FINAL REPORT

Whitaker Bayou Flood Attenuation Alternatives Analysis

Sarasota County

November 2004

BOYLE Engineering Corporation

Whitaker Bayou Flood Attenuation Alternatives Analysis

Sarasota County

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SECTION 1

1.0 INTRODUCTION

This report provides the results of the study conducted at the request of Sarasota County, Florida to find solutions to the existing flooding problems in the Whitaker Bayou basin in Sarasota County.

Whitaker Bayou is a 9-square mile drainage basin located in northwestern Sarasota County and includes portions of the City of Sarasota and adjacent unincorporated areas of Sarasota County. Several parts of this basin experience recurring flooding events that have caused damage to residential and commercial developments.

The objective of this study was to review and evaluate the existing flooding conditions and recommend stormwater drainage improvements in order to meet the 100-yr/24-hr design storm, identified as the intended level of service. Feasible alternative improvements were evaluated and a cost benefit analysis was prepared for each of the alternatives. These alternatives were evaluated based on the effectiveness in reducing the flood damages for structures during the 100-yr design storm event and the overall economic impact of implementing each alternative.

This report describes the available data for the study, modeling, improvement alternatives considered, and recommendations.

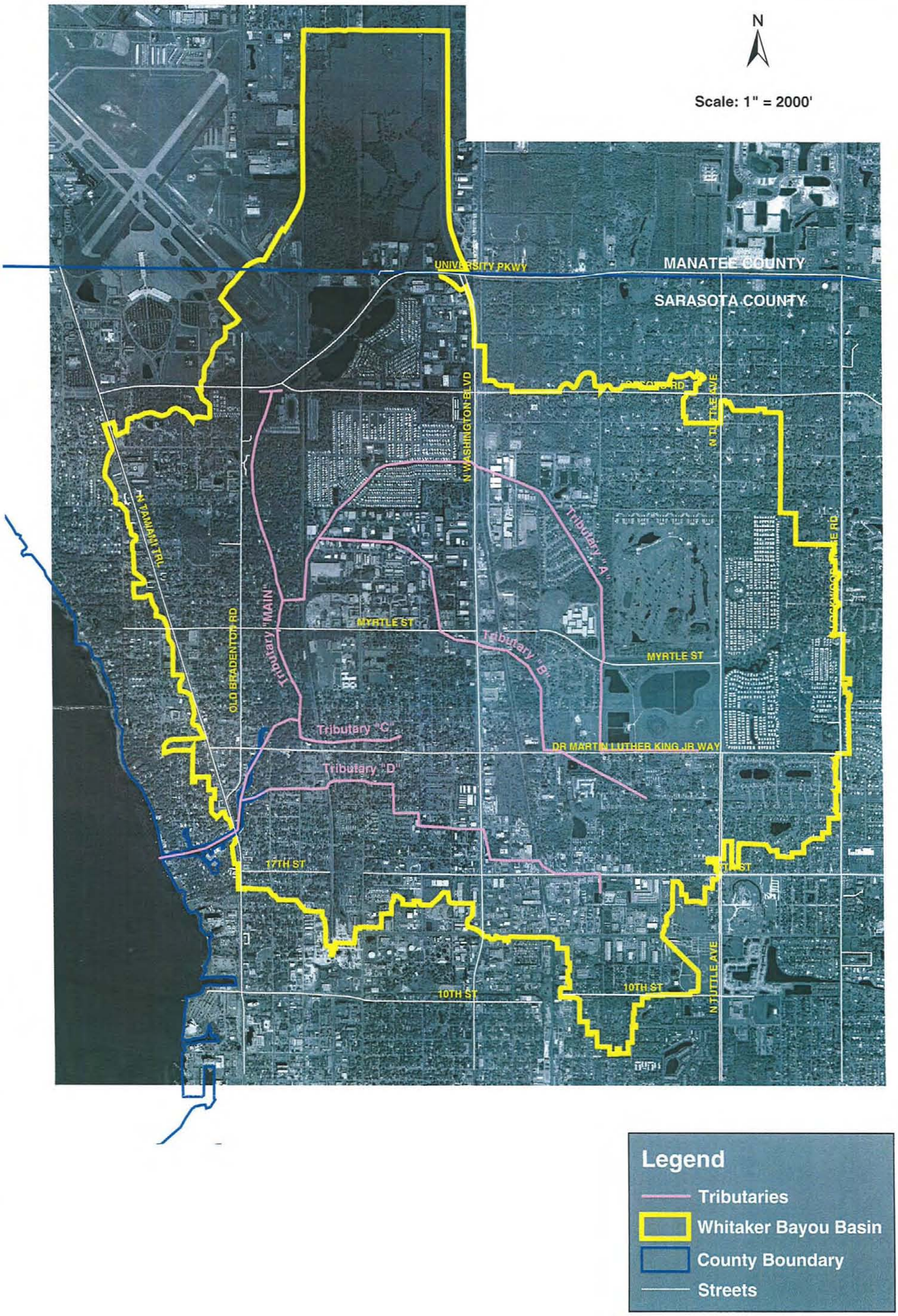
The work effort required to accomplish this study included the following tasks:

- Data Collection
- Hydrologic and Hydraulic Model Development
- Floodplain Mapping
- Alternatives Evaluation
- Cost Benefit Analysis
- Recommendations

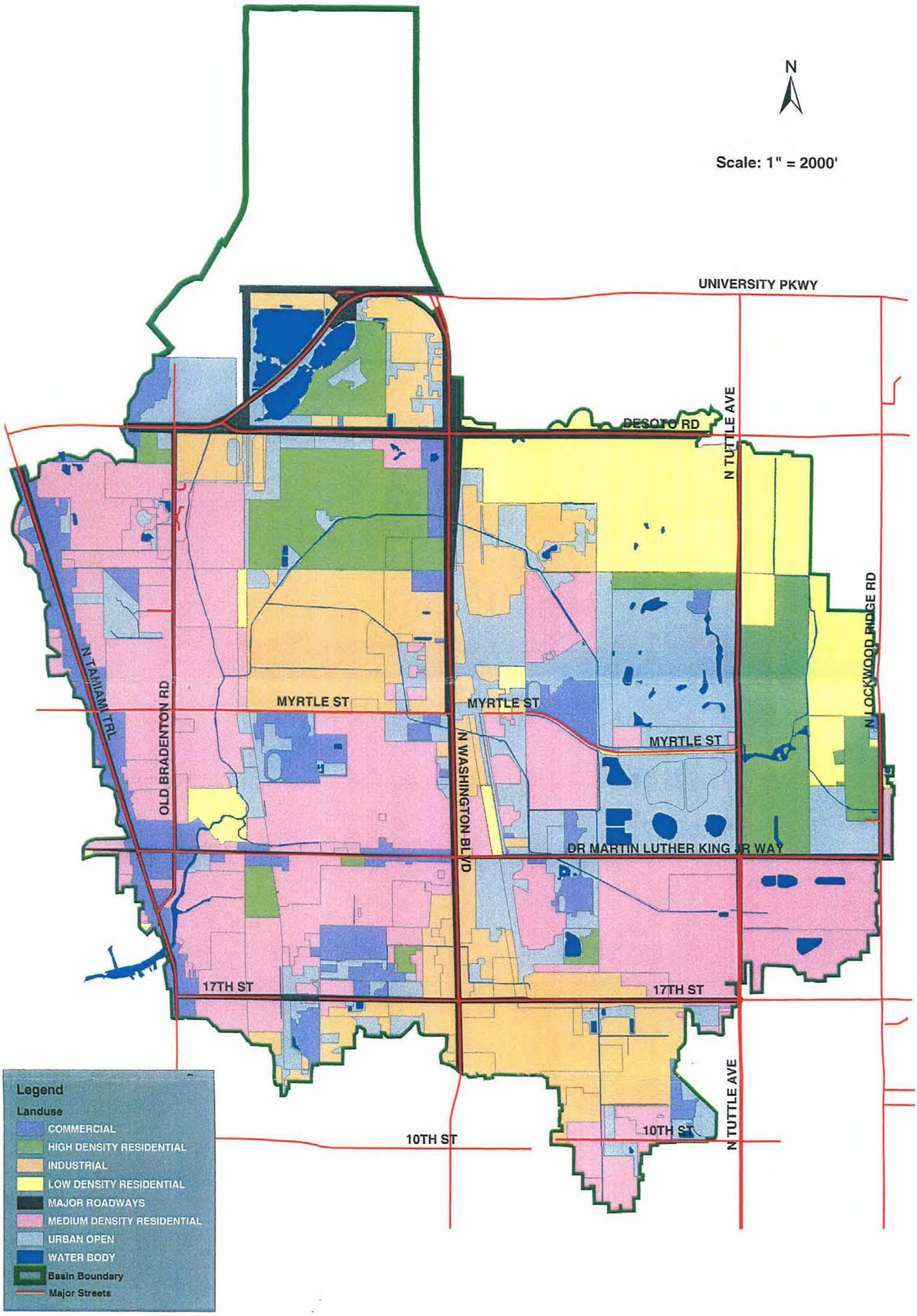
1.1 STUDY AREA

The Whitaker Bayou basin is located in Sarasota County on the Gulf Coast about 60 miles south of Tampa. Whitaker Bayou basin drains the northwestern portion of Sarasota County into Sarasota Bay as shown in Figure 1.1. The main channel of the Whitaker Bayou basin begins at a lake south of the Manatee-Sarasota County line and flows generally southwestward emptying at Sarasota Bay. Whitaker Bayou basin has been divided into five tributaries, shown in Figure 1.1. Tributary "Main" is the main

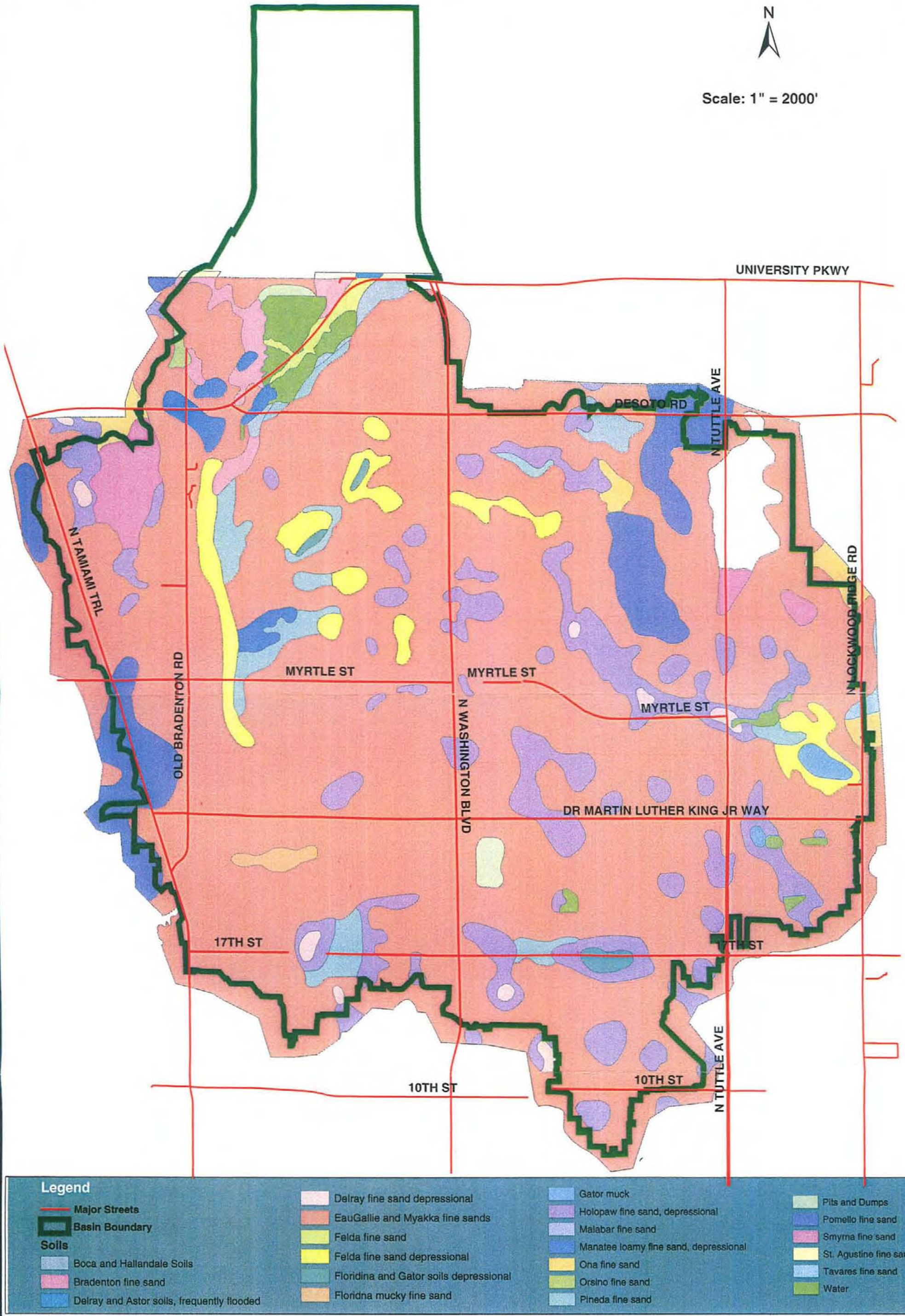
channel draining an area of mostly residential properties except for the Sarasota-Bradenton Airport and a racetrack located in the northwest portion of the city. Tributary "A" contains the Tri-Par Estates Mobile Home Community, a golf course, light industrial developments and warehouses. Tributary "B" joins Tributary "A" along Northgate Boulevard and its drainage area involves residential structures and some retail/light industry/commercial developments. Subbasins of tributaries "C" and "D" contain mostly of residential areas with one industrial area and some commercial/retail establishments. Figures 1.2 and 1.3 show the existing land use and soil classification maps of the Whitaker Bayou basin. The landuse map indicates that this basin contains mostly low, medium, and high density residential with some commercial and industrial areas. There were minimal open spaces available in the entire basin that could potentially be used as retention pond/storage systems as an improvement alternative to alleviate flooding in the basin. The soil classification map indicates that a major portion of the basin consists of Eau Gallie and Myakka fine sands. The average annual rainfall for this basin is about 52 inches accounting for major flooding within the basin.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 1.1: Project Location Map



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 1.2: Existing Conditions Landuse Map



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 1.3: Existing Conditions Soil Map

1.2 DATA COLLECTION

The data used for the study and the development of this report were obtained from a number of different resources. Sources of data, which were utilized, include:

- Existing Conditions Hydrologic and Hydraulic Model in ICPR Version 3.0 – Sarasota County
- GIS Data for Subbasins, Model Nodes and Links – Sarasota County
- Finished Floor Elevations for Selected Parcels within the Entire Basin – Sarasota County
- Level of Service for Flood Protection – Sarasota County Land Development Regulations
- Functional Classification of Roads – Transportation Appendix, Sarasota County Comprehensive Plan
- Aerial Photography for the Entire Basin – Sarasota County
- Parcel Digital Map in GIS Format – Sarasota County
- County Boundary Map in GIS Format – SWFWMD
- Street Map in GIS Format– Sarasota County
- Stormwater Quantity Level of Service and Design Criteria – Land development regulations (LDR)
- Cost Effective Analysis for Stormwater Projects – Stormwater Environmental Utility, Sarasota County
- Whitaker Bayou, Section 205 Feasibility Study for Sarasota County – US Army Corps of Engineers.
- Landuse and Soil Classification Map in GIS Format – Sarasota County

SECTION 2

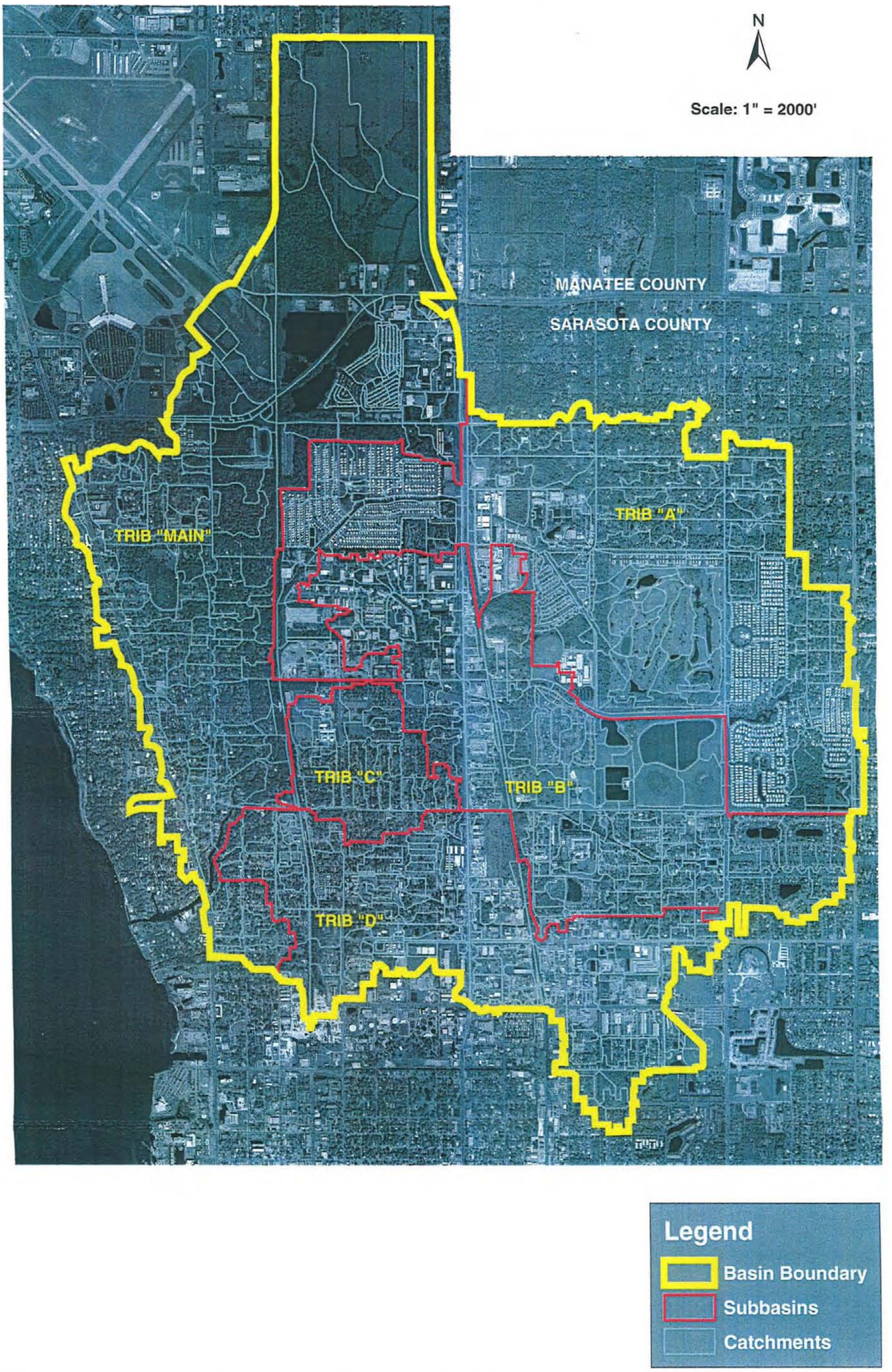
2.0 HYDROLOGIC AND HYDRAULIC MODEL DEVELOPMENT

Hydrologic and hydraulic analysis was performed for the Whitaker Bayou basin using ICPR Version 3.0 developed by Streamline Technologies, Inc., Florida. The purpose of this analysis was to determine the existing flooding conditions and feasible flood control alternatives intended to alleviate flooding in major areas of concern. The existing conditions model was developed by Sarasota County and it was used as the base model for the analysis of various improvement alternatives. The input data and output results of the Whitaker Bayou existing conditions model are provided in Appendix I.

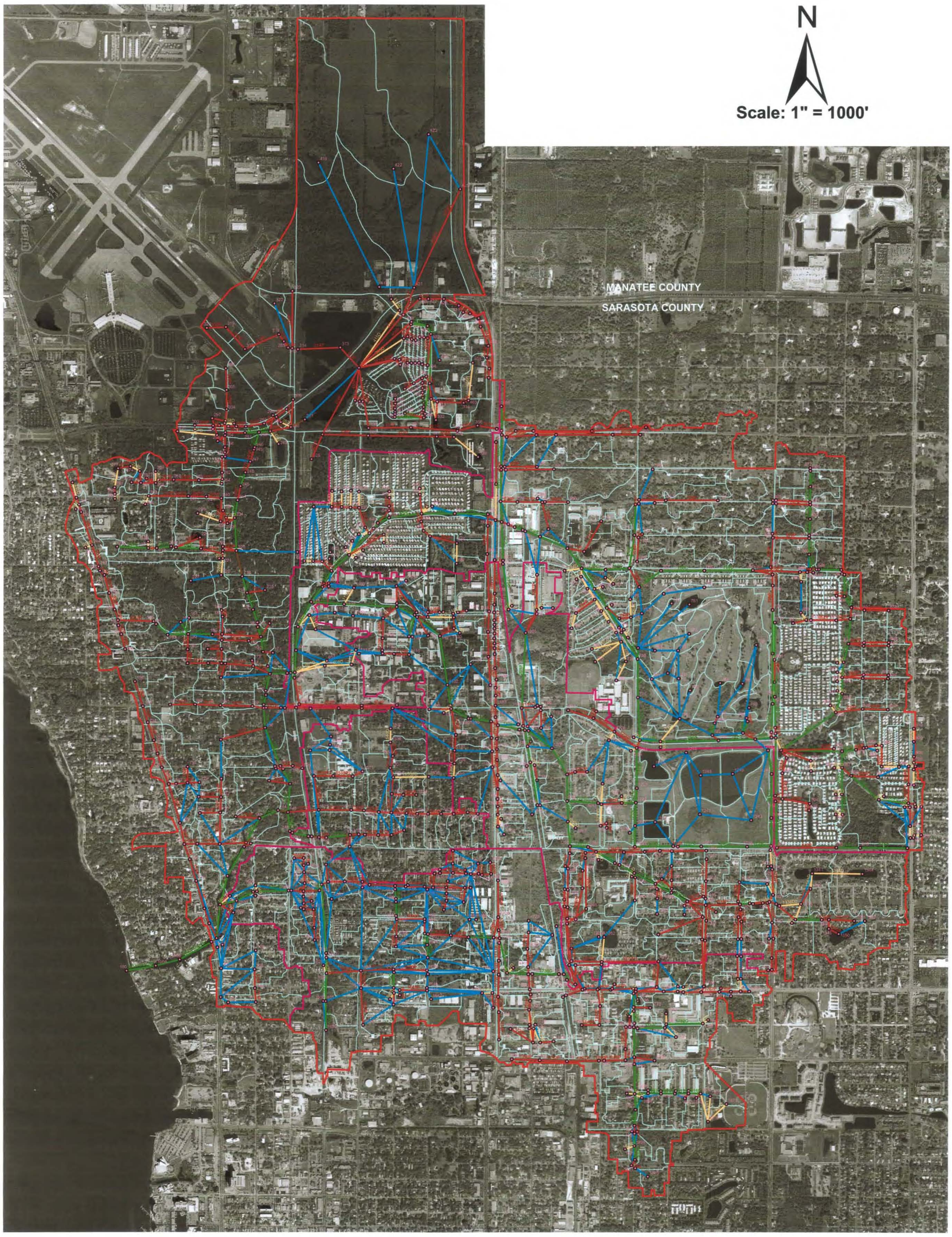
The existing conditions subbasin map (Figure 2.1) shows the boundary of the Whitaker Bayou basin. The basin is further delineated into five subbasins that are drained by the five tributaries as identified by their names on the map. Each subbasin was further divided into catchments for model development. In total, Nine hundred and fifty catchments were delineated by Sarasota County within the basin for model development and analysis.

Figure 2.2 shows the existing conditions Node-Link map. The Node-Link map represents the existing conveyance system for the entire basin. The map shows the nodes and the links involved in the hydraulic analysis of the existing conditions model. A total of 1144 nodes and 2051 links were used in the modeling and analysis for the basin.

Five different storm events (2-yr, 5-yr, 10-yr, 25-yr and 100-yr) with 24-hr durations were used for modeling simulations. Tables 2.1 and 2.2 show the summary of node maximum stage conditions and link maximum flow conditions for the 100-yr/24-hr design storm event.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 2.1: Existing Conditions Subbasin Map



Legend

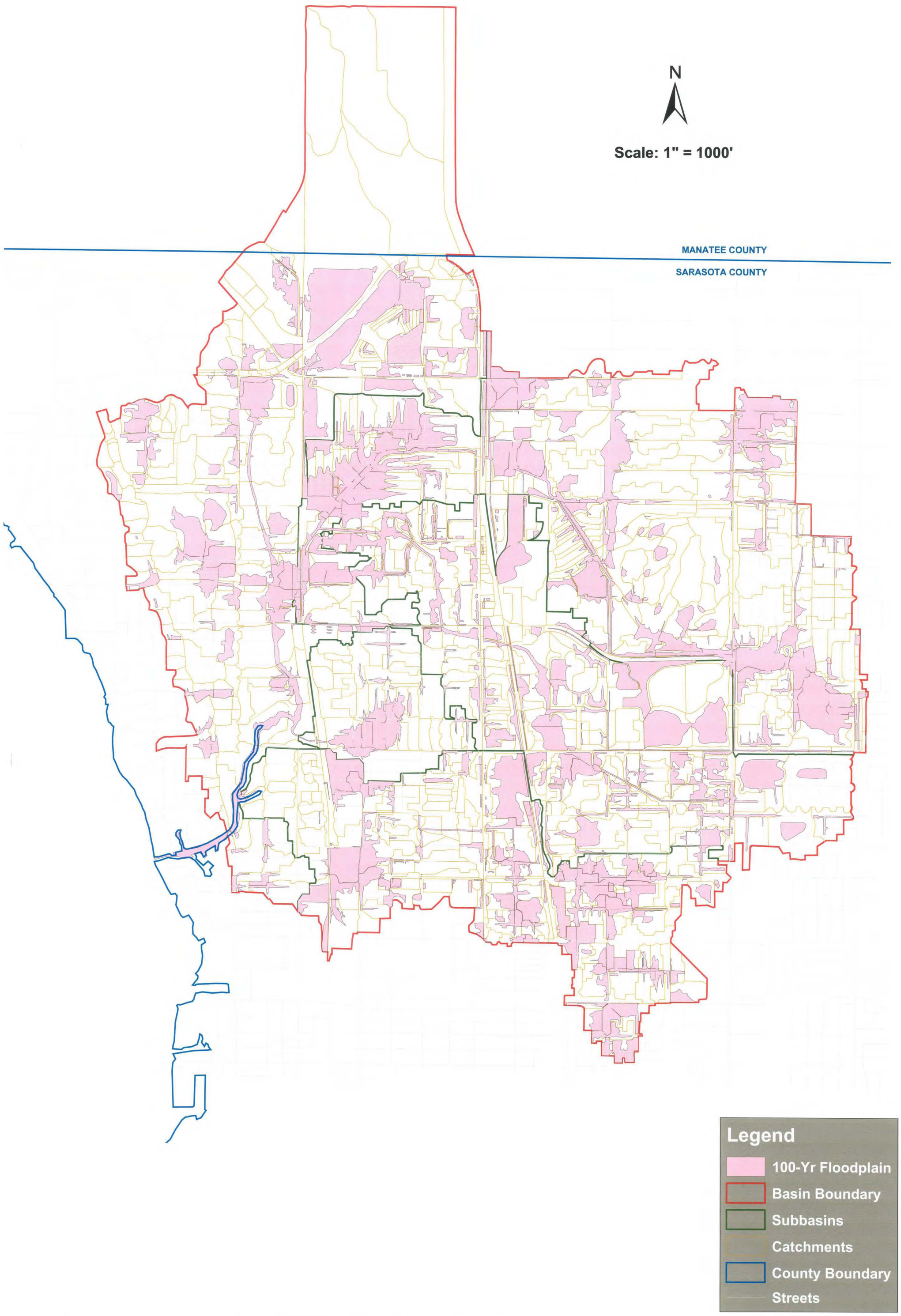
- Nodes
- Pipes
- Channels
- Drop Structures
- Bridges
- Weirs
- Basin Boundary
- Subbasins
- Catchments

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	**Sarasota County Florida**	**Figure 2.2: Existing Conditions Node Link Map**

2.1 FLOODPLAIN MAPPING – EXISTING CONDITIONS

Floodplain map of the 100-yr/24-hr design storm event was digitized in ArcGIS software to determine the flood prone areas in the basin. Figure 2.3 shows the existing conditions floodplain for the 100-yr/24-hr design storm. The floodplain map was created using the 100-yr/24-hr node maximum stages and the spot elevations/contours provided by Sarasota County. The major flood prone areas in the entire basin based on this floodplain map are as listed below:

- Tri-Par Estates
- Areas adjacent to the Tributaries
- Areas east of North Tuttle Avenue
- 17th Street Area



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 2.3: Existing Conditions 100-yr/24-hr Floodplain Map

2.2 LEVEL OF SERVICE (LOS)

The LOS criteria for flood protection is defined in the Sarasota County Land Development Regulations (LDR), as adopted by the Board of County Commissioners provided in Tables 2.3 and 2.4. All recommended stormwater drainage improvements described in this report are evaluated using this LOS criteria.

Table 2.3: Stormwater Level of Service Design Criteria (LDR)

	Flood Reference (buildings, roads, and sites)	Level of Service (flood intervals are in years)
I. Buildings: Pre-FIRM or Post-FIRM structures are at or above the flood water elevation	A. Emergency shelters and essential services	>100
	B. Habitable	100
	C. Employment/Service Centers	100
II. Road Access: Road Access: Roads shall be passable during flooding. Roadway flooding <6" depth at outside edge of pavement is considered passable.	A. Evacuation	>100
	B. Arterials	100
	C. Collectors	25
	D. Neighborhood	10
III. Sites: Flooding refers to standing water in agricultural land, developed open or grass space (yards and parking lots, etc.) and undeveloped lands designated for future development. This does not include areas incorporated into the storm water or Basin Master Plan as flow ways, floodplain, or flood storage areas.	A. Urban (>1 unit/acre)	5
	B. Rural	2
IV. The water quantity level of service can be adjusted to allow for greater amounts of flooding of roads and sites if the flooding is provided for a Basin Master Plan or as a part of a storm water management system design and does not adversely impact human health and safety, natural resources or property. Attenuation Calculations will be based only upon the volume available in the detention/retention ponds or wetlands. The level of service for improvements to existing roadways may be adjusted based on existing conditions such as adjacent topography and economic impacts		

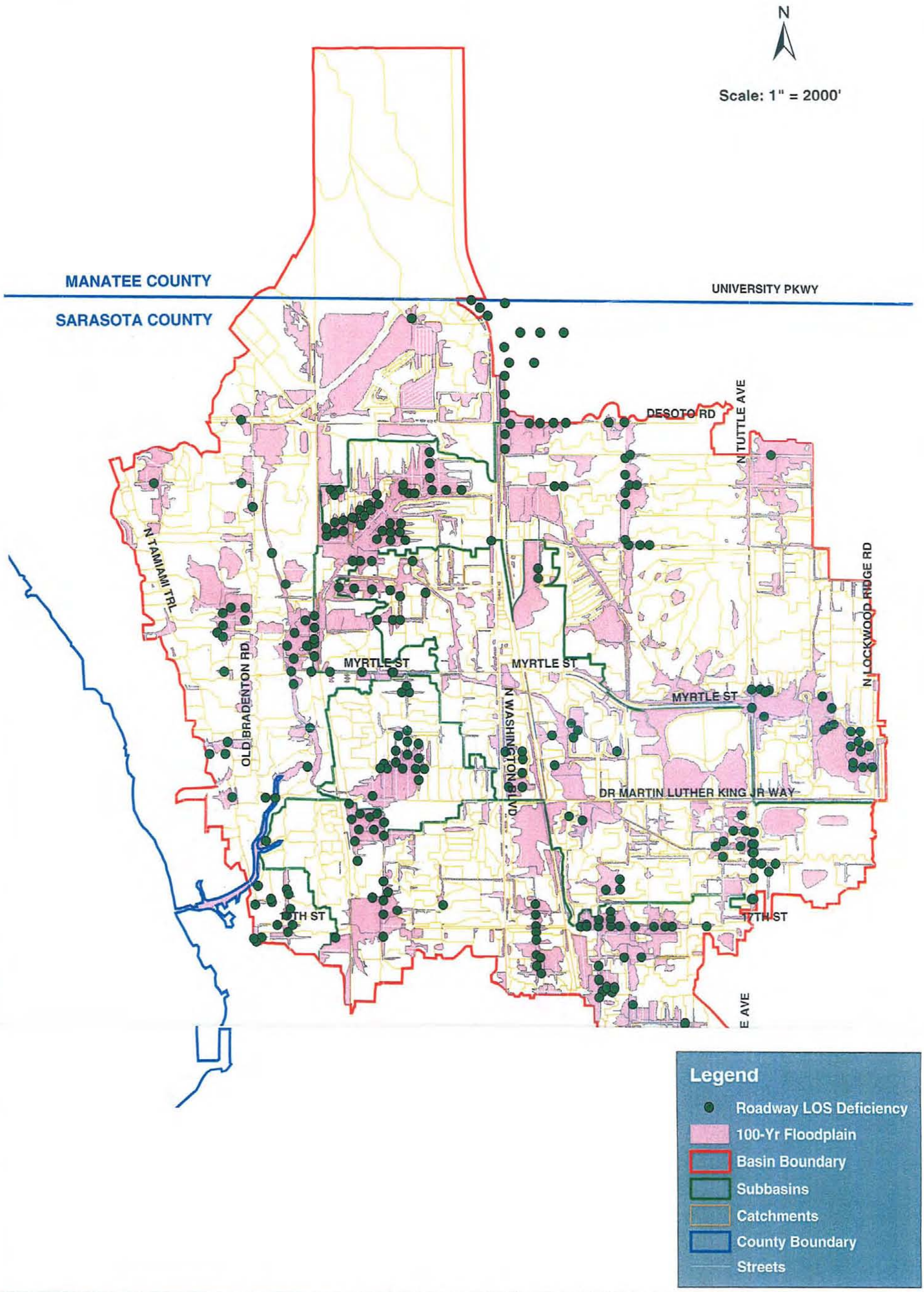
Table 2.4: Acceptable Levels of Flooding (LDR)

ROADWAYS	5-year	10-year	25-year	100-year
A. Evacuation Route	None	None	None	None
B. Arterials	None	None	None	6 inches
C. Collectors	None	None	6 inches	9 inches
D. Neighborhood	None	6 inches	9 inches	12 inches
PARKING AREAS	3 inches	9 inches	9 inches	12 inches
OPEN SPACE: Flooding of open space is acceptable if it does not compromise public health and safety				

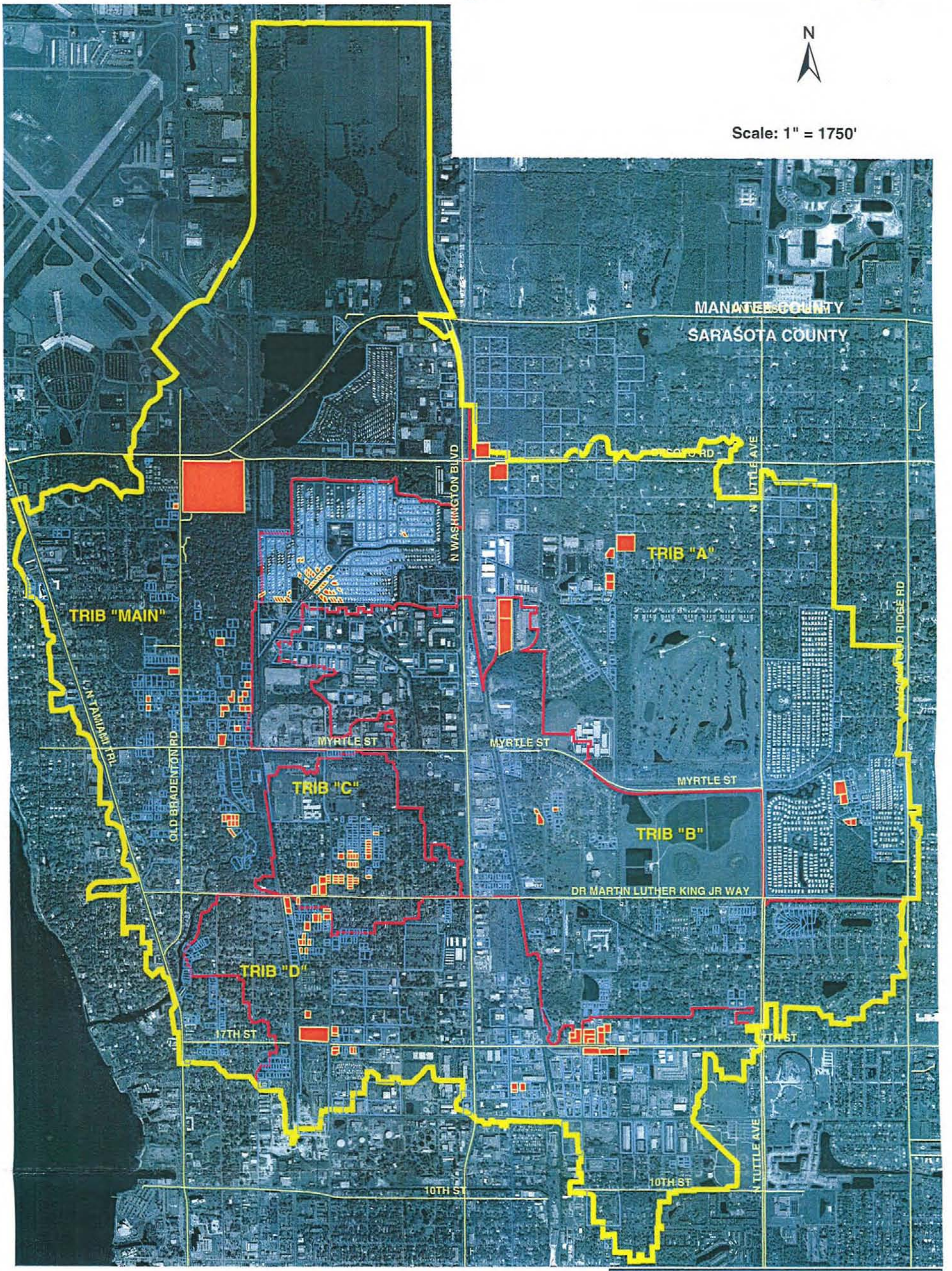
Based on the acceptable levels of flooding criteria, Figure 2.4 shows the existing conditions roadway flooding deficiencies for the 100-yr/24-hr design storm event. The occurrence of flooding on the roads was determined using the node maximum stages from the existing conditions model and the functional classification of the roads from the Sarasota County Comprehensive Plan (Appendix II).

To determine the LOS for structural flooding, Sarasota County provided the finished floor elevation survey for selected parcels within the Whitaker Bayou basin, which are listed in Table 2.5. The number of flooded structures was then determined for the 100-yr/24-hr design storm event, which is graphically represented in Figure 2.5. This was accomplished through a two-step process. The first step involved associating the nodes of the model to each of the parcels for which finished floor elevations were available. The second step was to find the difference between the 100-yr/24-hr node maximum stage for the respective nodes and the finished floor elevations surveyed by Sarasota County. The resulting number of flooded structures in the existing conditions was 154 out of 1594 parcels that were surveyed.

In order to alleviate structural flooding, various improvement alternatives were considered and are discussed in the next section.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 2.4: Existing Conditions 100-yr/24-hr Roadway LOS Map



100-Yr Damage Cost for Existing Conditions : $10.41 M

No. of Flooded Structures : 154

Range of Finished Floor Flooding Depth : 0.01 - 2.27 ft

Legend

- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 2.5: Existing Conditions Structure Flooding

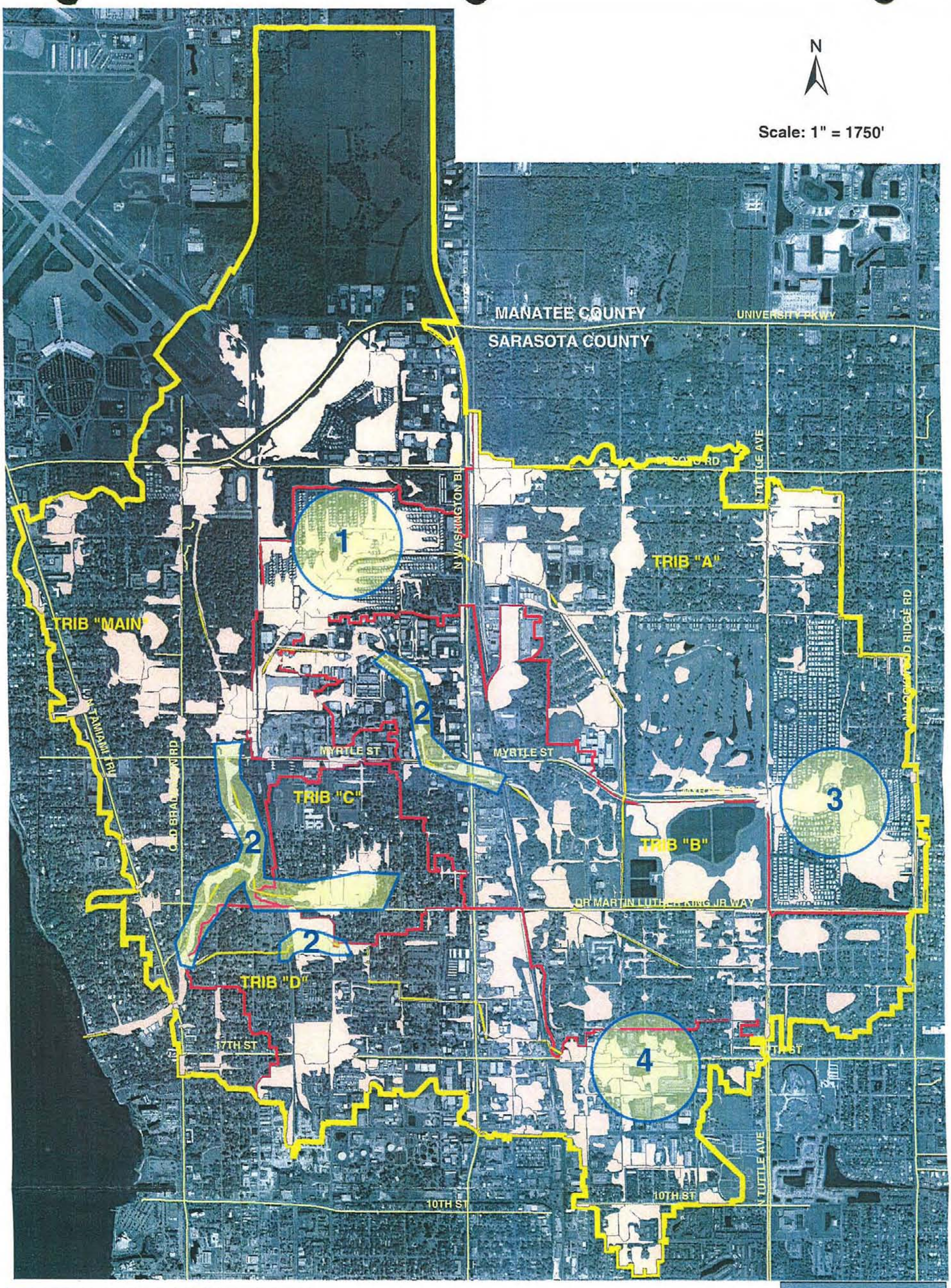
SECTION 3

3.0 EVALUATED ALTERNATIVES

As discussed in Section 2.1, in the existing conditions four generalized flooding areas were identified within the Whitaker Bayou basin. Figure 3.1 shows the general locations of these problem areas. Each problem area was independently analyzed by both Sarasota County and Boyle Engineering Corporation to determine the most effective means of alleviating the local flooding conditions. Improvements considered included,

- Culvert Enlargement
- Bridge Replacement
- In-Line Detention Basins
- Channel Enlargement
- Regional or basin wide stormwater retention facilities
- Use of stormwater pump stations

After thorough evaluation of the existing flooding conditions, different alternatives consisting of various improvements located at critical areas of the basin were selected. These improvements are identified as individual components and each alternative has been modeled as a combination of several components, as identified in Figure 3.2. The following section describes the individual improvement components that make up the evaluated alternatives.



Major Flood Prone Areas:

1) Tri-Par Estates

2) Areas adjacent to the Tributaries

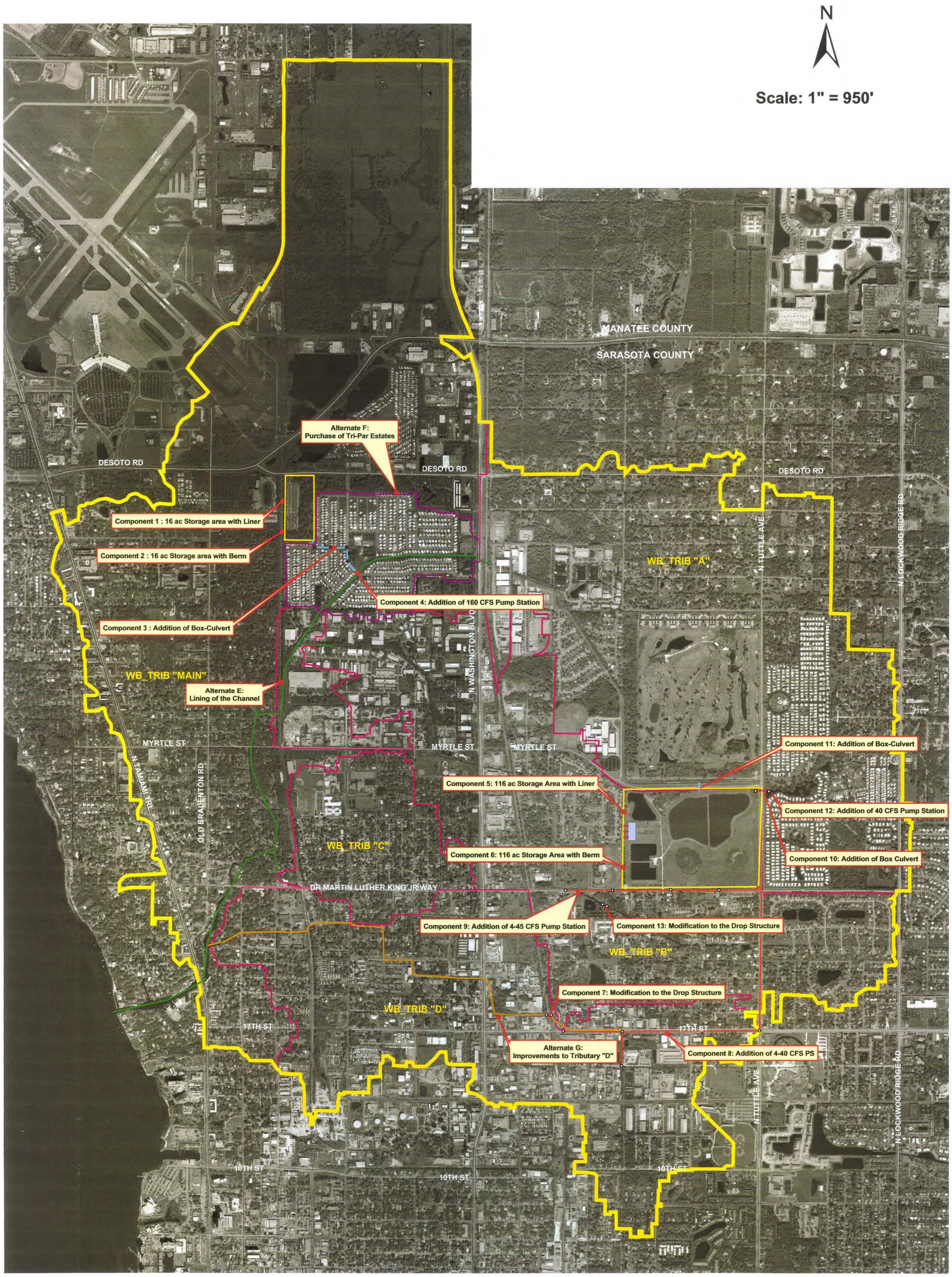
3) Areas East of NorthTuttle Avenue

4) 17th Street Area

Legend

- Flood Prone Areas
- 100-yr Floodplain
- Tributaries
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.1: Major Flood Prone Areas



Alternate A: Components 1, 3, 5, 7, 8, 9, 10, 11 & 13

Alternate B: Components 2, 4, 6, 7, 8, 9, 11, 12 & 13

Alternate C: Components 5, 7, 8, 9, 10, 11 & 13

Alternate D: Components 6, 7, 8 ,9, 11, 12 & 13

Legend

- Trib D Improvements
- Channel Lining
- Tripar Basin
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.2: Locations of Improvement Components

3.1 DESCRIPTION OF THE IMPROVEMENT COMPONENTS

Component 1: 16-acre Storage Area with Liner

This component makes provisions for a 16-acre stormwater storage area in the Dog Track parking area located south of Desoto Road. The purpose of this storage area is to reduce the flooding in Tri-Par Estates, which is one of the major flood prone areas. The storage area is designed to have inflow/outflow to tributary "A" with an initial stage elevation of 8.5 Feet NGVD. A flood storage volume of 127.2 ac-ft is provided in this stormwater area with the addition of liner. Since some of the storage volume is provided below seasonal high water table. A liner would be required in order to avoid ground water intrusion into the pond.

Component 2: 16-acre Storage Area with Berm

This component also uses the 16-acre storage area described in Component 1. In this component, the flood storage volume is provided above the seasonal high water table. Hence, a 10 Feet high berm is added instead of liner used in component 1. The addition of the berm significantly reduces the volume of excavation and hauling that needs to be done thereby making the component very economical. The initial stage of the 16-acre storage area is set at elevation of 12 Feet NGVD and the available storage volume is approximately 129.1ac-ft.

Component 3: Addition of Box Culvert in Tri-Par Estates

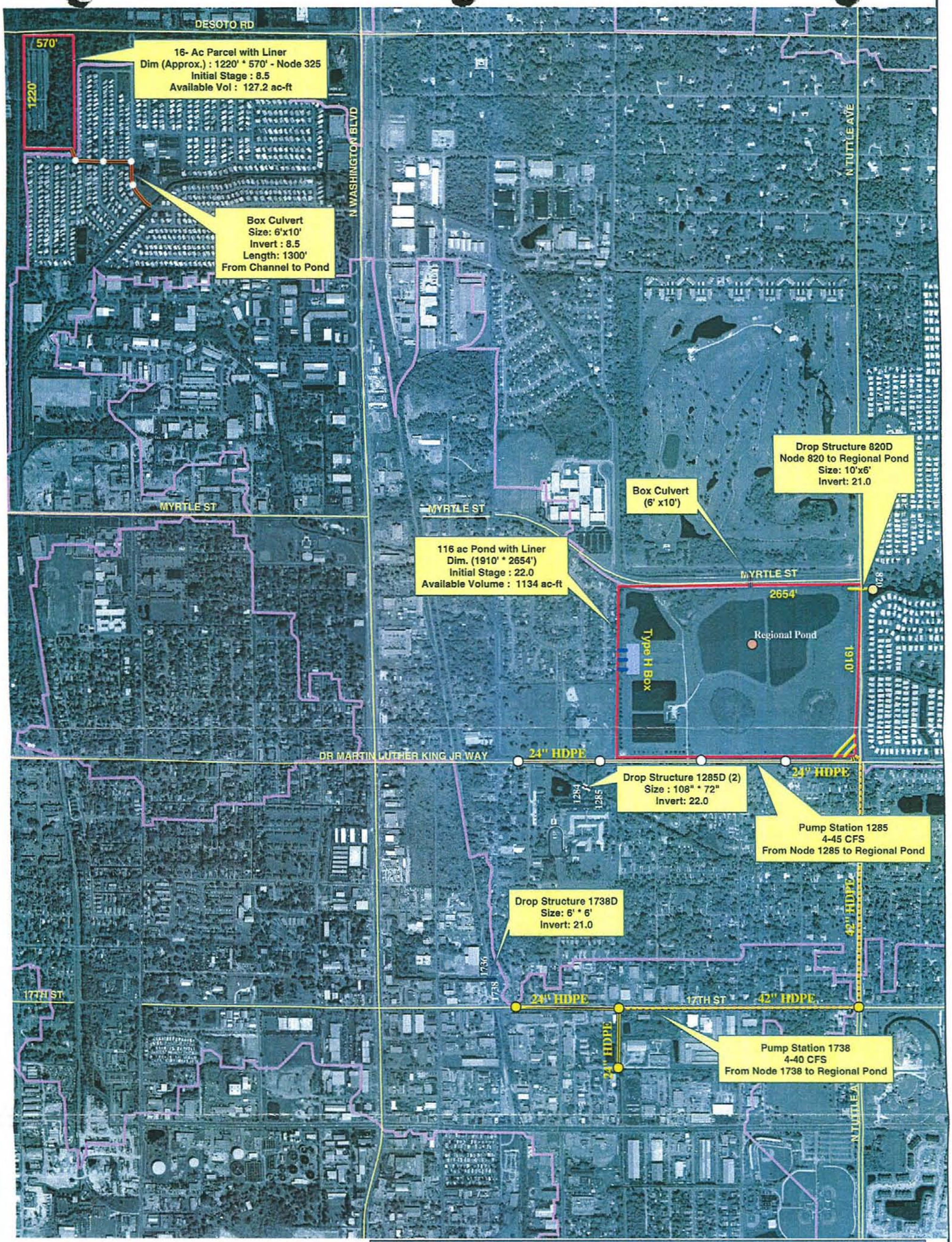
For Component 3, a box culvert is utilized as the medium of conveyance from tributary "A" to the 16-acre storage area previously described in Component 1. The required box culvert is modeled as a 6-foot x 10-foot concrete structure with an invert elevation 8.5 feet NGVD. The total length of box culvert is approximately 1300 feet. See Figure 3.2 for location of Component 3.

Component 4: Addition of 160 cfs Pump Station in Tri-Par Estates

In this component, a 160 cfs stormwater pump station is added instead of box-culvert used in Component 3 to discharge more flow from tributary "A" to the 16-ac storage area. The purpose of this component is to reduce cost thereby making the component economical.

Component 5: 116-acre Storage Area with Liner

This component makes provisions for a 116-acre stormwater storage area in the old wastewater treatment plant located between Myrtle Street and Dr. Martin Luther King Jr. Way, just west of North



N

Scale 1" = 1000'

Legend

- Subbasin
- Regional Pond Basin
- Pond 325
- Pump Station locations at 1235D
- Pump station locations at 1738D
- Regional Pond Node
- Node 820
- 1738D Nodes
- 1285D Nodes
- Box Culvert from Channel to Pond 325
- Drop Structure 820D
- Drop Structure 1285D
- Drop Structure 1738D
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY	Sarasota County Florida	Figure 3.3: Details of Improvement Alternate A

3.2 ALTERNATIVES

A total of seven different alternates were considered for reducing flooding within Whitaker Bayou basin. Each alternate uses a different combination of components identified in Section 3.0.

Alternate A

This alternate involves the construction of two regional stormwater pond sites (Components 1 & 5) with a pond liner for storage below the seasonal high water table and two box-culverts, one of which acts as a medium of conveyance from the 16-ac-stormwater pond to tributary "A" (Component 3) and the other one under Myrtle Street (Component 11) to drain water from golf course to 116-ac stormwater pond.

The alternate also includes the addition of three weir-structures (Components 7, 10 & 13) to restrict the flow within the existing pipes and four stormwater pump stations along 17th Street (Component 8) and Dr. Martin Luther King Jr. Way (Component 9). Details of this alternate used to develop the proposed conditions model are graphically represented in Figure 3.3.

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate A are listed in Table 3.2. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.4. The total number of structures flooded was reduced from 154 structures in the existing conditions to 101 structures with Alternate A, thereby removing a total of 53 structures from the 100-yr/24-hr flooding.

Tuttle Avenue. The purpose of this storage area is to reduce the flooding occurrence in the areas south of 17th street, east of North Tuttle Avenue and areas adjacent to the tributaries "A" and "B". The storage area is designed to have inflow/outflow to tributary "A" with an initial stage elevation of 22.0 feet NGVD. A flood storage volume of 1134 ac-ft is provided in this stormwater area with the addition of liner. Since some of the storage volume is provided below seasonal high water table. A liner would be required in order to avoid ground water intrusion into the pond. A control structure is provided to control the outflow from the storage area back into the channel and a dissipater structure is provided at the inflow point into the storage area to prevent erosion.

Component 6: 116-acre Storage Area with Berm

This component also uses the 116-acre storage area described in Component 5. In this component, the flood storage volume is provided above the seasonal high water table. Hence, a 10 Feet high berm is added instead of liner used in component 5. The addition of the berm significantly reduces the volume of excavation and hauling that needs to be done thereby making the component very economical. The initial stage of this storage area is set at elevation of 26.0 feet and the available storage volume is approximately 1217 ac-ft.

Component 7: Addition of Drop Structure in Tributary "D"

This component involves the addition of a 6-foot x 6-foot drop structure with an invert elevation of 21.0 feet NGVD in place of the existing pipes under the railroad near 17th Street. The purpose of this drop structure is to limit the flow in tributary "D" downstream of railroad and convey more water into the 116-ac-storage area thereby reducing the flooding in 17th Street.

Component 8: Addition of 4 Stormwater Pump Stations along 17th Street

Four 40 cfs pumps are utilized at different locations along the 17th Street from the drop structure described in Component 7 to the 116-acre-storage area. The purpose of this component is to effectively pump the stormwater entering the drop structure into the 116-acre-storage area to reduce the flooding in the 17th street, which is one of the major flood prone areas. The pumps are operated at different elevations depending on the level of flooding occurring at the 17th Street.

Component 9: Addition of 4 Stormwater Pump Stations along Dr. MLK Jr. Way

Four 45 cfs pumps are utilized at different locations along Dr. Martin Luther King Jr. Way from the drop structure to the 116-ac-storage area. The purpose of this component is to reduce the flooding occurrence along tributary "B" as seen on the 100-yr floodplain map shown in Figure 2.3.

Component 10: Addition of Drop Structure in Tributary "B"

This component involves the addition of a drop structure under North Tuttle Avenue directing stormwater into the 116-ac-storage area. The purpose of this drop structure is to reduce the flooding east of North Tuttle Avenue, which is one of the flood prone areas of major concern. The drop structure is modeled as a 10-foot x 6-foot concrete structure with an invert elevation of 21.0 feet NGVD.

Component 11: Addition of Box Culvert under Myrtle Street

For Component 11, a box culvert is utilized as the medium of conveyance from the golf course located North of Myrtle Street to the 116-acre storage area previously described in Component 3.

Component 12: Addition of 40 cfs Stormwater Pump Station

In this component, a 40 cfs stormwater pump station is added instead of drop structure used in Component 10 to discharge more flow from tributary "A" to the 16-ac storage area. The purpose of this component is to reduce cost thereby making the component economical.

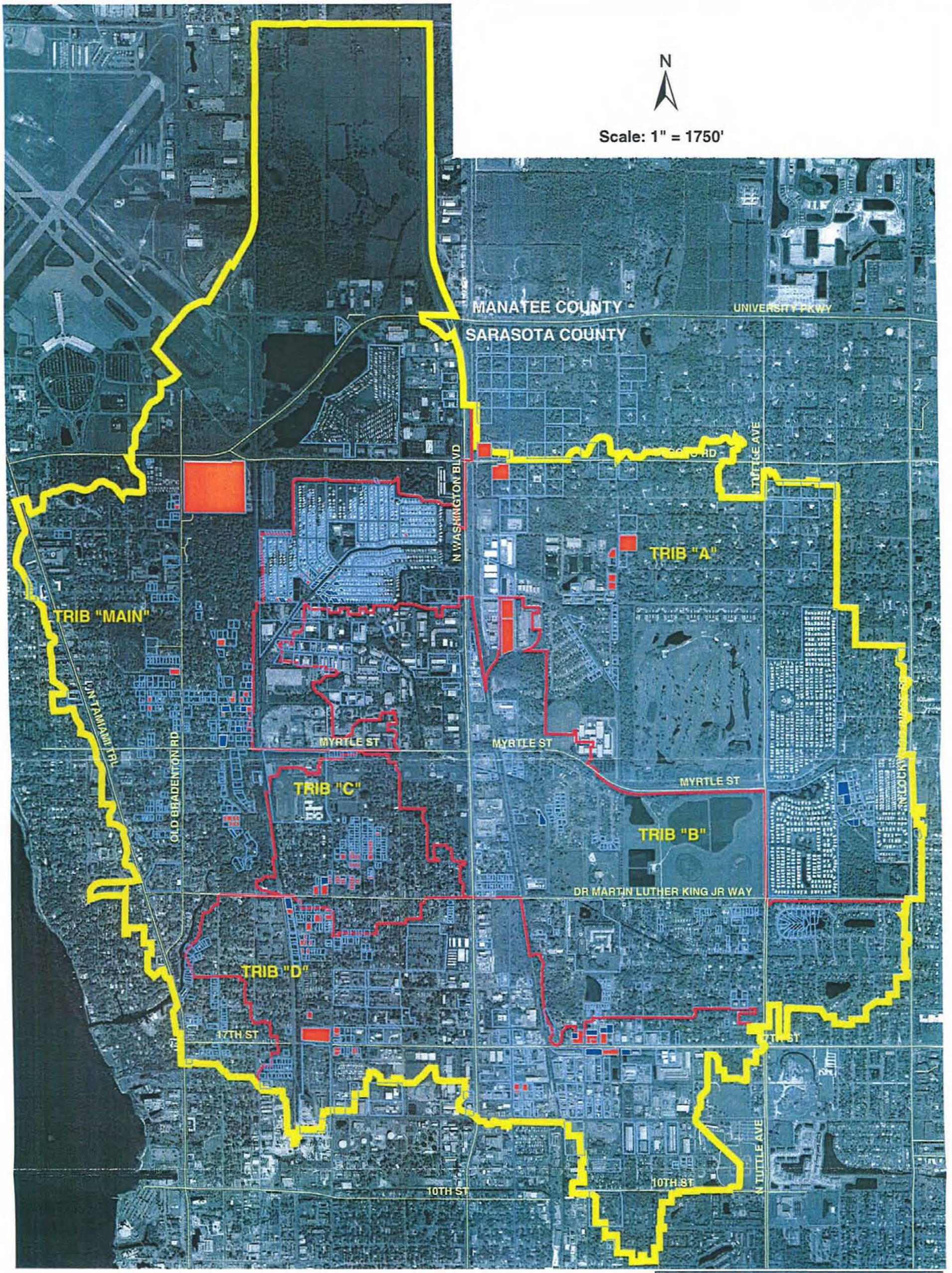
Component 13: Addition of Drop Structure in Tributary "B"

This component involves the addition of drop structure in place of the existing pipes. The drop structure is modeled as two 108-inch x 72-inch concrete structures with a pipe invert elevation set at 22.0 feet NGVD. The purpose of this drop structure is to reduce the flooding occurring along tributary "B" as seen on the 100-yr floodplain map shown in Figure 2.3.

Table 3.1 provides the summary of construction costs for each of these components. The construction costs were estimated based on the current market price and though they were estimated conservatively, the construction costs may vary in the future due to changes in market conditions.

Table 3.1: Summary of the Engineer's Estimate of Probable Construction Cost for Different Components

S.No	Construction Cost of Components	Cost
1	16-acre Storage Area with Liner	$4.0 M
2	16-acre Storage Area with Berm	$2.3 M
3	Addition of Box-Culvert in Tri-Par Estates	$3.0 M
4	Addition of 160 cfs Pump Station in Tri-Par Estates	$3.0 M
5	116-acre Storage Area with Liner	$49.9 M
6	116-acre Storage Area with Berm	$23.3 M
7	Addition of Drop Structure in Tributary "D"	$0.3 M
8	Addition of 4 Stormwater Pump Stations in 17th Street	$3.5 M
9	Addition of 4 Stormwater Pump Stations in Dr. MLK Jr. Wa	$3.5 M
10	Addition of Drop Structure in Tributary "B"	$0.5 M
11	Addition of Box-Culvert Under Myrtle Street	$0.3 M
12	Addition of 40 cfs Stormwater Pump Station	$1.8 M
13	Addition of Drop Structure in Tributary "B"	$0.3 M



Construction Cost for Alternate A : $65.27 M

Benefits for Alternate A : $3.04 M

Benefits to Cost Ratio (%) : 4.7

No. of Structures removed from Flooding : 53

Range of Finished Floor Flooding Depth : 0.01 - 2.19 ft

Legend

- Alternate A-Structures removed
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.4: Improvement Alternate A Structure Flooding

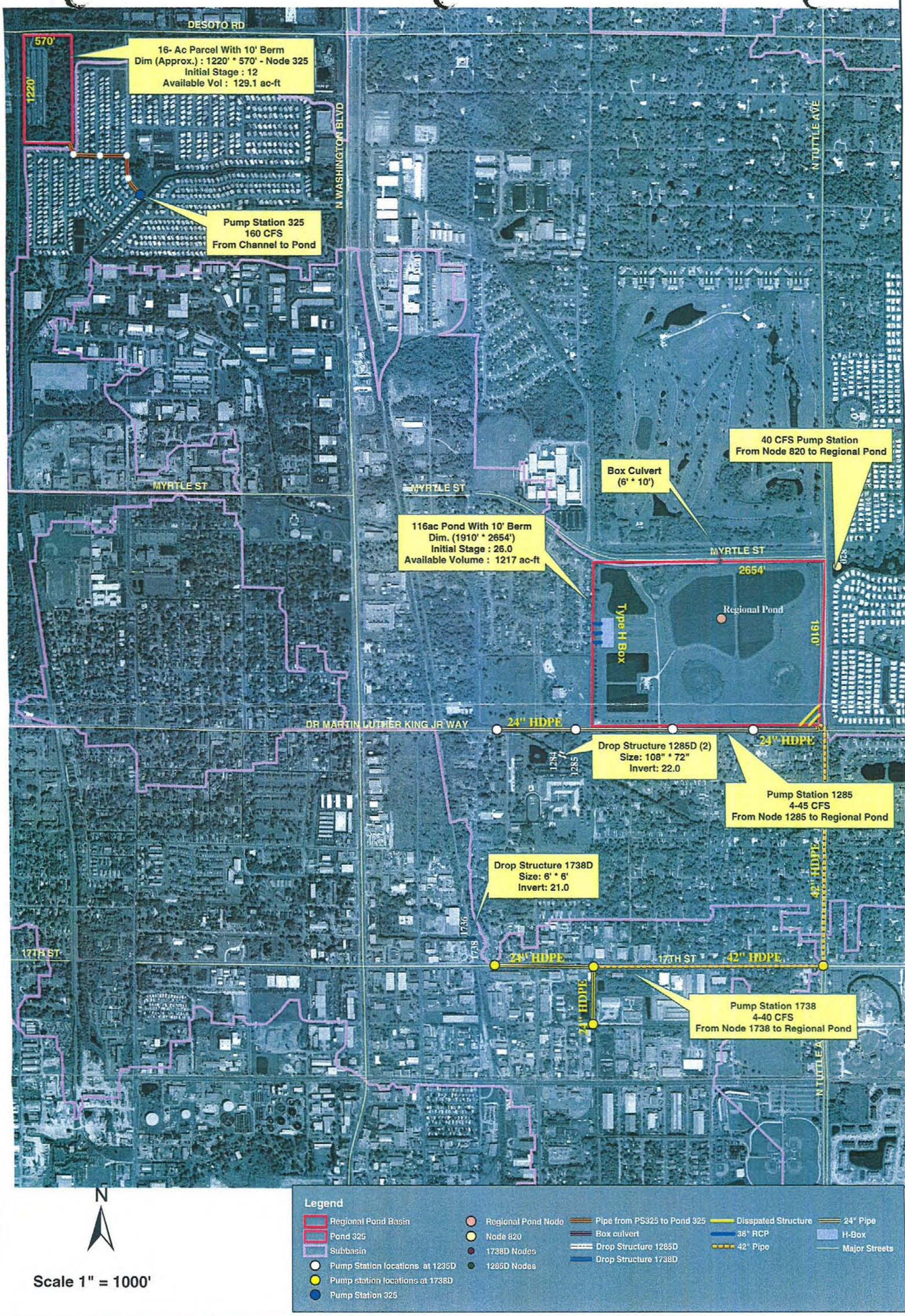
Alternate B

This alternate also involves the construction of two regional stormwater pond sites (Components 2 & 6) with a 10 feet high berm instead of a pond liner for storage above the seasonal high water table to reduce cost and a stormwater pump station (Component 4) instead of box-culvert used in Component 3 to discharge more flow from tributary "A" to the 16-ac storage area. Box-Culvert is also added under Myrtle Street (Component 11) to drain water from golf course to 116-ac stormwater pond.

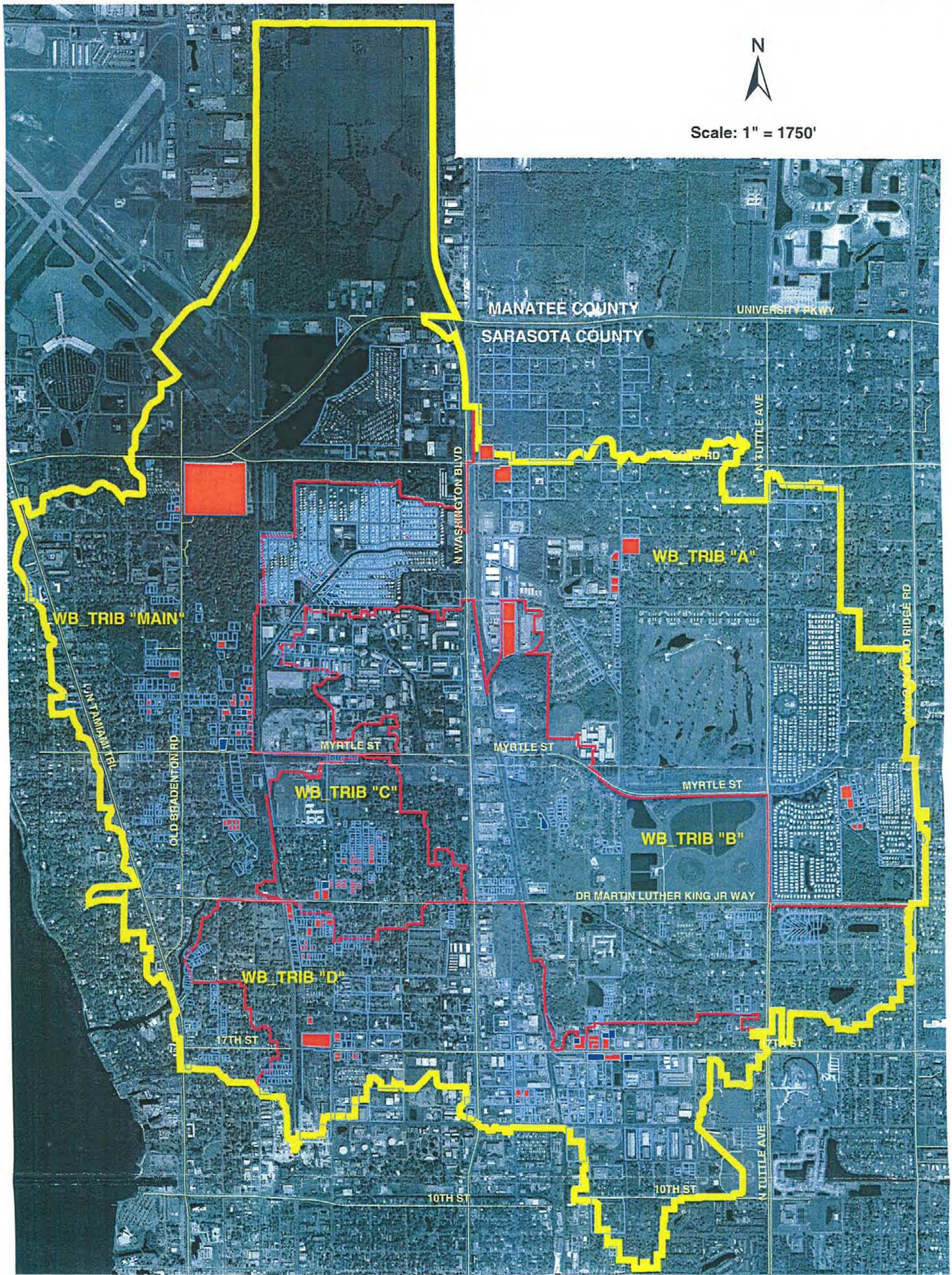
The alternate also includes the addition of two weir-structures (Components 7 & 13) to restrict the flow within the existing pipes and four stormwater pump stations along 17th street (Component 8) and Dr. Martin Luther King Jr. Way (Component 9). Details of this alternate used to develop the proposed conditions model are graphically represented in Figure 3.5.

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate B are listed in Table 3.4. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.6. The total number of structures flooded was reduced from 154 structures in the existing conditions to 114 structures with Alternate B, thereby removing a total of 40 structures from the 100-yr/24-hr flooding.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY	Sarasota County Florida	Figure 3.5: Details of Improvement Alternate B



Construction Cost for Alternate B : $38.27 M

Benefits for Alternate B : $2.54 M

Benefits to Cost Ratio (%) : 6.6

No. of Structures removed from Flooding : 40

Range of Finished Floor Flooding Depth : 0.01 - 2.20 ft

Legend

- Alternate B-Structures removed
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3-6: Improvement Alternate B Structure Flooding

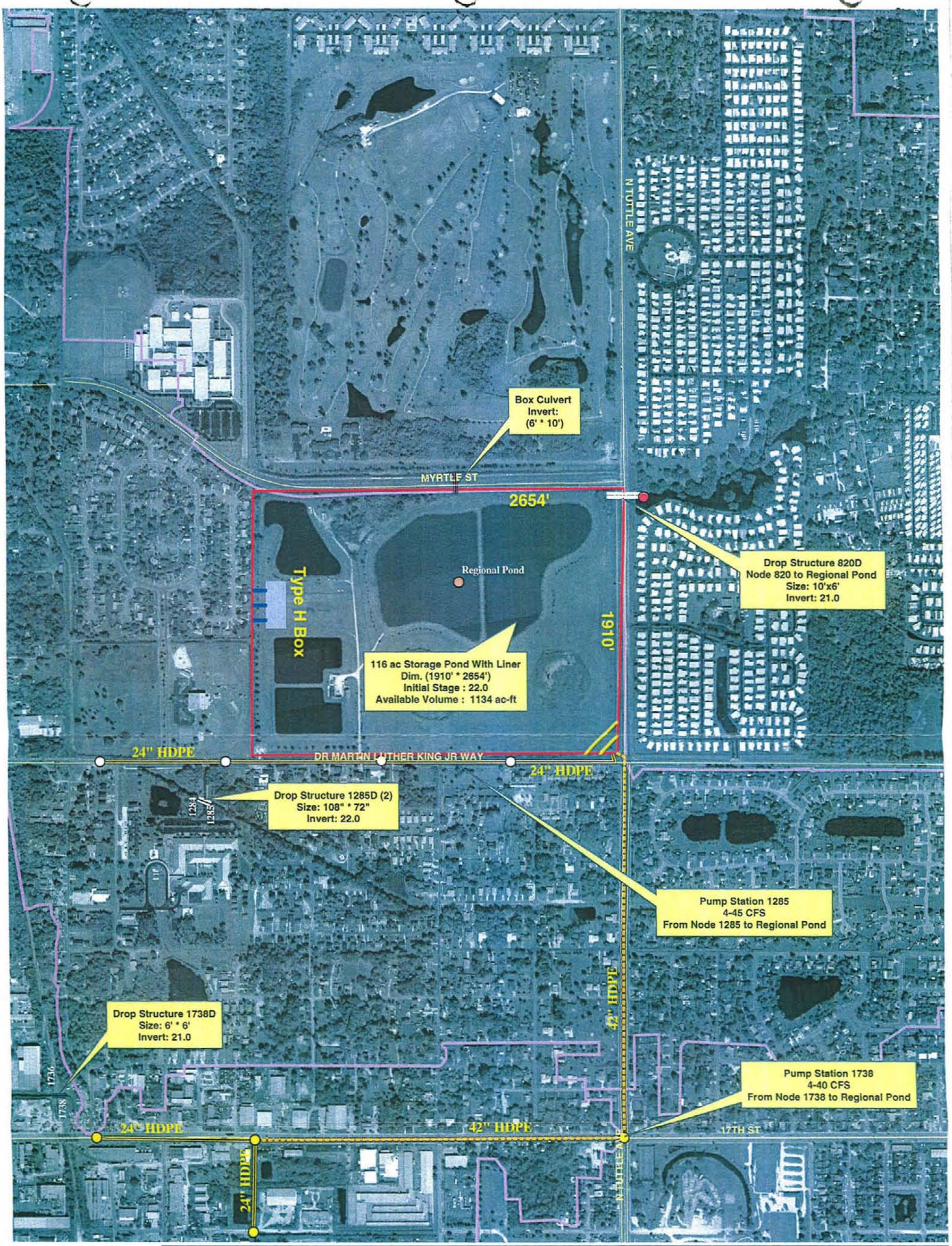
Alternate C

This alternate involves the construction of 116-acre regional stormwater pond site (Component 5) with a pond liner for storage below the seasonal high water table. Alternate also includes addition of two box-culverts, one of which is added under Myrtle Street (Component 11) to drain water from the golf course to the 116-ac stormwater pond and the other one under North Tuttle Avenue (Component 10).

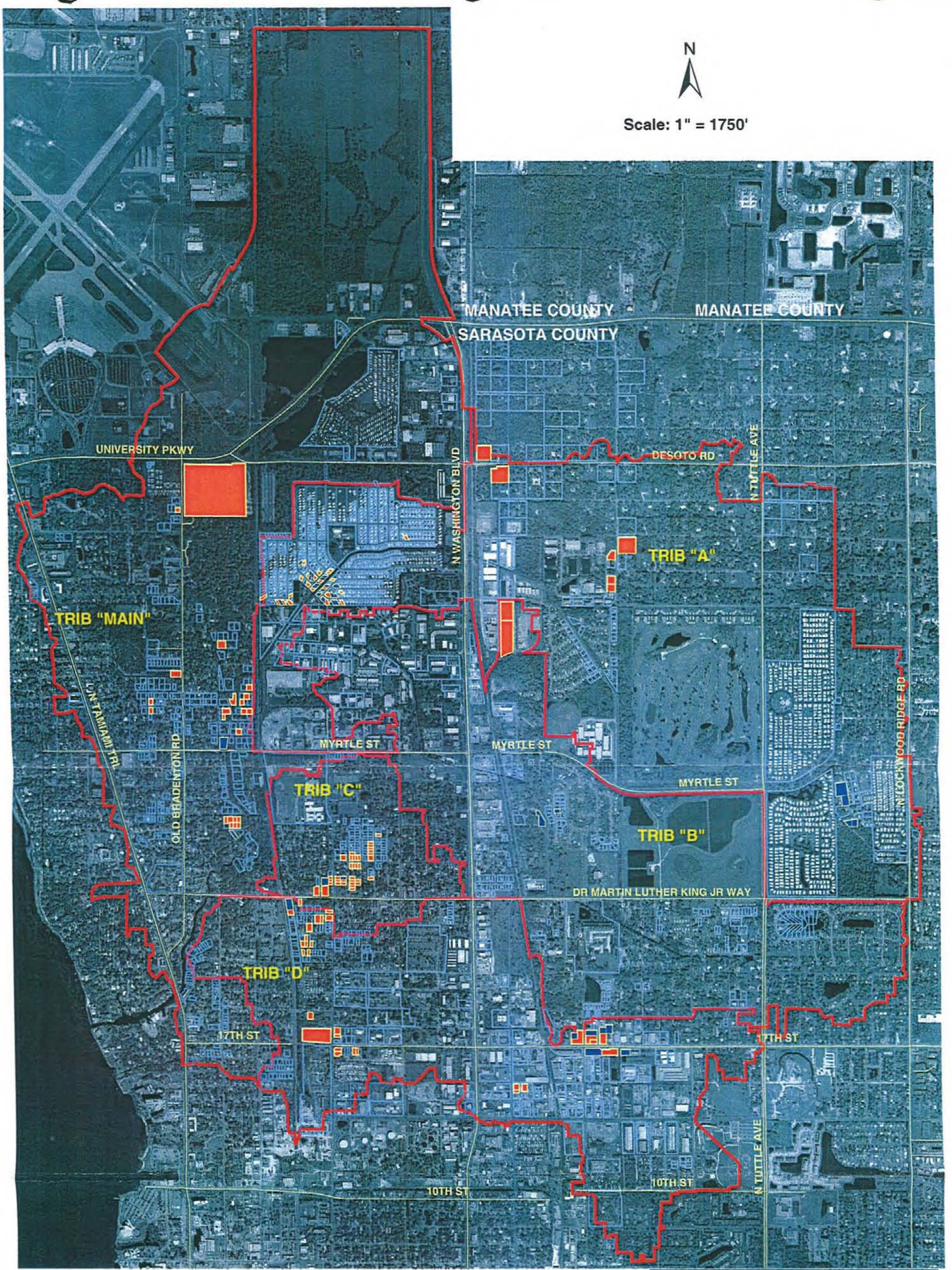
The alternate also includes the addition of two weir-structures (Components 7 & 13) to restrict the flow within the existing pipes and four stormwater pump stations along 17th street (Component 8) and Dr. Martin Luther King Jr. Way (Component 9). Details of this alternate used to develop the proposed conditions model are graphically represented in Figure 3.7.

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate C are listed in Table 3.5. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.8. The total number of structures flooded was reduced from 154 structures in the existing conditions to 118 structures with Alternate C, thereby removing a total of 36 structures from the 100-yr/24-hr flooding.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.7: Details of Improvement Alternate C



Construction Cost for Alternate C : $58.31 M

Benefits for Alternate C : $2.14 M

Benefits to Cost Ratio (%) : 3.7

No. of Structures removed from Flooding : 36

Range of Finished Floor Flooding Depth : 0.01 - 2.20 ft

Legend

- Alternate C-Structures removed
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.8: Improvement Alternate C Structure Flooding

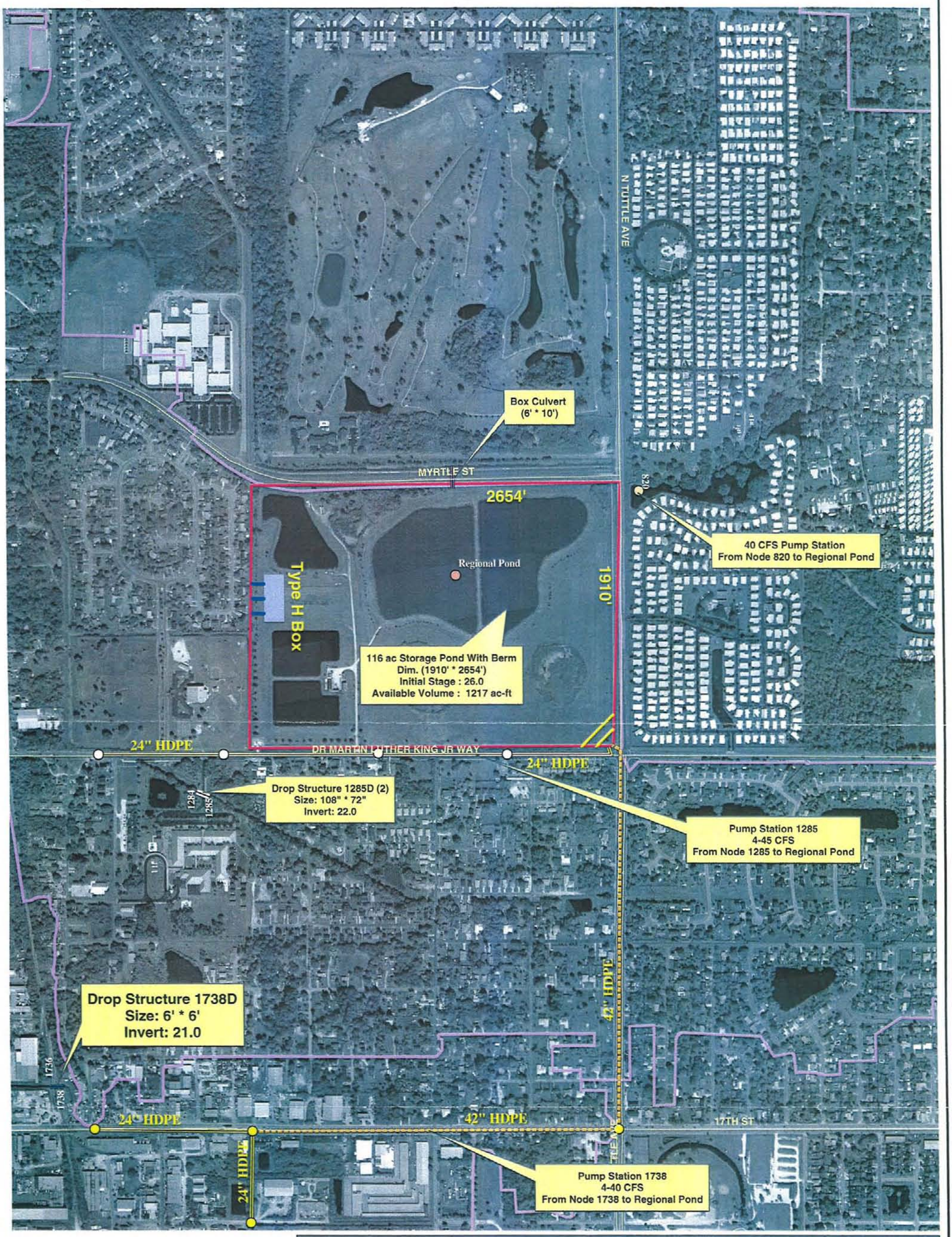
Alternate D

This alternate involves the construction of 116-acre regional stormwater pond site (Component 6) with a 10 feet high berm instead of a pond liner for storage above the seasonal high water table. Alternate also includes addition of a box-culvert under Myrtle Street (Component 11) to drain water from the golf course to the 116-ac stormwater pond and a stormwater pump station (Component 12) instead of the box-culvert under North Tuttle Avenue.

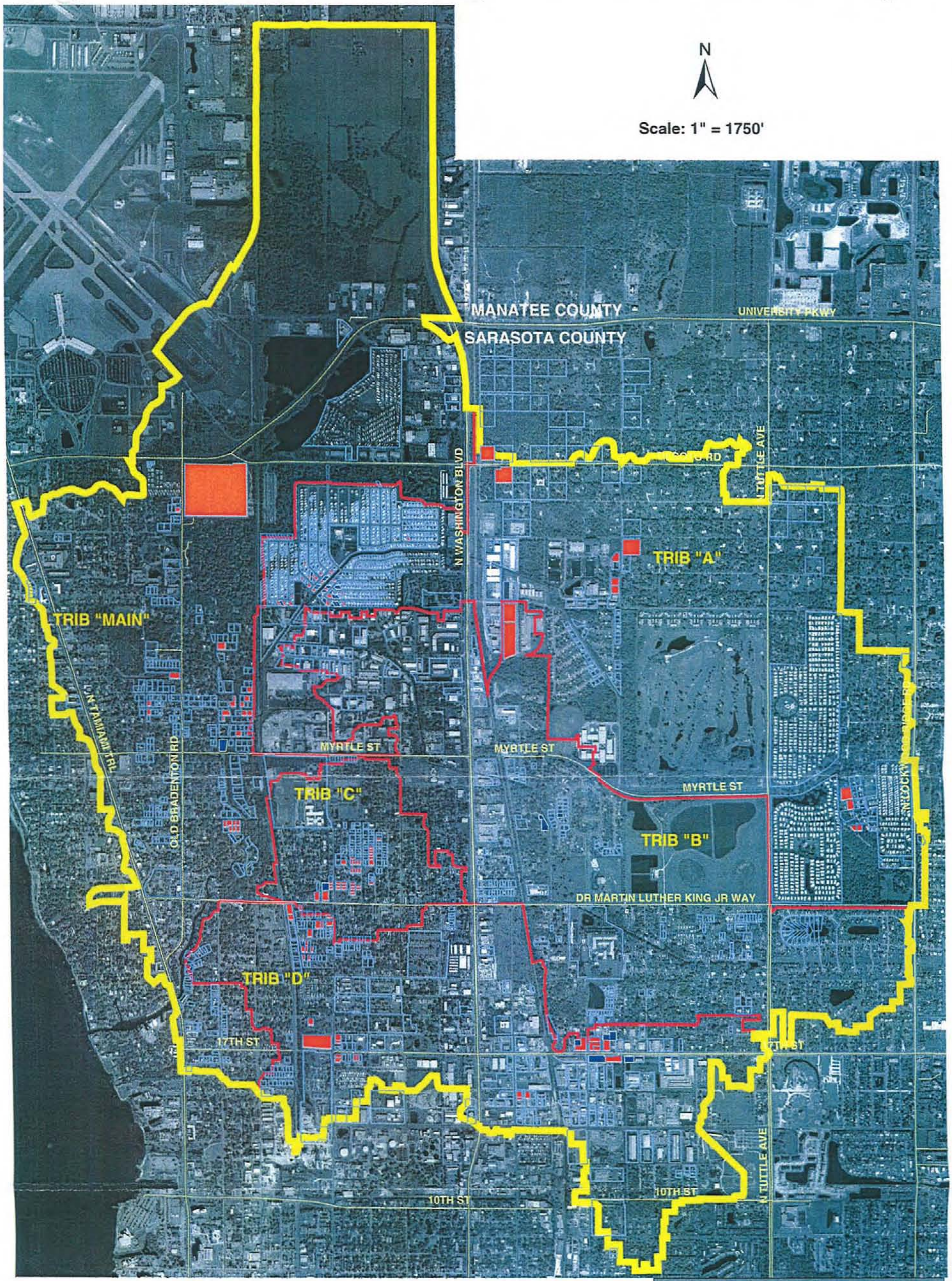
The alternate also includes the addition of two weir-structures (Components 7 & 13) to restrict the flow within the existing pipes and four stormwater pump stations along 17th street (Component 8) and Dr. Martin Luther King Jr. Way (Component 9). Details of this alternate used to develop the proposed conditions model are graphically represented in Figure 3.9.

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate D are listed in Table 3.6. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.10. The total number of structures flooded was reduced from 154 structures in the existing conditions to 127 structures with Alternate D, thereby removing a total of 27 structures from the 100-yr/24-hr flooding.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY	Sarasota County Florida	Figure 3.9: Details of Improvement Alternate D



Construction Cost for Alternate D : $32.97 M

Benefits for Alternate D : $2.00 M

Benefits to Cost Ratio (%) : 6.1

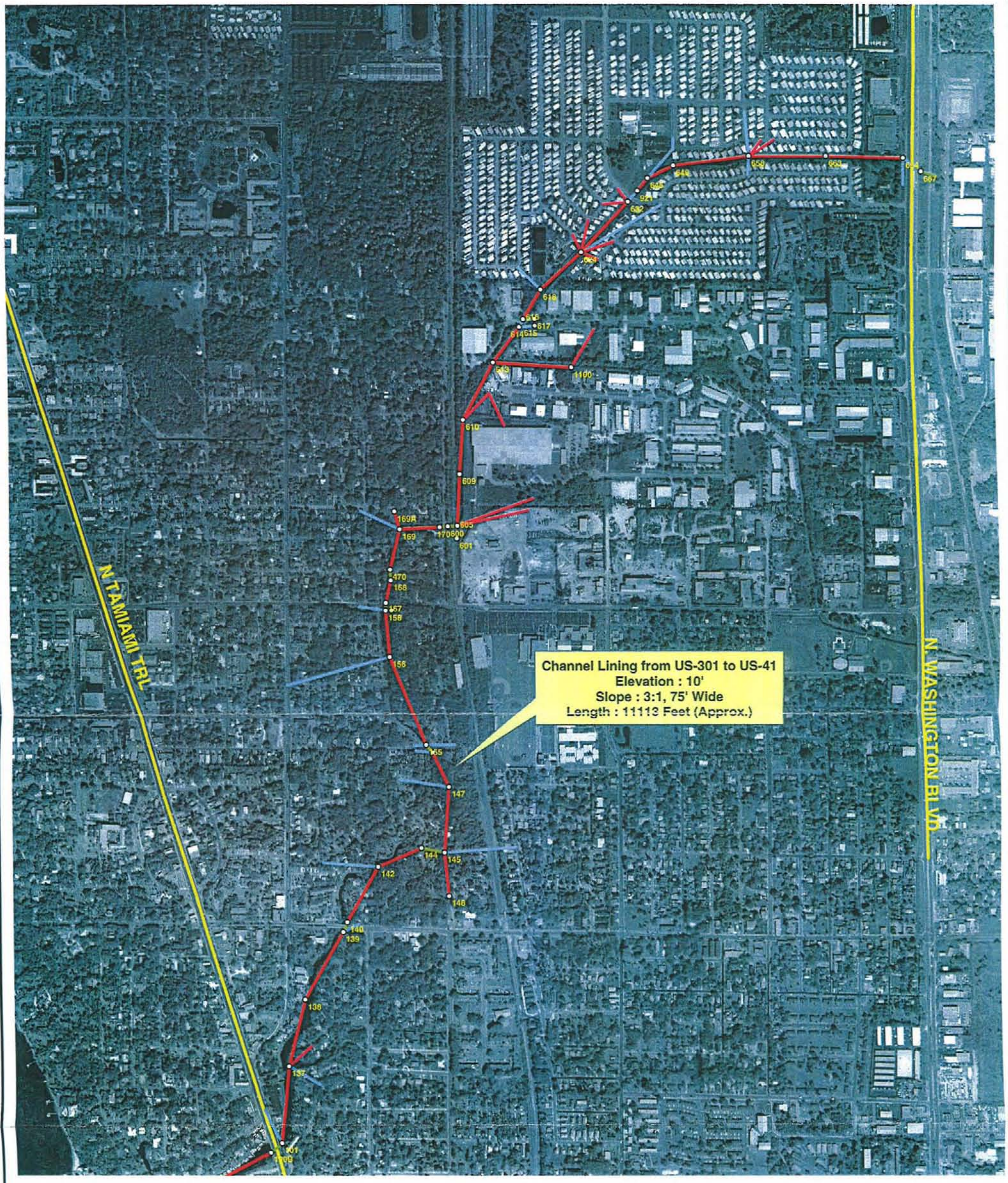
No. of Structures removed from Flooding : 27

Range of Finished Floor Flooding Depth : 0.01 - 2.21 ft

Legend

- Alternate D-Structures removed
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.10: Improvement Alternate D Structure Flooding



N

Scale: 1" = 800'

Legend

- 301-41-LC-Nodes
- 301-41-LC-Channels
- 301-41-LC-Pipes
- 301-41-LC-Bridges
- 301-41-LC-Dropstructures
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.11: Details of Improvement Alternate E

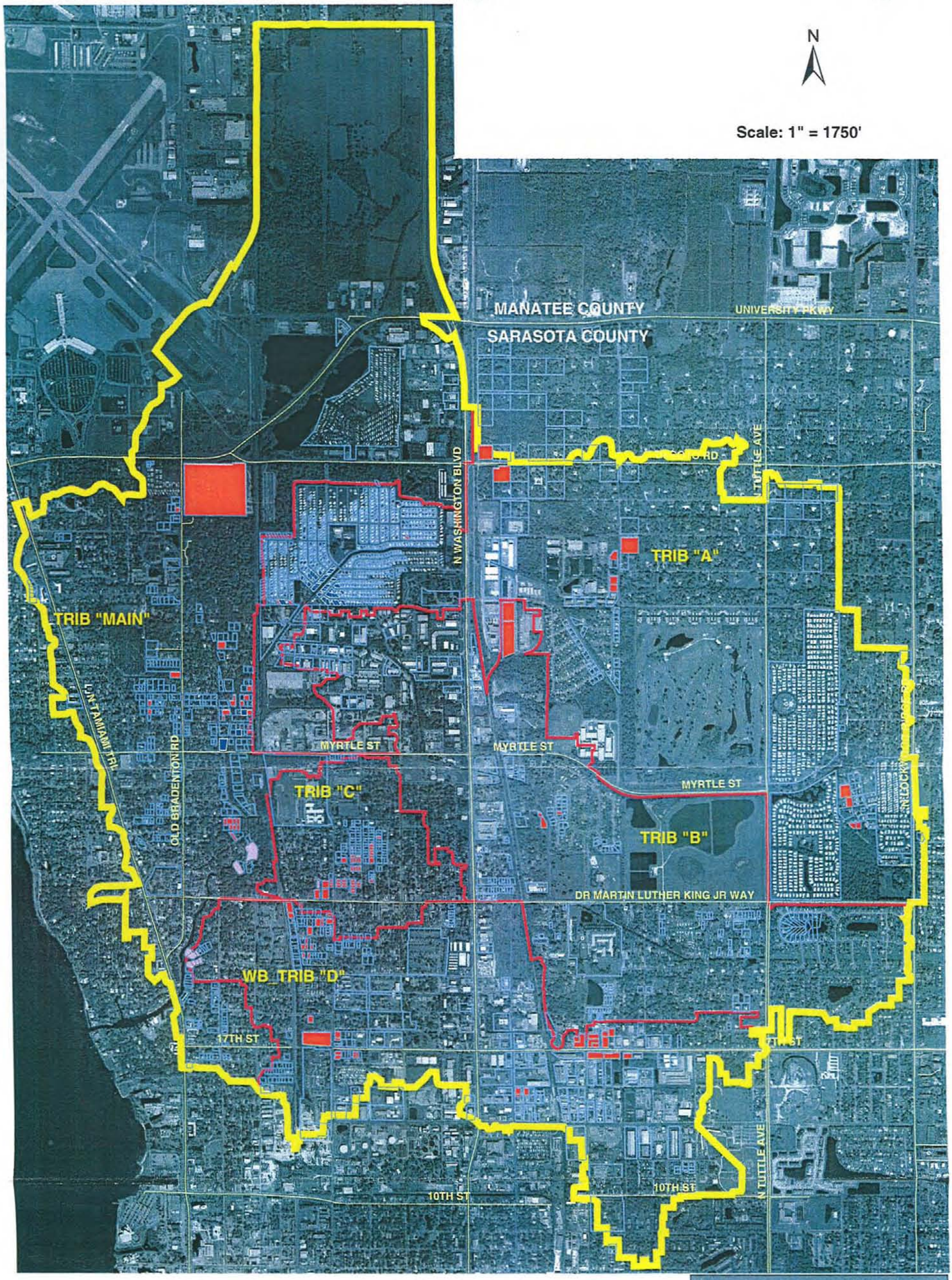
Alternate E

This alternate involves the lining of the channel from North Washington Boulevard (US-301) to North Tamiami Trail (US-41). Changes were made to the channel cross-section with top width of 75- feet along the entire stretch and side slopes of 3:1 as shown in Figure 3.11. The purpose of this alternative is to reduce flooding along tributary "MAIN", Tri-Par Estates, and east of US-301 as shown in the 100-yr floodplain map.

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate E are listed in Table 3.7. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.12. Figure 3.12 shows that additional 11 structures are flooded due to this alternate that were not flooded in the existing conditions.

The total number of structures removed from the existing flooded structures during the 100-yr/24-hr design storm event is 39 but with the addition of 11 flooded structures downstream of the channel, the total number of structures flooded reduced from an existing count of 154 to 126, thereby removing a total of 28 structures from the 100-yr/24-hr flooding.



Construction Cost for Alternate E : $18.32 M

Benefits for Alternate E : $1.44 M

Benefits to Cost Ratio (%) : 17.3

Additional Structures Flooded : 11

No. of Structures removed from Flooding : 28

Range of Finished Floor Flooding Depth : 0.01 - 3.84 ft

Legend

- Alternate E-Structures removed
- Additional Flooded Structures
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

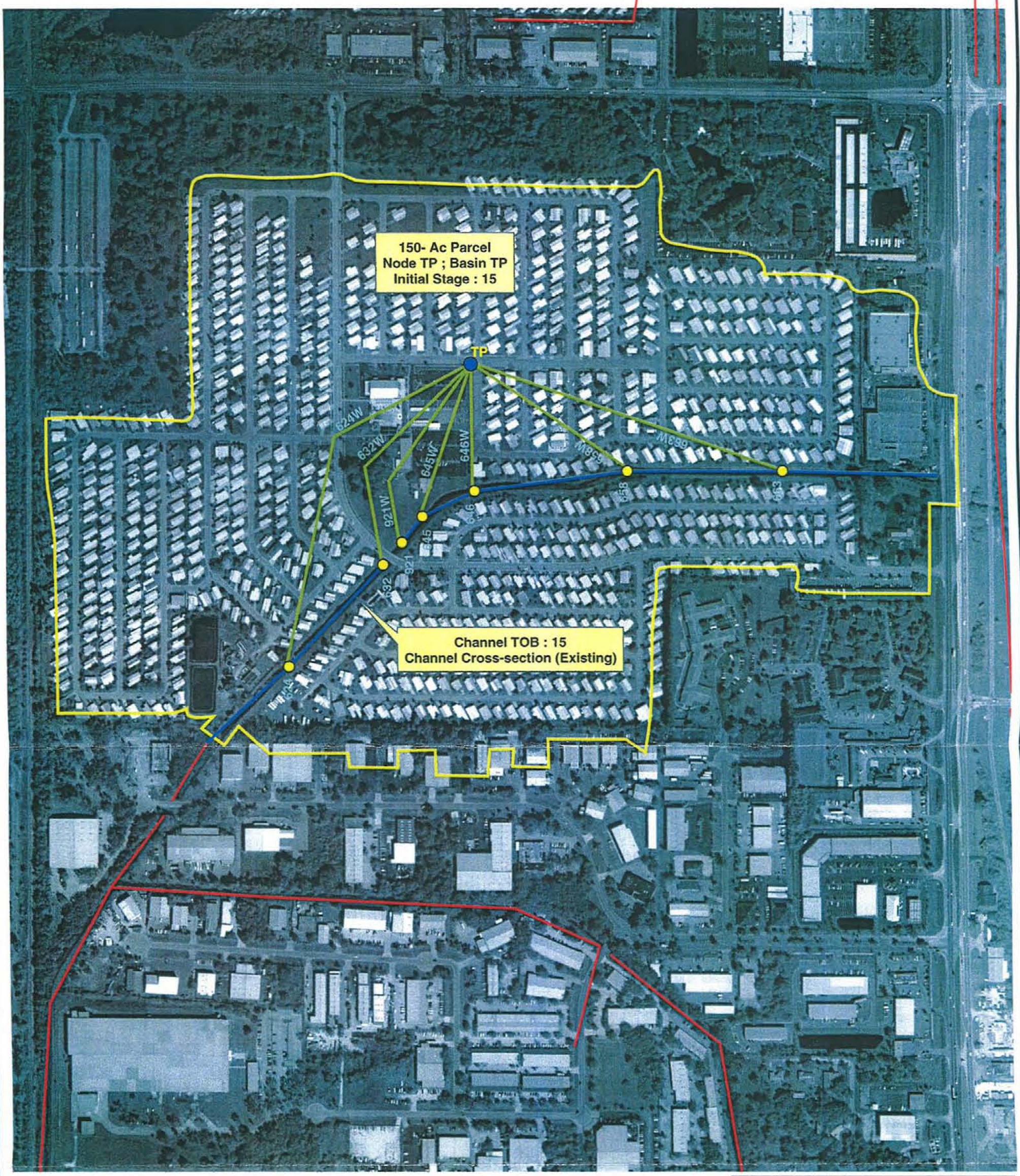
Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.12: Improvement Alternate E Structure Flooding

Alternate F

This alternate involves the purchase of Tri-Par Estates Mobile Home Community so that the structures could be removed from the floodplain. Details of this alternate used to develop the proposed conditions model are graphically represented in Figure 3.13. The purpose of this alternative is to reduce as much flooding east of US-301 and also along the channel

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate F are listed in Table 3.8. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.14. The total number of structures flooded was reduced from 154 structures in the existing conditions to 112 structures with Alternate F, thereby removing a total of 42 structures from the 100-yr/24-hr flooding.



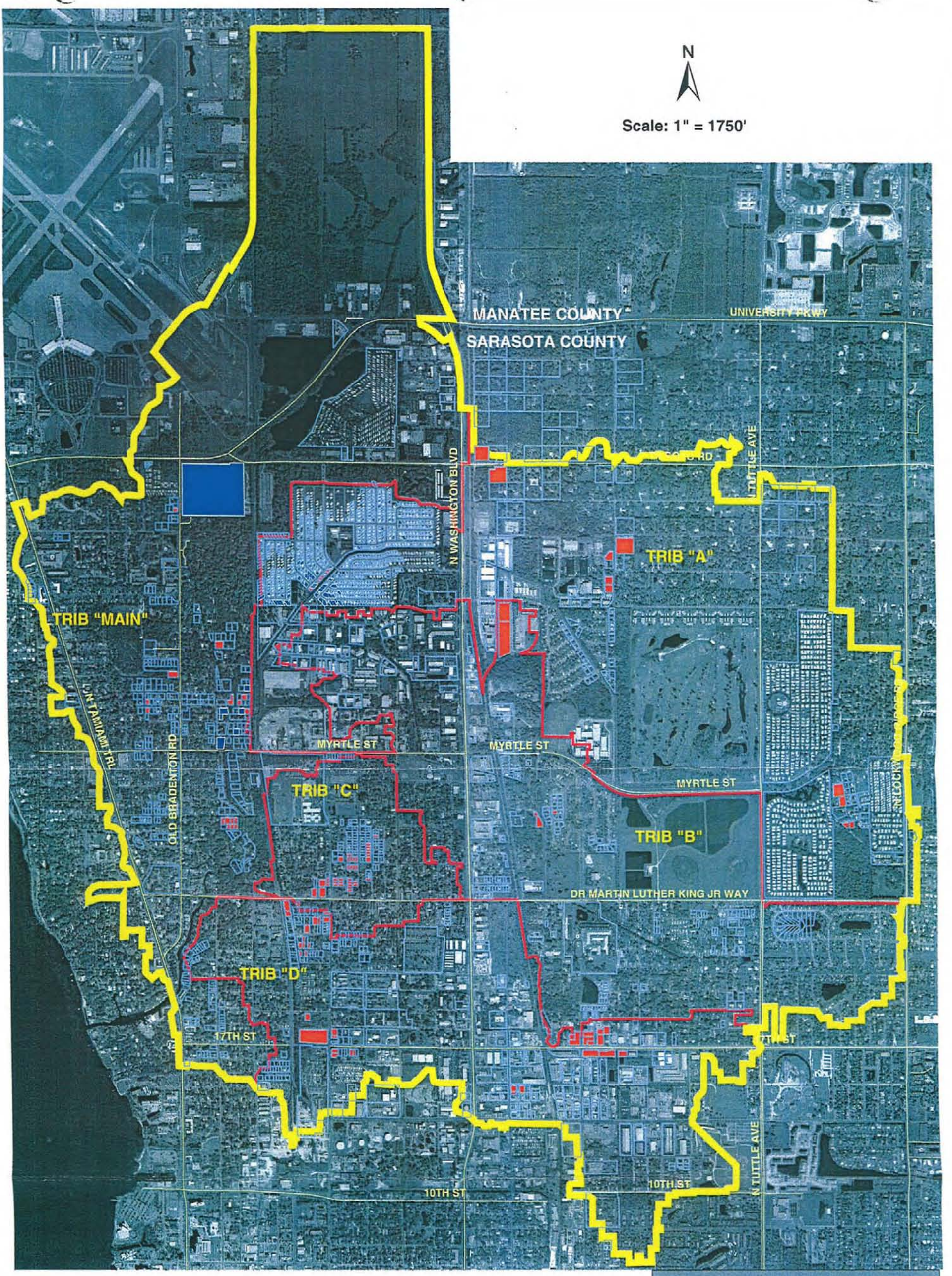
N

Scale: 1" = 400'

Legend

- Tripar Basin
- Tripar Node
- Tripar Channel Nodes
- Tripar Channel Links
- Tripar Weirs

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY	Sarasota County Florida	Figure 3.13: Details of Improvement Alternate F



Construction Cost for Alternate F : $110.48 M

Benefits for Alternate F : $3.93 M

Benefits to Cost Ratio (%) : 3.6

No. of Structures removed from Floodplain : 42

Range of Finished Floor Flooding Depth : 0.02 - 2.20 ft

Legend

- Alternate F-Structures removed
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

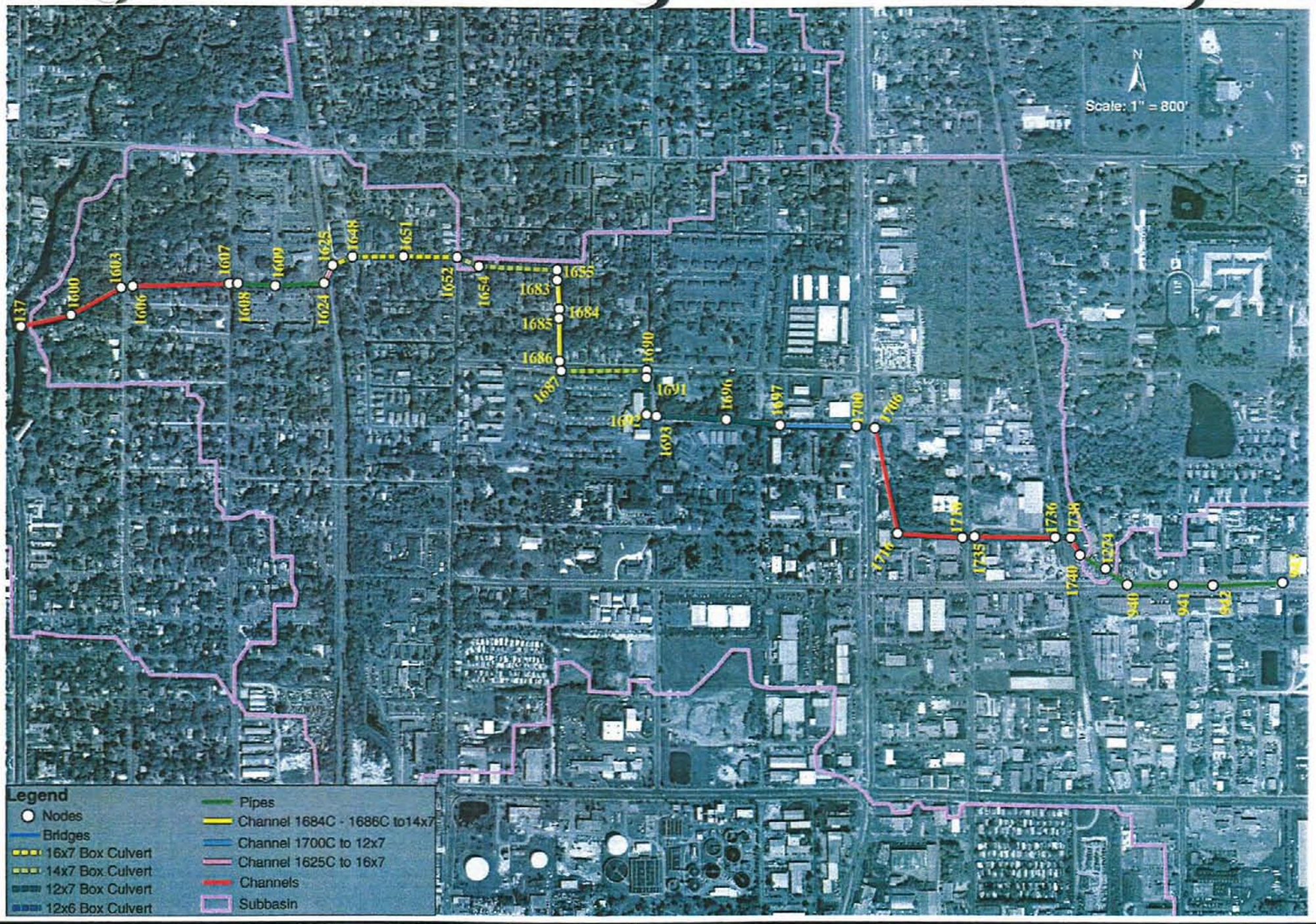
Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.14: Improvement Alternate F Structure Flooding

Alternate G

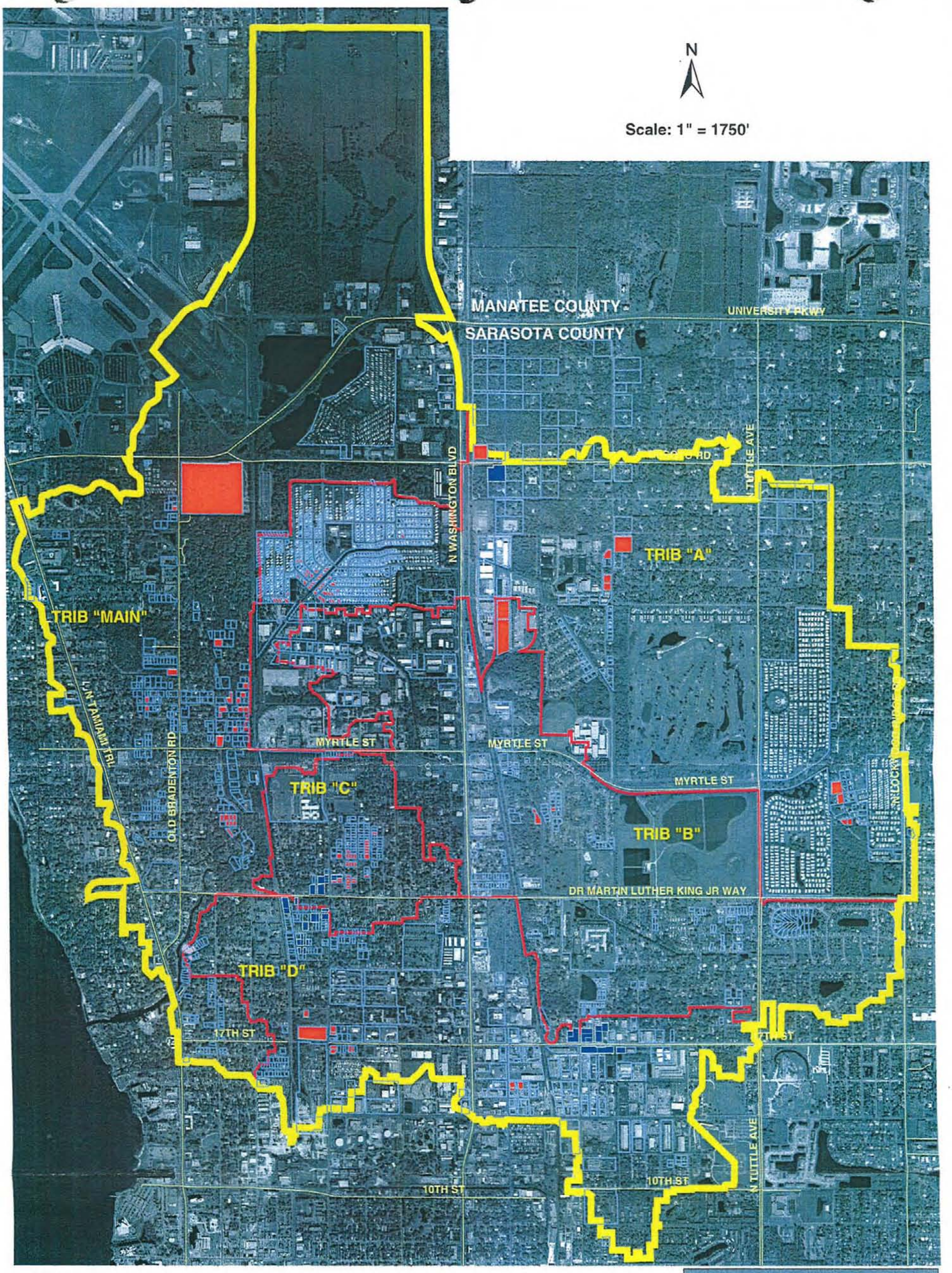
Alternate G includes the improvements done to tributary "D". The complete details of this alternate used to develop the proposed conditions model are graphically represented in Figure 3.15. Changes were made to the pipes and channel sizes, inverts, and cross-sections along the tributary to allow for more water to be conveyed to the Sarasota bay thereby reducing the flooding occurring in the 17th Street.

Changes made to the hydrology and hydraulics of the existing conditions model for Alternate G are listed in Table 3.9. Simulations were performed for the different storm events and the summary of the node maximum stage conditions for 100-yr/24-hr design storm event is shown in Table 3.3.

Flooding depths were also estimated based on the warning stages provided in the existing conditions model. The node maximum stages and the finished floor elevations were then used to identify the number of structures flooded, as shown in Figure 3.16. Figure 3.16 shows that 4 additional structures are flooded at the downstream end of tributary "D" due to this alternate that were not flooded in the existing conditions. The total number of structures flooded reduced from an existing count of 154 to 121, thereby removing a total of 33 structures from the 100-yr/24-hr flooding.



Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY	Sarasota County Florida	Figure 3.15: Details of Improvement Alternate G



Construction Cost for Alternate G : $9.71 M

Benefits for Alternate G : $2.05 M

Benefits to Cost Ratio (%) : 21.1

Additional Flooded Structures : 4

No. of Structures removed from Flooding : 33

Range of Finished Floor Flooding Depth : 0.01 - 1.86 ft

Legend

- Alternate G-Structures removed
- Additional Flooded Structures
- Flooded Structures - Existing
- Available Finished Floor Data from County
- Basin Boundary
- Subbasins
- Major Streets

Whitaker Bayou Flood Attenuation Alternatives Analysis	BOYLE	SARASOTA COUNTY 1921	Sarasota County Florida	Figure 3.16: Improvement Alternate G Structure Flooding

Evaluation of the flooding conditions in the Whitaker Bayou basin with the seven alternates reveals that less than one third of the parcels alone are eliminated from structural flooding during the 100-yr/24-hr design storm. Therefore it is evident that structural flooding itself poses a major concern. In addition to determining the effectiveness of these alternatives in terms of meeting the levels of service for structural flooding, the cost of implementation for each of these alternates must also be analyzed. Hence, a cost-benefit analysis for different storm events was performed for the alternates, which is described in the next section. The proposed conditions model simulation results for each of the seven alternates are provided in Appendix III.

SECTION 4

4.0 COST BENEFIT ANALYSIS

The Sarasota County Stormwater Environmental Utility (SEU) has developed a method of projecting damages associated with flood events consistent with the methodologies used by other agencies such as the US Army Corps of Engineers (ACOE) and the Federal Emergency Management Agency (FEMA). Projecting "Avoided Damages" by reducing structure and street flooding will allow SEU to determine if proposed alternatives are cost-effective by comparing the cost of the proposed alternative with the amount of "Damages Avoided" by flood level reductions. This methodology was used to evaluate the cost-effectiveness of the proposed improvement alternatives in Whitaker bayou basin.

Table 4.1 shows the summary of the Engineer's estimate of probable construction cost for various alternatives using the combination of appropriate component costs as given in Table 3.1. Based on the current estimates, Alternatives 5 and 7 appear to be the most economical alternatives with a construction cost under $10 Million.

Table 4.1: Summary of the Engineer's Estimate of Probable Construction Cost for Various Alternatives

No.	Improvement Alternatives	Cost
1	Alt A: Regional Pond/Dog Track without Pump Station	$65,267,914
2	Alt B: Regional Pond /Dog Track with Pump Station	$38,267,267
3	Alt C: Regional Pond without Pump Station	$58,308,758
4	Alt D: Regional Pond with Pump Station	$32,970,584
5	Alt E: Lining of the Channel	$8,322,499
6	Alt F: Purchase of Tri-Par Estates	$110,482,337
7	Alt G: Improvements to Tributary "D"	$9,708,988

In order to determine the most cost-effective alternative, cost of each improvement alternative was compared with the dollar value of the benefits gained by flood level reductions. Table 4.2 shows the summary of the dollar value of damages due to flooding for the improvement alternatives as well as the existing conditions for all design storm events. The difference between the dollar value of damages in the existing conditions in each design storm and the corresponding damages with each improvement alternative gave its respective benefits as shown in Table 4.3.

Table 4.2: Summary of the Damages for Improvement Alternatives for Various Design Storm Events

Improvement Alternatives	Total Damages ($)				
	Design Storm Event				
	5-yr	10-yr	25-yr	50-yr	100-yr
Existing Conditions (Base Model)	950,000	2,040,000	5,230,000	8,630,000	10,410,000
Alt A: Regional Pond/Dog Track Without Pump Station	350,000	920,000	2,620,000	3,970,000	7,370,000
Alt B: Regional Pond /Dog Track With Pump Station	420,000	1,070,000	2,770,000	6,170,000	7,870,000
Alt C: Regional Pond Without Pump Station	490,000	1,670,000	3,170,000	6,370,000	8,270,000
Alt D: Regional Pond With Pump Station	520,000	1,460,000	3,070,000	6,520,000	8,410,000
Alt E: Lining of the Channel	650,000	1,530,000	4,110,000	6,030,000	8,970,000
Alt F: Purchase of Tri-Par Estates	460,000	1,310,000	3,870,000	5,330,000	6,480,000
Alt G: Improvements to Tributary D	1,010,000	1,770,000	3,650,000	4,420,000	8,360,000

Table 4.3: Summary of the Benefits for Improvement Alternatives for Various Design Storm Events

Improvement Alternatives	Total Benefits ($)				
	Design Storm Event				
	5-yr	10-yr	25-yr	50-yr	100-yr
Alt A: Regional Pond/Dog Track Without Pump Station	600,000	1,120,000	2,610,000	4,660,000	3,040,000
Alt B: Regional Pond /Dog Track With Pump Station	530,000	970,000	2,460,000	2,460,000	2,540,000
Alt C: Regional Pond Without Pump Station	460,000	370,000	2,060,000	2,260,000	2,140,000
Alt D: Regional Pond With Pump Station	430,000	580,000	2,160,000	2,110,000	2,000,000
Alt E: Lining of the Channel	300,000	510,000	1,120,000	2,600,000	1,440,000
Alt F: Purchase of Tri-Par Estates	490,000	730,000	1,360,000	3,300,000	3,930,000
Alt G: Improvements to Tributary D	(-) 60,000	270,000	1,580,000	4,210,000	2,050,000

Benefit-to-cost ratio was then determined for each improvement alternative for each design storm event, which is provided in Table 4.4.

Table 4.4: Benefit-to-Cost Ratios for the Improvement Alternatives

Improvement Alternatives	Cost ($)	Benefit ($)				
		5-yr	10-yr	25-yr	50-yr	100-yr
		600,000	1,120,000	2,610,000	4,660,000	3,040,000
Alt A: Regional Pond/Dog Track Without Pump Station	65,267,914	0.009	0.017	0.040	0.071	0.047
		530,000	970,000	2,460,000	2,460,000	2,540,000
Alt B: Regional Pond /Dog Track With Pump Station	38,267,267	0.014	0.025	0.064	0.064	0.066
		460,000	370,000	2,060,000	2,260,000	2,140,000
Alt C: Regional Pond Without Pump Station	58,308,758	0.008	0.006	0.035	0.039	0.037
		430,000	580,000	2,160,000	2,110,000	2,000,000
Alt D: Regional Pond With Pump Station	32,970,584	0.013	0.018	0.066	0.064	0.061
		300,000	510,000	1,120,000	2,600,000	1,440,000
Alt E: Lining of the Channel	8,322,499	0.036	0.061	0.135	0.312	0.173
		490,000	730,000	1,360,000	3,300,000	3,930,000
Alt F: Purchase of Tri-Par Estates	110,482,337	0.004	0.007	0.012	0.030	0.036
		(-) 60,000	270,000	1,580,000	4,210,000	2,050,000
Alt G: Improvements to Tributary D	9,708,988	N/A	0.028	0.163	0.434	0.211

With the structural flooding LOS and Cost-Benefit analysis, an Alternative Evaluation Matrix was then developed to determine the most feasible and economical alternative of the seven improvement alternatives considered.

The complete SEU methodology to do the Cost effective analysis along with the detailed calculations of the seven improvement alternatives on construction cost estimate, damage analysis, and benefits are provided in Appendix IV.

SECTION 5

5.0 ALTERNATIVES EVALUATION MATRIX

Table 5.1 provides the comparison of all the seven alternates considered based on the number of structures removed from 100-yr/24-hr flooding, cost to implement each alternate and the benefits gained out of it.

Table 5.1: Alternatives Evaluation Matrix

No.	Alternatives	No. of Structures removed from 100-yr/24-hr flooding	Construction Cost	Benefits for 100-yr/24-hr design storm	Cost:Benefit ratio for 100-yr/24-hr design storm
1	Alternate A	53	$65.30 M	$3.04 M	22:1
2	Alternate B	40	$38.30 M	$2.54 M	15:1
3	Alternate C	36	$58.30 M	$2.14 M	27:1
4	Alternate D	27	$33.00 M	$2.00 M	17:1
5	Alternate E	28	$10.60 M	$1.44 M	7:1
6	Alternate F	42	$110.50 M	$3.93 M	28:1
7	Alternate G	33	$11.57 M	$2.05 M	6:1

SECTION 6

6.0 PUBLIC INFORMATION MEETING

As part of the public involvement program for this project, Sarasota County conducted a Public Information Meeting on September 23, 2004. All area residents were invited to attend the meeting to review the proposed alternatives for the Whitaker bayou flood attenuation study.

The Public Information meeting, attended by more than 45 persons representing area residents and commercial businesses, was held at the Booker High School Auditorium. Sarasota County-Center for Watershed Management staff and representatives from Boyle Engineering Corporation presented the project and addressed the questions and comments from the attendees. Exhibits showing the proposed improvement alternates were presented for review and a formal presentation was made by the County Staff and Boyle Engineering Corporation. Additionally, a survey and comment sheet was provided to solicit comments from all concerned citizens. Copies of the citizen's comments and the attendee list are provided in Appendix V.

The concerns expressed by the citizens through the survey and comment sheets are summarized below:

- Cost-Benefit Analysis does not seem to be in-line.
- Due to the high cost of the improvement alternatives, attendees felt that most homeowners will not be able to afford the cost.
- Since the value of homes are low in the area and the income level being low, some attendees felt that the flooded structures should be considered for buyout.
- Need to evaluate further options that are beneficial and cost-effective.
- Public Education of residents to help keep ditches clean
- Environmental issue is a major concern due to high Total Suspended Solids concentration in the Whitaker Bayou basin.
- Of the twelve respondents, six respondents felt that this project is not beneficial to their neighborhood.

SECTION 7

7.0 SUMMARY

Whitaker Bayou Basin is a 9-square mile watershed located in northwestern Sarasota County. It includes portions of the City of Sarasota and adjacent unincorporated. Several parts of this basin experience recurring flooding events that have caused damages to residential and commercial developments.

The objective of this study was to review and evaluate the existing flooding conditions and recommend drainage improvements in order to meet the 100-yr/24-hr design storm level of service as required by Sarasota County land development regulations. Seven different alternative improvements were evaluated. Evaluation of the proposed flooding conditions in the Whitaker Bayou basin with the seven alternates reveals that less than one third of the parcels only are eliminated from structural flooding during the 100-yr/24-hr design storm. Hence structural flooding itself is a major concern in Whitaker Bayou basin.

In addition to determining the effectiveness of these alternatives in terms of meeting the levels of service for structural flooding, the cost of implementation for each of these alternates was also evaluated. A comparison between the number of structures removed from flooding and the construction cost for each of these alternates is presented in the form of an Alternatives Evaluation Matrix. None of the seven alternatives meets the required level of service and no alternative is cost-effective.

Boyle Engineering Corporation in conjunction with Sarasota County presented these alternatives to the public and consolidated their comments as described in the previous section. The findings of this study along with the public comments will be presented to the Board of County Commissioners of Sarasota County. Based on the Board's decision, Sarasota County will determine how to proceed with the implementation of options evaluated in this study.