23-acre Drainage Area
Treated by Exfiltration
System
Basin PA-3F
22-acre Drainage Area
Treated by Exfiltration
System
Legend
BAFFLE BOX
INLET
MANHOLE
Proposed_Pipe
Drainage_Areas
Existing_Structure
Existing_Pipe
Roadway_Centerlines
N
W
E
S
390
195
0
390 Feet

Figure 42: Priority Area 4 Concept



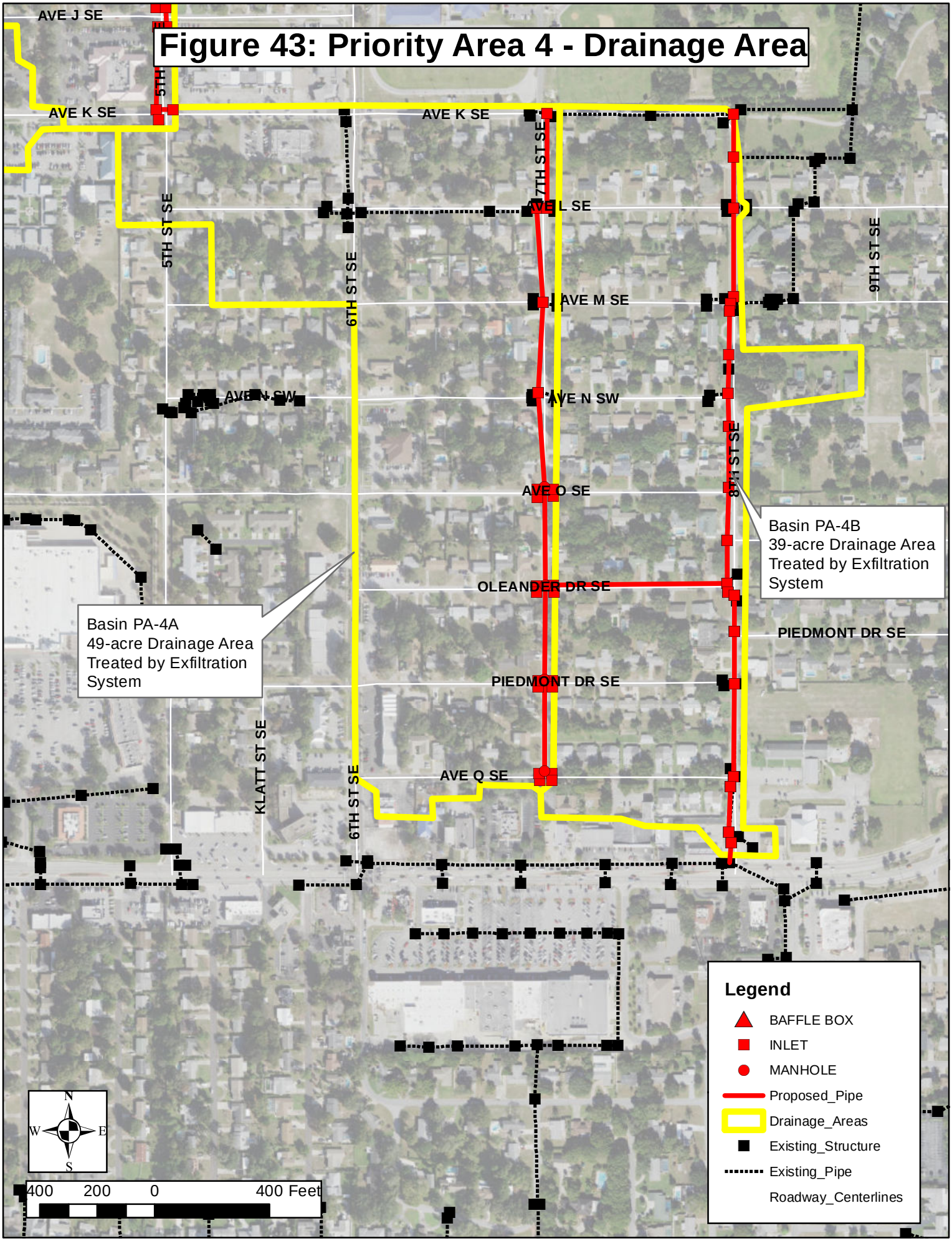


Figure 43: Priority Area 4 - Drainage Area
AVE J SE
AVE K SE
AVE K SE
5TH ST SE
5TH ST SE
6TH ST SE
7TH ST SE
9TH ST SE
AVE L SE
AVE M SE
AVE N SW
AVE N SW
AVE O SE
8TH ST SE
OLEANDER DR SE
PIEDMONT DR SE
PIEDMONT DR SE
AVE Q SE
KLATT ST SE
6TH ST SE
Basin PA-4A
49-acre Drainage Area
Treated by Exfiltration
System
Basin PA-4B
39-acre Drainage Area
Treated by Exfiltration
System
Legend
BAFFLE BOX
INLET
MANHOLE
Proposed_Pipe
Drainage_Areas
Existing_Structure
Existing_Pipe
Roadway_Centerlines
N
W
E
S
400 200 0 400 Feet

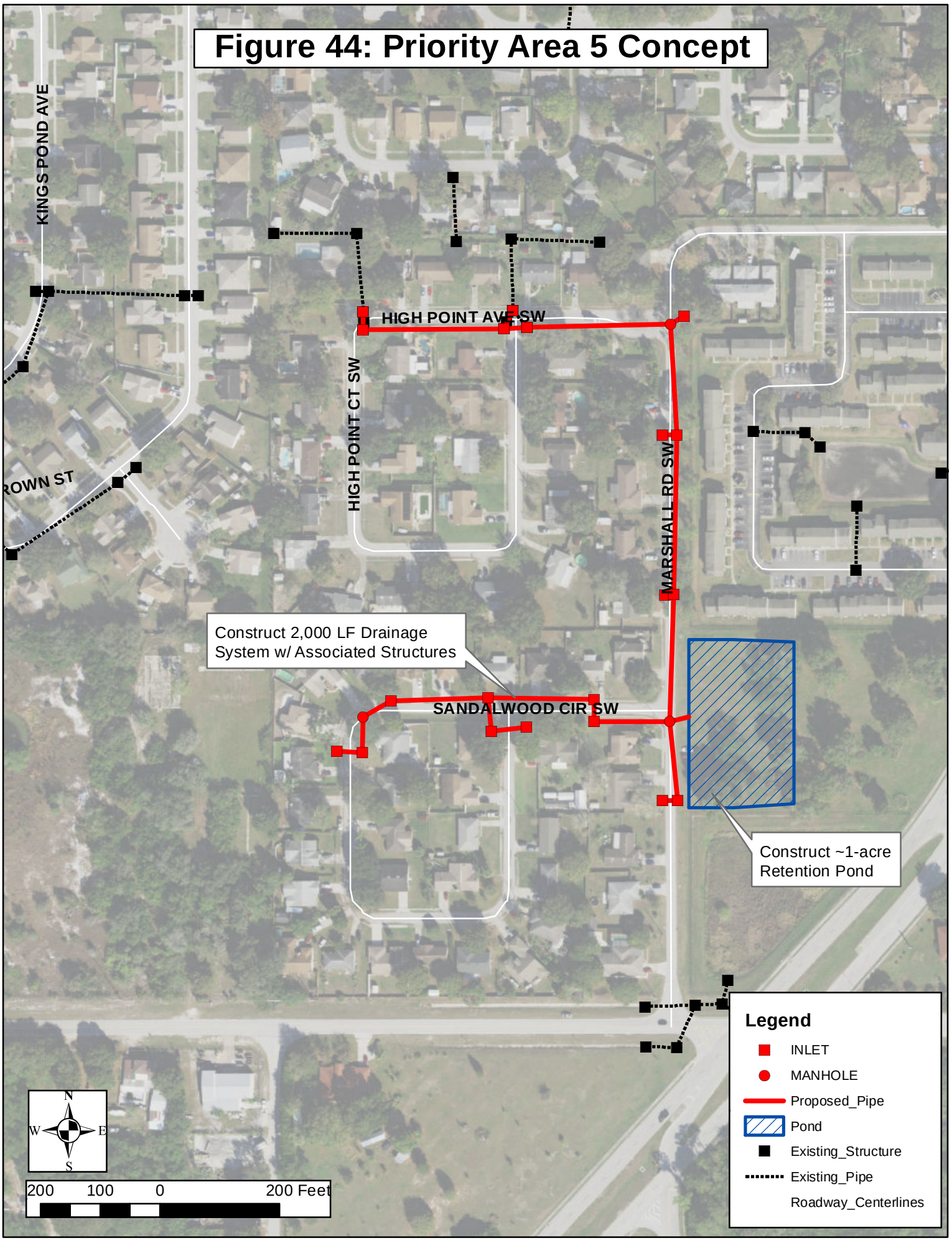
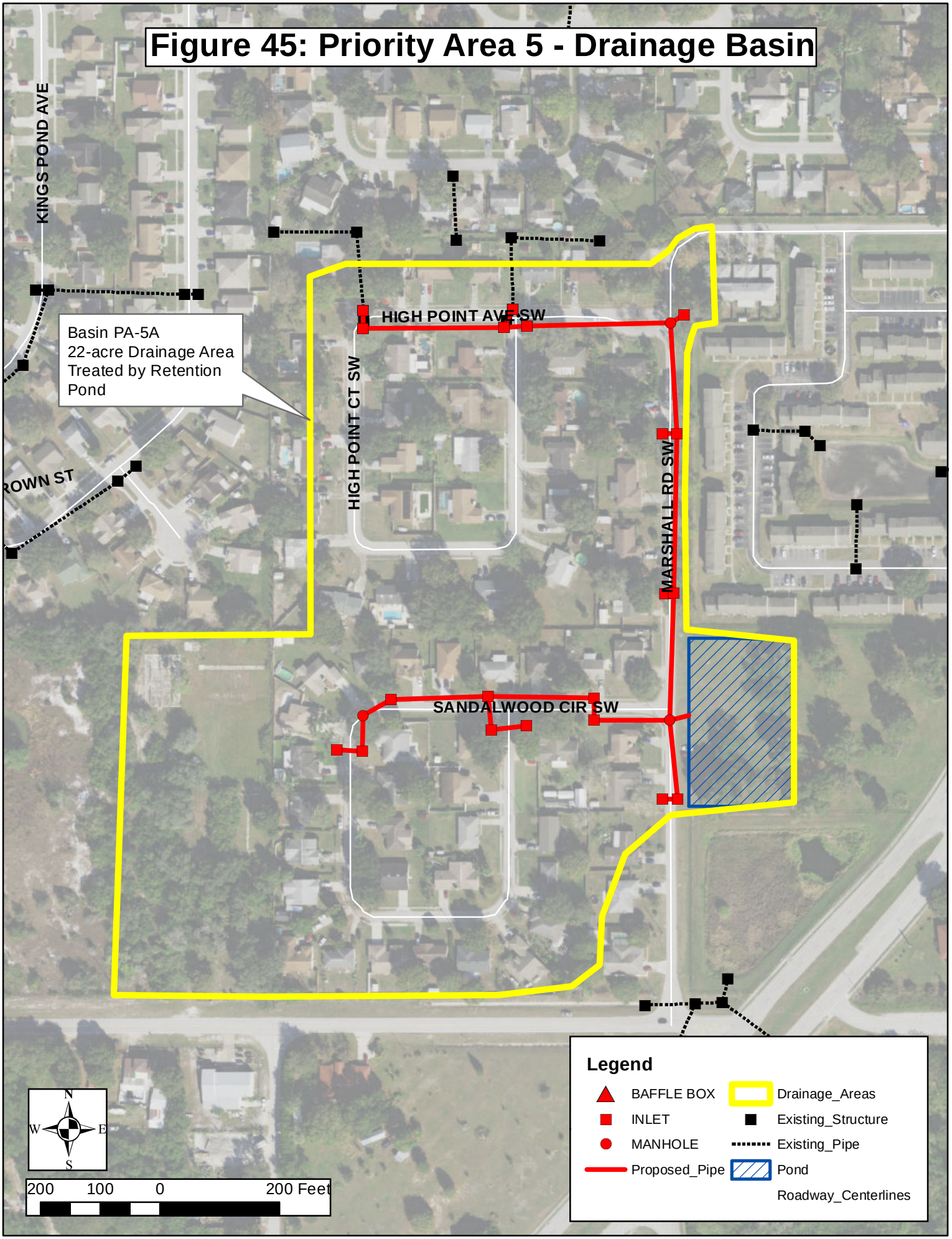


Figure 44: Priority Area 5 Concept
KINGS POND AVE
HIGH POINT AVE SW
HIGH POINT CT SW
MARSHALL RD SW
SANDALWOOD CIR SW
Construct 2,000 LF Drainage System w/ Associated Structures
Construct ~1-acre Retention Pond
Legend
INLET
MANHOLE
Proposed_Pipe
Pond
Existing_Structure
Existing_Pipe
Roadway_Centerlines
N
W
E
S
200 100 0 200 Feet

Figure 45: Priority Area 5 - Drainage Basin



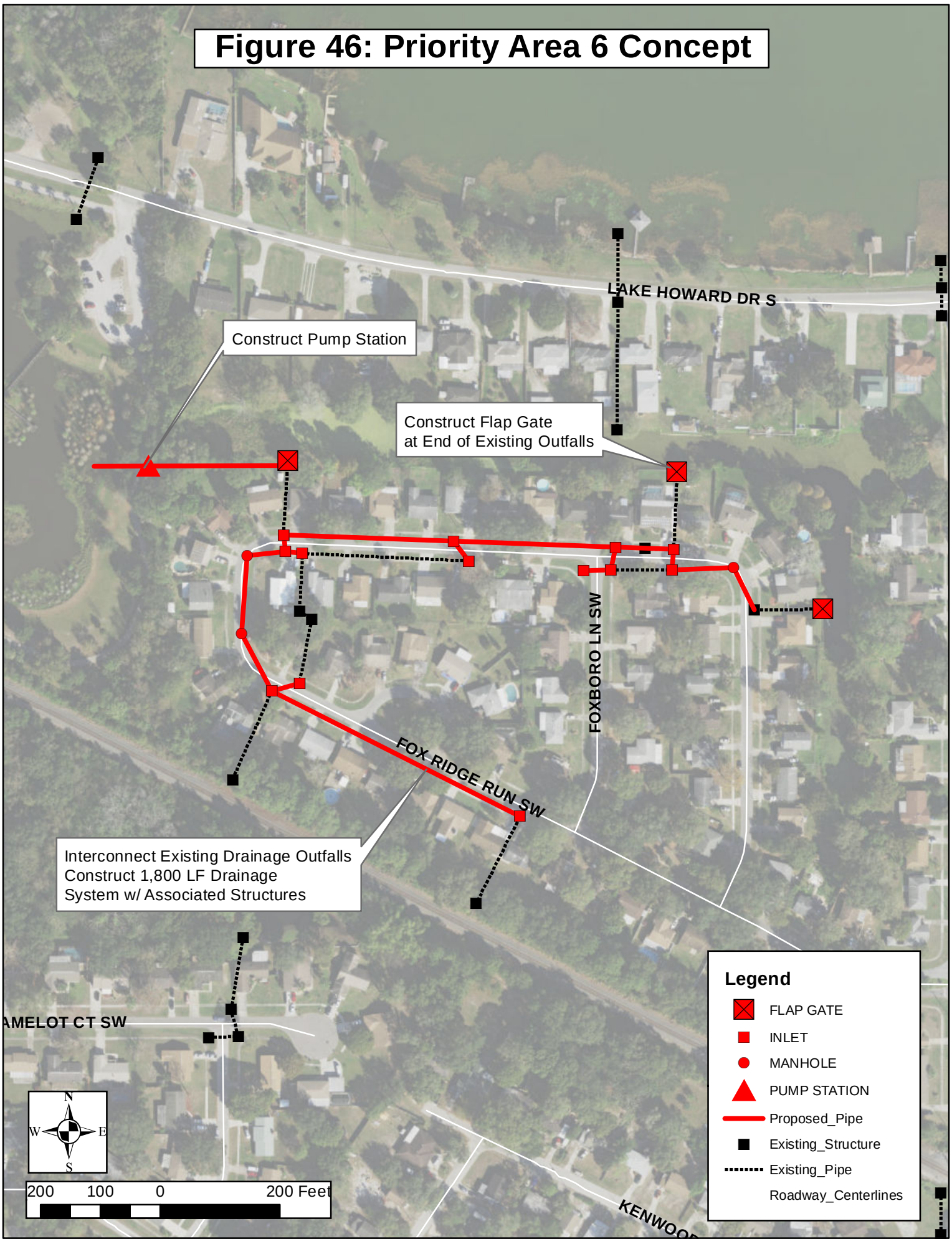
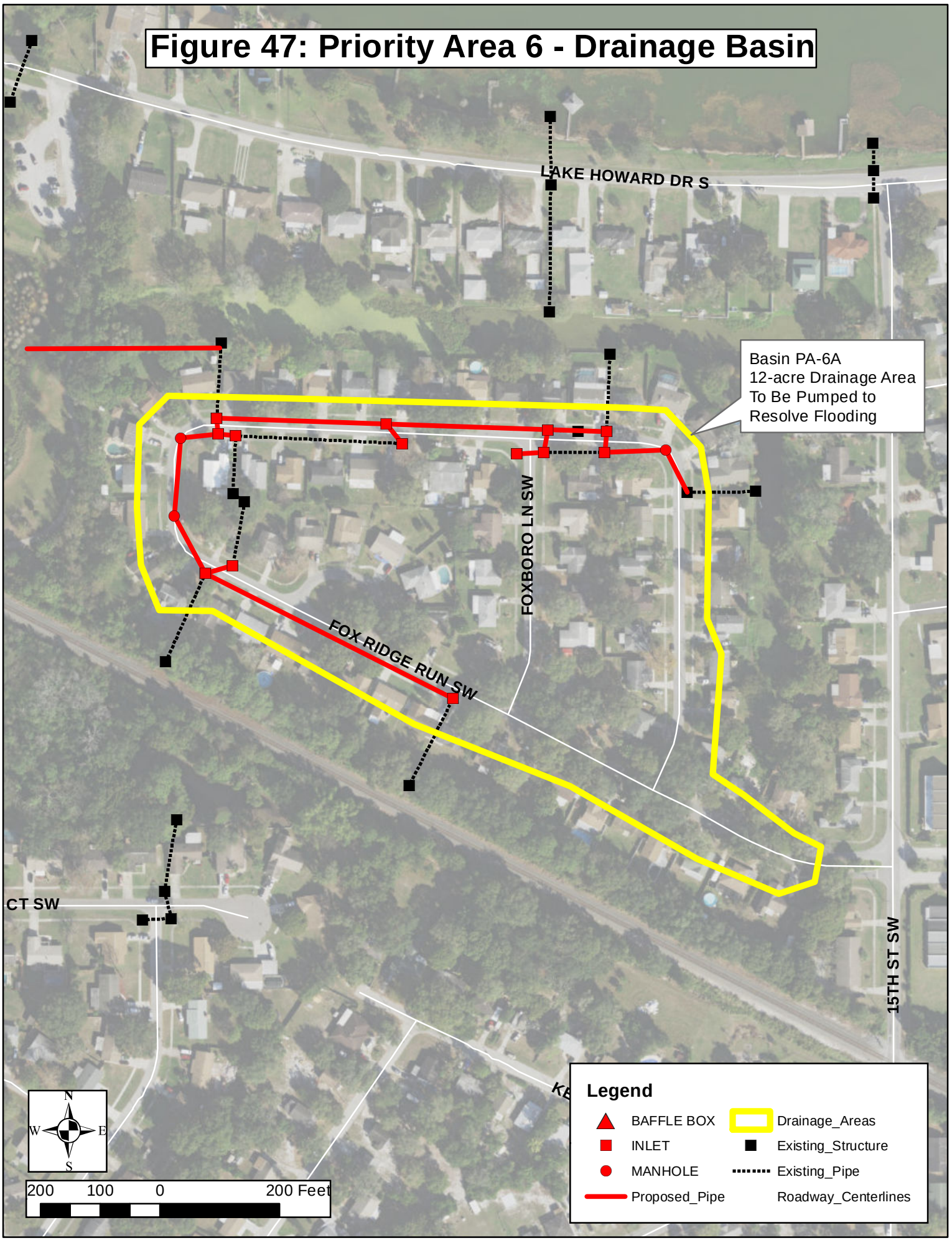


Figure 46: Priority Area 6 Concept
LAKE HOWARD DR S
Construct Pump Station
Construct Flap Gate
at End of Existing Outfalls
FOXBORO LN SW
FOX RIDGE RUN SW
Interconnect Existing Drainage Outfalls
Construct 1,800 LF Drainage
System w/ Associated Structures
AMELOT CT SW
KENWOOD
N
W
E
S
200 100 0 200 Feet
Legend
FLAP GATE
INLET
MANHOLE
PUMP STATION
Proposed_Pipe
Existing_Structure
Existing_Pipe
Roadway_Centerlines

Figure 47: Priority Area 6 - Drainage Basin



Appendix A - Concept Cost Estimate Phase 1A					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$33,657.41	$33,657.41
2	Maintenance of Traffic (7%)	1	LS	$23,560.19	$23,560.19
3	Engineering Services (15%)	1	LS	$50,486.11	$50,486.11
4	Construction Management (5%)	1	LS	$16,828.70	$16,828.70
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$10,097.22	$10,097.22
7	Utility Conflicts (5%)	1	LS	$16,828.70	$16,828.70
				Subtotal =	**$151,458.33**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	1,000	LF	$175.00	$175,000.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	100	LF	$80.00	$8,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	0	LF	$105.00	$0.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	10	EA	$4,000.00	$40,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	926	SY	$80.00	$74,074.07
18	Concrete Curb Replacement	2,000	LF	$12.50	$25,000.00
				Subtotal =	**$336,574.07**
				CONTINGENCY (30%)	**$146,409.72**
				GRAND TOTAL	**$634,442**

Appendix A - Concept Cost Estimate Phase 1B					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$18,466.67	$18,466.67
2	Maintenance of Traffic (7%)	1	LS	$12,926.67	$12,926.67
3	Engineering Services (15%)	1	LS	$27,700.00	$27,700.00
4	Construction Management (5%)	1	LS	$9,233.33	$9,233.33
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$5,540.00	$5,540.00
7	Utility Conflicts (5%)	1	LS	$9,233.33	$9,233.33
				Subtotal =	**$83,100.00**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	300	LF	$175.00	$52,500.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	0	LF	$80.00	$0.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	150	LF	$105.00	$15,750.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	150	LF	$130.00	$19,500.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
14	Curb Inlet	5	EA	$4,000.00	$20,000.00
15	Manhole	2	EA	$4,000.00	$8,000.00
16	Asphalt Pavement Replacement	583	SY	$80.00	$46,666.67
17	Concrete Curb Replacement	1,260	LF	$12.50	$15,750.00
				Subtotal =	**$184,666.67**
				CONTINGENCY (30%)	**$80,330.00**
				GRAND TOTAL	**$348,097**

Appendix A - Concept Cost Estimate Phase 1C					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$50,000.00	$50,000.00
2	Maintenance of Traffic (7%)	1	LS	$35,000.00	$35,000.00
3	Engineering Services (15%)	1	LS	$75,000.00	$75,000.00
4	Construction Management (5%)	1	LS	$25,000.00	$25,000.00
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$15,000.00	$15,000.00
7	Utility Conflicts (5%)	1	LS	$25,000.00	$25,000.00
				Subtotal =	**$225,000.00**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	0	LF	$175.00	$0.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	0	LF	$65.00	$0.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	0	LF	$80.00	$0.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	0	LF	$105.00	$0.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	100	LF	$145.00	$14,500.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	1	EA	$4,000.00	$4,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	93	SY	$80.00	$7,407.41
18	Concrete Curb Replacement	200	LF	$12.50	$2,500.00
19	Baffle Box	1	LS	$500,000.00	$500,000.00
				Subtotal =	**$536,407.41**
				CONTINGENCY (30%)	**$0.00**
				GRAND TOTAL	**$536,407**

Appendix A - Concept Cost Estimate Phase 2A					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$24,080.56	$24,080.56
2	Maintenance of Traffic (7%)	1	LS	$16,856.39	$16,856.39
3	Engineering Services (15%)	1	LS	$36,120.83	$36,120.83
4	Construction Management (5%)	1	LS	$12,040.28	$12,040.28
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$7,224.17	$7,224.17
7	Utility Conflicts (5%)	1	LS	$12,040.28	$12,040.28
				Subtotal =	**$108,362.50**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	750	LF	$175.00	$131,250.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	50	LF	$65.00	$3,250.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	0	LF	$80.00	$0.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	0	LF	$105.00	$0.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	6	EA	$4,000.00	$24,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	694	SY	$80.00	$55,555.56
18	Concrete Curb Replacement	1,500	LF	$12.50	$18,750.00
				Subtotal =	**$240,805.56**
				CONTINGENCY (30%)	**$104,750.42**
				GRAND TOTAL	**$453,918**

Appendix A - Concept Cost Estimate Phase 2B					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$15,412.96	$15,412.96
2	Maintenance of Traffic (7%)	1	LS	$10,789.07	$10,789.07
3	Engineering Services (15%)	1	LS	$23,119.44	$23,119.44
4	Construction Management (5%)	1	LS	$7,706.48	$7,706.48
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$4,623.89	$4,623.89
7	Utility Conflicts (5%)	1	LS	$7,706.48	$7,706.48
				Subtotal =	**$69,358.33**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	400	LF	$175.00	$70,000.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	50	LF	$65.00	$3,250.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	50	LF	$80.00	$4,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	50	LF	$105.00	$5,250.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	6	EA	$4,000.00	$24,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	370	SY	$80.00	$29,629.63
18	Concrete Curb Replacement	800	LF	$12.50	$10,000.00
				Subtotal =	**$154,129.63**
				CONTINGENCY (30%)	**$67,046.39**
				GRAND TOTAL	**$290,534**

Appendix A - Concept Cost Estimate Phase 2C					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$20,974.07	$20,974.07
2	Maintenance of Traffic (7%)	1	LS	$14,681.85	$14,681.85
3	Engineering Services (15%)	1	LS	$31,461.11	$31,461.11
4	Construction Management (5%)	1	LS	$10,487.04	$10,487.04
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$6,292.22	$6,292.22
7	Utility Conflicts (5%)	1	LS	$10,487.04	$10,487.04
				Subtotal =	**$94,383.33**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	550	LF	$175.00	$96,250.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	50	LF	$65.00	$3,250.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	50	LF	$80.00	$4,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	50	LF	$105.00	$5,250.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	50	LF	$130.00	$6,500.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	8	EA	$4,000.00	$32,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	509	SY	$80.00	$40,740.74
18	Concrete Curb Replacement	1,100	LF	$12.50	$13,750.00
				Subtotal =	**$209,740.74**
				CONTINGENCY (30%)	**$91,237.22**
				GRAND TOTAL	**$395,361**

Appendix A - Concept Cost Estimate Phase 3A					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$20,235.19	$20,235.19
2	Maintenance of Traffic (7%)	1	LS	$14,164.63	$14,164.63
3	Engineering Services (15%)	1	LS	$30,352.78	$30,352.78
4	Construction Management (5%)	1	LS	$10,117.59	$10,117.59
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$6,070.56	$6,070.56
7	Utility Conflicts (5%)	1	LS	$10,117.59	$10,117.59
				Subtotal =	**$91,058.33**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	300	LF	$175.00	$52,500.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	100	LF	$80.00	$8,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	0	LF	$105.00	$0.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	200	LF	$130.00	$26,000.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	8	EA	$4,000.00	$32,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	648	SY	$80.00	$51,851.85
18	Concrete Curb Replacement	1,400	LF	$12.50	$17,500.00
				Subtotal =	**$202,351.85**
				CONTINGENCY (30%)	**$88,023.06**
				GRAND TOTAL	**$381,433**

Appendix A - Concept Cost Estimate Phase 3B					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$26,708.89	$26,708.89
2	Maintenance of Traffic (7%)	1	LS	$18,696.22	$18,696.22
3	Engineering Services (15%)	1	LS	$40,063.33	$40,063.33
4	Construction Management (5%)	1	LS	$13,354.44	$13,354.44
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$8,012.67	$8,012.67
7	Utility Conflicts (5%)	1	LS	$13,354.44	$13,354.44
				Subtotal =	**$120,190.00**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	700	LF	$175.00	$122,500.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	50	LF	$65.00	$3,250.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	50	LF	$80.00	$4,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	50	LF	$105.00	$5,250.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	12	EA	$4,000.00	$48,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	711	SY	$80.00	$56,888.89
18	Concrete Curb Replacement	1,536	LF	$12.50	$19,200.00
				Subtotal =	**$267,088.89**
				CONTINGENCY (30%)	**$116,183.67**
				GRAND TOTAL	**$503,463**

Appendix A - Concept Cost Estimate Phase 3C					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$22,710.19	$22,710.19
2	Maintenance of Traffic (7%)	1	LS	$15,897.13	$15,897.13
3	Engineering Services (15%)	1	LS	$34,065.28	$34,065.28
4	Construction Management (5%)	1	LS	$11,355.09	$11,355.09
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$6,813.06	$6,813.06
7	Utility Conflicts (5%)	1	LS	$11,355.09	$11,355.09
				Subtotal =	**$102,195.83**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	700	LF	$175.00	$122,500.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	50	LF	$65.00	$3,250.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	50	LF	$80.00	$4,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	0	LF	$105.00	$0.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	5	EA	$4,000.00	$20,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	648	SY	$80.00	$51,851.85
18	Concrete Curb Replacement	1,400	LF	$12.50	$17,500.00
				Subtotal =	**$227,101.85**
				CONTINGENCY (30%)	**$98,789.31**
				GRAND TOTAL	**$428,087**

Appendix A - Concept Cost Estimate Phase 3D					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$40,463.89	$40,463.89
2	Maintenance of Traffic (7%)	1	LS	$28,324.72	$28,324.72
3	Engineering Services (15%)	1	LS	$60,695.83	$60,695.83
4	Construction Management (5%)	1	LS	$20,231.94	$20,231.94
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$12,139.17	$12,139.17
7	Utility Conflicts (5%)	1	LS	$20,231.94	$20,231.94
				Subtotal =	**$182,087.50**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	1,200	LF	$175.00	$210,000.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	100	LF	$80.00	$8,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	50	LF	$105.00	$5,250.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	12	EA	$4,000.00	$48,000.00
16	Manhole	2	EA	$4,000.00	$8,000.00
17	Asphalt Pavement Replacement	1,111	SY	$80.00	$88,888.89
18	Concrete Curb Replacement	2,400	LF	$12.50	$30,000.00
				Subtotal =	**$404,638.89**
				CONTINGENCY (30%)	**$176,017.92**
				GRAND TOTAL	**$762,744**

Appendix A - Concept Cost Estimate Phase 3E					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$70,837.04	$70,837.04
2	Maintenance of Traffic (7%)	1	LS	$49,585.93	$49,585.93
3	Engineering Services (15%)	1	LS	$106,255.56	$106,255.56
4	Construction Management (5%)	1	LS	$35,418.52	$35,418.52
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$21,251.11	$21,251.11
7	Utility Conflicts (5%)	1	LS	$35,418.52	$35,418.52
				Subtotal =	**$318,766.67**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	1,700	LF	$175.00	$297,500.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	100	LF	$80.00	$8,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	100	LF	$105.00	$10,500.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	600	LF	$130.00	$78,000.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	19	EA	$4,000.00	$76,000.00
16	Manhole	1	EA	$4,000.00	$4,000.00
17	Asphalt Pavement Replacement	2,130	SY	$80.00	$170,370.37
18	Concrete Curb Replacement	4,600	LF	$12.50	$57,500.00
				Subtotal =	**$708,370.37**
				CONTINGENCY (30%)	**$308,141.11**
				GRAND TOTAL	**$1,335,278**

Appendix A - Concept Cost Estimate Phase 3F					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$80,659.26	$80,659.26
2	Maintenance of Traffic (7%)	1	LS	$56,461.48	$56,461.48
3	Engineering Services (15%)	1	LS	$120,988.89	$120,988.89
4	Construction Management (5%)	1	LS	$40,329.63	$40,329.63
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$24,197.78	$24,197.78
7	Utility Conflicts (5%)	1	LS	$40,329.63	$40,329.63
				Subtotal =	**$362,966.67**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	2,000	LF	$175.00	$350,000.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	100	LF	$80.00	$8,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	100	LF	$105.00	$10,500.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	600	LF	$130.00	$78,000.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	20	EA	$4,000.00	$80,000.00
16	Manhole	4	EA	$4,000.00	$16,000.00
17	Asphalt Pavement Replacement	2,407	SY	$80.00	$192,592.59
18	Concrete Curb Replacement	5,200	LF	$12.50	$65,000.00
				Subtotal =	**$806,592.59**
				CONTINGENCY (30%)	**$350,867.78**
				GRAND TOTAL	**$1,520,427**

Appendix A - Concept Cost Estimate Phase 4A					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$91,072.22	$91,072.22
2	Maintenance of Traffic (7%)	1	LS	$63,750.56	$63,750.56
3	Engineering Services (15%)	1	LS	$136,608.33	$136,608.33
4	Construction Management (5%)	1	LS	$45,536.11	$45,536.11
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$27,321.67	$27,321.67
7	Utility Conflicts (5%)	1	LS	$45,536.11	$45,536.11
				Subtotal =	**$409,825.00**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	2,300	LF	$175.00	$402,500.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	100	LF	$65.00	$6,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	100	LF	$80.00	$8,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	100	LF	$105.00	$10,500.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	600	LF	$130.00	$78,000.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	21	EA	$4,000.00	$84,000.00
16	Manhole	6	EA	$4,000.00	$24,000.00
17	Asphalt Pavement Replacement	2,778	SY	$80.00	$222,222.22
18	Concrete Curb Replacement	6,000	LF	$12.50	$75,000.00
				Subtotal =	**$910,722.22**
				CONTINGENCY (30%)	**$396,164.17**
				GRAND TOTAL	**$1,716,711**

Appendix A - Concept Cost Estimate Phase 4B					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$93,694.44	$93,694.44
2	Maintenance of Traffic (7%)	1	LS	$65,586.11	$65,586.11
3	Engineering Services (15%)	1	LS	$140,541.67	$140,541.67
4	Construction Management (5%)	1	LS	$46,847.22	$46,847.22
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$28,108.33	$28,108.33
7	Utility Conflicts (5%)	1	LS	$46,847.22	$46,847.22
				Subtotal =	**$421,625.00**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	2,600	LF	$175.00	$455,000.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	300	LF	$65.00	$19,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	200	LF	$80.00	$16,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	100	LF	$105.00	$10,500.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	100	LF	$130.00	$13,000.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	20	EA	$4,000.00	$80,000.00
16	Manhole	4	EA	$4,000.00	$16,000.00
17	Asphalt Pavement Replacement	3,056	SY	$80.00	$244,444.44
18	Concrete Curb Replacement	6,600	LF	$12.50	$82,500.00
				Subtotal =	**$936,944.44**
				CONTINGENCY (30%)	**$407,570.83**
				GRAND TOTAL	**$1,766,140**

Appendix A - Concept Cost Estimate Phase 5A					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$52,914.81	$52,914.81
2	Maintenance of Traffic (7%)	1	LS	$37,040.37	$37,040.37
3	Engineering Services (15%)	1	LS	$79,372.22	$79,372.22
4	Construction Management (5%)	1	LS	$26,457.41	$26,457.41
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$15,874.44	$15,874.44
7	Utility Conflicts (5%)	1	LS	$26,457.41	$26,457.41
				Subtotal =	**$238,116.67**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	0	LF	$175.00	$0.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	500	LF	$65.00	$32,500.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	500	LF	$80.00	$40,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	500	LF	$105.00	$52,500.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	500	LF	$130.00	$65,000.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	3,600	CY	$12.50	$45,000.00
15	Curb Inlet	20	EA	$4,000.00	$80,000.00
16	Manhole	4	EA	$4,000.00	$16,000.00
17	Asphalt Pavement Replacement	1,852	SY	$80.00	$148,148.15
18	Concrete Curb Replacement	4,000	LF	$12.50	$50,000.00
				Subtotal =	**$529,148.15**
				CONTINGENCY (30%)	**$230,179.44**
				GRAND TOTAL	**$997,444**

Appendix A - Concept Cost Estimate Phase 6A					
No.	**Pay Item Description**	**Quan.**	**Unit**	**Unit Cost**	**Total**
I.	**GENERAL**				
1	Mobilization (Includes Survey, Bonds, Insurance, Etc.) (10%)	1	LS	$139,842.59	$139,842.59
2	Maintenance of Traffic (7%)	1	LS	$97,889.81	$97,889.81
3	Engineering Services (15%)	1	LS	$209,763.89	$209,763.89
4	Construction Management (5%)	1	LS	$69,921.30	$69,921.30
5	Land Acquisition	0	AC	$100,000.00	$0.00
6	Contractor's Quality Control (Construction Materials Testing) (3%)	1	LS	$41,952.78	$41,952.78
7	Utility Conflicts (5%)	1	LS	$69,921.30	$69,921.30
				Subtotal =	**$629,291.67**
II.	**CONSTRUCTION**				
7	Exfiltration Trench (w/ 24" perforated pipe)	0	LF	$150.00	$0.00
8	Exfiltration Trench (w/ 36" perforated pipe)	0	LF	$175.00	$0.00
9	Concrete Pipe 15" (Including trench excavation & dewatering if needed)	600	LF	$65.00	$39,000.00
10	Concrete Pipe 18" (Including trench excavation & dewatering if needed)	600	LF	$80.00	$48,000.00
11	Concrete Pipe 24" (Including trench excavation & dewatering if needed)	600	LF	$105.00	$63,000.00
12	Concrete Pipe 36" (Including trench excavation & dewatering if needed)	0	LF	$130.00	$0.00
13	Concrete Pipe 48" (Including trench excavation & dewatering if needed)	0	LF	$145.00	$0.00
14	Regular Excavation	0	CY	$12.50	$0.00
15	Curb Inlet	15	EA	$4,000.00	$60,000.00
16	Manhole	5	EA	$4,000.00	$20,000.00
17	Asphalt Pavement Replacement	1,574	SY	$80.00	$125,925.93
18	Concrete Curb Replacement	3,400	LF	$12.50	$42,500.00
19	Pump Station (5 MGD)	1	LS	$1,000,000.00	$1,000,000.00
				Subtotal =	**$1,398,425.93**
				CONTINGENCY (30%)	**$608,315.28**
				GRAND TOTAL	**$2,636,033**