Town of Cutler Bay
Stormwater Master Plan

Prepared for:
The Town of Cutler Bay
043145000
March 2008

EXECUTIVE SUMMARY

The purpose of this Stormwater Master Plan is to identify opportunities to protect surface water quality and reduce flooding within the limits of the Town of Cutler Bay, Florida. The Town of Cutler Bay (Town) is a community incorporated in November, 2005 of approximately 9.7 square miles located along Biscayne Bay in southern Miami-Dade County. In 2006, the South Florida Water Management District (SFWMD) recognized the importance of developing and implementing a Stormwater Master Plan for the newly created Town of Cutler Bay. Accordingly, SFWMD approved in its Fiscal Year 2007 budget funding to support this high priority project. In [month], SFWMD entered into a funding agreement with the Town, and in April 2007, the Town selected Kimley-Horn and Associates, Inc. (KHA) to prepare its Stormwater Master Plan.

This Stormwater Master Plan includes the following components:

- A review of existing stormwater and drainage data, reports, and plans available through SFWMD, Miami-Dade County, and Town sources
- A field inventory of existing drainage structures
- A drainage atlas including the type, size, and general location of drainage infrastructure elements
- Basin and Sub-basin delineations based on available survey data and other sources
- Hydrologic and hydraulic modeling analysis of the existing systems and their capacity to handle the 5-year/24-hour, 10-year/24-hour, 25-year/72-hour, 50-year/72-hour, and 100-year/72-hour storm events
- Identification and analysis of alternatives for improvements needed to alleviate deficiencies identified in the hydrologic and hydraulic modeling phase
- Development of an optional Capital Improvement Plan (CIP) to implement the identified improvements

Based on a review of the drainage deficiencies identified and input from Town staff, 17 drainage sub-basins were selected as a priority for detailed analysis through hydrologic and hydraulic modeling. Prior to modeling and evaluating the priority drainage sub-basins, performance goals were identified. These performance goals representing the minimum standards for sub-basin performance are as follows:

- During the five-year return design storm events, flooding in local and collector roadway travel lanes should not exceed the edge of the roadway pavement. This goal is consistent with SFWMD basis of review criteria and Miami-Dade County requirements.
- During the 10-year return design storm event, flooding in roadway travel lanes should be below the crown of the roadway. This standard is the same as the current Miami-Dade County standard for arterial roadways.
- During the 100-year return storm event, flooding should be below the building finish floor elevations. This standard is the same as the current Miami-Dade County standard.
- Drainage sub-basins which discharge directly into canals should have water quality pre-treatment for the first one inch of runoff. This standard is consistent with federal, state and county water quality treatment requirements.
- Drainage sub-basins which discharge into lakes or drainage wells should have water quality pre-treatment for the first one-half inch of runoff. This standard is consistent with federal, state and county water quality treatment requirements.

Projects to bring each of the priority sub-basins into compliance with the performance goals were identified and the 17 priority sub-basins were ranked from worst to best according to current performance against goals. The ranking and budgets for improvements for each basin were used to develop a 10-year CIP. The average annual budget for the 10-year CIP is $2,465,000. The CIP includes an annual budget of $1,040,000 for operations and maintenance costs such as cleaning catch basins, pipes and exfiltration trench, swale maintenance, street sweeping, participation in federally mandated programs, minor repairs, and administration.

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I. INTRODUCTION

The purpose of this Stormwater Master Plan is to identify opportunities to protect surface water quality and reduce flooding within the limits of the Town of Cutler Bay, Florida. The Town of Cutler Bay (Town) is a community incorporated November 2005 of approximately 9.7 square miles located along Biscayne Bay in southern Miami-Dade County (County). See *Figure 1* for a map of the Town. Prior to that date, the Town was a part of unincorporated Miami-Dade County, and the County continues to operate all stormwater management improvements and programs within the Town limits.

In 2006, the South Florida Water Management District (SFWMD) recognized the importance of developing and implementing a Stormwater Master Plan for the newly created Town of Cutler Bay. Accordingly, SFWMD approved in its Fiscal Year 2007 budget funding to support this high priority project. In November 2006, SFWMD entered into a funding agreement with the Town, and in April 2007, the Town selected Kimley-Horn and Associates, Inc. (KHA) to prepare its Stormwater Master Plan.

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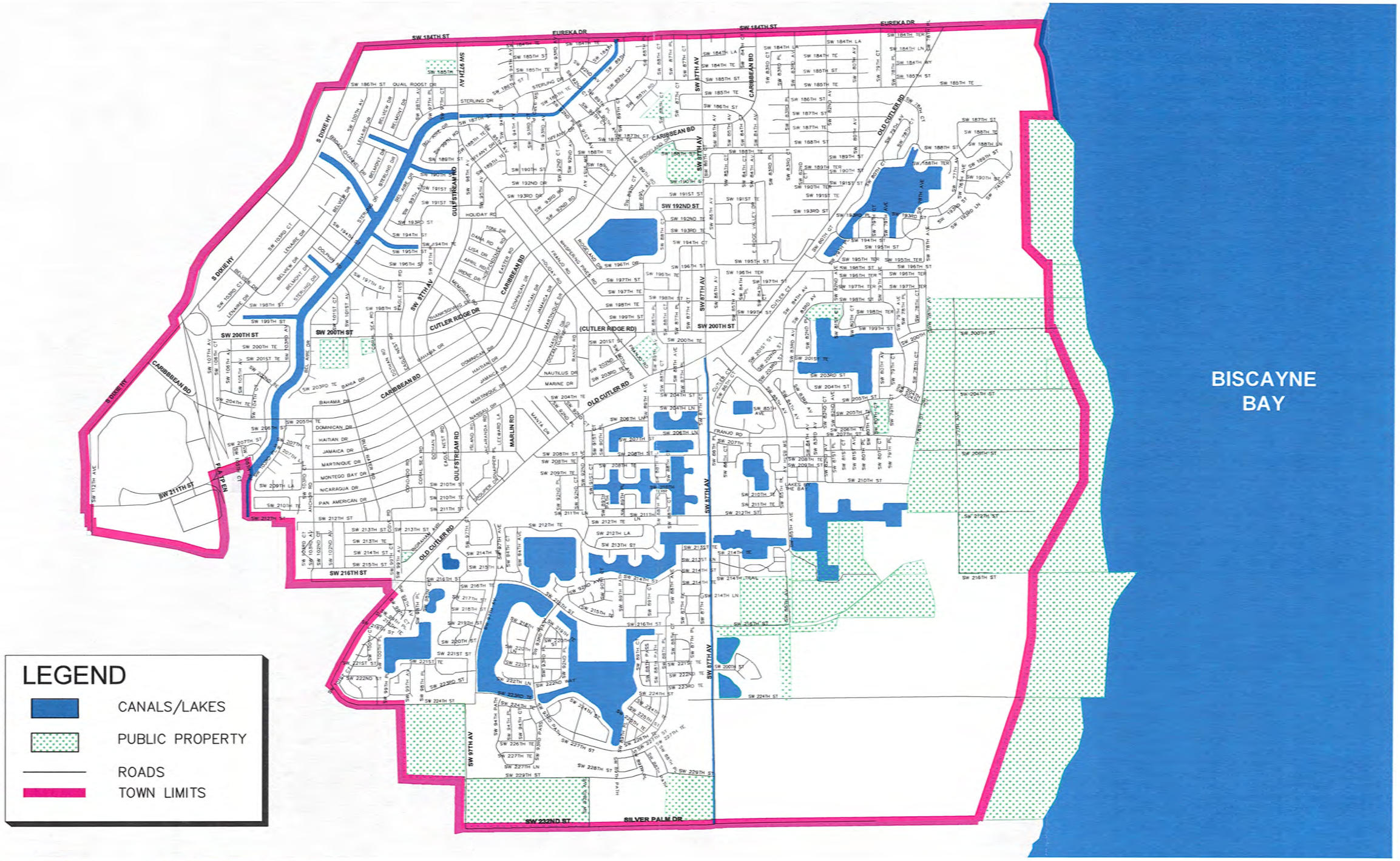

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TOWN OF CUTLER BAY
STORMWATER MASTER PLAN

BOUNDARY MAP

FIGURE 1

KHA has prepared a Stormwater Management Report for the Town to help supply information necessary for the Stormwater Master Plan. It discusses the establishment and organization of a Stormwater Utility, including basis for a utility fee, utility structures, recommended standard fees, a description of the billing system, legal authority, and collection and enforcement protocols. The Town will use the information contained in its Stormwater Master Plan and Stormwater Management Report to determine whether it will assume responsibility for stormwater management within Town boundaries.

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II. REVIEW OF AVAILABLE DATA

Kimley-Horn collected available data on the existing stormwater management system and stormwater management requirements within the Town of Cutler Bay as the first step in the preparation of the Stormwater Master Plan. The information was collected from local, regional, state, and national sources.

The South Miami-Dade Watershed Study and Plan (SMDWSP) was commissioned by the South Florida Regional Planning Council and published in 1996. Its mandate was to identify and protect lands that are essential to preserving the Everglades to the west and Biscayne National Park to the east by assuring compatible land use and zoning decisions in the watershed area that are consistent with the long-term objectives of a sustainable South Miami-Dade. Since the Town is located within the South Miami-Dade watershed, KHA reviewed this report and its recommendations.

Because the Town was a developed and established community within unincorporated Miami-Dade County prior to its incorporation as a municipality, the Miami-Dade County Department of Environmental Resource Management (DERM) was a source of extensive stormwater related information. The Miami-Dade County Stormwater Master Plans for the C-100 and C-1 basins cover approximately two-thirds of the Town and were published in 2004 and 2003 respectively. These master plans provide much of the background data to be used in the hydrologic and hydraulic modeling sections of the Town of Cutler Bay Stormwater Master Plan. The County master plans define the limits of the Town's basins (County sub-basins) and describes the water quality and flooding performance of the Town's basins when measured against Miami-Dade County Level-of-Service (LOS) criteria.

The Town of Cutler Bay is located within SFWMD boundaries. SFWMD is one of five water management districts established by the state to manage and protect water resources by balancing and improving water quality, flood control, natural systems, and water supply. The Comprehensive Everglades Restoration Plan (CERP) and the South Florida Environmental Report (SFER) are two initiatives implemented by the US Army Corps of Engineers (USACE) and SFWMD to maintain and improve the environmental quality of the Everglades and the surrounding South Florida ecosystems and to report on the progress of said improvements, respectively. The CERP was published in 1999 and is continually updated with the acquisition of

new data. The CERP initiated the construction of many of the canals and control structures that serve as the major stormwater collection infrastructure for the Town. The SFER was last published in 2007 and reviewed the development of water quality databases for the Everglades and Biscayne Bay from May 2006 to April 2007. The SFER forecasts Capital Improvement Programs (CIPs) from various agencies over a five-year period. The projects include restoration, monitoring programs, and land acquisitions to improve water quality in the South Florida region.

The Biscayne Bay Surface Water Improvement and Management Plan (SWIM Plan), published by SFWMD in 1989 and revised in 1995, has been superseded by the CERP and the SFER. However, it was one of the first water quality improvement plans for the area that includes the Town of Cutler Bay and it is, therefore, summarized in this report.

In addition to being governed by the local and regional plans described above, stormwater management in Florida is subject to state and federal regulations. Two programs regulated by the state and federal governments are the National Flood Insurance Program (NFIP) and the National Pollutant Discharge Elimination System (NPDES). The NFIP is managed by the Federal Emergency Management Agency (FEMA) and the Florida Department of Community Affairs (DCA). The NPDES is managed by the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (DEP). KHA collected information on stormwater management requirements from each of these agencies.

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A. South Miami-Dade Watershed Study and Plan

Kimley-Horn reviewed the South Miami-Dade Watershed Study and Plan, because the Town of Cutler Bay is located within the study area and the recommendations could have an impact on future development, water resources, and infrastructure within the Town. The South Miami-Dade Watershed in located in the southeastern portion of Miami-Dade County between two national treasures: Biscayne National Park and Everglades National Park and is considered one of the most critical watersheds in Florida. The watershed includes 20 municipalities and 20 % of the total land area of the County. The Watershed Study and Plan was mandated by the County's Comprehensive Development Master Plan Use Policy 3E on October 10, 1996 and commissioned by the South Florida Regional Planning Council. The report was designed to meet the following criteria:

1. Identify and protect lands, including their uses and functions, that are essential for preserving the environmental, economic and community values of Biscayne National Park
2. Identify and establish mechanisms for protecting constitutional private property rights
3. Support a viable, balanced, economy including agriculture, recreation, tourism, and urban development in the Plan area
4. Assure compatible land use and zoning decisions in the Watershed Area are consistent with the long term objectives for a sustainable South Miami-Dade

The scope of work was shaped by the Watershed Study Committee (WASC), who reviewed study reports and provided a venue for stakeholder and public input. They evaluated potential policy choices on how growth might occur and looked at the consequences of each of those choices.

Growth Patterns

The committee specified two distinct growth patterns in developing areas: sprawl and smart growth. Sprawl was defined as "non-contiguous, scattered or leap-frog patterns of development," including low-density communities that fan out from their established cores to incorporate open land. This type of growth negatively affects the land by reducing the ecological significance of wetlands, agriculture and forests. It also disrupts surface water flow and diminishes ground infiltration. The increase in impervious area associated with sprawl increases runoff and the conveyance of pollutants to waterways.

Smart growth is the incorporation of land use patterns that are more compact, transit-oriented, walkable, bicycle-friendly, and include mixed-use development with a range of housing choices. This type of growth preserves natural and cultural resources and long-range, regional considerations of sustainability over a short-term focus. Smart growth utilizes land more efficiently in order to reduce needless loss of ecological resources and to reduce the developments' impact on the environment.

Watershed Plan Guideline Zones

The watershed area was broken into three distinct zones:.

1) Zone A, located one-quarter mile on each side of US 1, has a minimum density of 15 units per acre and average density of 21 units per acre
2) Zone B is generally located one-half mile on each side of US 1 and along other major corridors such as Kendall Drive and 137th Avenue. The densities in this zone range from 6 to 20 units per acre with an average of 10 units per acre. The Town of Cutler Bay includes areas within these zones around US 1.
3) Zone C, located on the eastern portions of the watershed near the confluence of canals C-1, C-102, and C-103 with Biscayne Bay.

These areas are intended to be a mix of stormwater treatment areas, wetland restoration, and open space. The portions of the Town within the DA-4 Basin and southern parts of the C-1 Basin (described below in section 'B') are mostly classified as Zone C. It is stressed that the guidelines are not intended to be rigid rules, but are written to provide an understanding of how densely each zone is expected to be developed in comparison with the other zones.

Parameters and Thresholds

The SMDWSP developed parameters to measure characteristics and associated tolerance levels for land assessment and land use scenario planning. The parameters were based on the Miami-Dade County Comprehensive Development Master Plan Land Use Policy 3E and the Watershed Study Advisory Committee's goals/vision statement. Parameters assist in pointing out characteristic levels desired when designing for development and expansion. The following parameters were listed and used for the Watershed Study and Plan:

- Water Quality
- Groundwater Demand
- Surface Water Flows/Distribution
- Flood Protection
- Tidal Wetlands
- Native-Plant-Dominated Freshwater Wetlands
- Exotic-Plant-Dominated Freshwater Wetlands
- Transitional Freshwater Wetlands
- Remnant Natural Forests
- Development Patterns
- Agricultural Land
- Proximity of Housing and Employment of Transit
- Parks, Recreation and Open Space
- Economic Base
- Cost of Housing
- Mixed of Wages
- Transportation
- Public Schools
- Potable Water, Wastewater, and Air Quality

Once these parameters were established, thresholds were determined that would promote quality of life for development and nature alike. Water quality parameters set forth by the Miami-Dade County Comprehensive Development Plan force the use of water quality treatment stormwater systems, which are maintained to not allow pollutant discharge into the canals and groundwater.

Water Resources

Water quality in Biscayne Bay was one of the primary concerns that lead to the SMDWSP. Three separate development scenarios were tested:

- Test Scenario 1 utilized a low density development, sprawl pattern
- Test Scenario 2 was of average density, lightly compact development
- Test Scenario 3 utilized a high-density, compact development pattern.

Of the three scenarios tested for the watershed, the low-density development pattern of Test Scenario 1 resulted in substantially greater impacts in terms of water quality compared to the more compact development in Test Scenarios 2 and 3. All three scenarios, however, resulted in pollutant load increases compared to the baseline. For the projected year 2050, Test Scenario 3, the most compact development pattern, had the least negative impact on the environment and had the best overall performance with regard to water quality. It was determined that groundwater demands will substantially increase under all three of the test scenarios and, in the year 2025, there will be a slight decrease in the annual volume of surface runoff from the baseline. Based on the Flood Protection Level of Service (FPLOS), 350 sites exceeded threshold parameters. All three test scenarios resulted in some, if not substantial, flooding site increases. Test Scenario 1, low-density expansion, resulted in the most flooding site increases subsequently increasing by approximately 30 %.

The general results of the three test scenarios showed that the implementation of Smart Growth, high-density, transit-oriented, policies of Test Scenario 3 provide a more sustainable environment and economy compared to the current land development pattern represented by Test Scenario 1. Test Scenario 3 provides less water pollution, less increase in flooding, less loss of natural resources, less reliance on the automobile and less costs to the public. Therefore, the SMDWSP recommended implementation of land use and zoning regulations that encouraged growth to occur in a pattern more consistent with Test Scenario 3 than Test Scenario 1. The Town of Cutler Bay is considering these recommendations as it develops its own Growth Management Plan.

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B. Miami-Dade County Stormwater Master Plan for C-100 and C-1 Basins

The Town of Cutler Bay is located at the junction of three Miami-Dade County Canal Basins: C-100, C-1, and DA-4. The C-100 Basin encompasses the area of Cutler Bay north of SW 97th Avenue (Franjo Road) and Old Cutler Road. The C-1 Basin includes land west of Franjo Road and SW 87th Avenue (Galloway Road). The DA-4 Basin includes land east of Old Cutler Road and Galloway Road. The boundaries of said basins are delineated by Miami-Dade County DERM and SFWMD. There are six major canals that lie within and/or border the Town of Cutler Bay: C-100, C-100B, C-1, C-1N, C-1W, and L31E. These three canals provide three main functions:

- To provide drainage and flood protection for the C-100, C-1 and DA-4 Basins.
- To supply water to the basins for irrigation.
- To maintain a groundwater table elevation that is adequate near the lower reach of the C-100 and DA-4 Basins to prevent saltwater intrusion into local groundwater. Water is supplied to the basins during periods of low natural flow from C-1 by way of control structure S-122 and C-100B and from C-1W by way of control structure S-338.

The following is a brief description of the C-1 and C-100 basins as described Miami-Dade County DERM's Stormwater Master Plans for these two basins. DERM has not completed a stormwater master plan for the DA-4 Basin, which covers approximately 3.6 square miles in the eastern portion of the Town. The portion of the C-1 Basin within the Town's boundaries is approximately 4.7 square miles. The portion of the C-100 Basin within the Town's boundaries is approximately 1.8 square miles. *Figure 2* depicts the County basin/ sub-basin boundaries and canal jurisdiction within the Town of Cutler Bay.

Boundary Conditions

The C-1 Basin has a total area of approximately 58.3 square miles. Within the Town of Cutler Bay, the C-1 Basin covers the western portion, as its eastern boundary is SW 97th Avenue from the northern Town limit south to Franjo Road, Franjo Road southeast to Old Cutler Road, Old Cutler Road east to SW 87th Avenue, and SW 87th Avenue south to the southern Town limit. Upstream of Cutler Bay, the remainder of the C-1 Basin extends north to SW 88th Street and west to the L-31-N Borrow Canal with an additional mile wide strip that extends north from SW 88th Street to SW 8th Street between Krome Avenue and the L-31-N Borrow Canal. A number of

canals within the C-1 Basin are tributaries to the main C-1 Canal (Black Creek Canal). The C-1N Canal is a tributary canal located in Cutler Bay. It connects the C-1 Basin with the C-100 Basin as it meets the C-100B Canal just north of the intersection of SW 97th Avenue with Franjo Road. SFWMD control structure S-122 controls water flow and levels between the C-1N and C-100B canals. Just south of the southwest corner of the Town, the C-1N meets up with the main C-1 canal which discharges to Biscayne Bay via SFWMD control structure S-21 near Black Point.

The C-100 Basin has a total area of approximately 40.6 square miles. Within the Town of Cutler Bay, the C-100 Basin covers a triangular area bounded by the northern Town boundary, SW 97th Avenue and Franjo Road on the west, and Old Cutler Road on the east. Outside of Cutler Bay, the remainder of the C-100 Basin is bounded by SW 88th Street to the north, Old Cutler Road to the east and SW 147th Avenue to the west. A number of canals within the C-100 Basin are tributaries to the main C-100 Canal. The C-100B Canal is a tributary canal located in Cutler Bay. It connects the C-100 Basin with the C-1 Basin where it meets the C-1N Canal just north of the intersection of SW 97th Avenue with Franjo Road. SFWMD control structure S-122 controls water flow and levels between the C-1N and C-100B canals. The C-100 Canal outfalls to Biscayne Bay through SFWMD control structure S-123 located west of Old Cutler Road and south of the Deering Estate.

Within the Town of Cutler Bay, the DA-1 Basin is bounded by the C-100 Basin to the north, the C-1 Basin to the west, and Biscayne Bay to the east. The DA-4 Basin is hydraulically connected to the C-1 Basin by the SFWMD control structure S-21 near Black Point. The purpose of this structure is to divide the C-1 and DA-4 basins and to regulate water levels and salinity in the C-1 Basin.

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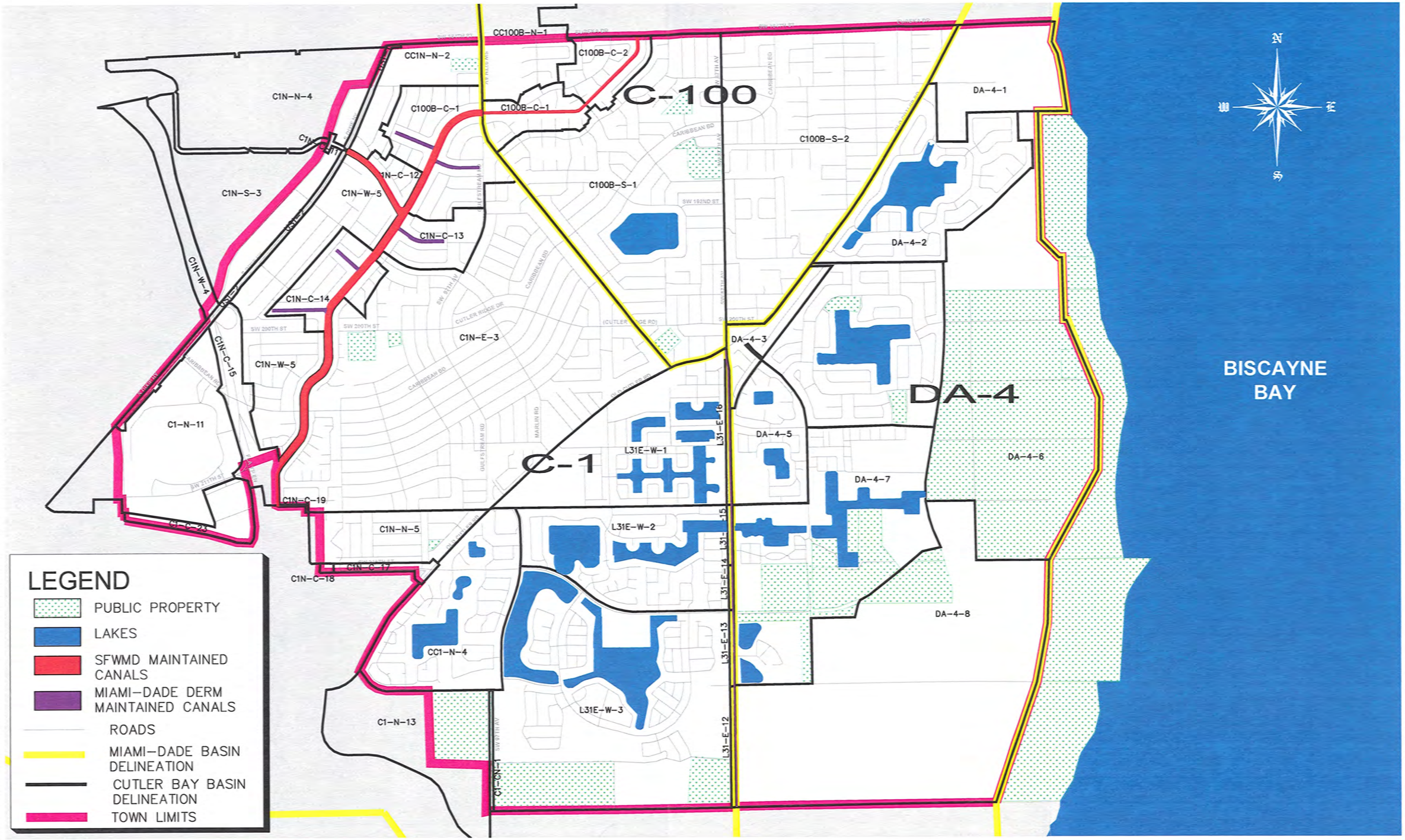

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Cutler Bay FLORIDA ESTABLISHED 2005

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

BASIN DELINEATION AND CANAL JURISDICTION MAP

FIGURE 2

Basin Characterization

General

The C-1 Basin and C-100 Basin have negligible topographic relief. They are urbanized areas drained by a network of canals that intersect the groundwater table in the unconfined Biscayne Aquifer. This aquifer is highly transmissive and provides base flow to the canals. The following sections discuss the hydrologic and hydraulic characteristics of the C-1 and C-100 basins.

Soils Data

Major soil types within the C-1 and C-100 basins were determined from the National Resources Conservation Service's (NRCS) Soil Survey. Due to the urban nature of the area and the sandy soils of southeastern Florida, soil properties in Miami-Dade County are highly variable, with saturated hydraulic conductivities ranging from 0.6 inches per hour to 20 inches per hour.

Hydraulic Characteristics

SFWMD manages the major canals within the C-1 and C-100 basins to perform the following functions:

- Provide drainage and flood protection for the basins
- Supply water to the basins for irrigation
- Maintain a groundwater table elevation near the lower reach of the basins adequate to prevent saltwater intrusion to local groundwater

The C-1 and C1W canals are continuous and make up the main canal (hereafter designated C-1/C-1W) in the C-1 Basin. Canal C-1N and the L-31N Borrow Canal is tributary to C-1/C-1W. C-1/C-1W begins in the east borrow canal of L-31N, one and a half miles north of Howard Drive. Flow in the canal is to the southeast with discharge via control structure S-21 to Biscayne Bay, near Black Point. Canal C-1N begins at the intersection of Lingren Road and Coral Reef Drive. Flow in the canal is to the south to the confluence of the canal with C-1/C-1W just east of the West Dade Expressway. The C-100B Canal connects canals C-1N to C-100 and joins Canal C-1N one-half mile downstream of the FEC Railway. This canal connects to the C-100 basin at SFWMD control structure S-122. Normal flows in the canal are to the north to the C-100 basin.

The primary conveyance in the C-100 Basin is the C-100 Canal. The C-100 Canal begins just north of the intersection of Killian Road and Lingren Road. Flow in the canal is to the southeast, with discharge via the SFWMD Outfall Structure S-123 to Biscayne Bay east of Old Cutler Road. The C-100A, C-100B, and C-100C canals are tributary to the C-100 Canal. The C-100A Canal begins in Green Mar Acres at US 1. Flow in the C-100A Canal is to its confluence with the C-100 Canal one-half mile west of Biscayne Bay. The C-100B Canal connects Canal C-100 to the C-1 Canal to the south of the C-100 Basin. Canal C-100B enters the C-100 Basin at SFWMD control structure S-122 one-tenth of a mile south of the east end of Peters Road. Normal flows in Canal C-100B are to the northeast to the canal's confluence with Canal C-100 one-quarter mile west of Biscayne Bay. The C-100C Canal connects Canal C-100 to Canal C-2 to the north of the C-100 Basin. C-100C enters the C-100 Basin at SFWMD Structure S-121 at SR 94. Normal flows in C-100C are to the southeast to the canal's confluence with C-100A one-quarter mile north of Coral Reef Drive.

Stormwater Management Facilities

There are five control structures that directly affect portions of the C-1, C-100, and DA-4 basins within the Town of Cutler Bay: S-21, S-122, S-123, S-148, and S-149. The structures function as follows:

Structure S-21 is a fixed crest, reinforced concrete, gated spillway located near the mouth of the C-1 canal at its junction with Levee 31E, approximately 3,500 feet from the Biscayne Bay shoreline. The structure operates automatically to maintain a seasonally optimal headwater varying between 2.0 feet during dry season and 2.4 feet during rainy season. The structure also operates to regulate salinity. It will automatically close the gates under high flood tides when the differential between headwater and tailwater pool elevations reaches 0.2 feet.

Structure S-122 is a gated culvert located in C-100B, one-tenth of a mile south of the east end of Peters Road. There are no specific operational guidelines for this structure. In general it is closed to prevent flood flows in the C-1 Basin from entering the C-100 Basin. It is opened as necessary to supply water from the C-1 Basin to the C-100 Basin for irrigation and to maintain the optimum stage in the lower reaches of canals in the basin.

Structure S-123 is a reinforced, gated spillway located near the mouth of the C-100 Canal below the junction of the C-100, C-100A, and C-100B canals, approximately 600 feet from the Biscayne Bay shoreline. The structure operates automatically to maintain a seasonally optimal headwater between 2.0 feet and 3.5 feet. The structure is also operated to regulate salinity. It will automatically close the gates under high flood tides when the differential between headwater and tailwater pool elevations reaches 0.3 feet. The structure also incorporates a special timing device to protect manatees during automatic operations.

Structure S-148 is a reinforced, gated spillway located on the C-1 Canal, approximately 1,800 feet west of Highway 1. The structure operates automatically to maintain the optimal upstream water level at 5.0 feet for Canal C-1.

Structure S-149 is a double-barreled, reinforced-concrete pipe culvert located on the C-1N Canal, approximately one-quarter mile west of Highway 1. The structure operates automatically to maintain the optimal upstream water level at 5.5 feet for Canal C-1.

Other stormwater management facilities include infiltration devices such as drainage wells, exfiltration trenches, and swales which allow stormwater runoff to percolate into the groundwater system. This water enters the canal system though groundwater interflow.

Sub-basin Delineation

The C-1 Basin was originally divided into 142 sub-basins and the C-100 Basin was divided into 201 sub-basins by the DERM Stormwater Planning and Design Section. The sub-basin delineations are described below (from *DERM Stormwater Master Plan C-7 Basin Report,* Volume 2, "Hydrologic and Hydraulic Modeling of Existing and Future Conditions without Control Measures", September 1997 and *DERM Stormwater Master Plan C-1 Basin Report,* Volume 2, "Hydrologic and Hydraulic Modeling for Existing and Future Conditions without Control Measures", October 2003).

DERM developed section maps in AutoCAD format in association with Florida Power and Light (FPL) geographic information system (GIS) base mapping. The section maps identify edge and centerline of roads, canal right-of-ways, lakes, buildings, subdivisions, and parcel lines. The following information is available on the GIS maps:

- Roadway crown elevations
- Locations of storm sewer systems
- Locations of drainage wells
- Location of cross drains

Through the use of the topographic (road crown elevations) data, and by combining many of the conterminous closed sub-basins into one sub-basin, the C-1 Basin and the C-100 Basin were delineated into sub-basins ranging in size from 0.17 acres to 703.7 acres.

Each sub-basin is given a name based on its location within the basins, proximity to one of the major canals or tributaries, or proximity to a major roadway. Sub-basins are assigned a direction from the adjacent canal and numbered from upstream to downstream in that area.

Therefore, the first upstream basin east of the C-100C Canal is labeled C100C-E-1; the next is C100C-E-2 and so forth. Sub-basins that contain portions of the canals are assigned the canal name, a 'C' label, and are numbered upstream to downstream such as C100-C-14. Sub-basins along major roads are assigned names based on the roadway such as SR874-3. Closed sub-basins are assigned a leading 'C' label in the name, such as CC100-W-1.

KHA used the C-1 and C-100 sub-basins provided by DERM within the Town of Cutler Bay as the guideline for establishing the stormwater basins throughout the Town. The County sub-basins became the Town's basins. KHA further reduced the Town's basins into sub-basins for use in modeling the Town. Basin and sub-basin maps for the Town are included and discussed later in this report. KHA utilized the elevation data provided by the County in CAD format to delineate basins and sub-basins within the DA-4 Basin.

Level of Service Criteria

As part of developing a stormwater master plan, *level of service* is an established criterion that defines levels of stormwater management for a community. As part of the Town's stormwater master plan, a level of service will be developed. The following is a description of the levels of service for the C-100 and C-1 Basins as defined by Miami-Dade County:

- All structures (commercial, residential, and public) should be flood-free during the 100-year storm event.
- Principal arterial roadways, including major evacuation routes, should be passable during the 100-year storm event, i.e. at most eight inches of water on roadway.
- All canals should operate within their banks during the respective design floods. Primary canal design criteria vary from 10-year to 100-year storm events and are described for the major drainage basins in the Miami-Dade County Comprehensive Plan. The C-1 Canal is designed for the 100-year, 25-year, and 10-year storm event for the part east of the Turnpike, east of US 1, and west of US 1, respectively. The C-1 secondary canal systems are designed for the 25-year storm event. The C-100C and C-100 secondary canals are designed for a 10-year storm event.
- Minor arterial roadways such as four-lane roads should be passable during the 10-year storm event, i.e. water level does not exceed the crown of the road.
- Collector and local residential streets should be passable during the five-year storm event per Miami-Dade County drainage policy.

Results

KHA reviewed the C-1 and C-100 Stormwater Master Plans to see which of the County's Priority Sub-Basins for water quality and flooding severity were within the Town of Cutler Bay's boundary limits and which of the projects proposed in these reports would impact the Town. Between the C-1 Basin and the C-100 Basin, 11 priority sub-basins, or portions thereof, were within Town limits. Water quality within the C-1 and C-100 basins is of average standing with respect to the other Miami-Dade County basins. Therefore, this indicator was weighted less than the Flooding Problem Severity when the County determined priority sub-basins for proposed projects within the C-1 and C-100 basins. Taking only flooding problem areas into account, there are seven County priority sub-basins within Town limits as shown in *Figure 3*.

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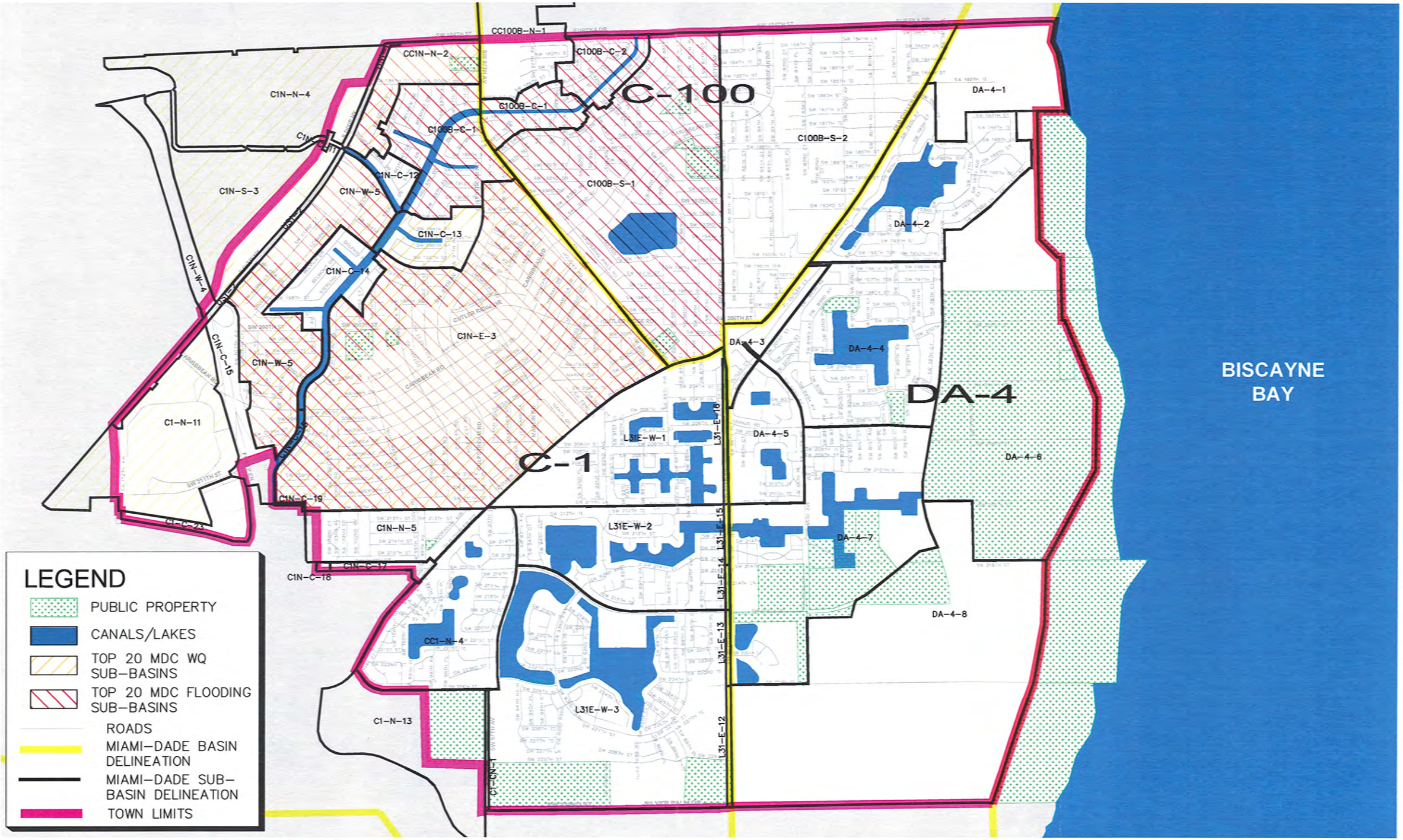

Drawing name: H:\043 Jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 3 MDC SUB-BASIN PRIORITIES.dwg FIG 3 Feb 28, 2008 5:17pm by jairo.castro

Cutler Bay FLORIDA ESTABLISHED 2005

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

MDC PRIORITY SUB-BASIN AND FLOOD CONTROL PROJECTS

FIGURE 3

Proposed C-1 Basin Projects

The C-1 Basin Stormwater Master Plan calls for 8 Flood Control Projects (FCP) to mitigate flooding within the basin. Of these, FCP's 6, 7, and 8 relate to the Town of Cutler Bay and are described below. Water quality within the C-1 Basin is relatively good and, thus, no water quality control measures were proposed in the C-1 Basin Stormwater Master Plan.

The purpose of FCP 6 is to improve flood control in County sub-basin C1N-E-3. This sub-basin currently overflows into the C-1N Canal. However, lower portions of this sub-basin can only overflow into the C-1N Canal at very high water levels that cause excessive flooding of existing buildings. FCP 6 proposes routing the runoff to a proposed 12-acre dry retention pond located on the northeast corner of Old Cutler Road and SW 212th Street and then off to the nearby L31-E Canal at SW 87th Avenue and SW 212th Street would allow overflow at a lower elevation and result in lower water levels within the C1N-E-3 basin. Widening of approximately 6,840 feet of the L31-E Canal would be required to handle this load. FCP 6 also proposes 7,400 linear feet (LF) of French drains throughout the C1N-E-3 Sub-basin. The entire C1N-E-3 sub-basin and the majority of the proposed improvements associated with FCP 6 are located within the Town of Cutler Bay as shown in *Figure 3*. The present worth cost of FCP 6 was determined to be $9,661,000 with DERM being responsible for 100% of the funding.

FCP 7 is a regional measure intended to reduce water levels along the entire C-1 Basin. It consists of dredging of the downstream portions of the C-1 Canal between Old Cutler Road and SW 87th Avenue. FCP 7 positively affects most of the entire C-1 Basin due to increased capacity in the downstream portions of the C-1 Canal. If this project is implemented by SFWMD, flooding within all areas of the Town that currently outfall into the C-1 Canal would be reduced. The location of this proposed project is shown in *Figure 3*. The present worth cost of FCP 7 was determined to be $9,965,000 with DERM being splitting the cost with SFWMD.

FCP 8 is a regional measure intended to reduce water levels throughout the C-1 Basin by widening the C-1N canal and the existing Caribbean Boulevard bridge crossing. If implemented by SFWMD, this project would benefit the area in the Town of Cutler Bay adjacent to the C-1N canal. *Figure 3* shows the location of the proposed project. The present worth cost of FCP 7 was determined to be $2,294,000 with DERM being splitting the cost with SFWMD.

Miami-Dade County ranked the feasibility of the eight FCP's in the C-1 Stormwater Master Plan using the following criteria:

1. Ability of the project to be permitted.
2. Aquifer recharge potential.
3. Land availability.
4. Public acceptance.
5. Coordination with existing projects.
6. Aesthetic value.

For each of the criteria, a high score means the project is less feasible and a low score means it is more feasible. All three of the proposed FCP's that impact the Town of Cutler Bay received high scores for ability of the project to be permitted, because they include dredging of the C-1, C-1N and L31E canals which would require by SFWMD and U.S. Army Corps of Engineers (USACE) permits. The three FCP's that impact the Town also received high scores for land availability and coordination with existing projects and low scores for public acceptance. FCP 6 received a low score on the aquifer recharge and aesthetic value criteria due to the inclusion of exfiltration trenches and dry retention. FCP's 7 and 8 received high scores for aquifer recharge and aesthetic value. Of the eight projects proposed in the C-1 Basin Stormwater Master Plan, FCP's 7 and 8 were ranked as the least feasible and FCP 6 was the next least feasible project.

Miami-Dade County assigned priority rankings to the eight FCP's described in the C-1 Basin Stormwater Master Plan, based on a combination of project feasibility and flood reduction effectiveness. FCP 6 received a priority ranking of 2. Due to lower feasibility, FCP 7 received a priority ranking of 3 and FCP 8 received a priority ranking of 5. All of the proposed projects for the C-1 Basin, require large capital expenditures and impact DERM/ SFWMD/ USACE controlled canals. Therefore, if the Town would like to see these projects implemented, the Town should coordinate with SFWMD, Miami-Dade County, and neighboring municipalities that would be impacted by the proposed projects.

Proposed C-100 Basin Projects

Of the five FCP's proposed in the C-100 Basin Stormwater Master Plan, only FCP 1 relates to the Town of Cutler Bay. FCP 1 is intended to mitigate flooding in the sub-basins adjacent to the C-100B canal by dredging the C-100 and C-100B canals and replacing culverts U-40 and U-41 with

bridge spans. Culvert U-40 lies at the crossing of the C-100B Canal with SW 184th Street and Culvert U-41 lies north of the Town of Cutler Bay along the same canal. Dredging would take place between the intersection of the C-100 and C-100B Canals to the intersection of the C-100 and C-100C Canals. If this project is implemented by SFWMD, flooding within all areas of the Town that currently outfall into the C-100B Canal would be reduced. The location of this proposed project is shown in *Figure3*. The present worth cost of FCP 1 was determined to be $8,309,000 with DERM contributing 12.4% of the cost and SFWMD contributing the remaining 87.6%.

Miami-Dade County ranked the feasibility of the eight FCP's in the C-1 Stormwater Master Plan using the following criteria:

1. Ability of the project to be permitted.
2. Aquifer recharge potential.
3. Land availability.
4. Public acceptance.
5. Coordination with existing projects.
6. Aesthetic value.

For each of the criteria, a high score means the project is less feasible and a low score means it is more feasible. FCP 1 received a high score for ability of the project to be permitted, because they include dredging of the C-100 and C-100B canals which are controlled by SFWMD and USACE. FCP 1 received a high score for public acceptance, because it includes widening of the C-100B canal by up to 12-feet and this is expected to meet resistance from the affected landowners adjacent to the canal. FCP 1 also received high scores for aquifer recharge and coordination with existing projects and low scores for land availability and aesthetic value. Of the five projects proposed in the C-100 Basin Stormwater Master Plan, FCP 5 received the best feasibility ranking and the other projects including FCP 1 tied for second place.

Miami-Dade County assigned priority rankings to the eight FCP's described in the C-100 Basin Stormwater Master Plan, based on a combination of project feasibility and flood reduction effectiveness. FCP 1 received a priority ranking of 4. FCP 1 requires large capital expenditures and impacts DERM/ SFWMD/ USACE controlled canals. Therefore, if the Town would like to see this project implemented, the Town should coordinate with SFWMD, Miami-Dade County, and neighboring municipalities that would be impacted by the proposed project.

C. Comprehensive Everglades Restoration Plan (CERP)

The Comprehensive Everglades Restoration Plan (CERP) is a plan to restore and preserve the Everglades, enhance water supplies, and maintain flood protection. The U.S. Army Corps of Engineers has partnered with the South Florida Water Management District and other local, state, tribal and federal partners to reach a common goal based on a vision for the future quality of the natural and human systems in South Florida. The CERP is a comprehensive plan for the restoration, protection, and preservation of water resources for central and southern Florida, specifically the Everglades. The plan integrates a *Programmatic Environmental Impact Statement* (PEIS) which entails the identification and the discussion of the plan's proposed features, its beneficial effects and its impacts on the existing habitat. Over 60 project features are included within the plan that will generate approximately 217,000 acres of new reservoir and wetlands-based water treatment areas. These features are expected to greatly increase water storage and supply for urban and agricultural demands while maintaining current Central and Southern Florida Project (C&SF) purposes. The purpose of the CERP is to achieve vast improvement to the presently depleting natural habitats by restoring natural flows, improving water quality and generating more natural hydro-periods in South Florida ecosystem. Ultimately the improvements to the native flora and fauna, including threatened and endangered species will be achieved with the restoration of hydrologic conditions.

The CERP is made up of several projects with an estimated total budget of $7.8 billion. Two of the projects are located in or near the Town of Cutler Bay: the Biscayne Bay Coastal Wetlands project and the South Miami-Dade Wastewater Reuse Project.

Biscayne Bay Coastal Wetlands Project

The Biscayne Bay Coastal Wetlands Project is scheduled to be completed between 2008 and 2015. It is located along the undeveloped lands that make up the south and eastern areas of the Town of Cutler Bay and continues north along the coast to include the eastern areas of the Village of Palmetto Bay. The project benefits will include restoring Biscayne Bay including Biscayne National Park. The natural overland sheetflow of water has been changed with the construction of drainage canals. This project will restore the overland sheetfloow in a 13,600-acre area through the construction of spreader canals and other features. The more natural water flow will improve the ecology of Biscayne Bay including its freshwater and tidal wetlands, nearshore bay habitat,

marine nursery habitat, oysters and oyster reef community. The Biscayne Bay Coastal Wetlands project will consist of constructing pump stations, spreader swales, stormwater treatment areas, flowways, levees and culverts, and backfill canals.

South Miami-Dade Wastewater Reuse Project

The South Miami-Dade Wastewater Reuse Project is scheduled to be completed between 2015 and 2025. It will start with a Pilot project scheduled between 2015 and 2020. The purpose of the pilot project will be to determine the levels of treatment and technologies needed to discharge reclaimed water into natural areas, determine the ecological effects of using superior, advanced treated reclaimed water and determine the parameters/ constituents of concern. The purpose of the pilot treatment facility is to determine the effects of using reclaimed water to replace and augment freshwater flow to Biscayne Bay and to determine the level of treatment required to prevent degradation of estuarine and freshwater wetlands and Biscayne Bay. Major elements include assessment of the effects of using reclaimed water on freshwater or estuarine wetlands and design, construction, operation, and monitoring of a pilot plant in a south Miami-Dade facility to produce reclaimed water to discharge to freshwater wetlands and Biscayne Bay. The pilot project will provide the basis for a full scale project to be completed between 2020 and 2025.

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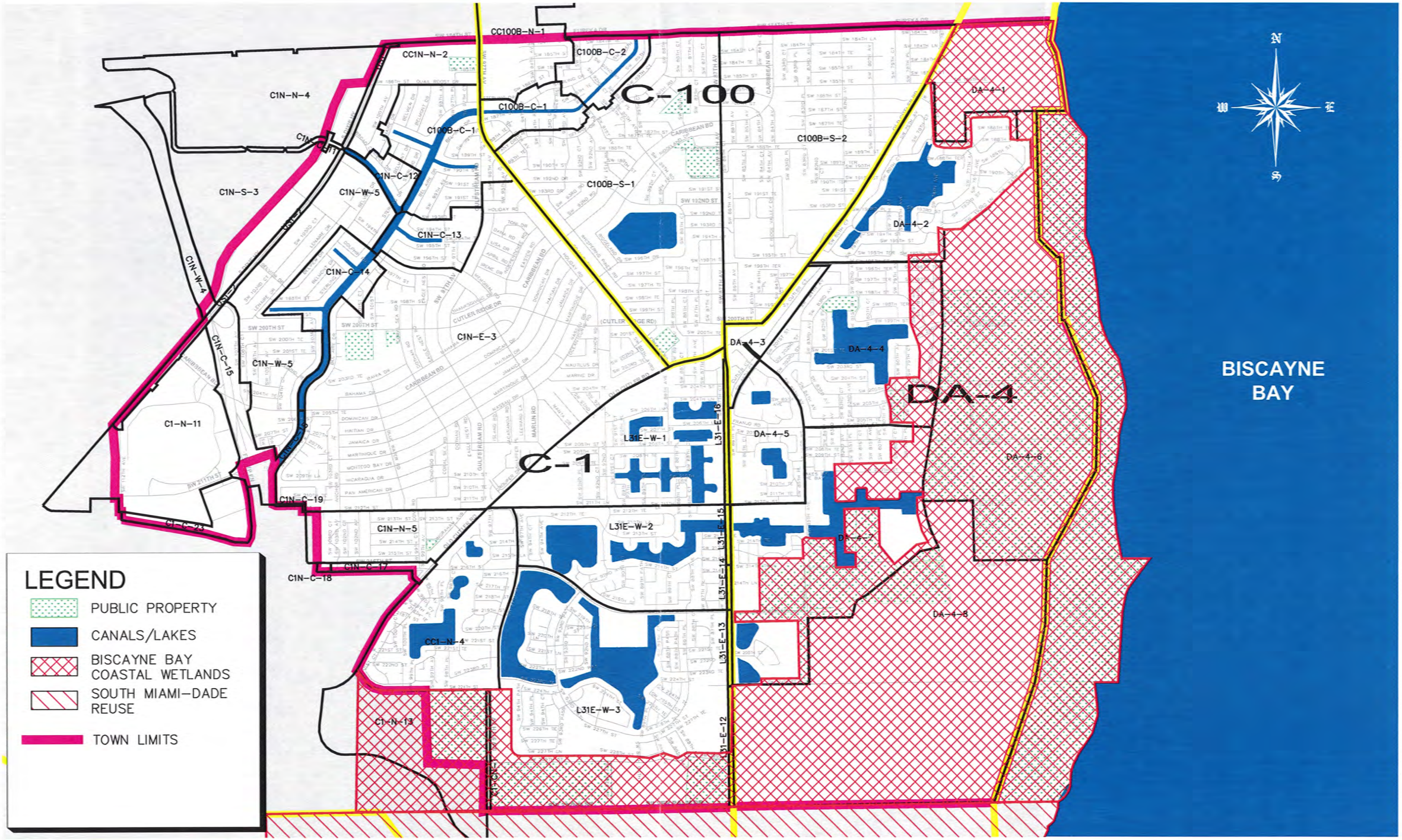

Drawing name: H:\043 Jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 4 PROP CERP PROJECT.dwg FIG-4 Mar 10, 2008 9:26am by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

PROPOSED CERP PROJECTS IN AND NEAR TOWN

FIGURE 4

D. South Florida Environmental Report (SFER)

The *2007 South Florida Environmental Report* (SFER) is the latest version of an annual report focusing on updates and highlights of the past fiscal year, May 2006 to April 2007, regarding the South Florida environment. The SFER is a compilation of updates from SFWMD, the Florida Department of Environmental Protection (FDEP), the Florida Department of Agriculture and Consumer Services (FDACS), and other state, local, and tribal governments. It highlights programs such as CERP, the Biscayne Bay Surface Water Improvement and Management Plan (SWIM Plan), the Everglades Forever Act (EFA), and other programs. The Everglades, being the largest ecosystems of its kind, is the primary focal point of this report. The Town of Cutler Bay lies within the Biscayne Bay – South Bay watershed of SFWMD. This area extends along the Biscayne Bay coast between Shoal Point (north) and Turkey Point (south). The SFER is broken into two volumes. The first reviews the South Florida environment at large and the second reviews the district annual plans and reports.

Volume I: South Florida Environment

Water quality in South Florida is of major concern and programs have been implemented over the years to monitor it and to mitigate its degradation. Current programs established by EFA, such as phosphorous source control and nitrogen monitoring, are exceeding expectations and the water quality of the Everglades overall has generally been meeting state criteria. Another achievement is the decrease in mercury levels in fish throughout South Florida.

A long-term plan was developed for achieving Everglades's water quality goals that included the monitoring of Stormwater Treatment Areas (STA) and Everglades Source Control. Mandated by EFA, over 40,000 acres of large constructed wetlands, STAs have been established along the southern extent of the Everglades Agricultural Area (EAA) and are managed by SFWMD. In order to reduce total phosphorous levels in the waters entering the Everglades Protection Area, surface water is directed through vegetated treatment cells and the STAs accumulate phosphorous in sediments through biological and chemical processes. This process has removed over 800 metric tons of phosphorous entering the Everglades Protection Area since 1994, effectively reducing the concentration of phosphorous by 69 %. Other methods of restoration included planting rice to stabilize sediments and removing sediment from water control structures. A full scale implementation project using algae, referred to as Periphyton Stormwater Treatment Areas, is in the grow-in phase with the assistance of United States Army Corps of Engineers (USACE).

With regards to Biscayne Bay, the development of a water quality database was initiated to better analyze water quality trends. In addition, a funding agreement with U.S. Geological Survey was established for modeling the surface water and groundwater flows to the Bay. This will assist in identifying causes of recurring hyper-salinity events in near-shore regions of the Bay. High salinity levels affect many species of animals and plants, while unusually high salinity levels create harsh environments that decrease the amount of area that is habitable to these species.

The remainder of Volume I reviews hydrological and ecological issues of South Florida; CERP and Accelera8 performance; and management and restoration plans for the Lake Okeechobee, Kissimmee, and coastal ecosystem.

Volume II: District Annual Plans and Reports

Volume II reviews past projects, current work plans, and future improvement plans. In order to "...limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area," the State defined minimum flow requirements of multiple water bodies. Florida law mandates that all water management districts establish Minimum Flows and Levels (MFL) for surface waters and aquifers within their jurisdictions. In addition to this, the State mandated that each district establishes water reservations, or water areas set aside in a certain location, time, or quantity. The water reservations were mandated for a specific use that may be required for the protection of fish and wildlife or public health and safety. The Town of Cutler Bay is located within Biscayne Bay–South District. MFLs for Biscayne Bay–South are scheduled for development in 2008.

SFWMD Capital Improvement Projects were forecasted for a five-year period. Budget estimates for project implementation are expected to peak in 2008 and gradually decline by 2011. This is due to the plan for proposed projects to be in full production in 2008 and to be relatively accomplished or in sustaining phases in the following years. These projects include restoration, monitoring programs, and land acquisitions for STA projects. Projects that relate to the Town of Cutler Bay may be reviewed in sections A, C, and E: the SMDWSP, the CERP, and SWIM Plan sections, respectively.

E. Biscayne Bay Surface Water Improvement and Management Plan (SWIM Plan)

Water quality, water quantity, and environmental impact are the three major concerns that the Biscayne Bay Surface Water Improvement and Management Plan (SWIM Plan) was implemented to review. The current plan, prepared by SFWMD in 1995, incorporated portions of the original plan enacted in 1989 and provides more comprehensive research and updated objectives. Though this report has been superseded by the CERP and the SFER, KHA reviewed it to gain a historical perspective on past surface water management programs in Miami-Dade County.

Water Quality

From Miami-Dade's water quality monitoring program, the SWIM Plan proposed to develop water quality targets for contamination levels. Much rainfall within Miami-Dade County directly enters into the surficial Biscayne Aquifer system, which represents the sole source of drinking water for the greater Miami metropolitan area. Biscayne Bay's water quality has been degrading due to poorly treated surface water runoff. In addition, sewage pollution requires attention, which has shown to be a direct threat to humans via parasites and microorganisms and indirectly via other substances that may discharge through the sewage system. The developed targets assisted project effectiveness determination in the area of mitigation of water quality degradation.

Water Quantity

Changes in water flow throughout the Miami-Dade area disrupted the ecosystem and species composition in Biscayne Bay. Timing patterns of flow rates must be as closely identical to nature as possible to maintain a balanced ecosystem. The flow timing also affects the salinity of the bay. Too much, or too little, salinity in the bay will threaten many species. As more industry is developed, more fresh water is used and less flows into the bay. The inflow of freshwater into the bay must be regulated to maintain proper salinity levels.

Environmental Protection

Certain plants and animals play a role in water quality and, thus, must be looked into. For example, mangroves provide buffers between the land and water and help protect against erosion.

Seagrass helps anchor sea floor sediments, reducing turbidity, and provides a habitat for marine organisms. Filter feeding organisms, such as oysters, sponges, and sea squirts assist in maintaining water clarity by removing particles. It is important to rebuild the lost habitats and restore the wetlands in order to save these species and to increase water quality in the Bay.

Due to limited resources, the SWIM Plan focused on a few priority areas including south Miami-Dade County. Among specified areas within south Miami-Dade County, Canal 1, Canal 100, and Levee L-1E were selected. These three drainage mechanisms directly affect the Cutler Bay drainage system. The SWIM Plan proposed projects for each problem area that would meet set objectives and goals including canal water monitoring programs. Levee L-31E was proposed to have a *Flow Redistribution Project* implemented as a pilot project in enhancing the timing of freshwater flow to Biscayne Bay via wetlands. This project was to be implemented by the end of 1995 and a monitoring program was set up to detect changes to the hydrology, chemistry, and biota of the canal. The vast majority of the proposed SWIM Plan projects have been either been completed or abandoned. The SWIM Plan is no longer used by SFWMD as more current reports such as the SMDWSP, Miami-Dade County Stormwater Master Plans, CERP, and SFER supersede it.

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F. National Flood Insurance Program (NFIP) Data

The requirements of the National Flood Insurance Program (NFIP) will play an important role in flood protection for the Town of Cutler Bay. Therefore, KHA researched these requirements for the areas included within the Town.

The U.S. Congress established NFIP with the passage of the National Flood Insurance Act of 1968. The NFIP is a program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the federal government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal government will make flood insurance available within the community as financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.
The NFIP is administered through the Federal Emergency Management Agency (FEMA).

Flood Hazard Identification and Risk Assessment

The director of FEMA is required by statute to identify and map flood-prone areas and to establish flood-risk zones in such areas. The FEMA flood hazard maps are used for community floodplain management regulations, for calculating flood insurance premiums, and for determining whether property owners are required by law to obtain flood insurance as a condition of obtaining mortgage loans or other federal or federally related financial assistance. FEMA's flood hazard maps are also used by states and communities for emergency management.

The "100-Year" Standard

The NFIP would not be able to offer insurance at affordable rates without the existence of risk management (floodplain management) to reduce flood losses. In order to assess and manage the flood risk, a national standard was needed. The U.S. Department of Housing and Urban Development, which initially administered the NFIP before FEMA was created, began its administration of the NFIP by calling on a group of experts to advise the agency as to the best

standard to be used as the basis for risk assessment, insurance rating, and floodplain management for the program. After extensive study and coordination with federal and state agencies, this group recommended the 1-percent-annual-chance flood (also referred to as the "100-year" or "Base Flood") be used as the standard for the NFIP.

The 1-percent-annual-chance flood is a regulatory standard used by federal agencies, and most states to administer floodplain management programs. It has been used since the inception of the NFIP and is used for floodplain management purposes in all of the at least 20,200 participating communities that have been issued flood hazard maps.

Identifying and Mapping Flood-Prone Areas

Flood Insurance Studies (FIS) that use detailed hydrologic and hydraulic analyses to develop Base Flood Elevations (BFE) and designate floodways and risk zones for developed areas of the floodplain have been produced for most NFIP communities.

In producing and updating FISs, FEMA typically uses a combination of two study approaches (approximate and detailed) in identifying a community's flood hazards. Detailed study methods typically employ the use of engineering models and, at a minimum, result in the determination of BFEs or flood depths and floodways that will be displayed on the Flood Insurance Rate Maps (FIRM). In general, the decision whether to use the approximate method or detailed method is based on existing and anticipated development in and near the floodplain. Flood hazard information for flooding sources that affect developed or developing areas are based on detailed studies whenever possible; approximate study methods, which are less rigorous than detailed methods and do not determine BFEs or floodways, may be used for undeveloped or sparsely developed areas.

An FIS usually generates the following flood hazard information:

- BFEs are presented as either water-surface elevations or average depths of flow above the ground surface. These elevations and depths are usually referenced to either the National Geodetic Vertical Datum of 1929 (NGVD29) or the North American Vertical Datum of 1988 (NAVD88).

- Water-surface elevations for the 10-year (10-percent-annual-chance), 50-year (2-percent-annual-chance), 100-year (1-percent-annual-chance), and 500-year (0.2-percent-annual-chance) floods.
- Boundaries of the regulatory 100-year floodway. The regulatory floodway is defined as the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the entire Base Flood (100-year flood) discharge can be conveyed with no greater than a 1.0-foot increase in the BFE.
- The boundaries of the 100- and 500-year floodplains. The 100-year floodplain is referred to as the Special Flood Hazard Area (SFHA).

The results of the FIS are presented on a map, referred to as a Flood Insurance Rate Map (FIRM), and presented in the FIS report in a narrative and graphically as flood profiles attached to the narrative. FEMA determines the 1-percent-annual-chance flood, shown on the FIRMs as A-Zones or V-Zones, from information obtained through consultation with the community, and from floodplain topographic surveys, detailed hydrologic and hydraulic analyses, and historic records. FEMA uses commonly accepted computer models and engineering methods that estimate hydrologic and hydraulic conditions to determine the 1-percent-annual-chance flood and to determine BFEs, and to designate flood-risk zones.

Along rivers, streams, and lakes within the United States, FEMA computes flood elevations using computer models, statistical techniques, or both. These elevations are a function of the amount of water expected to enter a particular system by means of precipitation and runoff. SFHAs in river areas are primarily identified as A-Zones on the FIRM.

Along the coast, FEMA determines SFHAs by an analysis of storm surge, wind direction and speed, wave heights, and other factors. FEMA designates these areas along the coast as both V-Zones and A-Zones on the FIRM. V-Zones are the more hazardous coastal flood zones because they are subject to high velocity wave action. FEMA applies the V-Zone designation to those areas along the coast where water depth and other conditions would support at least a three-foot wave height. FEMA also considers other factors in identifying V-Zones, such as wave run-up. FEMA usually designates A-Zones in coastal areas landward of the V-Zone. Coastal flood hazards areas mapped as A-Zones can be subject to storm surge and damaging waves; however, the waves are less than three feet in height.

Changes to the Flood Maps

The flood risk information presented on the FIRM and in the FIS report forms the technical basis for the administration of the NFIP. FEMA exercises great care to ensure that the analytical methods employed in the FISs are scientifically and technically correct, that the engineering standards followed meet professional standards, and, ultimately, that the results of the FIS are accurate. Although the NFIP maps and FIS reports are prepared according to rigorous technical standards, FEMA recognizes that changes to the maps and reports may be necessary. Some reasons for the changes are due to improvements in the techniques used in assessing flood risks, changes in physical conditions in the floodplains or watersheds, and the availability of new scientific or technical data.

The NFIP regulations allow FEMA to revise and amend maps and FIS reports as warranted or after it receives requests from community officials and individual property owners. To help FEMA ensure that the maps and reports present information that accurately reflects existing flood risks, the NFIP regulations require that each NFIP community inform FEMA of any physical changes that affect BFEs in the community and, within six months of the date that this data is available, submit the data that shows the effects of the changes.

In making revisions and amendments, FEMA must adhere to the same engineering standards applied in the preparation of the original NFIP maps and FIS reports. Therefore, when requesting changes to NFIP maps and reports, community officials and property owners are required to submit adequate supporting data. That data enables FEMA to review and evaluate the requests and to carry out its responsibility of ensuring that the flood-risk information presented is scientifically and technically correct.

Minimum NFIP Floodplain Management Requirements

Under the NFIP, the minimum floodplain management requirements that a community must adopt depend on the type of flood risk data (detailed FIS and FIRMs with BFEs or approximate A-Zones and V-Zones without BFEs) that the community has been provided by FEMA. Under the NFIP regulations, participating NFIP communities are required to regulate all development in SFHAs. Before a property owner can undertake any development in the SFHA, a permit must be obtained from the community. The community is responsible for reviewing the proposed

development to ensure that it complies with the community's floodplain management ordinance. Communities are also required to review proposed development in SFHAs to ensure that all necessary permits have been received from those governmental agencies from which approval is required by federal or state law.

Under the NFIP, communities must review subdivision proposals and other proposed new development, including manufactured home parks or subdivisions to ensure that these development proposals are reasonably safe from flooding and that utilities and facilities servicing these subdivisions or other developments are constructed to minimize or eliminate flood damage.

In general, the NFIP minimum floodplain management regulations require that new construction or substantially improved or substantially damaged existing buildings in A-Zones must have their lowest floor (including basement) elevated to or above the Base Flood Elevation (BFE). Non-residential structures in A-Zones can be either elevated or flood-proofed.

For all new and substantially improved buildings in V-Zones:

- All new construction and substantial improvements of buildings must be elevated on piles and columns so that the bottom of the lowest horizontal structural member of the lowest floor is elevated to or above the BFE. No fill can be used for structural support.
- All new construction and substantial improvements of buildings must be properly anchored to resist flotation, collapse, and lateral movement.

In V-Zones, the velocity of water and wave action associated with coastal flooding can exert strong hydrodynamic forces on any obstruction to the flow of water. Standard foundations such as solid masonry walls or wood-frame walls will obstruct flow and be at risk to damage from high-velocity flood forces. In addition, solid foundation walls can direct coastal floodwaters into the elevated portion of the building or into adjacent buildings. The result can be structural failure of the buildings. For these reasons, the area below the lowest floor of the elevated building in V-Zones must either be free of obstruction or be constructed with open wood lattice panels or insect screening or constructed with non-supporting/non-load bearing breakaway walls that meet applicable NFIP criteria. Any enclosed area below the BFE can only be used for the parking of vehicles, building access, or storage.

In order to further protect structures from damaging wave impacts, structures must be located landward of the reach of mean high tide. Furthermore, man-made alterations of sand dunes and mangrove stands, which would increase potential flood damage, are prohibited within V-Zones. In responding to the public's desire to have an enclosed area below an elevated building, but recognizing the potential risks to lives and property, the NFIP floodplain management regulations permit certain limited uses of enclosures below the lowest floor in A-Zones or V-Zones. Under the NFIP, the enclosed area below an elevated building in an A-Zone or V-Zone can only be used for the parking of vehicles, building access, or storage. The allowance of these uses below the BFE is permitted because the amount of damage caused by flooding to these areas can easily be kept to a minimum by following the performance standards for the design and construction of enclosures in A-Zones and V-Zones described above and by using flood-resistant building materials. To further minimize flood damages, mechanical, electrical, plumbing equipment, and other service facilities must be designed and/or located above the BFE as to prevent damage during flooding conditions.

The NFIP substantial improvement requirement and substantial damage requirement provides a mechanism to ensure that a significant increase in investment in existing pre-FIRM buildings will receive needed protection from the flood risk. If a community determines that the cost of improvements to a home or business equals or exceeds 50 % of the market value of the building, the building is considered a "substantial improvement.". If a community determines that the cost of restoring a home or business equals or exceeds 50 % of the market value of the building before the damage from any origin occurred, the building is considered "substantially damaged." A substantially improved building or substantially damaged building must meet the minimum requirements of the NFIP. It is the community's responsibility to make substantial improvement or substantial damage determinations.

Ordinance Adoption

Once FEMA provides a community with the flood hazard information upon which floodplain management regulations are based, the community is required to adopt a floodplain management ordinance that meets or exceeds the minimum NFIP requirements. FEMA can suspend communities from the program for failure to adopt once the community is notified of being flood-prone or for failure to maintain a floodplain management ordinance that meets or exceeds the minimum requirements of the NFIP.

In suspended communities, flood insurance is not available to property owners. In addition, these communities are subject to limitations on federal financial assistance accordingly to Section 202(a) of 1973 Act which prohibits federal officers or agencies from approving any form of loan, grant, guaranty, insurance, payment, rebate, subsidy, disaster assistance loan or grant, for acquisition or construction purposes within SFHAs. For example, this would prohibit mortgage loans guaranteed by the Department of Veterans Affairs, insured by the Federal Housing Administration, or secured by the Rural Economic and Community Development Services. In the case of disaster assistance under the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, as amended, this prohibition only applies to assistance in connection with a flood.

Monitoring Community Compliance

FEMA monitors communities to ensure that they have adopted an ordinance that meets or exceeds the minimum NFIP floodplain management criteria and to ensure that they are effectively enforcing their ordinance. While the NFIP floodplain management criteria are administered by states and communities through their floodplain management regulations, FEMA's role is to provide technical assistance and to monitor communities for compliance with the minimum NFIP criteria. If communities do not adequately enforce their floodplain management regulations, they can be placed on probation and potentially suspended from the program following probation.

FEMA (or states on behalf of FEMA) conduct Community Assistance Visits (CAV) and Community Assistance Contacts (CAC) to monitor community floodplain management programs. A CAV is a scheduled visit to an NFIP community for the purpose of conducting a comprehensive assessment of the community's floodplain management program. The CAV is also used as an opportunity to provide technical assistance to the community. A CAV typically involves a tour of the floodplain, a meeting with local floodplain management officials, and an examination of the community's floodplain development permit and variance files. The visit is documented in a follow-up letter to the community. If any issues are identified during the CAV, such as a possible floodplain violation or program deficiency, these issues are also addressed in the follow-up letter. The community is responsible for resolving any program deficiencies or remedying any violations identified. A CAC is used to establish a contact with a community for the purpose of determining if any problems or issues exist and to offer the community assistance if necessary. CACs can be conducted by means of a telephone call or brief visit. While CACs are

a less comprehensive assessment of a community's floodplain management program, sufficient information about the community's floodplain management program can be obtained in order to determine whether there are more serious floodplain management problems in the community.

Flood Zones Located in the Town of Cutler Bay

According to the currently effective FIRM, portions of the Town of Cutler Bay are located within FIRM panals 12025C 0357 J, 12025C 0269 J, 12025C 0356 J, and 12025C 0268 J. *Figure 5* depicts the FIRM Flood Zones for the Town as shown on the FIRM Maps that are currently in effect. A review of the information contained in the FIRM Maps shows that the Town contains VE, AE and X Zones. VE-Zones are areas subject to coastal flooding in the 100-year flood with velocity hazard (wave action) where base flood elevations have been determined. AE-Zones are areas subject to flooding in the 100-year flood without velocity hazard (wave action) where base flood elevations have been determined. X-Zones are areas that are not subject to flooding in the 100-year flood. Some areas within X-Zones are subject to flooding in the 500-year flood. The areas located within AE-Zones and VE-Zones can be referred to as Special Flood Hazard Areas (SFHA). Based on KHA's analysis of the FIRM Maps and aerial photographs, approximately 4,656 acres within the Town boundary are located within SFHAs, or 75 % of the Town. This includes all property east of Old Cutler Road and most property within one-quarter mile on either side of the C-1N and C-100B Canals. Approximately 10,000 residential units are within SFHAs.

The current FIRM maps for Miami-Dade County, became effective on January 20, 1993. The entire County is now undergoing FEMA's map revision process, and new maps are expected to become effective in either 2008 or 2009. The Town has draft copies of the revised map panals that cover Cutler Bay. The changes to the FIRM that impact the Town of Cutler Bay include revised base flood elevations for a portion of the AE zone.

The Town has adopted Resolution No. 06-19 to join the NFIP and Floodplain Management Ordinance No. 06-10 and will be responsible for regulating development in the floodplain. The Building Department will require plans for new and substantially improved buildings to be in compliance with the requirements of the Floodplain Management Ordinance before issuance of a building permit.

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A — No base flood elevations determined.

ZONE AE — Base flood elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 — To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.

ZONE V — Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X — Areas determined to be outside 500-year floodplain.

ZONE D — Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS*

Identified 1983 | Identified 1989 | Otherwise Protected Areas

*Coastal barrier areas are generally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Urban and Expected Flood Insurance Rates Within Special Flood Hazard Zones.

513 — River Flood Elevation Line/Identification

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

A — A — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform within Zone**

RM7x — Elevation Reference Mark

•M1.5 — River Mile

**Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all ponding areas available. Special Flood Hazard Areas. The community map repository should be consulted for possible updated flood hazard information prior to use of this map for property purchase or construction purposes.

Coastal base flood elevations apply only landward of 0.0 (NGVD), and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of special flood hazard (100 year flood) include: Zones A, AE, AH, AO, A99, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Flooding, alone in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Elevation reference marks are described in the flood insurance Study Report.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed since publication of this map.

Base Map Source: Base map information prepared by the Metropolitan Dade County, Office of Computer Services and Information Systems from enhanced TIGER files.

For community map revision history prior to countywide mapping, refer to Section 6(f) of the Flood Insurance Study Report.

For additional area panels see separately printed Map Index.

MAP REPOSITORY

Refer to Repository Listing on Map Index

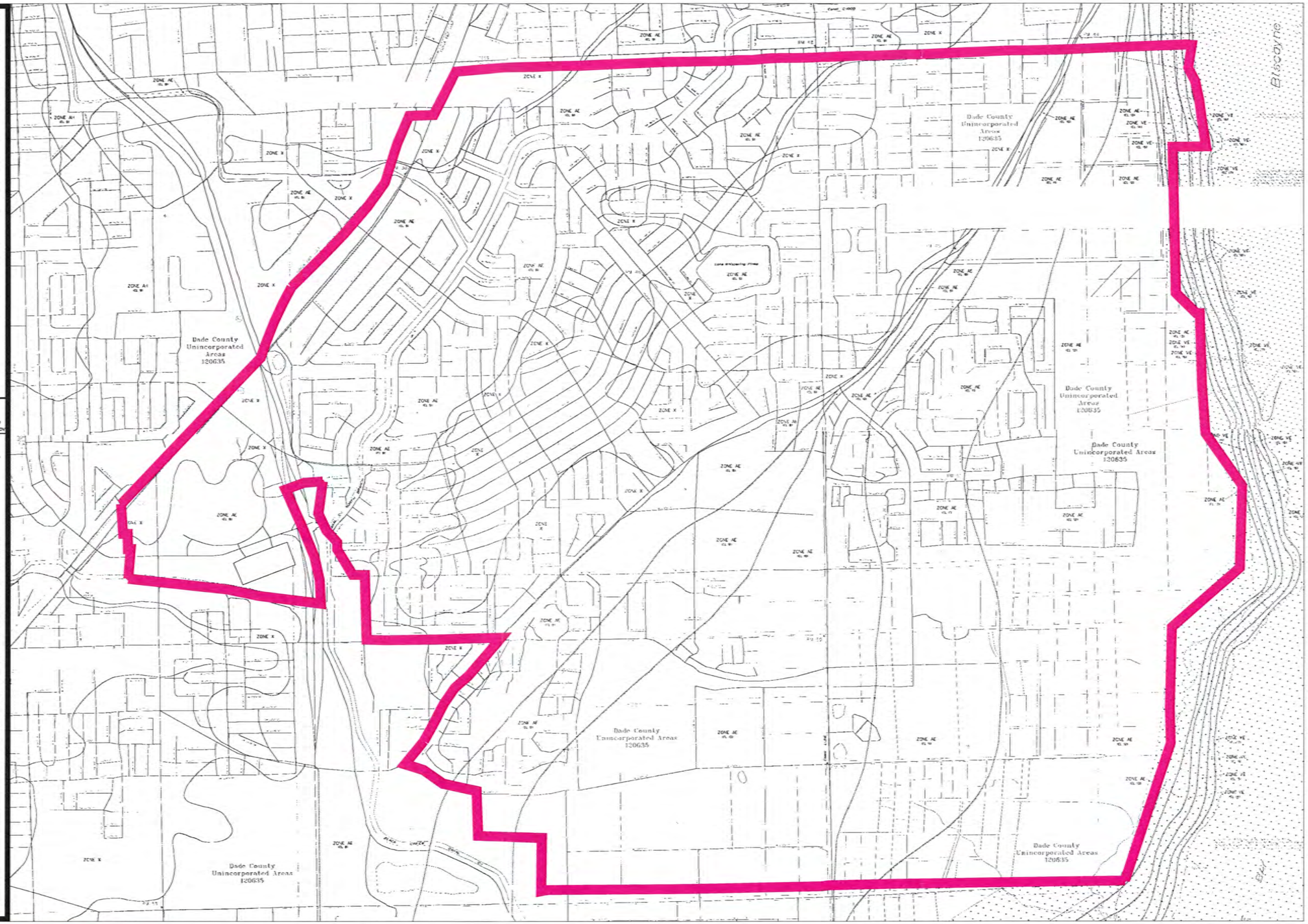
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

JANUARY 20, 1993

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

MARCH 2, 1994 - to change base flood elevations, to change special flood hazard areas and to update map format.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.



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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

FIRM FLOOD ZONES

FIGURE 5

G. National Pollution Discharge Elimination System (NPDES)

Urbanization and industrial activities around the country have significantly altered the natural landscape of our nation's watersheds. This, in turn, has adversely affected both the quantity and quality of stormwater runoff and has contributed to the chemical, physical, and biological impairment of receiving waters. Studies have shown that stormwater from urban and industrial areas are commonly contaminated with heavy metals, synthetic organics, pesticides, fuels, waste oils, and pathogens.

Congress, recognizing the importance of controlling these discharges, passed amendments to the Clean Water Act (CWA) in 1987 requiring that the U.S. Environmental Protection Agency (EPA) issue regulations addressing stormwater discharges under the National Pollutant Discharge Elimination System (NPDES) program. Promulgated on November 16, 1990, Phase I NPDES regulations establish permit application requirements for operators of certain Municipal Separate Storm Sewer Systems (MS4), as well as stormwater discharges associated with certain industrial activity. Regulated municipalities include those cities and counties operating medium and large MS4s (serving a population of 100,000 or greater) and other MS4s specifically designated by the permitting authority.

According to the CWA mandate, municipalities regulated under the NPDES program must, at a minimum, achieve technology-based requirements. Therefore they must reduce pollutant loadings in MS4s to the Maximum Extent Practicable (MEP) and must effectively prohibit non-stormwater discharges through their MS4s as a first step toward achieving loading reductions consistent with applicable water quality standards. While MEP was not explicitly defined by Congress, EPA interpreted it to mean that municipalities will develop and implement comprehensive stormwater management programs. These programs, proposed by the regulated municipalities under Part 2 of the permit application, are required to address a number of stormwater control measures, including methods to detect and remove illicit discharges entering municipal storm sewer systems, as well as appropriate Best Management Practices (BMP) to address discharges from industrial, commercial, and development activities.

Polluted stormwater runoff is often transported to MS4s and ultimately discharged into local rivers and streams without treatment. EPA's MS4 stormwater management program is intended to improve the nation's waterways by reducing the quantity of pollutants that stormwater picks up

and carries into storm sewer systems during storm events. Common pollutants include oil and grease from roadways, pesticides from lawns, sediment from construction sites, and carelessly discarded trash, such as cigarette butts, paper wrappers, and plastic bottles. When deposited into nearby waterways through MS4 discharges, these pollutants can impair the waterways, thereby discouraging recreational use of the resource, contaminating drinking water supplies, and interfering with the habitat for fish, other aquatic organisms, and wildlife.

As required by law, the Town of Cutler Bay has coordinated with Miami-Dade County and is now a co-permittee on the MS4 permit for Miami-Dade County after adopting Resolution No. 07-19 As a co-permittee, the Town is required to meet the obligations of the permit. These obligations fall into the following general categories:

- Maintaining and inspecting stormwater quality treatment infrastructure such as swales, exfiltration trench, pollution control boxes, catch basins, and manholes
- Updating maps and inventories of outfalls and stormwater management infrastructure
- Adhering to the policies of the 2000/2010 Miami-Dade County Comprehensive Development Master Plan
- Requiring compliance with Miami-Dade County DERM and Public Works Department drainage design requirements
- Reviewing current municipal land development regulations to determine where changes can be made to reduce the stormwater impact of new development.
- Implementing roadway litter control and street sweeping programs
- Assuring that all flood control projects include stormwater quality treatment consistent with SFWMD rules
- Evaluating, monitoring, and inspecting municipal waste treatment, storage, and disposal facilities.
- Providing public education programs related to the application of pesticides, herbicides and fertilizers
- Requiring employees and contractors responsible for application of pesticides, herbicides and fertilizers to be certified and/or licensed
- Implementing an inspection program to detect illicit discharges and illegal connections to the stormwater management system
- Publicizing the Miami-Dade County pollution complaint hotline

- Maintaining a citizen complaint log documenting illicit discharges
- Implementing a public outreach program to instruct the public on the proper disposal of used motor oil, leftover hazardous household products and lead acid batteries
- Identifying and maintaining a GIS database of areas served by septic systems and advising the local health department of potential violations if constituents common to wastewater contamination due to malfunctioning septic tank systems are discovered
- Advising the appropriate utility owner of potential violation if constituents common to wastewater contamination are found in areas served by sanitary sewer systems
- Inspecting industrial and high risk facilities for illegal discharges into the MS4
- Requiring new construction sites to obtain NPDES permits from DEP prior to land clearing
- Enforcing compliance with approved erosion and sediment control BMPs for construction sites
- Conducting stormwater erosion control training for construction site operators and inspectors

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III. REVIEW AND EVALUATION OF EXISTING CONDITIONS

A. Geographic Information System (GIS) Data Review

Canal Locations and Cross-Sections

Miami-Dade County is responsible for the operation and maintenance of the finger canals connected to the C1-N canal. Other canals within Cutler Bay are operated and maintained by the South Florida Water Management District. SFWMD maintains the C-100B Canal, the C-1N Canal, the C-1W Canal, the C-1 Canal, and the L-31E Canal. Canal location and cross-section information were obtained from Miami-Dade County DERM. *Figures 6 through 9* show the canal locations. In general, canal depths range from 8 to 25 feet and canal widths range from 25 to 140 feet.

Catch Basin and Pipe Data

In 2003, Miami-Dade County DERM created a GIS map of the C-1 and C-100 basins as part of their C-1 and C-100 Basin Stormwater Master Plans. As part of the data collection effort for the Town's Stormwater Master Plan, Kimley-Horn obtained a copy of the GIS data from DERM. The GIS data includes the following:

- AutoCAD files containing base information including section boundaries, street names, right-of-way lines, lot lines, and edge of pavement lines
- AutoCAD files containing location information for drainage structures such as catch basins, manholes, pipe, exfiltration trench, and outfalls
- An AutoCAD file showing subdivision names and boundaries
- AutoCAD file containing topographic (road crown elevations) developed by FPL

Additional data on the drainage structures is contained in Microsoft Excel spreadsheets. For cross-reference, the structures within the subdivisions are numbered both on the GIS maps and in the subdivision spreadsheets. The spreadsheets contain grate/rim elevations for manholes and catch basins; length, width, size and invert elevations for pipes; and trench width and depth information for exfiltration trenches.

A disc containing the AutoCAD mapping information and the drainage structure data spreadsheets is included in Appendix B. *Figures 6 through 9* illustrate the drainage structure locations.

Types of Systems

Based on a review of the data included in the GIS obtained from Miami-Dade DERM, KHA developed the map in *Figure 10*. This map shows the types of drainage systems located within the Town of Cutler Bay. The drainage systems were classified into the following four categories:

1. Outfall systems – systems with no exfiltration trench. Pipe connections are made to the canal system.
2. Closed systems – systems that do not have pipe connections to the canal system and rely solely on exfiltration trench and/or swales for drainage.
3. Combination systems – systems that have both exfiltration trench and outfall pipe connections to the canal system.
4. Undeveloped or unknown – systems located in areas where GIS information is not available or areas that are not developed.

Based on the area served, the majority of the Town of Cutler Bay currently relies on closed systems for drainage.

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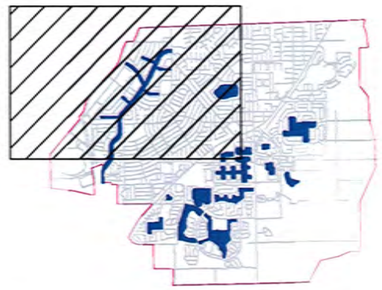
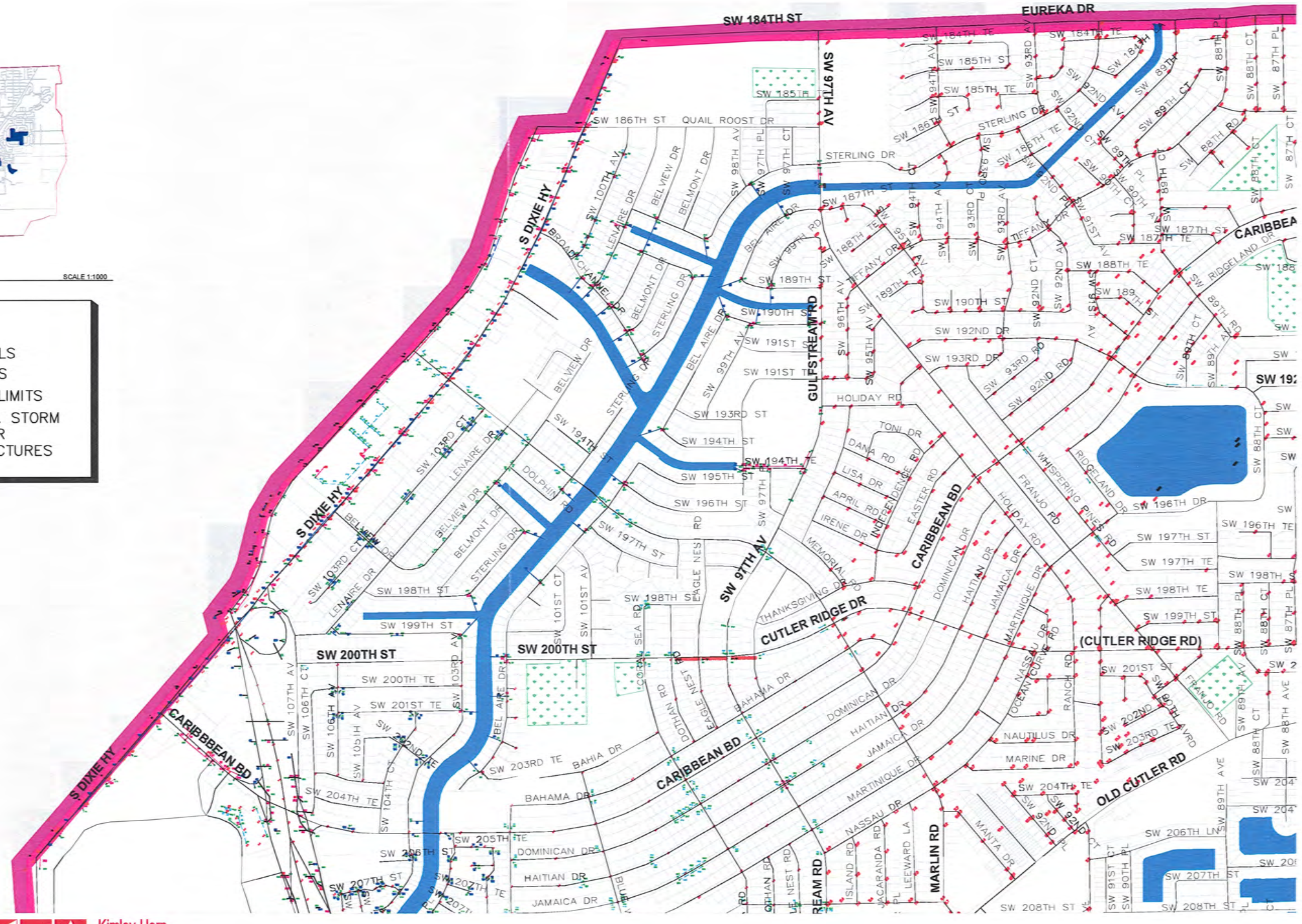


KEY MAP

SCALE 1:1000

LEGEND

- CANALS
- ROADS
- CITY LIMITS
- EXIST. STORM SEWER STRUCTURES



Drawing name: H:\043 Jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 6 DRAINAGE STRUCTURES.dwg FIG 6 SW Master Plan NW Feb 28, 2008 5:25pm by jairo.castro

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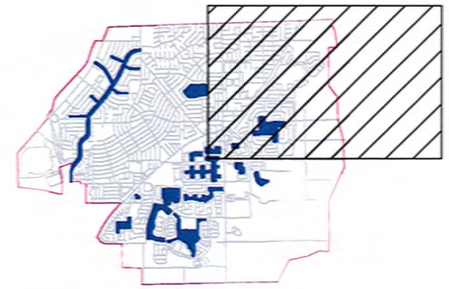
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE STRUCTURE LOCATION MAP (1 / 4)

FIGURE 6



KEY MAP

SCALE 1:1000

LEGEND

- CANALS
- ROADS
- CITY LIMITS
- EXIST. STORM SEWER STRUCTURES

BISCAYNE BAY

Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTY\FIG 7 DRAINAGE STRUCTURES.dwg FIG 7 SW Master Plan NE Feb 28, 2008 5:28pm by: jairo.castro

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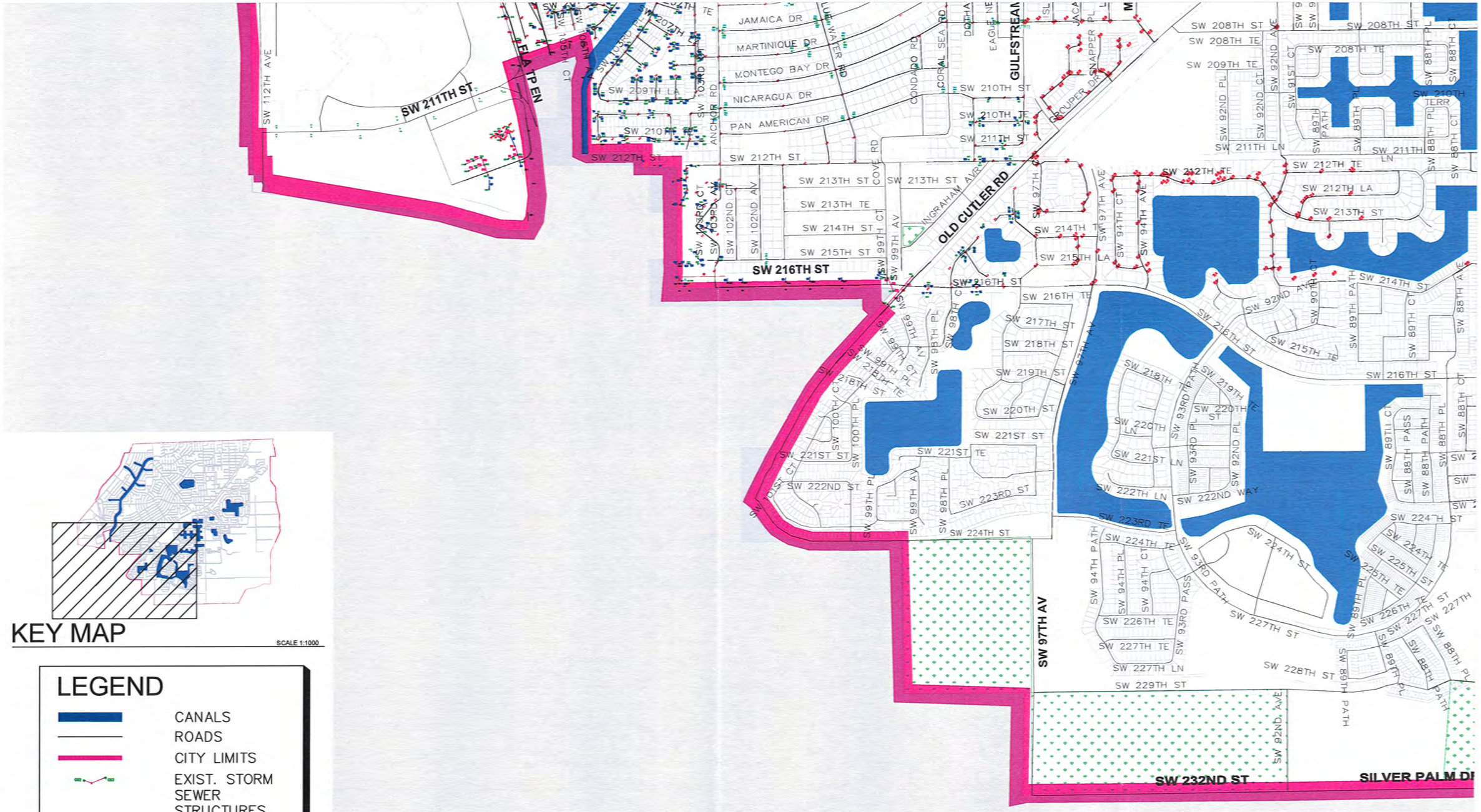
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE STRUCTURE LOCATION MAP (2 / 4)

FIGURE 7



KEY MAP

SCALE 1:1000

LEGEND

- CANALS
- ROADS
- CITY LIMITS
- EXIST. STORM SEWER STRUCTURES

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE STRUCTURE LOCATION MAP (3 / 4)

FIGURE 8

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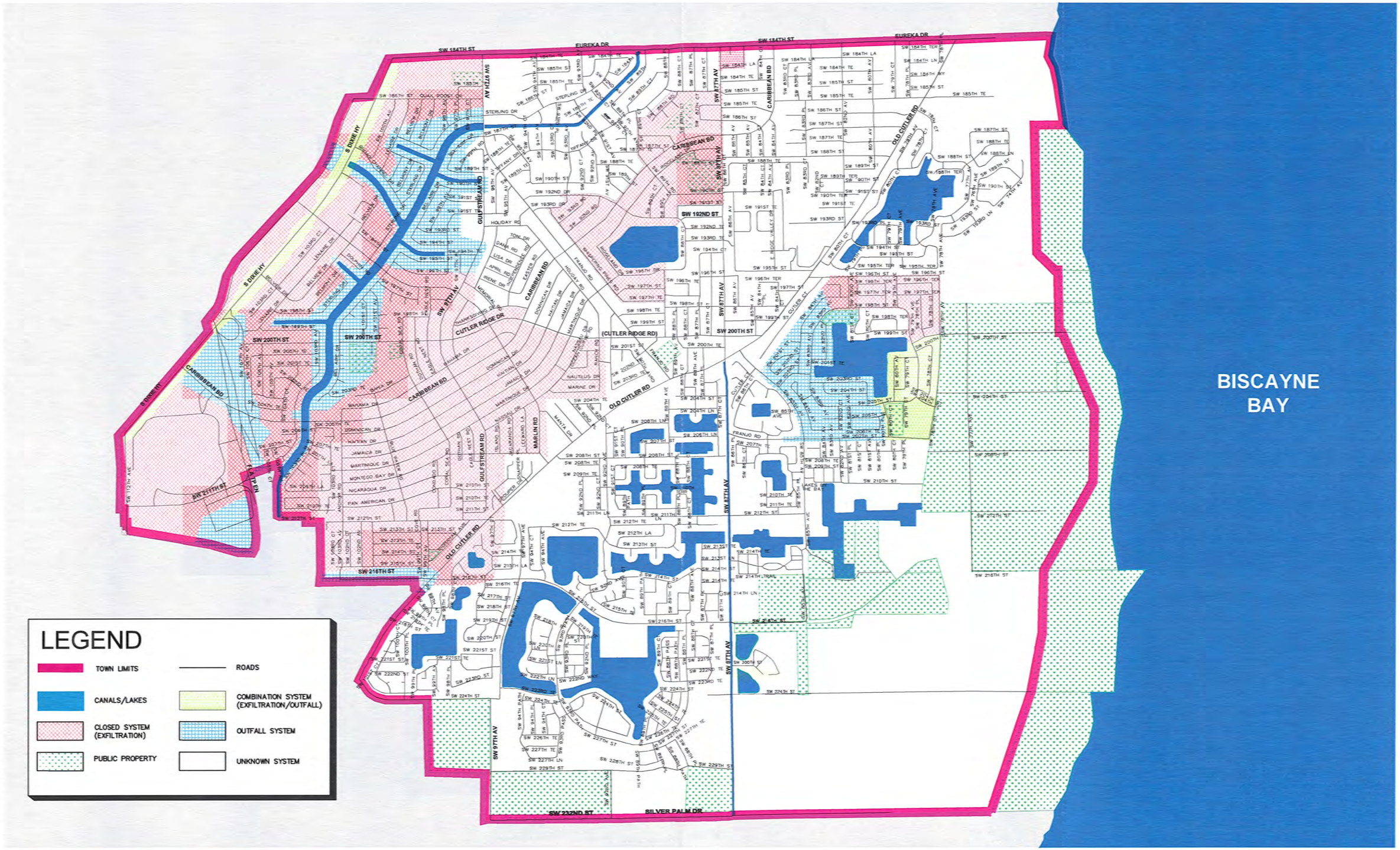
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE STRUCTURE LOCATION MAP (4 / 4)

FIGURE 9



Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 10 DRAINAGE STRUCTURE TYPES.dwg FIG 10 Feb 28, 2008 5:34pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE SYSTEM TYPES

FIGURE 10

B. Visual Assessment of Existing Conditions

Kimley-Horn reviewed drainage complaints reported to DERM, Miami-Dade County Public Works, and the Town of Cutler Bay . *Figure 11* shows the location of these drainage complaint areas.

In order to evaluate existing drainage conditions within the Town, KHA visually assessed roadway flooding conditions during and after rainfall events lasting one hour or more. Locations, where flooding extended across the entire width of the roadway, are noted on *Figure 11*. KHA also evaluated the condition of existing drainage structures within the Town. GIS data provided by DERM was used to map the location of the majority of the public drainage structures within the Town. Approximately 100 of these structures were chosen for field evaluation. The objective in choosing the 100 structures was to provide a wide cross-section of the structures in the Town. The location of the evaluated structures can be seen in *Figure 12*. Photographs and log sheets of the evaluated structures are contained in Appendix A.

Some maintenance-related causes of roadway flooding that were discovered during the drainage structure evaluation are noted below:

Clogged inlets It was noticeable during the visual observation of the drainage structures that some catch basins had debris covering the asphalt apron and the top of the grate that may contribute to inadequate flow of water through systems and localized flooding near structures. In some of the structures, the bottom of the inlet itself was filled with leaves, silt, and other debris. Debris at the bottom of the inlet can find its way into pipes and exfiltration trench, thereby reducing the efficiency of the drainage system.

Blocked drainage outfalls Some of the drainage outfalls pipes appear to have blockages or damage that prevent them from discharging the amount of runoff they were designed to carry. This decreases the ability of the pipes and their respective drainage structures to drain stormwater.

No baffles to protect exfiltration trench from oil and grease deposits. Few drainage structures observed contained pollution retardant baffles to prevent the accumulation of grease, oil, and debris within the trench. Grease and oil accumulation within exfiltration trenches reduces the drainage effectiveness and lifespan of the trench.

Poorly graded/settled asphalt and pavement. Many areas where flooding and ponding were observed showed signs of poorly graded asphalt that did not allow proper flow of stormwater to the catch basins. Other locations showed signs of settling asphalt. This may create low points on roads and driveways that could permit ponding to form.

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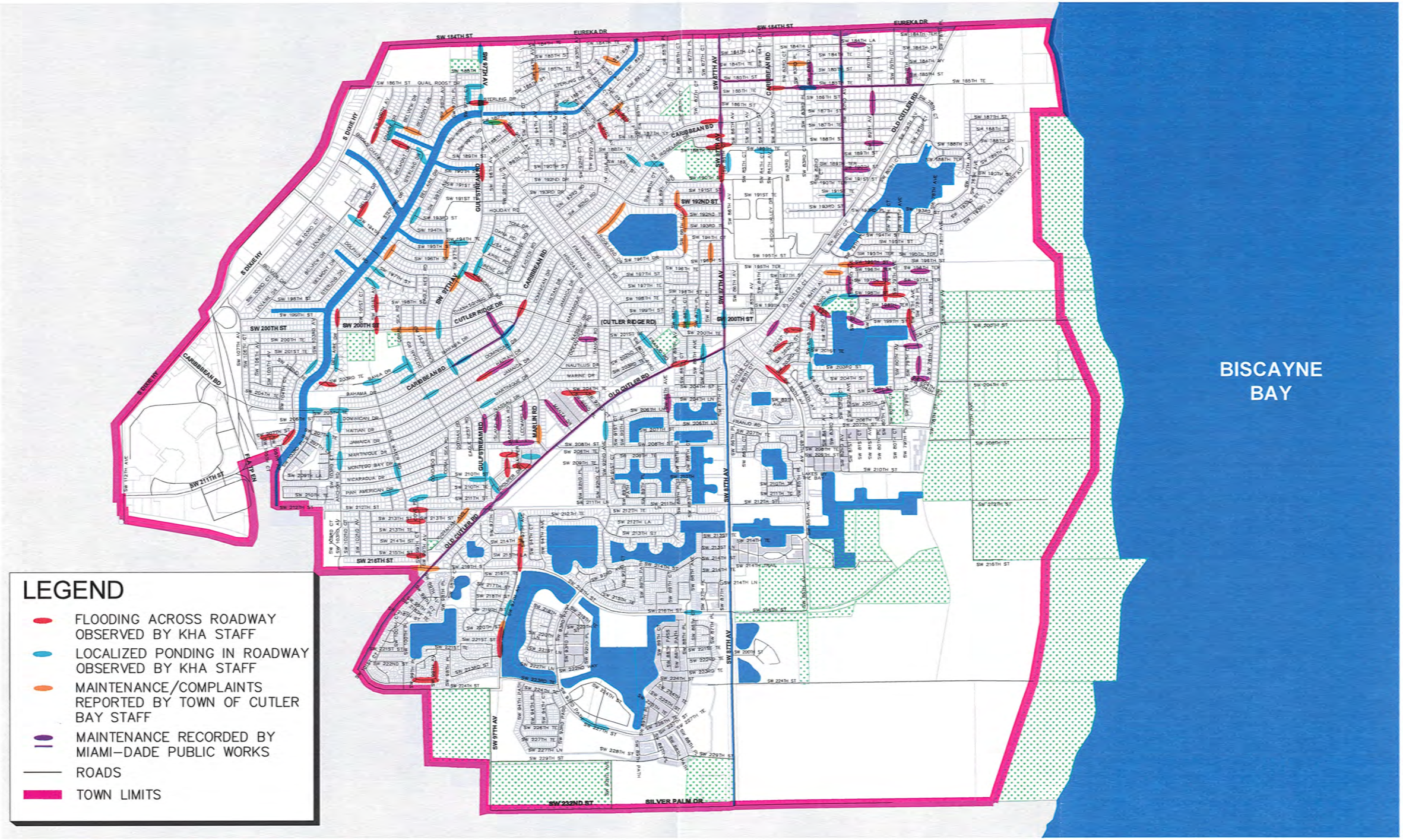

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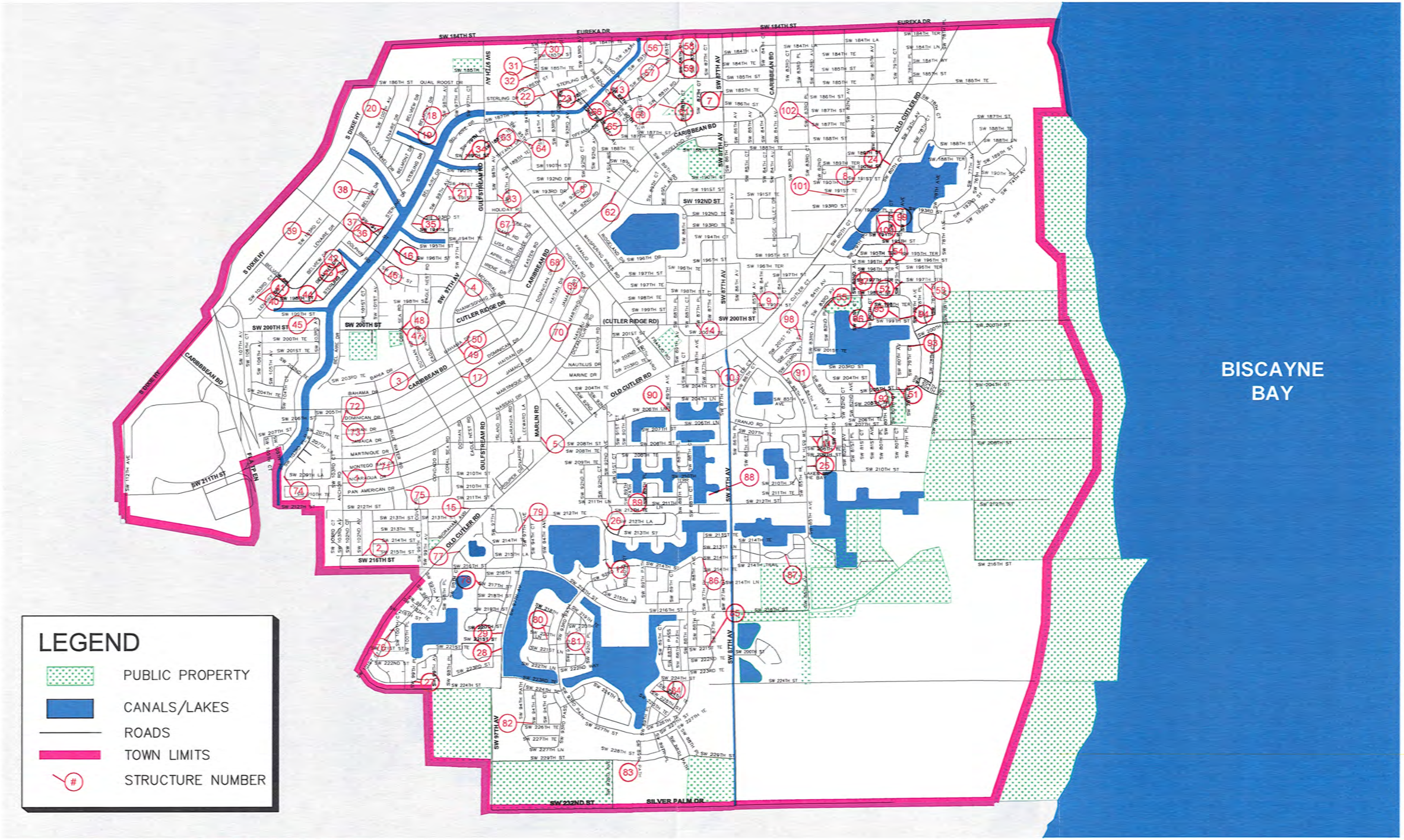
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE DEFICIENCIES MAP

FIGURE 11



Drawing name: H:\043 Jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 12 DRAINAGE STRUCTURE INVENTORY.dwg FIG 12 Feb 28, 2008 5:37pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

DRAINAGE STRUCTURE INVENTORY MAP

FIGURE 12

C. Basin Delineation

The Town of Cutler Bay is located at the junction of three Miami-Dade County Canal Basins: C-100, C-1, and DA-4.

The C-100 Basin portion of the Town is bounded as follows: starting at the intersection of SW 184th Street (Eureka Drive) and SW 97th Avenue (Franjo Road), east on Eureka Drive to Old Cutler Road, southwest along Old Cutler Road to SW 200th Street, west on SW 200th Street to SW 87th Avenue (Galloway Road), then south on Galloway Road to Old Cutler Road, t west southwest on Old Cutler Road to Franjo Road, and then northwest on Franjo Road to Eureka Drive.

The C-1 Basin portion of the Town is bounded as follows: starting at the intersection of Eureka Drive and Franjo Road, west on Eureka Drive to US 1, following the west and south borders of the Town to Galloway Road, north on Galloway Road to Old Cutler Road, west southwest on Old Cutler Road to Franjo Road, and then northwest on Franjo Road to Eureka Drive.

The DA-4 Basin portion of the Town is bounded as follows: starting at the intersection of Eureka Drive and Old Cutler Road, east on Eureka Drive, along the north, east and south borders of the Town to Galloway Road, the north on Galloway Road to SW 200th Street, east on SW 200th Street to Old Cutler Road, and then northeast on Old Cutler Road to Eureka Drive.

The boundaries of these basins are delineated by DERM and SFWMD. There are six major canals that lie within and/or border the Town of Cutler Bay: C-100, C-100B, C-1, C-1N, C-1W, and L-31E. These canals provide three main functions:

- To provide drainage and flood protection for the C-100, C-1N, and DA-4 basins
- To supply water to the basins for irrigation
- To maintain a groundwater table elevation that is adequate near the lower reach of C-100 and to DA-4 in order to prevent saltwater intrusion into local groundwater. Water is supplied to the basins during periods of low natural flow from C-1 by way of S-122 and C-100B and from C-1W by way of S-338.

To more effectively delineate the C-100, C-1, and DA-4 canal basins according to Miami-Dade County's Stormwater Master Plan, DERM divided the drainage basins into drainage sub-basins based on topography, land use, and drainage characteristics. The Town will adopt the boundaries and numbering system of the Miami-Dade County drainage sub-basins that are located within the Town from the C-1 and C-100 basins, although, the County has not delineated such sub-basins for the DA-4 Basin. These Miami-Dade County sub-basins will be designated as drainage basins for the Town of Cutler Bay Stormwater Master Plan. The Town's Basins (County sub-basins and KHA delineated DA-4 sub-basins) will then be further sub-divided into Town sub-basins based on hydrologic characteristics and subdivision boundaries. *Figure 13* is a map showing the location of the Town's Basins and Sub-basins.

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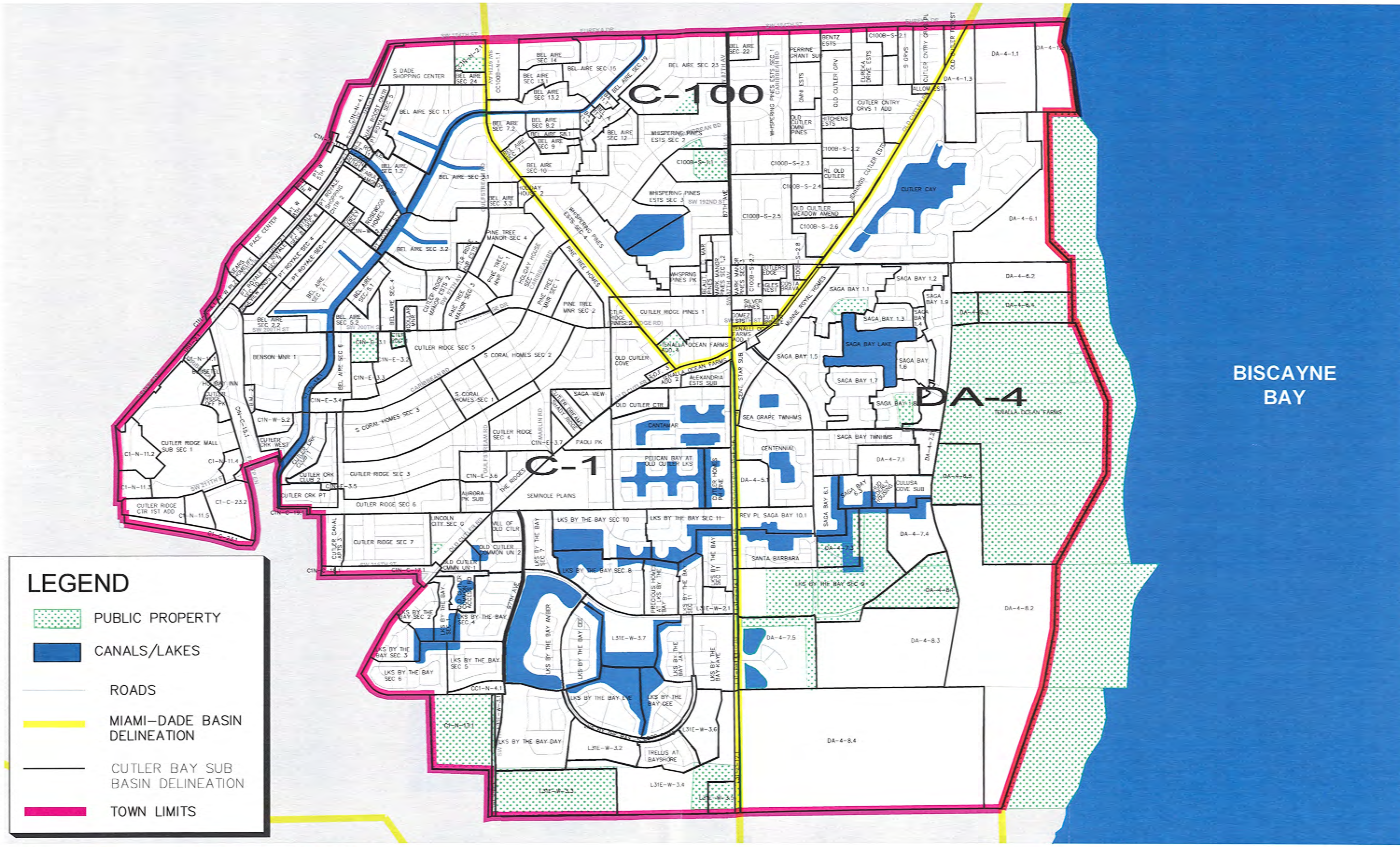
Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 13 CUTLER SUB-BASIN DELINEATION.dwg FIG 13 Feb 28, 2008 5:39pm by: jairo.castro



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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SUB-BASIN DELINEATION MAP

FIGURE 13

D. Basin Prioritization

Based on a review of the drainage deficiencies identified and input from Town staff, 17 drainage sub-basins were selected as a priority for more detailed analysis. The development of the priority sub-basin list was based on several factors including:

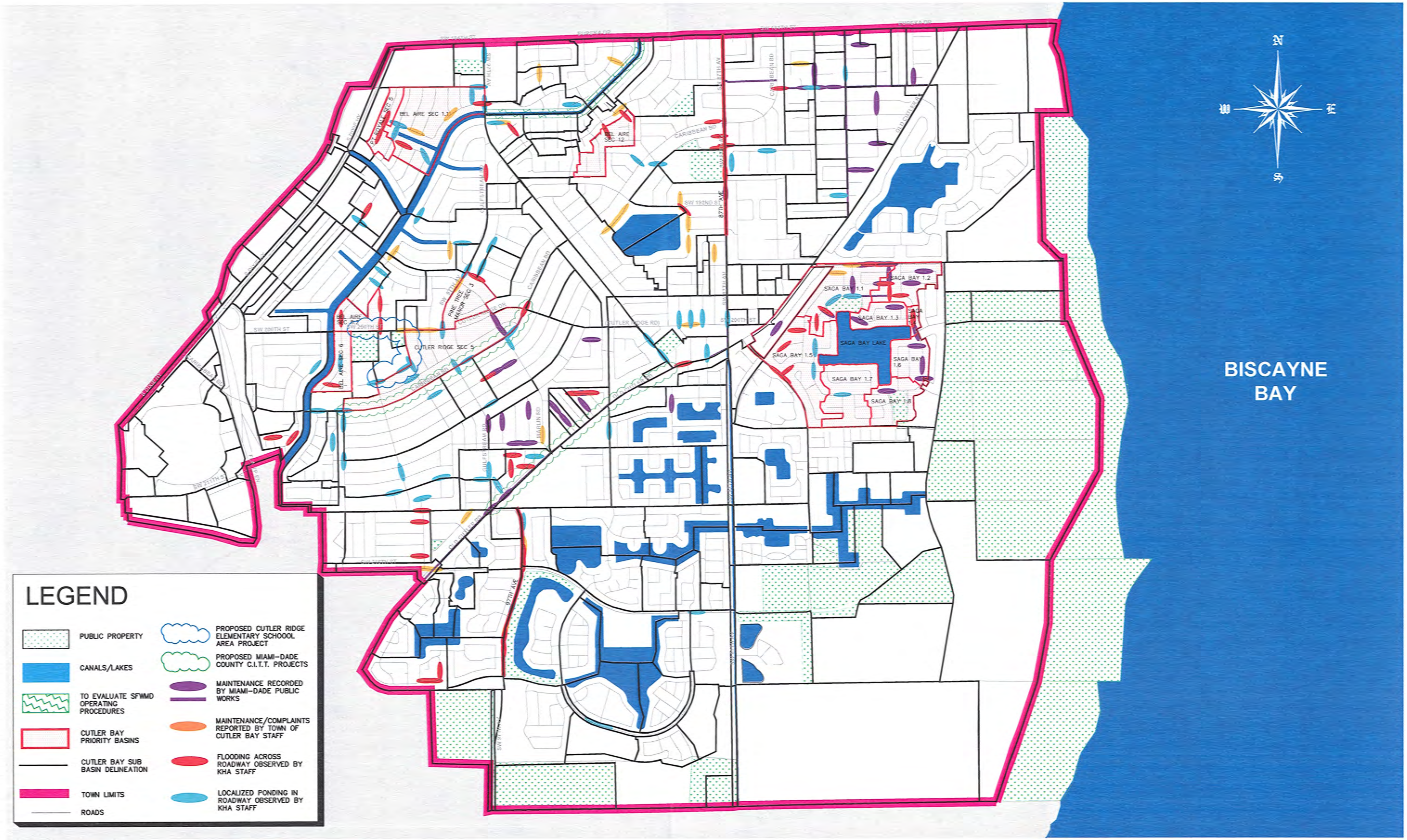
- Magnitude of observed flooding
- Flood complaint records
- Town input
- Condition of existing roadways
- Proximity to other priority sub-basins
- Relative traffic volumes on the affected roadways

The locations of the priority sub-basins are shown in *Figure 14*. The next section of this report will detail the hydraulic and hydrologic analysis of these priority drainage sub-basins and make recommendations for correcting the observed deficiencies. It should be noted that there are three areas with conditions that warrent them as priority sub-basins. They are not included in the list because drainage improvement projects are currently planned. These areas are the two proposed Miami-Dade County C.I.T.T. projects along Caribbean Boulevard and Old Cutler Road and the proposed Cutler Ridge Elementary School area project which will be funded by FDEP grant number LP6819. The location of these projects is shown on *Figure 14*. Two of the priority sub-basins are located within the SW 97th Avenue and SW 87th Avenue right-of-way. Since these two roadways are proposed to remain under Miami-Dade County control, the proposed drainage improvements within these priority sub-basins will be negotiated with Miami-Dade County.

Flood mitigation plans for the priority areas are likely to consist of one or more of the following:

- Constructing additional catch basins and drainage system connectors or exfiltration trench for low points without positive drainage.
- Increasing drainage capacity by adding exfiltration trench or increasing the size of existing pipes. Exfiltration trench consists of a perforated pipe placed underground and surrounded with gravel. The gravel is wrapped in a porous textile cloth that allows water to gradually seep into the surrounding soil. Exfiltration trench is commonly referred to as a French drain. It provides underground water storage in the pores between the gravel. Increased pipe size can allow for greater capacity in the movement of water from one place to another (i.e. from the road to the lake).

Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 14 CUTLER PRIORITY BASINS.dwg FIG 14 Mar 27, 2008 12:12pm by: heather.spencer



Cutler Bay FLORIDA

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

PRIORITY SUB-BASINS

FIGURE 14

- Installing exfiltration trench where none currently exists to provide pre-treatment prior to discharge into lakes. Pretreatment improves the water quality of stormwater runoffs from rain and other areas. The filtration provided by the gravel and geotextile in an exfiltration trench can remove pollutants before the water is allowed to discharge onto a body of water. Federal, state, and county resolutions require this pre-treatment.
- Installing stormwater injection wells to provide increased discharge capacity to the drainage systems. An injection well uses the principle of hydraulic head to inject water deep into the ground. They can be used in areas where discharge to a lake is not available.
- Increased maintenance within the sub-basin. This is a likely recommendation for all areas, but especially those where grates were observed to be covered with leaves, catch basins were full of dirt, leaves, and debris, swales were overgrown, and/or damage to pipes and exfiltration trench was observed.
- Adding baffles and sumps in catch basins to protect exfiltration trench from oil and grease deposits and excess debris and sediment. Oil and grease deposits can block the pores in the gravel and geotextile in an exfiltration trench, decreasing the seepage of water out of the trench and into the surrounding soil. Debris and sediment can also block these pores over time. Baffles protect the trench from oil and grease by forcing water to go under them before entering the pipe. Since oil and grease float, they are prevented from entering the pipe. This depression provides an area where debris and sediment can settle and accumulate instead of entering the pipe system.
- Limited re-grading of roadways to promote flow to existing drainage structures. This is a recommendation that would apply to areas where the roadway has deteriorated or where "birdbaths" (minor low spots) have occurred. The roadway would be "evened out" to eliminate such birdbaths.
- Increasing pervious areas within the right-of-way. A pervious area is land that is not covered with pavement, concrete, or other surfaces that prevent rainfall from soaking into the ground. The opposite of a pervious area is an impervious area. Increasing pervious area while decreasing impervious area allows more rainfall to soak directly into the ground. The increase in pervious areas provides minor reduction in runoff and is typically considered in areas designated for major drainage improvements or pavement resurfacing. This is a likely recommendation in areas where the right-of-way contains more pavement than is necessary for roadways, parking, and sidewalks.

- Increasing swale capacity within the right-of-way. Swales are low pervious areas located outside of the roadway travel lanes in the right-of-way. Swales store runoff from the roadway and allow it to percolate into the soil over time. Swale storage capacity can be expanded by increasing the slope of the sides of the swale and making the overall swale deeper.

IV. DRAINAGE BASIN ANALYSIS

A. Town of Cutler Bay Performance Goals

Prior to modeling and evaluating the priority drainage sub-basins, performance goals were identified. These performance goals represent the minimum stan dards for sub-basin performance. The drainage sub-basins were evaluated based on the following performance goals:

Water Quantity Performance Goals

- Per the Town's Growth Management Plan, where two or more standards impact a specific development, the most restrictive standards shall apply: Post-development runoff shall not exceed the pre-development runoff rate for a 25-year storm event, up to and including an event with a 24-hour duration. Treatment of the runoff from the first 1 inch of rainfall onsite or the first 0.5 inch of runoff, whichever is greater.
- During the five-year return design storm events, flooding in local and collector roadway travel lanes should not exceed the edge of the roadway pavement. This goal is consistent with SFWMD basis of review criteria and Miami-Dade County requirements.
- During the 10-year return design storm event, flooding in roadway travel lanes should be below the crown of the roadway. This standard is the same as the current Miami-Dade County standard for arterial roadways.
- During the 100-year return storm event, flooding should be below the building finish floor elevations. This standard is the same as the current Miami-Dade County standard.

Water Quality Treatment Performance Goals

- Per the Town's Growth Management Plan, Stormwater facilities shall be designed to meet the design and performance standards established in Chapter 62-25, 25.025, F.A.C. as amended with treatment of the first 1 inch of rainfall runoff to meet water quality standards required by Chapter 62-302, 862-302.500, F.A.C., as amended.
- Drainage sub-basins which discharge into lakes or drainage wells should have water quality pre-treatment for the first one-half inch of runoff. This standard is consistent with federal, state and county water quality treatment requirements.

The hydrologic and hydraulic modeling utilized to evaluate whether each priority sub-basin meets the performance goals are based on the data collected and described in previous sections of this report. The following sections of this report describe existing conditions, hydrologic and hydraulic modeling results, potential storm drainage deficiencies and recommended drainage infrastructure improvements for each of the priority sub-basins.

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B. Saga Bay Section 1.1 Sub-basin

Location

Saga Bay Section 1.1 is approximately located north of SW 200th Street, south of SW 196th Street, east of SW 84th Avenue and west of SW 79th Avenue and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 15 shows existing conditions for Saga Bay Section 1.1. The sub-basin consists of approximately 39 acres of existing detached single family development with approximately 6,500 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of interconnected French drains and catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 15.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 5.1 feet to a high of approximately 7.3 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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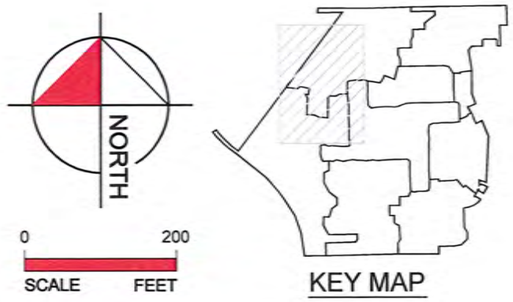


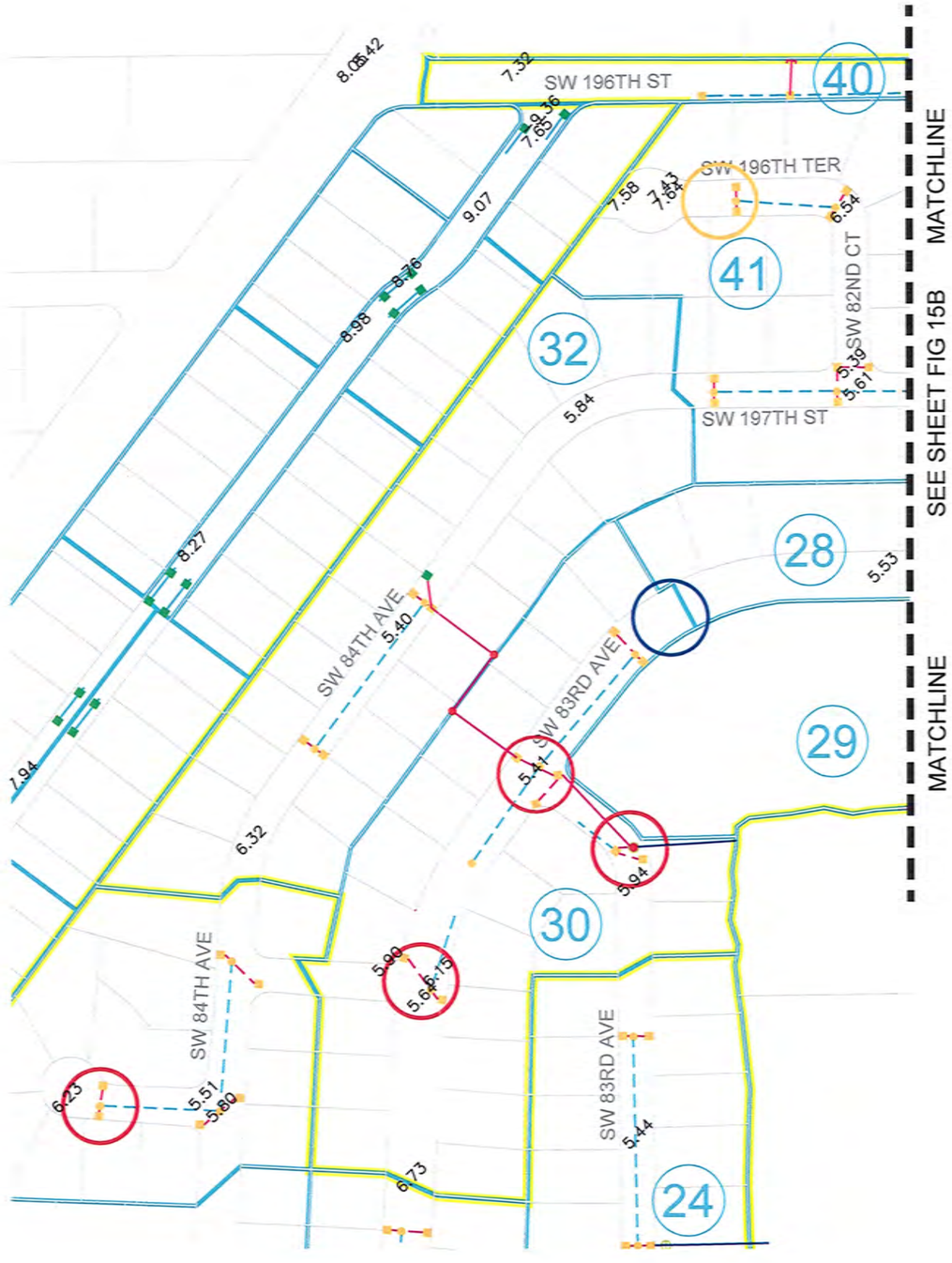
KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 2 CB WITH WEIR STRUCTURE
-REPLACE 12 EXISTING CATCH BASINS
-ADD 12 CATCH BASINS
-ADD 17 MANHOLES
-ADD 1,545 LF 18" HDPE PIPE
-ADD 1,145 LF FRENCH DRAIN



AREA 29 PROPOSED MODIFICATIONS
-NO IMPROVEMENTS PROPOSED

AREA 30 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 3 EXIST. C.B.
-ADD 4 MANHOLES
-ADD 6 CATCH BASINS
-ADD 605 LF OF 18" PIPE
-ADD 260 LF OF FRENCH DRAIN

AREA 32 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 1 CATCH BASINS
-ADD 45 LF OF 18" PIPE
-ADD 245 LF OF FRENCH DRAIN

AREA 41 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. C.B.
-ADD 4 MANHOLES
-ADD 2 CATCH BASINS
-ADD 90 LF OF 18" PIPE
-ADD 220 LF OF FRENCH DRAIN

Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 15A-22.dwg FIG 15A SAGA BAY 1.1 EAST Mar 25, 2008 11:20am by heather.spencer

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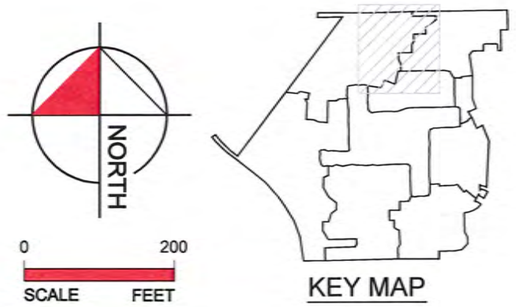
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.1 - EAST SUB-BASIN

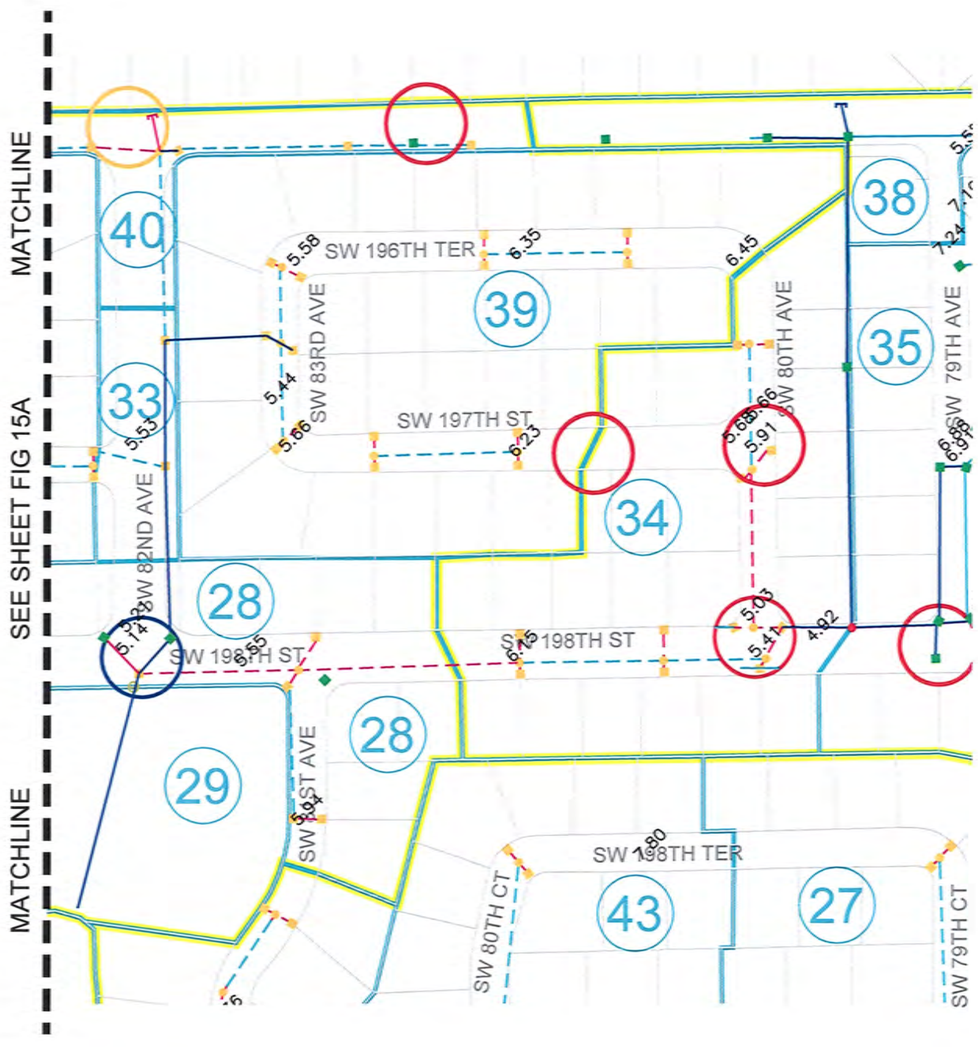
FIGURE 15.A



LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING

- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



AREA 28 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 1 CATCH BASINS
-ADD 575 LF OF 18" PIPE
-ADD 30 LF OF FRENCH DRAIN

AREA 33 PROPOSED MODIFICATIONS
-NO IMPROVEMENTS PROPOSED

AREA 39 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. C.B.
-ADD 5 MANHOLES
-ADD 2 CATCH BASIN
-ADD 125 LF OF 18" PIPE
-ADD 210 LF OF FRENCH DRAIN

AREA 40 PROPOSED MODIFICATIONS
-REPLACE 3 EXIST. C.B.
-ADD 105 LF OF 18" PIPE
-ADD 180 LF OF FRENCH DRAIN

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.1 - WEST SUB-BASIN

FIGURE 15B

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 1. Saga Bay Section 1.1 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
28	*No*	*Yes*	*Yes*	*Yes*	*No*
29	*Yes*	*No*	*No*	*No*	*Yes*
30	*No*	*No*	*Yes*	*Yes*	*No*
32	*No*	*No*	*No*	*Yes*	*Yes*
33	*No*	*Yes*	*Yes*	*Yes*	*No*
39	*No*	*No*	*No*	*Yes*	*Yes*
40	*No*	*No*	*No*	*No*	*No*
41	*No*	*No*	*No*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 15.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 3* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 2. Saga Bay Section 1.1 Sub-basin – Performance Goal Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	23.18	21.48	1.70	92.7%
Total Nitrogen (TN)	182.66	163.48	19.18	89.5%
Total Suspended Solids (TSS)	2189.58	1982.67	206.92	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increasing dissolved oxygen levels and reducing nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 3. Saga Bay Section 1.1 Sub-Basin - Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$53,500	**$54,000**
2	Remove Existing Structure	14	Ea.	$500	**$7,000**
3	Inlet Pavement (7' x 7')	26	Ea.	$800	**$21,000**
4	Swale Inlet (Type C - P Bottom)	24	Ea.	$3,000	**$72,000**
5	Manhole	17	Ea.	$3,500	**$60,000**
6	Inlet Protection	26	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	100	L.F.	$12	**$2,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	1545	L.F.	$50	**$78,000**
10	French Drain	1,145	L.F.	$120	**$138,000**
11	Weir Structure	2	Ea.	$6,000	**$12,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	3,587	S.Y.	$40	**$144,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$26,750	**$27,000**
16	Professional Services	1	L.S.	$80,250	**$81,000**
17	Contingency	1	L.S.	$107,000	**$107,000**
TOTAL					**$800,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

C. Saga Bay Section 1.2 Sub-basin

Location

Saga Bay Section 1.2 is located north of SW 198th Terrace, south of SW 196th Street, east of SW 81st Court and west of SW 78th Avenue and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 16 shows existing conditions for Saga Bay Section 1.2. The sub-basin consists of approximately 23.5 acres of existing detached single family development with approximately 4,800 linear feet of roadway. The drainage system in this sub-basin consists of isolated French drains and catch basins. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway in the roadway in multiple locations within this sub-basin. The location of these observed deficiencies can be seen in *Figure 16.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 5.0 feet to a high of approximately 9.0 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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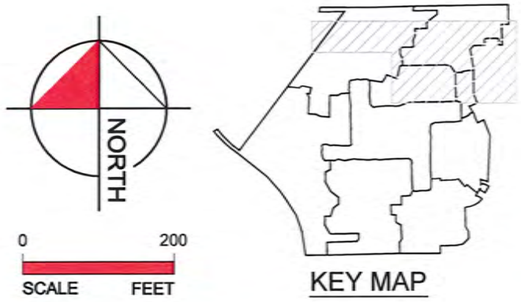
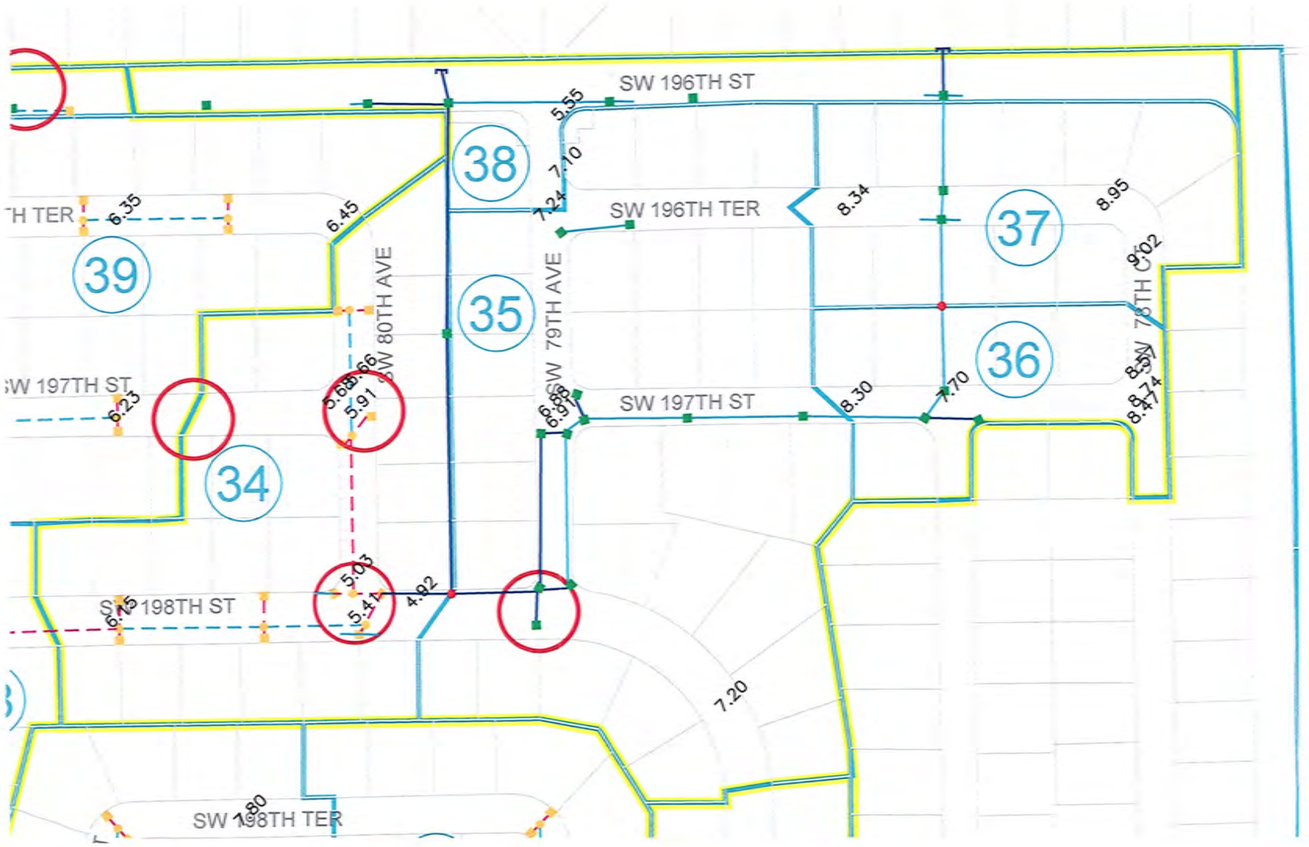


KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



AREA 34 PROPOSED MODIFICATIONS
-REPLACE 3 EXIST. C.B.
-ADD 6 MANHOLES
-ADD 6 CATCH BASIN
-ADD 725 LF OF 18" PIPE
-ADD 250 LF OF FRENCH DRAIN

AREA 35 PROPOSED MODIFICATIONS
-NO IMPROVEMENTS PROPOSED

AREA 36 PROPOSED MODIFICATIONS
-NO IMPROVMENTS PROPOSED

AREA 37 PROPOSED MODIFICATIONS
-NO IMPROVEMENTS PROPOSED

AREA 38 PROPOSED MODIFICATIONS
-NO IMPROVEMENTS PROPOSED

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 3 EXIST. C.B.
-ADD 6 MANHOLES
-ADD 6 CATCH BASIN
-ADD 725 LF OF 18" PIPE
-ADD 250 LF OF FRENCH DRAIN

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.2 SUB-BASIN

FIGURE 16

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 4. Saga Bay Section 1.2 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
34	*No*	*No*	*No*	*Yes*	*No*
35	*Yes*	*No*	*Yes*	*Yes*	*No*
36	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
37	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
38	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales and French drains is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: None of the areas within this drainage sub-basin connect to an outfall to the lake.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 16.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and/or manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 6* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 5. Saga Bay Section 1.2 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	14.54	13.47	1.07	92.7%
Total Nitrogen (TN)	114.57	102.54	12.03	89.5%
Total Suspended Solids (TSS)	1373.33	1243.55	129.78	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 6. Saga Bay 1.2 Sub-Basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$17,800	**$18,000**
2	Remove Existing Structure	3	Ea.	$500	**$2,000**
3	Inlet Pavement (7' x 7')	9	Ea.	$800	**$8,000**
4	Swale Inlet (Type C - P Bottom)	9	Ea.	$3,000	**$27,000**
5	Manhole	6	Ea.	$3,500	**$21,000**
6	Inlet Protection	9	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	0	L.F.	$12	**$0**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	725	L.F.	$50	**$37,000**
10	French Drain	250	L.F.	$120	**$30,000**
11	Weir Structure	0	Ea.	$6,000	**$0**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	1,300	S.Y.	$40	**$52,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$8,900	**$9,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$35,600	**$36,000**
TOTAL					**$290,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

D. Saga Bay Section 1.3 Sub-basin

Location

Saga Bay Section 1.3 is located north of SW 200th Terrace, south of SW 198th Street, east of SW 82th Avenue and west of SW 79th Avenue and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 17 shows existing conditions for Saga Bay Section 1.3. The sub-basin consists of approximately 14.2 acres of existing detached single family development with approximately 2,450 linear feet of roadway. The drainage system consists of catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

Miami-Dade County has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 17.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 5.3 feet to a high of approximately 7.8 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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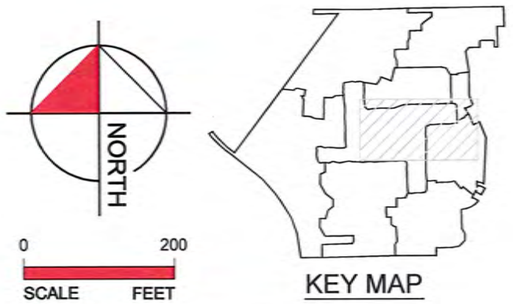
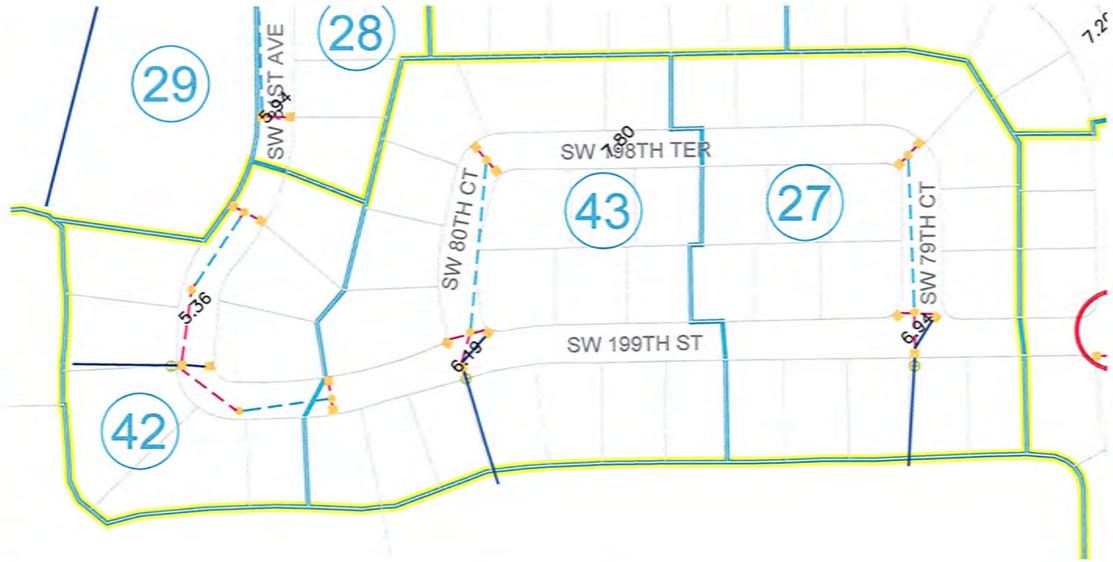


KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



SAGA BAY 1.3

AREA 27 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 2 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 110 LF OF 18" PIPE
-ADD 110 LF OF FRENCH DRAIN

AREA 42 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 280 LF OF 18" PIPE
-ADD 245 LF OF FRENCH DRAIN

AREA 43 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 2 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 55 LF OF 18" PIPE
-ADD 180 LF OF FRENCH DRAIN

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 3 MH WITH WEIR STRUCTURES
-REPLACE 5 EXISTING CATCH BASINS
-ADD 6 MANHOLES
-ADD 445 LF 18" HDPE PIPE
-ADD 535 LF FRENCH DRAIN

SAGA BAY 1.4

AREA 26 PROPOSED MODIFICATIONS
-REPLACE 1 M.H. WITH WEIR STRUCTURE
-ADD 2 MANHOLES
-ADD 2 CATCH BASIN
-ADD 230 LF OF 18" PIPE
-ADD 125 LF OF FRENCH DRAIN

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 1 M.H. WITH WEIR STRUCTURE
-ADD 2 MANHOLES
-ADD 2 CATCH BASINS
-ADD 230 LF 18" HDPE PIPE
-ADD 125 LF FRENCH DRAIN

Drawing name: H:\043 jobs\04314500-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 15A-22.dwg FIG 17 SAGA BAY 1.3 & 1.4 Mar 25, 2008 11:23am by: heather.spencer

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.3 AND 1.4 SUB-BASIN

FIGURE 17

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 7. Saga Bay Section 1.3 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
27	*No*	*No*	*No*	*Yes*	*Yes*
42	*No*	*No*	*No*	*No*	*Yes*
43	*No*	*No*	*No*	*Yes*	*Yes*

Storm Drainage Deficiencies

Maintenance: Basins in this sub-basin may to be filled with debris and sediment blocking or highly restricting flow. The outfalls may have been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins and pipe.

Capital Improvements: Install the additional infrastructure depicted in *Figure 17.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to

ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 9* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 8. Saga Bay Section 1.3 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	8.44	7.82	0.62	92.7%
Total Nitrogen (TN)	66.50	59.52	6.98	89.5%
Total Suspended Solids (TSS)	797.18	721.85	75.33	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 9. Saga Bay 1.3 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$55,350	**$56,000**
2	Remove Existing Structure	8	Ea.	$500	**$4,000**
3	Inlet Pavement (7' x 7')	8	Ea.	$800	**$7,000**
4	Swale Inlet (Type C - P Bottom)	5	Ea.	$3,000	**$15,000**
5	Manhole	6	Ea.	$3,500	**$21,000**
6	Inlet Protection	8	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	150	L.F.	$12	**$2,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	445	L.F.	$50	**$23,000**
10	French Drain	535	L.F.	$120	**$65,000**
11	Weir Structure	3	Ea.	$6,000	**$18,000**
12	Concrete Endwall	3	Ea.	$3,000	**$9,000**
13	Roadway Restoration	1,307	S.Y.	$40	**$53,000**
14	Regrading Swale	1,000	S.Y.	$10	**$10,000**
15	Existing Utility Adjustments	1	L.S.	$18,240	**$19,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Roadway Resurfacing - 1-inch Asphalt	6,500	SY	$9	**$59,000**
18	Right-of-way Landscaping	6,500	SY	$2	**$13,000**
19	Contingency	1	L.S.	$73,800	**$74,000**
TOTAL					**$500,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Costs include resurfacing and landscape improvements associated with the Roadway CIP.

E. Saga Bay Section 1.4 Sub-basin

Location

Saga Bay Section 1.4 is located north of SW 200th Terrace, south of SW 198th Street, east of SW 79th Court and west of SW 78th Place and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 18 shows existing conditions for Saga Bay Section 1.4. The sub-basin consists of approximately 3.5 acres of existing detached single family development with approximately 800 linear feet of roadway. The drainage system consists of catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway within this sub-basin. The location of these observed deficiencies can be seen in *Figure 18.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 6.2 feet to a high of approximately 7.0 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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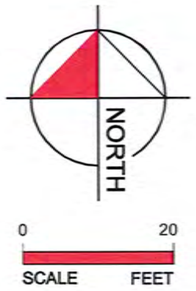
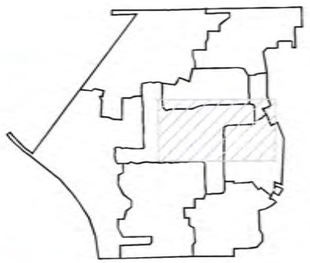
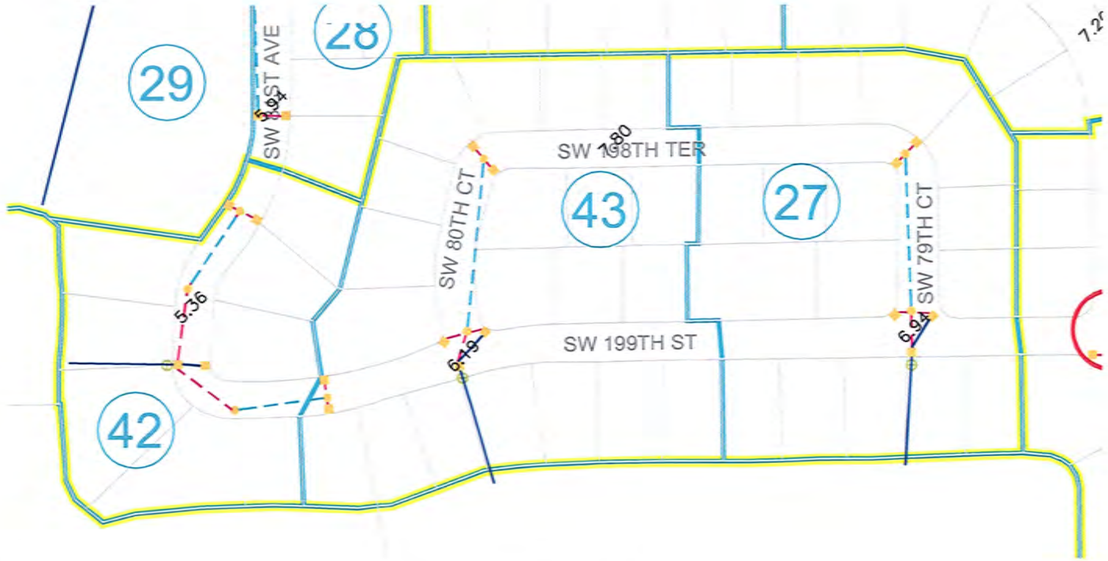




KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



SAGA BAY 1.3

SAGA BAY 1.4

AREA 26 PROPOSED MODIFICATIONS
-REPLACE 1 M.H. WITH WEIR STRUCTURE
-ADD 2 MANHOLES
-ADD 2 CATCH BASIN
-ADD 230 LF OF 18" PIPE
-ADD 125 LF OF FRENCH DRAIN

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 1 M.H. WITH WEIR STRUCTURE
-ADD 2 MANHOLES
-ADD 2 CATCH BASINS
-ADD 230 LF 18" HDPE PIPE
-ADD 125 LF FRENCH DRAIN

AREA 27 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 2 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 110 LF OF 18" PIPE
-ADD 110 LF OF FRENCH DRAIN

AREA 42 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 280 LF OF 18" PIPE
-ADD 245 LF OF FRENCH DRAIN

AREA 43 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 2 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 55 LF OF 18" PIPE
-ADD 180 LF OF FRENCH DRAIN

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 3 MH WITH WEIR STRUCTURES
-REPLACE 5 EXISTING CATCH BASINS
-ADD 6 MANHOLES
-ADD 445 LF 18" HDPE PIPE
-ADD 535 LF FRENCH DRAIN

Drawing name: H:\...\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTY\FIG 15A-22.dwg FIG 18 SAGA BA & 1.4 Mar 25, 2008 11:38am by: heather.spencer

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.3 AND 1.4 SUB-BASIN

FIGURE 18

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 10. Saga Bay Section 1.4 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
26	*No*	*No*	*No*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: The basin in this sub-basin may be filled with debris and sediment blocking or highly restricting flow. The outfall may have been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales and outfall is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from the catch basin and pipe.

Capital Improvements: Install the additional infrastructure depicted in *Figure 18.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and/or manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to

ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 12* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 11. Saga Bay Section 1.4 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	2.11	1.95	0.15	92.7%
Total Nitrogen (TN)	16.61	14.87	1.74	89.5%
Total Suspended Solids (TSS)	199.16	180.33	18.82	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 12. Saga Bay 1.4 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$7,100	**$8,000**
2	Remove Existing Structure	1	Ea.	$500	**$1,000**
3	Inlet Pavement (7' x 7')	3	Ea.	$800	**$3,000**
4	Swale Inlet (Type C - P Bottom)	2	Ea.	$3,000	**$6,000**
5	Manhole	2	Ea.	$3,500	**$7,000**
6	Inlet Protection	3	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	50	L.F.	$12	**$1,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	230	L.F.	$50	**$12,000**
10	French Drain (18" HDPE Pipe)	125	L.F.	$120	**$15,000**
11	Weir Structure	1	Ea.	$6,000	**$6,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	473	S.Y.	$40	**$19,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$3,550	**$4,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$14,200	**$15,000**
TOTAL					**$150,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

F. Saga Bay Section 1.5 Sub-basin

Location

Saga Bay Section 1.5 is located north of Franjo Road (SW 207th Street), south of SW 199th Street, east of Old Cutler Road and west of SW 82nd Court and is part of the DA-4-4 Basin.

Existing and Future Conditions

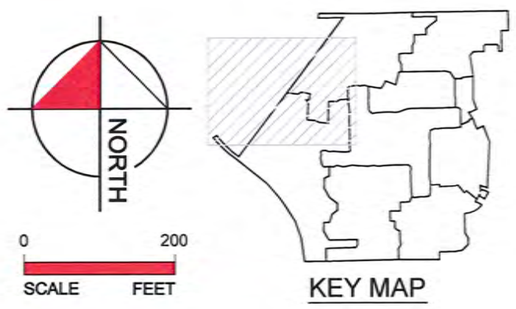
Figure 19 shows existing conditions for Saga Bay Section 1.5. The sub-basin consists of approximately 48.4acres of existing detached single family development with approximately 8,700 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of interconnected French drains and catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. The location of these observed deficiencies can be seen in *Figure 19*. The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 4.7 feet to a high of approximately 7.2 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

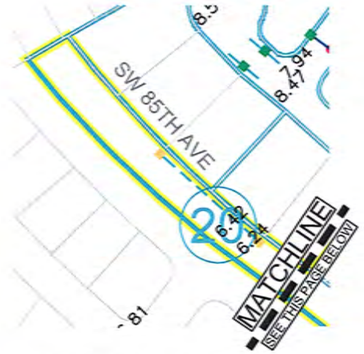
Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.



LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



AREA 20 PROP. MODIFICATIONS
-ADD 2 CATCH BASINS
-ADD 100 LF OF 18" HDPE PIPE
-ADD 25 LF OF FRENCH DRAIN

AREA 21 PROP. MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-REPLACE 1 EXIST. MANHOLE
-ADD 2 CATCH BASINS
-ADD 3 MANHOLES
-ADD 195 LF OF 18" HDPE PIPE
-ADD 500 LF OF FRENCH DRAIN

AREA 22 PROP. MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 40 LF OF 18" HDPE PIPE
-ADD 200 LF OF FRENCH DRAIN

AREA 23 PROP. MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-ADD 3 CATCH BASINS
-ADD 3 MANHOLES
-ADD 235 LF OF 18" HDPE PIPE
-ADD 225 LF OF FRENCH DRAIN

AREA 24 PROP. MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 45 LF OF 18" HDPE PIPE
-ADD 200 LF OF FRENCH DRAIN

AREA 31 PROP. MODIFICATIONS
-ADD 2 MANHOLES
-ADD 2 CATCH BASINS
-ADD 45 LF OF 18" HDPE PIPE
-ADD 160 LF OF FRENCH DRAIN

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 2 C.B. WITH WEIR STRUCTURES
-REPLACE 5 EXISTING CATCH BASINS
-REPLACE 1 EXISTING MANHOLES
-ADD 12 MANHOLES
-ADD 9 CATCHBASINS
-ADD 660LF 18" PIPE
-ADD 1,310 LF FRENCH DRAIN

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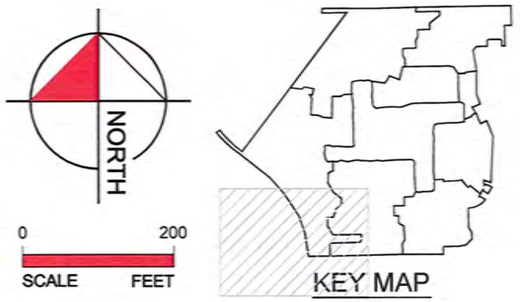
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.5 - NORTH SUB-BASIN

FIGURE 19A

Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 19A-22.dwg FIG 19A SAGA BAY 1.5 NORTH Mar 25, 2008 11:24am by: heather.spencer



LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING

AREA NUMBER

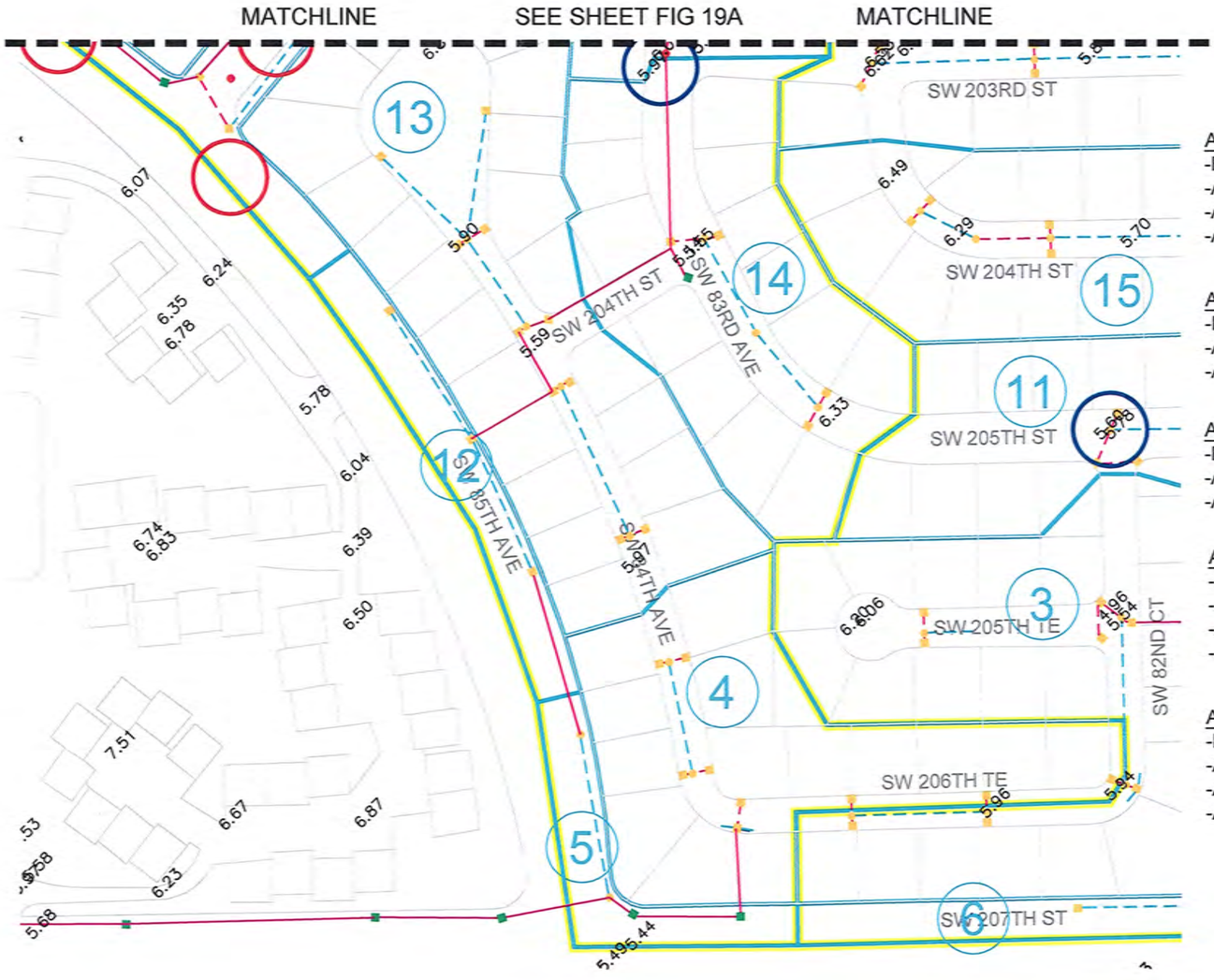
KHA OBSERVED PONDING

KHA OBSERVED FLOODING

TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 9 EXISTING CATCH BASINS
-REPLACE 2 EXISTING MANHOLES
-ADD 9 MANHOLES
-ADD 540 LF 18" PIPE
-ADD 865 LF FRENCH DRAIN



AREA 4 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST CATCH BASIN
-ADD 3 MANHOLES
-ADD 70 LF OF 18" HDPE PIPE
-ADD 230 LF OF FRENCH DRAIN

AREA 5 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. MANHOLES
-ADD 290 LF OF 18" HDPE PIPE
-ADD 50 LF OF FRENCH DRAIN

AREA 12 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-ADD 35 LF OF 18" HDPE PIPE
-ADD 75 LF OF FRENCH DRAIN

AREA 13 PROPOSED MODIFICATIONS
-REPLACE 4 EXIST. CATCH BASINS
-ADD 4 MANHOLES
-ADD 90 LF OF 18" HDPE PIPE
-ADD 310 LF OF FRENCH DRAIN

AREA 14 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 55 LF OF 18" HDPE PIPE
-ADD 200 LF OF FRENCH DRAIN

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.5 - SOUTH SUB-BASIN

FIGURE 19B

Table 13. Saga Bay Section 1.5 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
4	*No*	*No*	*No*	*No*	*Yes*
5	*No*	*No*	*No*	*Yes*	*Yes*
12	*No*	*No*	*No*	*Yes*	*Yes*
13	*No*	*No*	*No*	*Yes*	*Yes*
14	*No*	*No*	*No*	*Yes*	*No*
21	*No*	*No*	*No*	*No*	*No*
22	*No*	*No*	*No*	*No*	*No*
23	*No*	*No*	*No*	*Yes*	*No*
24	*No*	*No*	*No*	*Yes*	*Yes*
31	*No*	*No*	*No*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and/or outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not connect to an outfall.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 19.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to

ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 15* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 14. Saga Bay Section 1.5 Sub-basin – Pollutant Loading Analysis

Pollutant	**Existing Load (kg/yr)**	**Reduction (kg/yr)**	**Proposed Load (kg/yr)**	**Percentage Reduction**
Total Phosphorous (TP)	28.77	26.66	2.11	92.7%
Total Nitrogen (TN)	226.70	202.90	23.80	89.5%
Total Suspended Solids (TSS)	2717.48	2460.68	256.80	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 15. Saga Bay 1.5 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$68,800	**$69,000**
2	Remove Existing Structure	18	Ea.	$500	**$9,000**
3	Inlet Pavement (7' x 7')	26	Ea.	$800	**$21,000**
4	Swale Inlet (Type C - P Bottom)	25	Ea.	$3,000	**$75,000**
5	Manhole	21	Ea.	$3,500	**$74,000**
6	Inlet Protection	26	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	50	L.F.	$12	**$1,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	1200	L.F.	$50	**$60,000**
10	French Drain (18" HDPE Pipe)	2,175	L.F.	$120	**$261,000**
11	Weir Structure	1	Ea.	$6,000	**$6,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	4,500	S.Y.	$40	**$180,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$34,400	**$35,000**
16	Professional Services	1	L.S.	$103,200	**$104,000**
17	Contingency	1	L.S.	$137,600	**$138,000**
TOTAL					**$1,030,000**

Notes

1. Costs do not include inflation or interest costs. See Table 19 for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

G. Saga Bay Section 1.6 Sub-basin

Location

Saga Bay Section 1.6 is located north of SW 205th Street, south of SW 200th Street, east of SW 80th Court and west of SW 78th Court and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 20 shows existing conditions for Saga Bay Section 1.6. The sub-basin consists of approximately 18 acres of existing detached single family development with approximately 3,400 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of interconnected French drains and catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 20.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 5.5 feet to a high of approximately 10.0 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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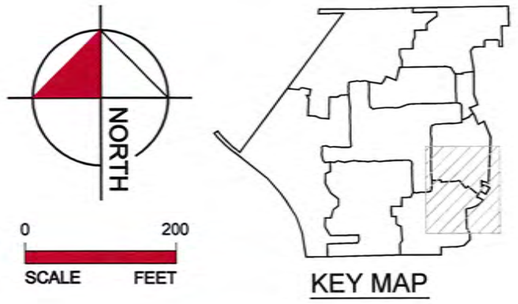

KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 2 CB WITH WEIR STRUCTURES
-REPLACE 3 EXISTING CATCH BASINS
-ADD 4 MANHOLES
-ADD 60 LF 18" HDPE PIPE
-ADD 210 LF FRENCH DRAIN

AREA 18 PROPOSED MODIFICATIONS

-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 20 LF OF 18" PIPE
-ADD 115 LF OF FRENCH DRAIN

AREA 19 PROPOSED MODIFICATIONS

-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 2 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 40 LF OF 18" PIPE
-ADD 95 LF OF FRENCH DRAIN

Drawing name: H:\043 jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 15A-22.dwg FIG 20 SAGA BAY 1.6 Mar 25, 2008 11:29am by: heather.spencer

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.6 SUB-BASIN

FIGURE 20

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table16. Saga Bay Section 1.6 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
18	*No*	*No*	*No*	*Yes*	*Yes*
19	*No*	*No*	*No*	*No*	*No*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 20.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to

ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 18* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 17. Saga Bay Section 1.6 Sub-basin – Pollutant Loading Analysis

Pollutant	**Existing Load (kg/yr)**	**Reduction (kg/yr)**	**Proposed Load (kg/yr)**	**Percentage Reduction**
Total Phosphorous (TP)	10.70	9.91	0.79	92.7%
Total Nitrogen (TN)	84.29	75.44	8.85	89.5%
Total Suspended Solids (TSS)	1010.36	914.88	95.48	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 18. Saga Bay 1.6 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$8,900	**$9,000**
2	Remove Existing Structure	5	Ea.	$500	**$3,000**
3	Inlet Pavement (7' x 7')	5	Ea.	$800	**$4,000**
4	Swale Inlet (Type C - P Bottom)	3	Ea.	$3,000	**$9,000**
5	Manhole	4	Ea.	$3,500	**$14,000**
6	Inlet Protection	5	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	100	L.F.	$12	**$2,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	60	L.F.	$50	**$3,000**
10	French Drain (18" HDPE Pipe)	210	L.F.	$120	**$26,000**
11	Weir Structure	2	Ea.	$6,000	**$12,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	360	S.Y.	$40	**$15,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$4,450	**$5,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$17,800	**$18,000**
TOTAL					**$170,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

H. Saga Bay Section 1.7 Sub-basin

Location

Saga Bay Section 1.7 is located north of Franjo Road (SW 207^{h} Street), south of SW 202th Street, east of SW 83rd Avenue and west of SW 80th Place and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 21 shows existing conditions for Saga Bay Section 1.7. The sub-basin consists of approximately 33.4 acres of existing detached single family development with approximately 7,200 linear feet of roadway. The drainage system consists of catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed localized ponding in the roadway within this sub-basin. The location of the observed deficiencies can be seen in *Figure 21.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 4.9 feet to a high of approximately 6.6 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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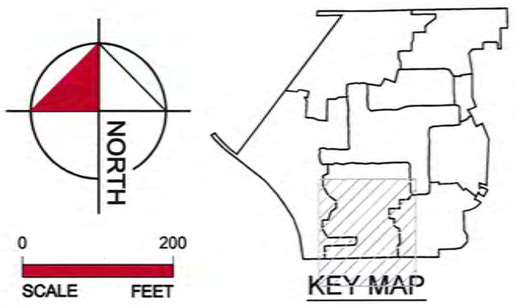


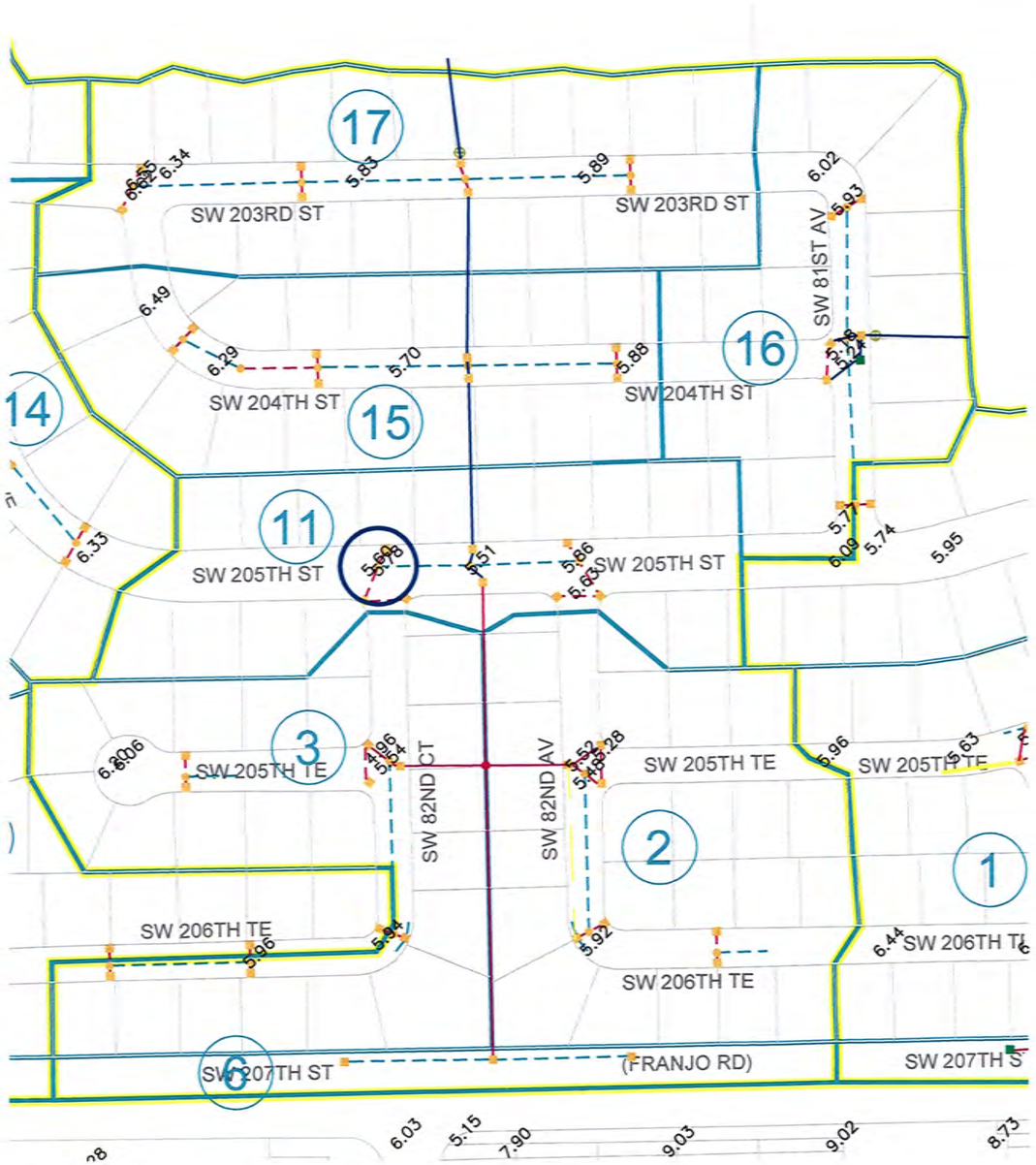
LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING

- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 2 C.B. WITH WEIR STRUCTURES
-REPLACE 15 EXISTING CATCH BASINS
-REPLACE 1 EXISTING MANHOLE
-ADD 13 MANHOLES
-ADD 3 CATCH BASINS
-ADD 610 LF 18" PIPE
-ADD 1,400 LF FRENCH DRAIN



AREA 2 PROPOSED MODIFICATIONS
-REPLACE 3 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 65 LF OF 18" PIPE
-ADD 220 LF OF FRENCH DRAIN

AREA 3 PROPOSED MODIFICATIONS
-REPLACE 3 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 110 LF OF 18" PIPE
-ADD 230 LF OF FRENCH DRAIN

AREA 6 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASIN
-ADD 1 MANHOLE
-ADD 20 LF OF 18" PIPE
-ADD 85 LF OF FRENCH DRAIN

AREA 11 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-REPLACE 1 EXIST. MANHOLE
-ADD 2 MANHOLES
-ADD 3 CATCH BASINS
-ADD 200 LF OF 18" PIPE
-ADD 190 LF OF FRENCH DRAIN

AREA 15 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 45 LF OF 18" PIPE
-ADD 210 LF OF FRENCH DRAIN

AREA 16 PROPOSED MODIFICATIONS
-REPLACE 1 C.B. WITH WEIR STRUCTURE
-REPLACE 3 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 115 LF OF 18" PIPE
-ADD 205 LF OF FRENCH DRAIN

AREA 17 PROPOSED MODIFICATIONS
-REPLACE 1 C.B WITH WEIR STRUCTURE
-REPLACE 1 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 55 LF OF 15" PIPE
-ADD 260 LF OF FRENCH DRAIN

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.7 SUB-BASIN

FIGURE 21

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 19. Saga Bay Section 1.7 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
2	*No*	*No*	*No*	*No*	*Yes*
3	*No*	*No*	*No*	*No*	*Yes*
6	*No*	*No*	*No*	*Yes*	*Yes*
11	*No*	*No*	*No*	*Yes*	*No*
15	*No*	*No*	*No*	*Yes*	*Yes*
16	*No*	*No*	*No*	*No*	*Yes*
17	*No*	*No*	*No*	*No*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin may be filled with debris and sediment blocking or highly restricting flow. The outfalls may have been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins and pipe.

Capital Improvements: Install the additional infrastructure depicted in *Figure 21.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed

prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 21* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 20. Saga Bay Section 1.7 Sub-basin – Pollutant Loading Analysis

Pollutant	**Existing Load (kg/yr)**	**Reduction (kg/yr)**	**Proposed Load (kg/yr)**	**Percentage Reduction**
Total Phosphorous (TP)	19.85	18.39	1.46	92.7%
Total Nitrogen (TN)	156.41	139.98	16.42	89.5%
Total Suspended Solids (TSS)	1874.86	1697.69	177.17	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 21. Saga Bay 1.7 Sub-basin Capital Improvements

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$44,700	**$45,000**
2	Remove Existing Structure	18	Ea.	$500	**$9,000**
3	Inlet Pavement (7' x 7')	20	Ea.	$800	**$16,000**
4	Swale Inlet (Type C - P Bottom)	18	Ea.	$3,000	**$54,000**
5	Manhole	13	Ea.	$3,500	**$46,000**
6	Inlet Protection	20	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	100	L.F.	$12	**$2,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	610	L.F.	$50	**$31,000**
10	French Drain (18" HDPE Pipe)	1,400	L.F.	$120	**$168,000**
11	Weir Structure	2	Ea.	$6,000	**$12,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	2,680	S.Y.	$40	**$108,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$22,350	**$23,000**
16	Professional Services	1	L.S.	$67,050	**$68,000**
17	Contingency	1	L.S.	$89,400	**$90,000**
TOTAL					**$670,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

I. Saga Bay Section 1.8 Sub-basin

Location

Saga Bay Section 1.8 is located north of Franjo Road (SW 207th Street), south of SW 203rd Street, east of SW 81st Court and west of SW 78th Court and is part of the DA-4-4 Basin.

Existing and Future Conditions

Figure 22 shows existing conditions for Saga Bay Section 1.8. The sub-basin consists of approximately 22.4 acres of existing detached single family development with approximately 4,300 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of interconnected French drains and catch basins with pipe connections to outfalls into the Saga Bay Lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway within this sub-basin. The location of these observed deficiencies can be seen in *Figure 22.* The sub-basin area was modeled together with the other sub-basins within the Saga Bay area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 4.9 feet to a high of approximately 10.0 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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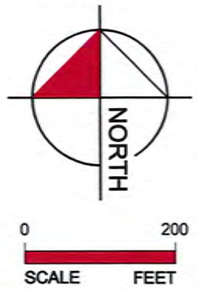
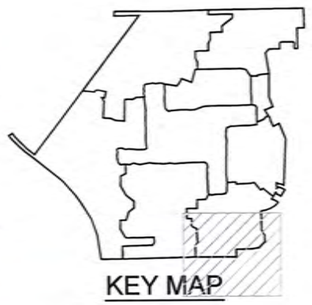
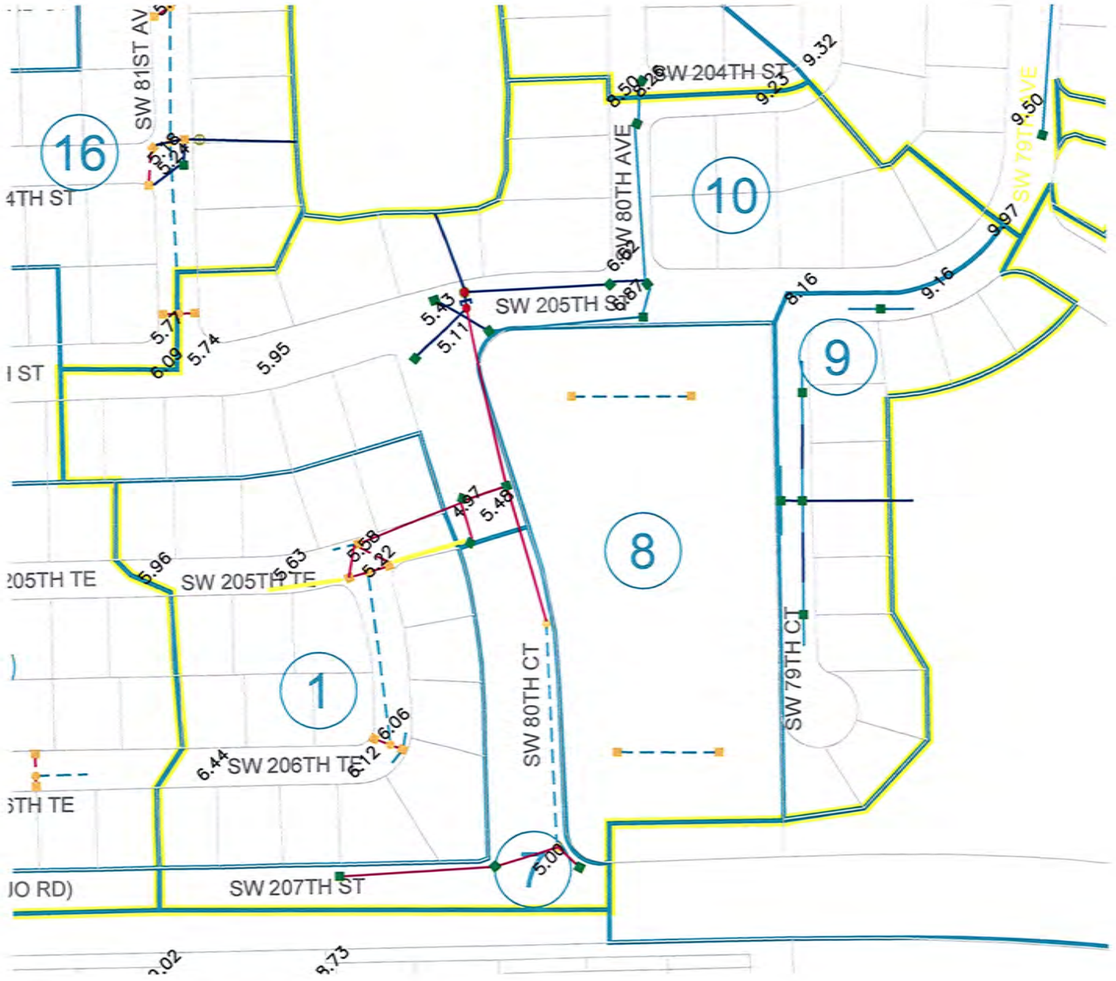




LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



AREA 1 PROPOSED MODIFICATIONS
-REPLACE 3 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 110 LF OF 18" HDPE PIPE
-ADD 125 LF OF FRENCH DRAIN

AREA 7 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CURB INLET
-REPLACE 1 EXIST MANHOLE
-ADD 165 LF OF 18" HDPE PIPE
-ADD 120 LF OF FRENCH DRAIN

AREA 8 PROPOSED MODIFICATIONS
-ADD 2 CATCH BASIN
-ADD 20 LF OF 18" HDPE PIPE
-ADD 90 LF OF FRENCH DRAIN

AREA 9 PROPOSED MODIFICATIONS
-NO IMPROVEMENT PROPOSED

AREA 10 PROPOSED MODIFICATIONS
-REPLACE 1 MH WITH WEIR STRUCTURE

SUMMARY OF PROPOSED MODIFICATIONS

-REPLACE 1 MH WITH WEIR STRUCTURES
-REPLACE 3 EXISTING CATCH BASINS
-REPLACE 1 EXISTING CURB INLET
-ADD 2 CATCH BASINS
-ADD 2 MANHOLES
-ADD 295 LF 18" HDPE PIPE
-ADD 335 LF FRENCH DRAIN

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SAGA BAY 1.8 SUB-BASIN

FIGURE 22

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 22. Saga Bay Section 1.8 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*No*	*No*	*Yes*	*Yes*
7	*No*	*No*	*No*	*Yes*	*Yes*
8	*Yes*	*No*	*No*	*Yes*	*Yes*
9	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
10	*Yes*	*No*	*No*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin may be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls may have been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 22.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed

prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 24* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 23. Saga Bay Section 1.8 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	13.33	12.35	0.98	92.7%
Total Nitrogen (TN)	105.02	93.99	11.03	89.5%
Total Suspended Solids (TSS)	1258.88	1139.92	118.96	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 24. Saga Bay 1.8 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$13,600	**$14,000**
2	Remove Existing Structure	6	Ea.	$500	**$3,000**
3	Inlet Pavement (7' x 7')	7	Ea.	$800	**$6,000**
4	Swale Inlet (Type C - P Bottom)	6	Ea.	$3,000	**$18,000**
5	Manhole	3	Ea.	$3,500	**$11,000**
6	Inlet Protection	7	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	50	L.F.	$12	**$1,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	295	L.F.	$50	**$15,000**
10	French Drain (18" HDPE Pipe)	335	L.F.	$120	**$41,000**
11	Weir Structure	1	Ea.	$6,000	**$6,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	840	S.Y.	$40	**$34,000**
14	Regrading Swale	0	S.Y.	$10	**$0**
15	Utility Adjustments	1	L.S.	$6,800	**$7,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$27,200	**$28,000**
TOTAL					**$240,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

J. SW 87th Avenue Sub-basin

Location

SW 87th Avenue Sub-basin is located along 87th Avenue extending southwards from Eureka Drive (SW 184th Street) to SW 194th Court. SW 87th Avenue. Extending to the Caribbean Blvd. and SW 84th Avenue to the east and varies in the limits of the western boundary line. Sub-basin is part of the C100B-S-1 Basin. SW 87th Avenue is a County maintained roadway and the proposed improvements will need to be negotiated with the County.

Existing and Future Conditions

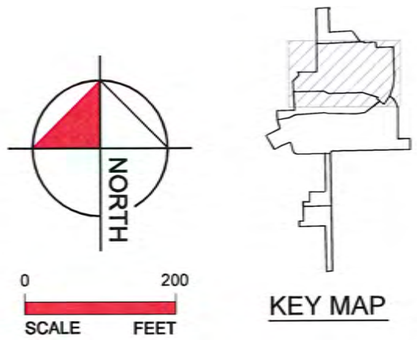
Figure 23 shows existing conditions for SW 87th Avenue. The sub-basin consists of approximately 93.58 acres of existing detached single family development with approximately 21,000 linear feet of roadway. The drainage system in this sub-basin is a closed exfiltration system. Roadside swales also provide some water quality pre-treatment and storage of run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 23.*

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 5.92 feet to a high of approximately 11.95 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development will not vary significantly from existing conditions.

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

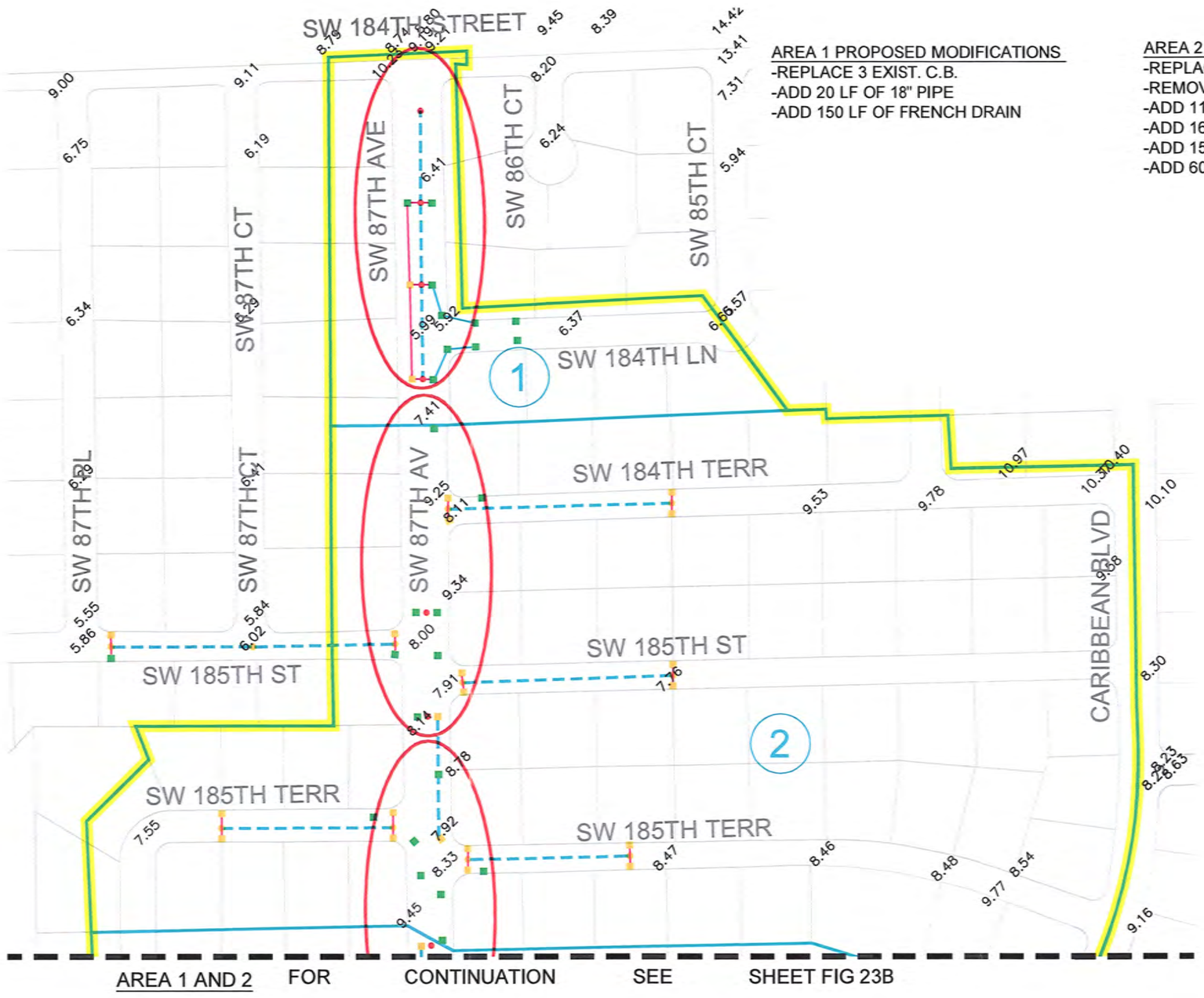


KEY MAP

LEGEND

- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING

SUMMARY OF PROPOSED MODIFICATIONS
-REPLACE 19 EXISTING CATCH BASINS
-REMOVE 3 CATCH BASINS
-ADD 15 MANHOLES
-ADD 35 CATCH BASINS
-ADD 2,435 LF 18" HDPE PIPE
-ADD 1,725 LF FRENCH DRAIN



AREA 1 PROPOSED MODIFICATIONS
-REPLACE 3 EXIST. C.B.
-ADD 20 LF OF 18" PIPE
-ADD 150 LF OF FRENCH DRAIN

AREA 2 PROPOSED MODIFICATIONS
-REPLACE 6 EXIST. C.B.
-REMOVE 2 EXIST. C.B.
-ADD 11 MANHOLES
-ADD 16 CATCH BASINS
-ADD 1560 LF OF 18" PIPE
-ADD 600 LF OF FRENCH DRAIN

Drawing name: . j:\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 23A-23C SW 87TH AVE.dwg 23A BASIN 2 S.W. 87TH AVE Feb 28, 2008 5:47pm by: jairo.castro

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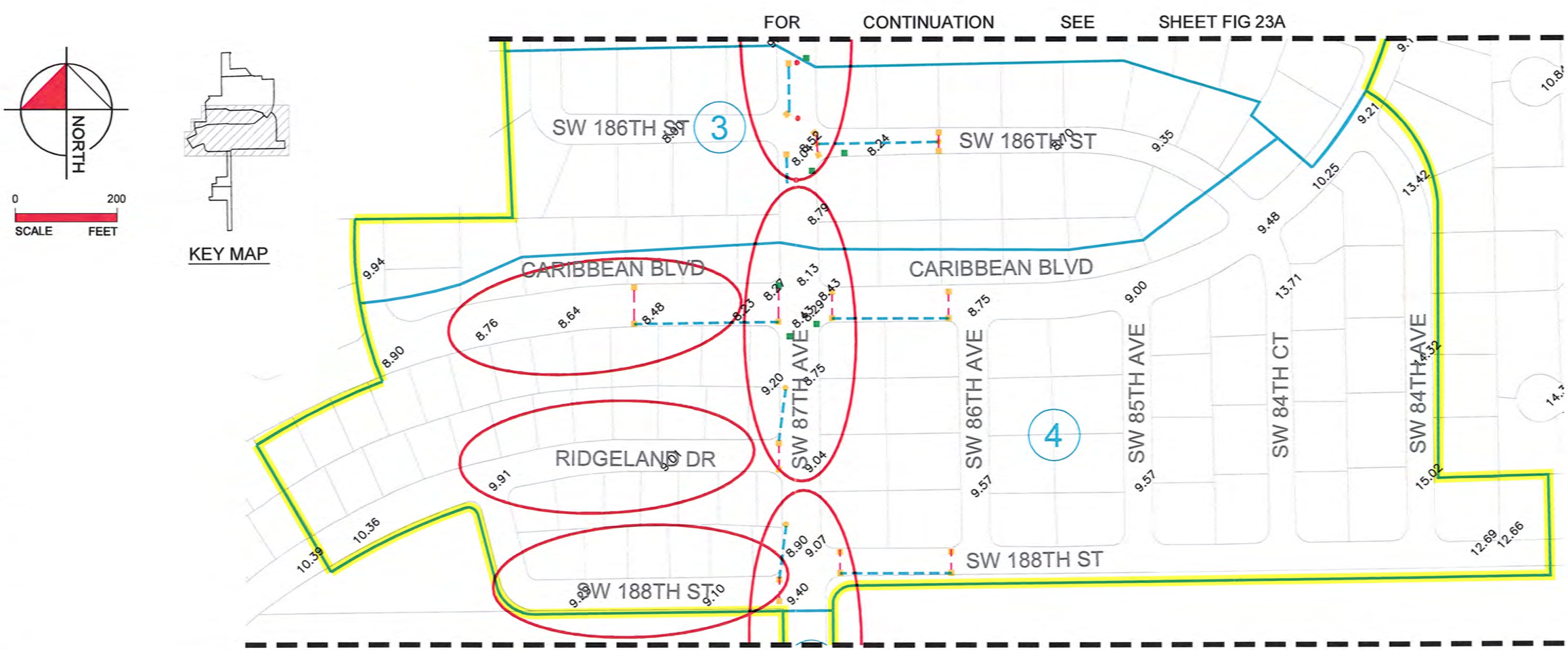
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

S.W. 87TH AVENUE SUB-BASIN

FIGURE 23A



LEGEND

- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING

AREA 3 PROPOSED MODIFICATIONS
-REPLACE 5 EXIST. C.B.
-REMOVE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 2 CATCH BASIN
-ADD 195 LF OF 18" PIPE
-ADD 225 LF OF FRENCH DRAIN

AREA 3 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. C.B.
-ADD 2 MANHOLES
-ADD 15 CATCH BASIN
-ADD 450 LF OF 18" PIPE
-ADD 600 LF OF FRENCH DRAIN

Drawing name: J:\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 23A-23C SW 87TH AVE.dwg 23B BASIN 3 S.W. 87TH AVE Feb 28, 2008 5:48pm by: joiro.castro

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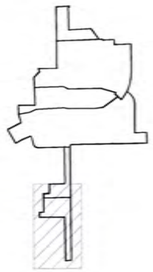
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

S.W. 87TH AVENUE SUB-BASIN

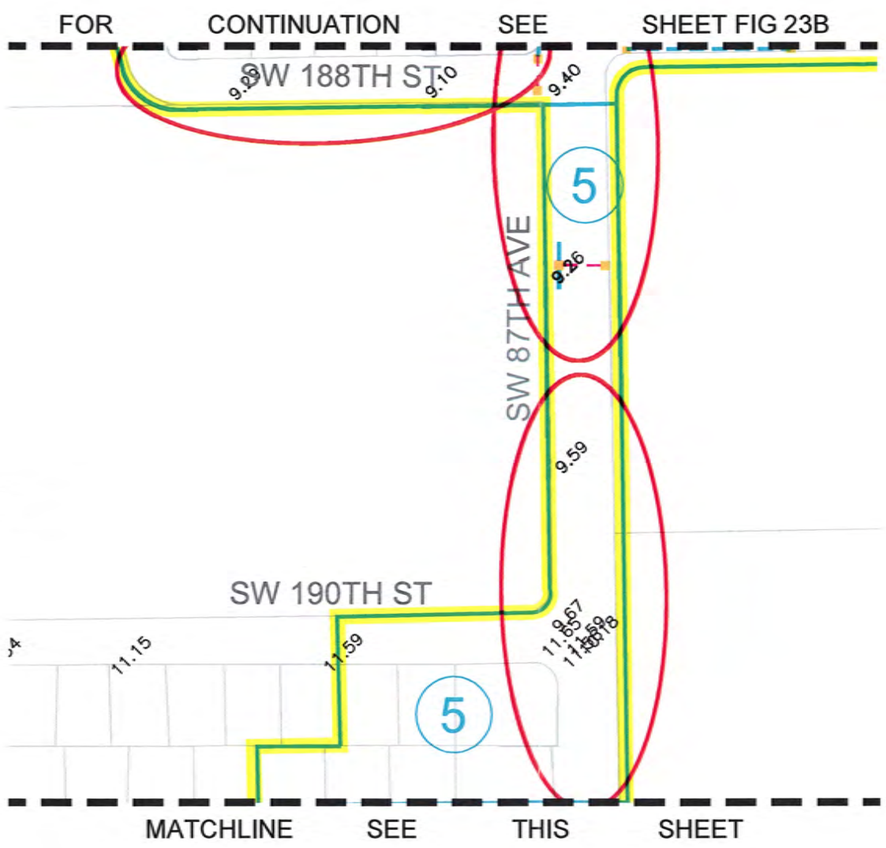
FIGURE 23B

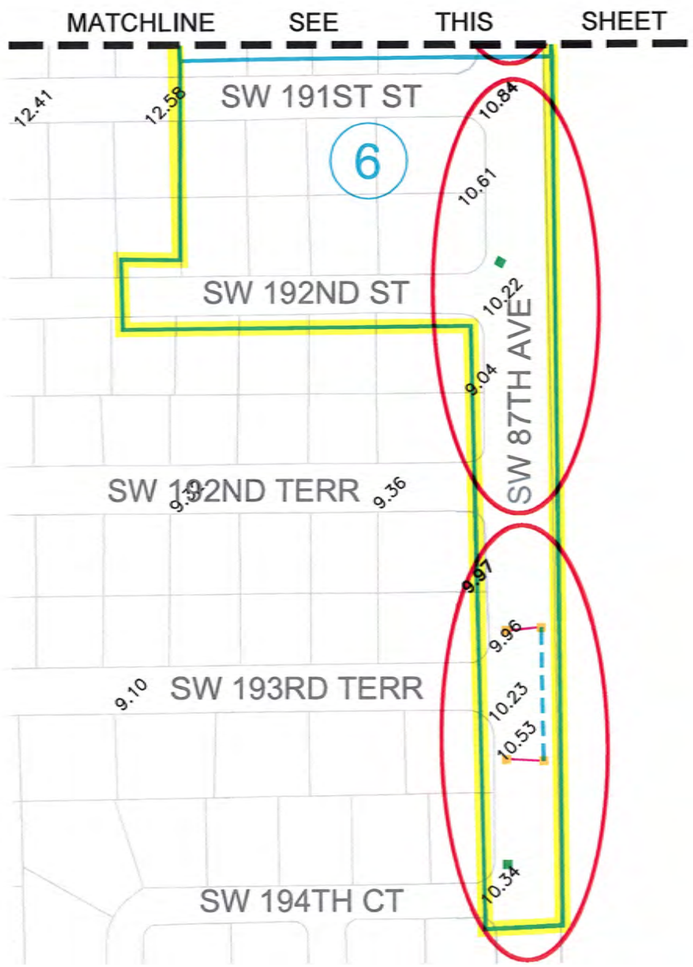


KEY MAP

LEGEND

- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING





AREA 5 PROPOSED MODIFICATIONS
-ADD 2 CATCH BASIN
-ADD 60 LF OF 18" PIPE
-ADD 50 LF OF FRENCH DRAIN

AREA 6 PROPOSED MODIFICATIONS
-REPLACE 4 EXIST. C.B.
-ADD 150 LF OF 18" PIPE
-ADD 100 LF OF FRENCH DRAIN

Drawing name: H:\bs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 23A-23C SW 87TH AVE.dwg
; BASIN 4 S.W. 87TH AVE Feb 28, 2008 5:49pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

S.W. 87TH AVENUE SUB-BASIN

FIGURE 23C

Table 25. SW 87th Avenue Sub-Basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*No*	*No*	*No*	*Yes*
2	*No*	*No*	*No*	*No*	*Yes*
3	*No*	*No*	*No*	*No*	*Yes*
4	*No*	*No*	*No*	*No*	*Yes*
5	*No*	*No*	*No*	*Yes*	*Yes*
6	*No*	*No*	*No*	*No*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not connect to an outfall to the lake.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 23.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 27* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 26. SW 87th Avenue Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	55.59	51.50	4.09	92.7%
Total Nitrogen (TN)	437.95	391.97	45.99	89.5%
Total Suspended Solids (TSS)	5249.84	4753.73	496.11	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 27. SW 87th Avenue Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$67,600	**$68,000**
2	Remove Existing Structure	22	Ea.	$500	**$11,000**
3	Inlet Pavement (7' x 7')	54	Ea.	$450	**$25,000**
4	Swale Inlet (Type C - P Bottom)	54	Ea.	$3,000	**$162,000**
4	Manhole	15	Ea.	$3,500	**$53,000**
5	Inlet Protection	54	Ea.	$30	**$2,000**
6	Floating Turbidity Barrier	0	L.F.	$12	**$0**
7	Core Drill Existing Inlets	0	Ea.	$500	**$0**
8	18" HDPE Pipe	2435	L.F.	$40	**$98,000**
9	French Drain	1,725	L.F.	$75	**$130,000**
10	Weir Structure	0	Ea.	$6,000	**$0**
11	Concrete Endwall	0	Ea.	$3,000	**$0**
12	Roadway Restoration	5,547	S.Y.	$35	**$195,000**
13	Utility Adjustments	1	L.S.	$33,800	**$34,000**
14	Professional Services	1	L.S.	$101,400	**$102,000**
15	Contingency	1	L.S.	$135,200	**$136,000**
TOTAL					**$1,020,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Budget for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

K. SW 97th Avenue Sub-basin

Location

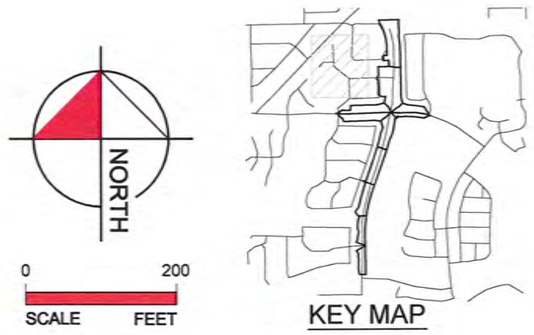
SW 97th Avenue sub-basin is located along SW 97th Avenue from SW 212th street southwards to the end of SW 97th Avenue. The sub-basin also extends into SW 216th street on both the east and west sides of SW 97th Avenue for approx. 600ft. The SW 97th Avenue sub-basin is part of the DA-4 Basin. SW 97th Avenue is a County maintained roadway and improvements will need to be negotiated with the County.

Existing and Future Conditions

Figure 25 shows existing conditions for SW 97th Avenue. The sub-basin consists of 20.05 acres of existing detached single family development with approximately 1355 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins with pipe connections to outfalls into the nearby lake. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

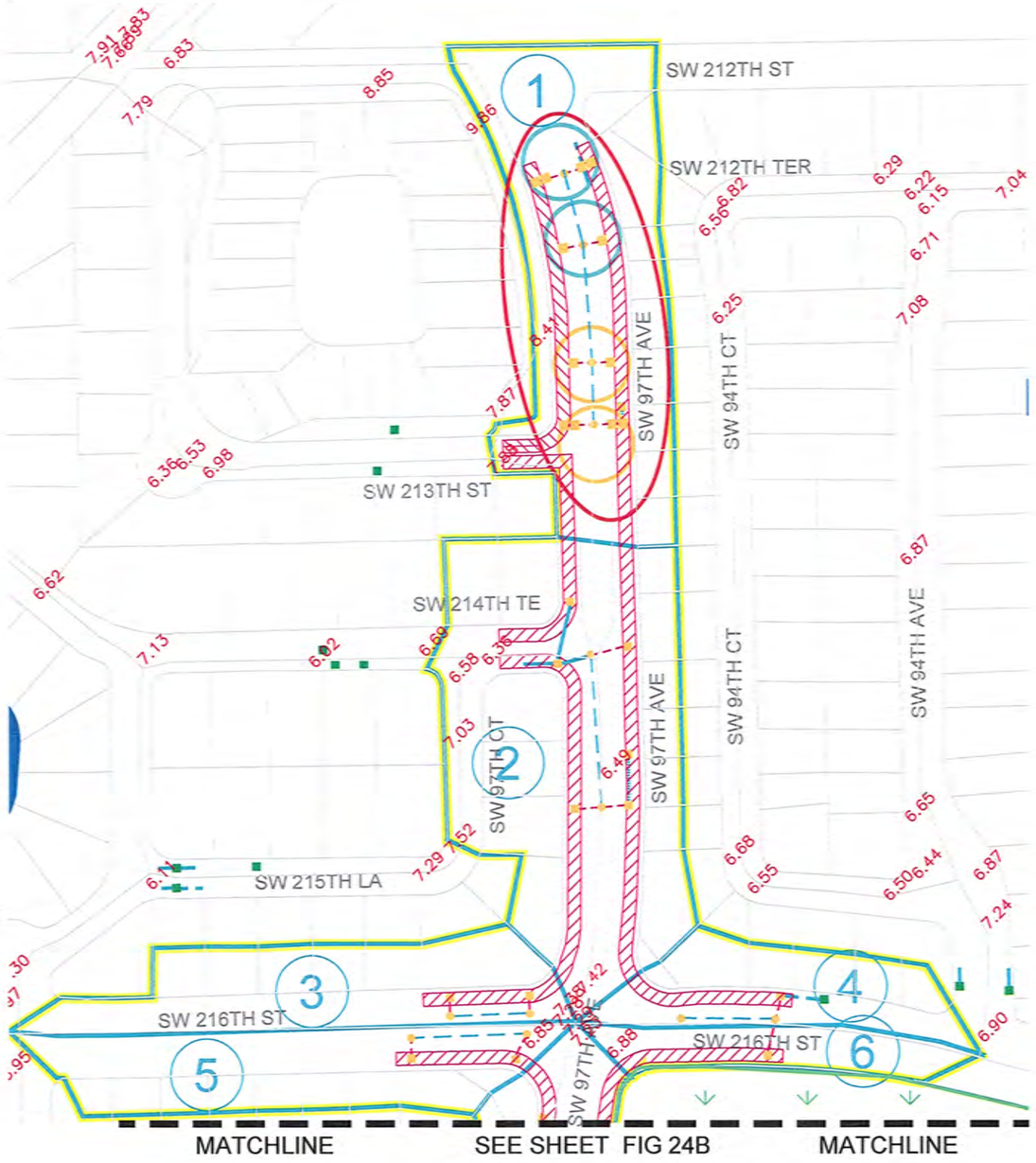
KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 24.* The sub-basin area was modeled independently from basin CC1-N-4.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 6.36 feet to a high of approximately 9.86 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development will not vary significantly from existing conditions.



LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



SUMMARY OF PROPOSED MODIFICATIONS
-REPLACE 15 EXIST. CATCH BASINS
-ADD 27 CATCH BASINS
-ADD 886 LF OF 18" PIPE
-ADD 1,610 LF OF FRENCH DRAIN

AREA 1 PROPOSED MODIFICATIONS
-REPLACE 2 EXIST. CATCH BASINS
-ADD 10 CATCH BASINS
-ADD 276 LF OF 18" PIPE
-ADD 360 LF OF FRENCH DRAIN
-ADD 4 MANHOLES
-REGRADE 3,200 S.Y. OF SWALE AREA

AREA 2 PROPOSED MODIFICATIONS
-REPLACE 5 EXIST. CATCH BASINS
-ADD 2 MANHOLES
-ADD 1 CATCH BASIN
-ADD 200 LF OF 18" PIPE
-ADD 170 LF OF FRENCH DRAIN
-REGRADE 2,800 S.Y. SWALE AREA

AREA 3 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASINS
-ADD 1 CATCH BASIN
-ADD 2 MANHOLE
-ADD 25 LF OF 18" PIPE
-ADD 110 LF OF FRENCH DRAIN
-REGRADE 300 S.Y. OF SWALE AREA

AREA 4 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASINS
-ADD 2 MANHOLE
-ADD 30 LF OF 18" PIPE
-ADD 120 LF OF FRENCH DRAIN
-REGRADE 300 S.Y. OF SWALE AREA

AREA 5 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASINS
-ADD 1 CATCH BASIN
-ADD 2 MANHOLE
-ADD 25 LF OF 18" PIPE
-ADD 150 LF OF FRENCH DRAIN
-REGRADE 300 S.Y. SWALE AREA

AREA 6 PROPOSED MODIFICATIONS
-ADD 1 CATCH BASIN
-ADD 30 LF OF 18" PIPE
-REGRADE 400 S.Y. OF SWALE AREA

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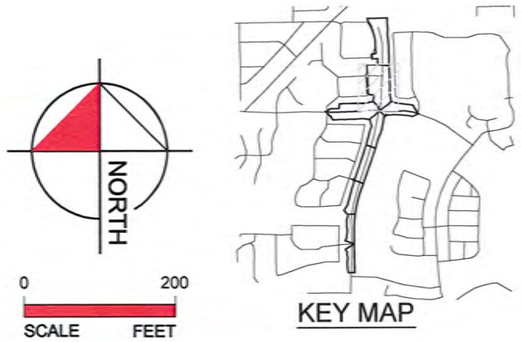
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

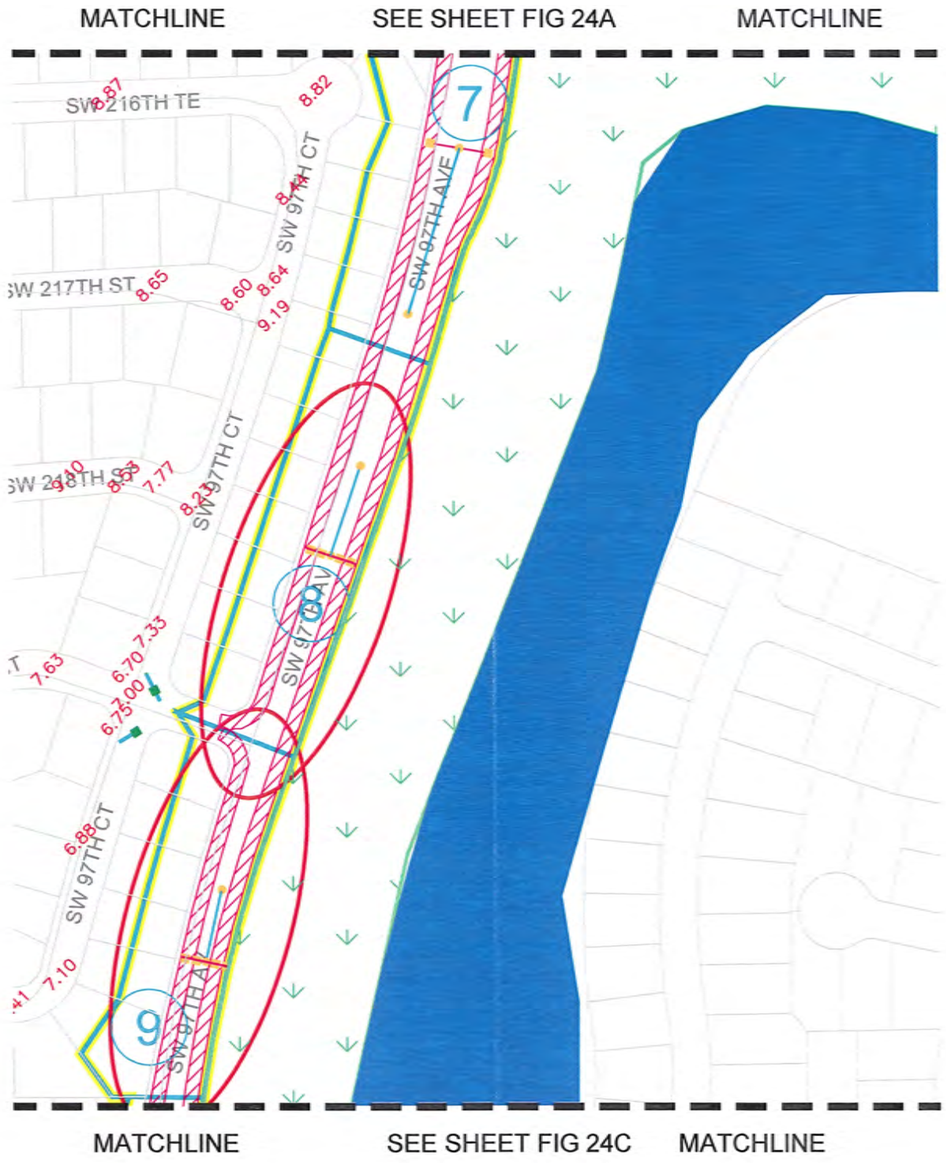
SW 97TH AVENUE SUB-BASIN - NORTH

FIGURE 24A



LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



AREA 7 PROP. MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASIN
-ADD 1 CATCH BASIN
-ADD 2 MANHOLE
-ADD 60 LF OF 18" HDPE PIPE
-ADD 230 LF OF FRENCH DRAIN
-REGRADE 2,000 S.Y. OF SWALE AREA

AREA 8 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST CATCH BASIN
-ADD 3 CATCH BASINS
-ADD 2 MANHOLE
-ADD 60 LF OF 18" HDPE PIPE
-ADD 120 LF OF FRENCH DRAIN
-REGRADE 2,200 S.Y. OF SWALE AREA

AREA 9 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASIN
-ADD 3 CATCH BASINS
-ADD 2 MANHOLE
-ADD 60 LF OF 18" PIPE
-ADD 90 LF OF FRENCH DRAIN
-REGRADE 2,400 S.Y. OF SWALE AREA

Drawing name: H:\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTY\FIG 24A-24C SW 97TH AVE.dwg FIG 24 - SW 97TH AVENUE - CENTRAL Mar 25, 2008 10:53am by: heather.spencer

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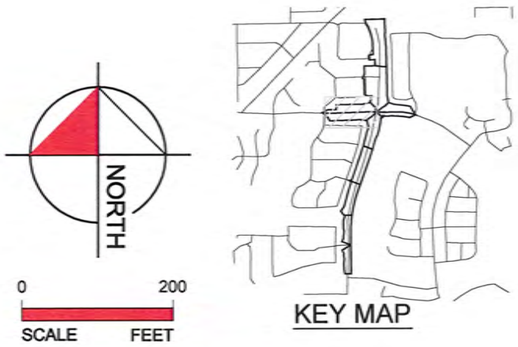
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

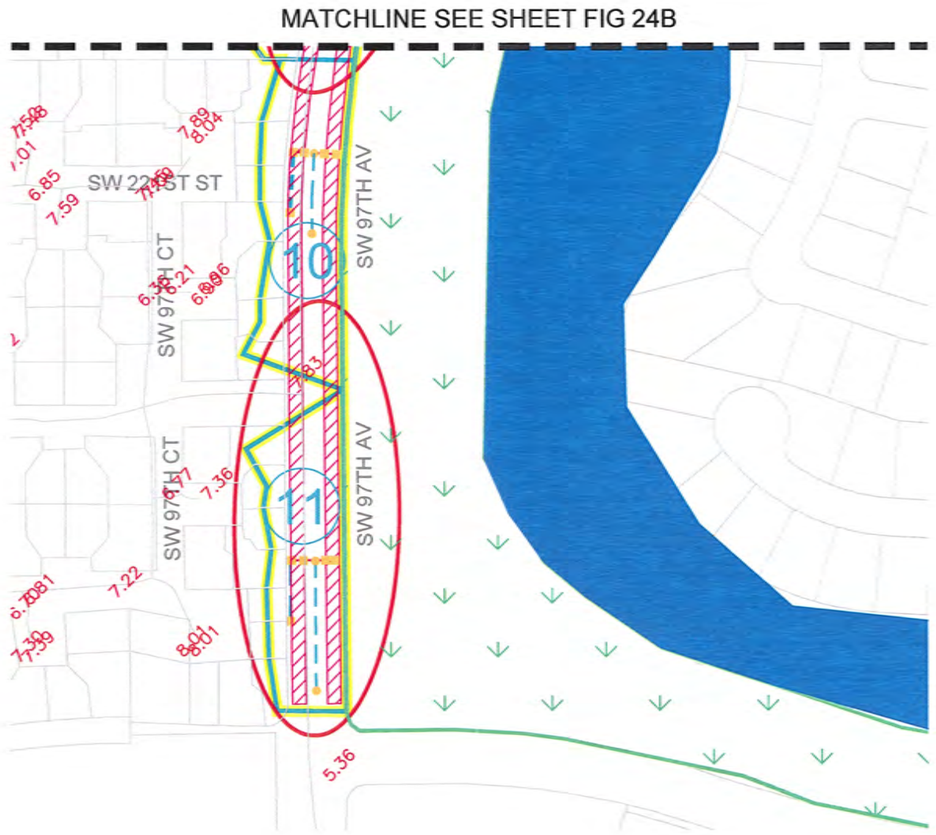
SW 97TH AVENUE SUB-BASIN - CENTRAL

FIGURE 24B



LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



AREA 10 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASIN
-ADD 2 MANHOLE
-ADD 3 CATCH BASINS
-ADD 60 LF OF 18" PIPE
-ADD 100 LF OF FRENCH DRAIN
-REGRADE 1,600 S.Y. OF SWALE AREA

AREA 11 PROPOSED MODIFICATIONS
-REPLACE 1 EXIST. CATCH BASIN
-ADD 2 MANHOLE
-ADD 3 CATCH BASINS
-ADD 60 LF OF 18" PIPE
-ADD 160 LF OF FRENCH DRAIN
-REGRADE 1,600 S.Y. OF SWALE

Drawing name: H:\043 43145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTY\FIG 24A-24C SW 97TH AVE.dwg FIG 24 97TH AVENUE - SOUTH Mar 25, 2008 10:54am by: heather.spencer

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

SW 97TH AVENUE SUB-BASIN - SOUTH

FIGURE 24C

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 28. SW 97th Avenue Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*No*	*No*	*Yes*	*Yes*
2	*No*	*No*	*No*	*No*	*Yes*
3	*No*	*No*	*No*	*No*	*Yes*
4	*No*	*No*	*No*	*Yes*	*Yes*
5	*No*	*No*	*No*	*No*	*Yes*
6	*No*	*No*	*No*	*Yes*	*Yes*
7	*No*	*No*	*No*	*No*	*Yes*
8	*No*	*No*	*No*	*Yes*	*Yes*
9	*No*	*No*	*No*	*No*	*Yes*
10	*No*	*No*	*No*	*No*	*Yes*
11	*No*	*No*	*No*	*No*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not connect to an outfall.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 24.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 30* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 29. SW 97th Avenue Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	11.91	11.03	0.88	92.7%
Total Nitrogen (TN)	93.83	83.98	9.85	89.5%
Total Suspended Solids (TSS)	1124.81	1018.51	106.29	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 30. SW 97th Avenue Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$79,600	**$80,000**
2	Remove Existing Structure	16	Ea.	$500	**$8,000**
3	Inlet Pavement (7' x 7')	42	Ea.	$800	**$34,000**
4	Swale Inlet (Type C - P Bottom)	42	Ea.	$3,000	**$126,000**
5	Manhole	23	Ea.	$3,500	**$81,000**
5	Inlet Protection	42	Ea.	$30	**$2,000**
6	Floating Turbidity Barrier	0	L.F.	$12	**$0**
7	Core Drill Existing Inlets	0	Ea.	$500	**$0**
8	18" HDPE Pipe	886	L.F.	$50	**$45,000**
9	French Drain	1,610	L.F.	$120	**$194,000**
10	Weir Structure	0	Ea.	$6,000	**$0**
11	Concrete Endwall	0	Ea.	$3,000	**$0**
12	Roadway Restoration	3,328	S.Y.	$40	**$134,000**
13	Regrading Swale	17,200	S.Y.	$10	**$172,000**
13	Utility Adjustments	1	L.S.	$39,800	**$40,000**
14	Professional Services	1	L.S.	$119,400	**$120,000**
15	Contingency	1	L.S.	$159,200	**$160,000**
TOTAL					**$1,200,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

L. Bel Aire Section 1.1 Sub-Basin

Location

Bel Aire Section 1.1 Sub Basin is located in the northwestern corner of the town limits of Cutler Bay, east of South Dixie Hwy, south of Quail Roost Drive (SW 186th Street), west of Gulfstream Road (S.W. 97th Avenue). Bel Aire Section 1.1 is also part of the C-1 Basin.

Existing and Future Conditions

Figure 25 shows existing conditions for Bel Aire Section 1.1. The sub-basin consists of approximately 58.12 acres of existing detached single family development with approximately 11,166 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins with pipe connections to outfalls into the main canal within basin C-1. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 25.* The sub-basin area was modeled together with the other sub-basins within the C-1 Basin of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 6.46 feet to a high of approximately 10.75 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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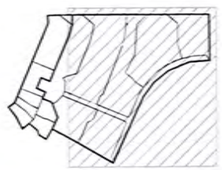


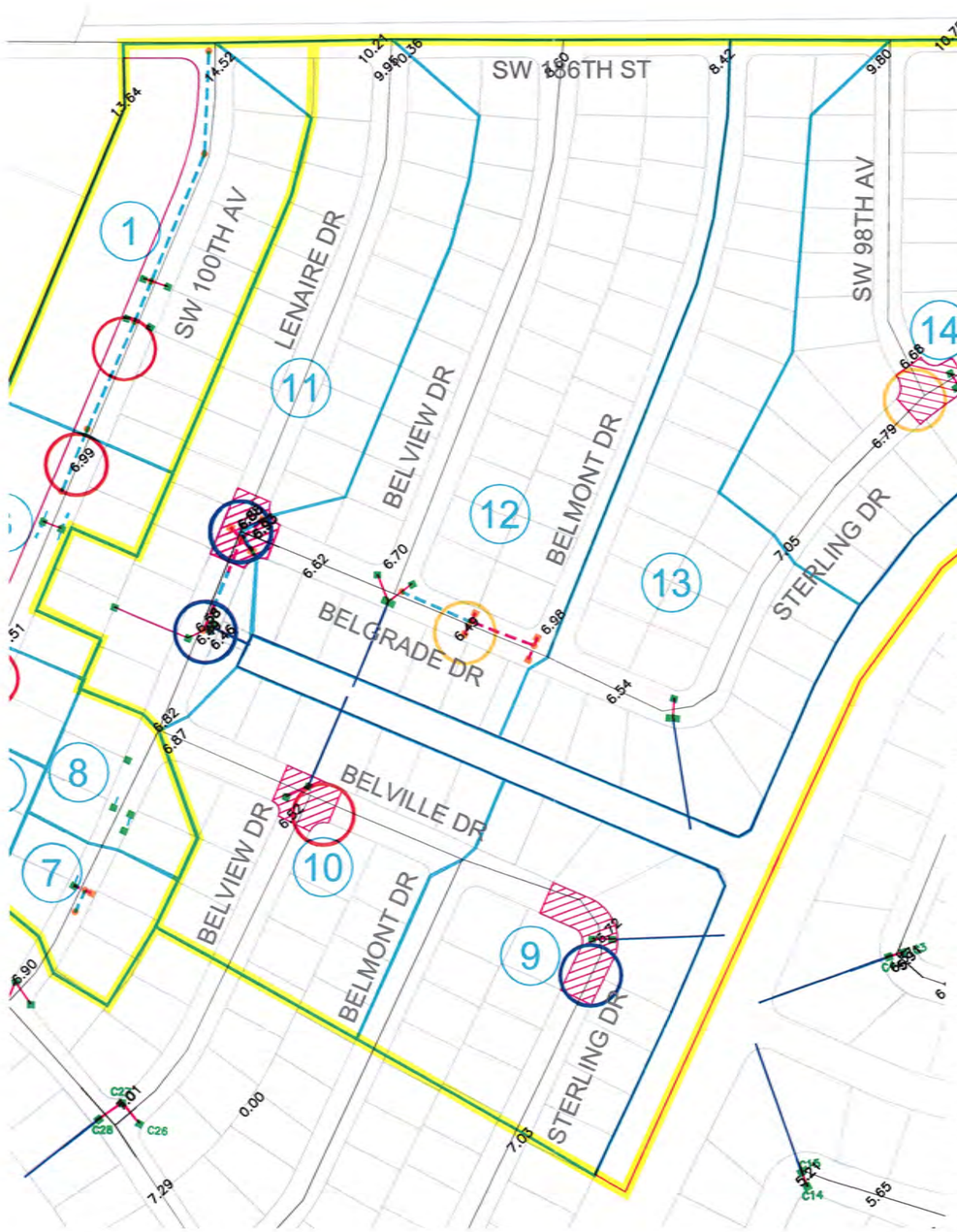
KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-ADD 9 CATCH BASINS
-ADD 25 CONCRETE APRONS
-ADD 7 MANHOLES
-ADD 500 LF 18" PIPE
-ADD 240 LF FRENCH DRAIN
-REMOVE 3 CATCH BASINS
-ADD 3 WEIR STRUCTURES
-RE-GRADE 9,050 SY OF R/W



AREA 9 PROPOSED MODIFICATIONS

-ADD 2 CONCRETE APRONS
-RE-GRADE 1500 SY OF R/W

AREA 10 PROPOSED MODIFICATIONS

-ADD 2 CONCRETE APRONS
-RE-GRADE 900 SY OF R/W

AREA 11 PROPOSED MODIFICATIONS

-ADD 3 CATCH BASINS
-ADD 5 CONCRETE APRONS
-ADD 2 MANHOLES
-ADD 60 LF FRENCH DRAIN
-ADD 210 LF 18" PIPE
-REPLACE 1 CATCH BASIN WITH 1 WEIR STRUCTURE
-RE-GRADE 1100 SY OF R/W

AREA 12 PROPOSED MODIFICATIONS

-ADD 4 CATCH BASINS
-ADD 7 CONCRETE APRONS
-ADD 3 MANHOLES
-ADD 240 LF 18" PIPE
-ADD 100 LF FRENCH DRAIN
-REPLACE 1 CATCH BASIN WITH 1 WEIR STRUCTURE

AREA 13 PROPOSED MODIFICATIONS

-ADD 2 CONCRETE APRONS

AREA 14 PROPOSED MODIFICATIONS

-ADD 2 CONCRETE APRONS
-RE-GRADE 950 SY OF R/W

AREA 15 PROPOSED MODIFICATIONS

-ADD 2 CATCH BASINS
-ADD 5 CONCRETE APRONS
-ADD 2 MANHOLES
-ADD 50 LF 18" PIPE
-ADD 80 LF FRENCH DRAIN
-REPLACE 1 CATCH BASIN WITH 1 WEIR STRUCTURE
-RE-GRADE 4,600 SY OF R/W

Drawing name: H:\Jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 25 BEL AIRE SEC 1-1 SUB-BASIN , FIG 24 BEL AIRE SEC1.1 SUB-BASIN Feb 28, 2008 5:57pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

BEL AIRE SEC 1.1 SUB-BASIN

FIGURE 25

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 31. Bel Aire 1.1 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
9	*Yes*	*No*	*Yes*	*Yes*	*Yes*
10	*No*	*No*	*Yes*	*Yes*	*Yes*
11	*Yes*	*No*	*Yes*	*No*	*Yes*
12	*Yes*	*No*	*Yes*	*Yes*	*Yes*
13	*Yes*	*No*	*Yes*	*No*	*No*
14	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
15	*Yes*	*Yes*	*Yes*	*No*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not connect to an outfall to the Canal.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 25.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 33* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 32. Bel Aire 1.1Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	34.52	31.99	2.54	92.7%
Total Nitrogen (TN)	272.00	243.44	28.56	89.5%
Total Suspended Solids (TSS)	3260.53	2952.41	308.12	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 33. Bel Aire 1.1 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$54,100	**$55,000**
2	Remove Existing Structure	0	Ea.	$500	**$0**
3	Inlet Pavement (7' x 7')	25	Ea.	$800	**$20,000**
4	Swale Inlet (Type C - P Bottom)	9	Ea.	$3,000	**$27,000**
5	Curb Inlet (Type 6 - P Bottom)	2	Ea.	$2,500	**$5,000**
6	Manhole	7	Ea.	$2,000	**$14,000**
7	Inlet Protection	25	Ea.	$30	**$1,000**
8	Floating Turbidity Barrier	0	L.F.	$12	**$0**
9	Core Drill Existing Inlets	0	Ea.	$500	**$0**
10	18" HDPE Pipe	500	L.F.	$50	**$25,000**
11	French Drain	240	L.F.	$120	**$29,000**
12	Weir Structure	3	Ea.	$6,000	**$18,000**
13	Concrete Endwall	0	Ea.	$3,000	**$0**
14	Roadway Restoration	987	S.Y.	$40	**$40,000**
15	Regrading	9,050	S.Y.	$40	**$362,000**
16	Utility Adjustments	1	L.S.	$27,050	**$28,000**
17	Professional Services	1	L.S.	$81,150	**$82,000**
18	Contingency	1	L.S.	$108,200	**$109,000**
TOTAL					**$820,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

M. Bel Aire Section 1.2 Sub-basin

Location

Bel Aire Section 1.2 Sub-basin is located north of SW 192nd Drive, south of Eureka Drive, east of SW 93rd Avenue and west of SW 89th Road and is part of the C-100.

Existing and Future Conditions

Figure 26 shows existing conditions for Bel Aire 1.2. The sub-basin consists of approximately 19.83 acres of existing detached single family development with approximately 3,451linear feet of roadway. The drainage system in this sub-basin consists of roadside swales to provide some water quality pre-treatment as well as storage of roadway runoff.

KHA observed flooding across the roadway and localized ponding in the roadway in a couple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions adjacent to the sub-basin. The location of these observed deficiencies can be seen in *Figure 26.* The sub-basin area was modeled as a single drainage basin not including any other areas within the Town.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 6.27 feet to a high of approximately 7.78 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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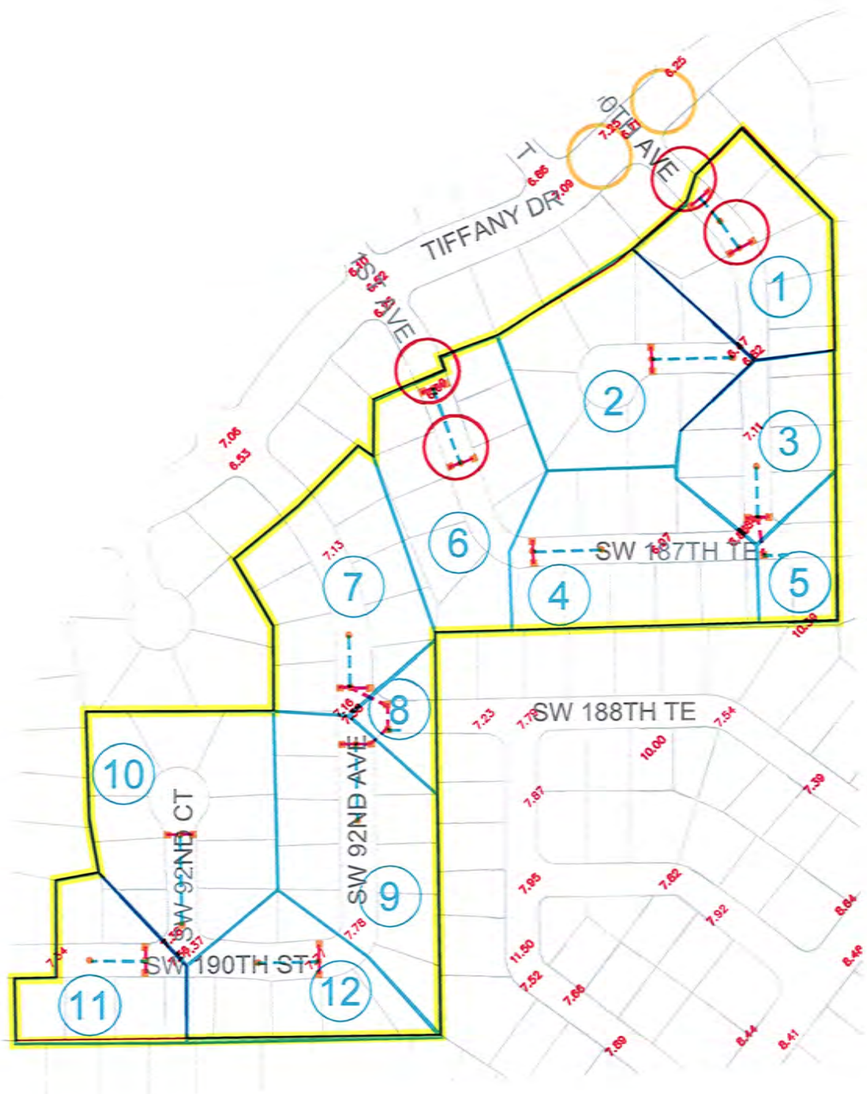
KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-ADD 27 SWALE INLETS
-ADD 27 CONCRETE APRONS
-ADD 1080 LF FRENCH DRAIN
-ADD 727 LF HDPE PIPE
-ADD 20 MANHOLES



AREA 1 PROPOSED MODIFICATIONS

-ADD 105 LF FRENCH DRAIN
-ADD 85 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 4 SWALE INLETS

AREA 2 PROPOSED MODIFICATIONS

-ADD 125 LF FRENCH DRAIN
-ADD 40 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 3 PROPOSED MODIFICATIONS

-ADD 75 LF FRENCH DRAIN
-ADD 40 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 4 PROPOSED MODIFICATIONS

-ADD 100 LF FRENCH DRAIN
-ADD 40 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 5 PROPOSED MODIFICATIONS

-ADD 30 LF FRENCH DRAIN
-ADD 60 LF HDPE PIPE
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 1 SWALE INLET

AREA 6 PROPOSED MODIFICATIONS

-ADD 120 LF FRENCH DRAIN
-ADD 85 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 4 SWALE INLETS

AREA 7 PROPOSED MODIFICATION

-ADD 75 LF FRENCH DRAIN
-ADD 47 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 8 PROPOSED MODIFICATION

-ADD 20 LF FRENCH DRAIN
-ADD 150 LF HDPE PIPE
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 9 PROPOSED MODIFICATION

-ADD 115 LF FRENCH DRAIN
-ADD 50 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 10 PROPOSED MODIFICATIO

-ADD 135 LF FRENCH DRAIN
-ADD 40 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 11 PROPOSED MODIFICATIO

-ADD 80 LF FRENCH DRAIN
-ADD 40 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

AREA 12 PROPOSED MODIFICATIO

-ADD 100 LF FRENCH DRAIN
-ADD 50 LF HDPE PIPE
-ADD 2 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS
-ADD 2 SWALE INLETS

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

BEL AIRE SEC 1.2 SUB-BASIN

FIGURE 26

Drawing name: H:\civil jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 26 BEL AIRE SEC 1-2 SUB-Basin.dwg FIG 26 BEL AIRE SEC 1-2 SUB-BASIN Feb 28, 2008 6:00pm by jairo.castro

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 34. Bel Aire 1.2 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*No*	*No*	*Yes*	*Yes*
2	*No*	*No*	*No*	*Yes*	*No*
3	*No*	*No*	*No*	*Yes*	*No*
4	*No*	*No*	*No*	*Yes*	*No*
5	*No*	*No*	*No*	*Yes*	*No*
6	*No*	*Yes*	*No*	*Yes*	*No*
7	*No*	*No*	*No*	*Yes*	*No*
8	*No*	*No*	*No*	*Yes*	*No*
9	*No*	*No*	*No*	*Yes*	*No*
10	*No*	*No*	*No*	*Yes*	*No*
11	*No*	*No*	*No*	*Yes*	*No*
12	*No*	*No*	*No*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: Several sub-basins were observed to have debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, and pipe.

Capital Improvements: Install the additional infrastructure depicted in *Figure26.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains (if any). In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 36* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 35. Bel Aire 1.2 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	11.78	10.96	0.87	92.7%
Total Nitrogen (TN)	92.80	83.06	9.74	89.5%
Total Suspended Solids (TSS)	1112.46	1007.34	105.13	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 36. Bel Aire 1.2 Sub-Basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$43,800	**$44,000**
2	Remove Existing Structure	0	Ea.	$500	**$0**
3	Inlet Pavement (7' x 7')	27	Ea.	$800	**$22,000**
4	Swale Inlet (Type C - P Bottom)	27	Ea.	$3,000	**$81,000**
5	Storm Manhole	20	Ea.	$3,500	**$70,000**
6	Inlet Protection	27	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	0	L.F.	$12	**$0**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	15" HDPE Pipe	727	L.F.	$50	**$37,000**
10	French Drain	1,080	L.F.	$120	**$130,000**
11	Weir Structure	0	Ea.	$6,000	**$0**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	2,409	S.Y.	$40	**$97,000**
14	Regrading	0	S.Y.	$40	**$0**
15	Utility Adjustments	1	L.S.	$21,900	**$22,000**
16	Professional Services	1	L.S.	$65,700	**$66,000**
17	Contingency	1	L.S.	$87,600	**$88,000**
TOTAL					**$660,000**

Notes

1. Costs do not include inflation or interest costs. See Table 19 for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

N. Bel Aire Section 5.2 Sub-Basin

Location

Bel Aire Section 5.2 Sub Basin is located north of Cutler Ridge Drive (S.W. 200th street, west of S.W. 101st Avenue and lays on the eastern side of South Florida Water Management District (SFWMD) canal C-1N. Bel Aire Section 5.2 sub-basin is also part of the C-1 Basin.

Existing and Future Conditions

Figure 27 shows existing conditions for Bel Aire Section 5.2 sub-basin. The sub-basin consists of approximately 14.24 acres of existing detached single family development with approximately 3,880 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins with pipe connections to outfalls into the Basin C-1 canal system. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 27.* The sub-basin area was modeled together with the other sub-basins within the Bel Aire Section 5.2 area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 5.5 feet to a high of approximately 9.5 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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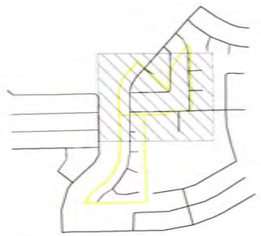
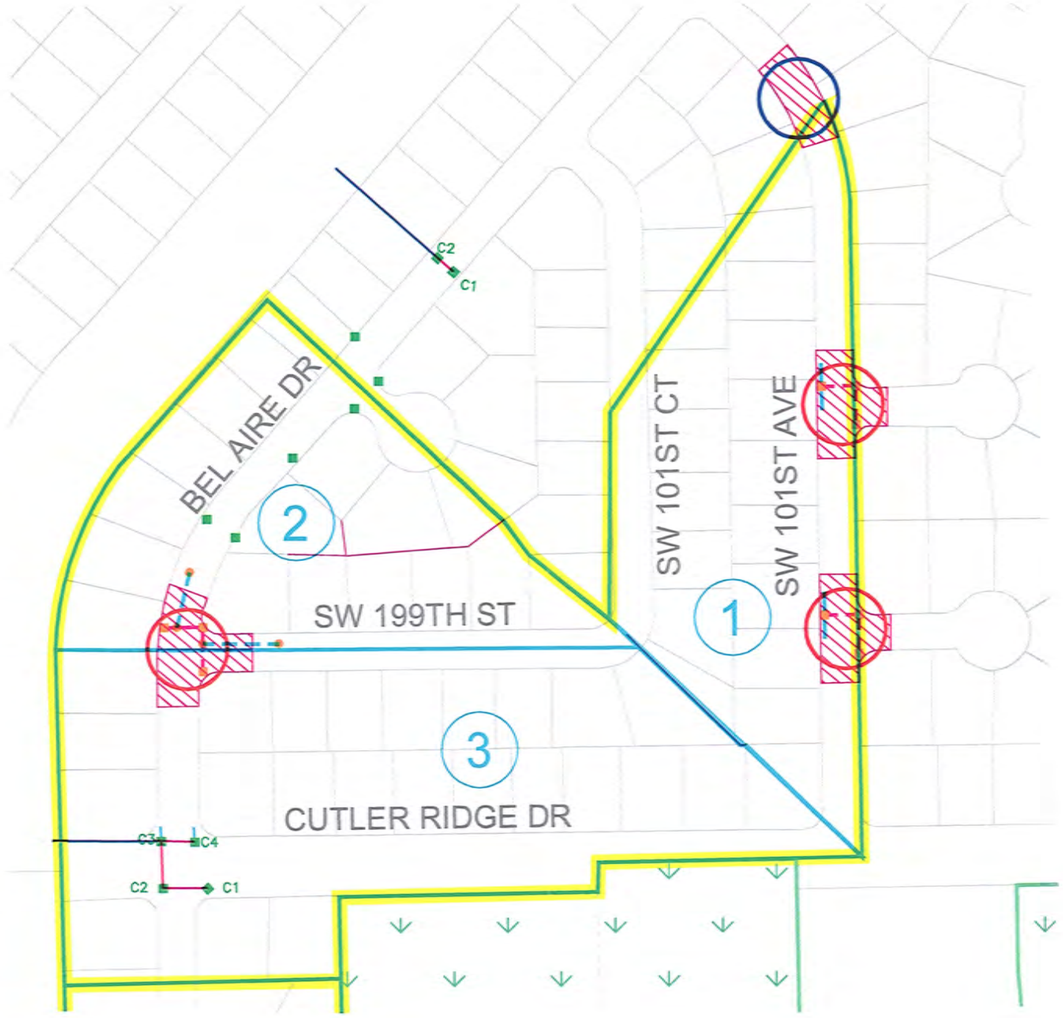


KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS



SUMMARY OF PROPOSED MODIFICATIONS

-ADD 9 CATCH BASINS
-ADD 17 CONCRETE APRONS
-ADD 4 MANHOLES
-ADD 235 LF 18" PIPE
-ADD 275 LF FRENCH DRAIN
-RE-GRADE 4,150 SY OF R/W

AREA 1 PROPOSED MODIFICATIONS

-ADD 4 CONCRETE APRONS
-RE-GRADE 2800 SY OF R/W
-ADD 6 CATCH BASINS
-ADD 100 LF OF FRENCH DRAIN
-ADD 150 LF 18" PIPE

AREA 2 PROPOSED MODIFICATIONS

-ADD 8 CONCRETE APRONS
-RE-GRADE 650 SY OF R/W
-ADD 2 CATCH BASIN
-ADD 4 MANHOLE
-ADD 55 LF 18" PIPE
-ADD 175 LF OF FRENCH DRAIN

AREA 3 PROPOSED MODIFICATIONS

-ADD 4 CONCRETE APRONS
-RE-GRADE 700 SY OF R/W
-ADD 1 CATCH BASIN
-ADD 30 LF OF 18" PIPE

Drawing name: I:\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTY\FIG 27 BEL AIRE SEC 5-2 SUB-SEC 5-2 FIG 27 BEL AIRE SEC 5.2 Feb 28, 2008 6:04pm by: jairo.castro.dwg

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

BEL AIRE SEC 5.2 SUB-BASIN

FIGURE 27

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 37. Bel Aire Section 5.2 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*No*	*No*	*Yes*	*Yes*
2	*No*	*No*	*No*	*No*	*Yes*
3	*No*	*Yes*	*Yes*	*No*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not connect to an outfall to the lake.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 24.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and

pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 39* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 38. Bel Aire 5..2 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	8.46	7.84	0.62	92.7%
Total Nitrogen (TN)	66.64	59.65	7.00	89.5%
Total Suspended Solids (TSS)	798.86	723.37	75.49	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

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Table 39. Bel Aire 5.2 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$29,700	**$30,000**
2	Remove Existing Structure	2	Ea.	$500	**$1,000**
3	Inlet Pavement (7' x 7')	17	Ea.	$800	**$14,000**
4	Swale Inlet (Type C - P Bottom)	9	Ea.	$3,000	**$27,000**
5	Manhole	4	Ea.	$3,500	**$14,000**
6	Inlet Protection	17	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	50	L.F.	$12	**$1,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	235	L.F.	$50	**$12,000**
10	French Drain	275	L.F.	$120	**$33,000**
11	Weir Structure	0	Ea.	$6,000	**$0**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	680	S.Y.	$40	**$28,000**
14	Regrading	4,150	S.Y.	$40	**$166,000**
15	Utility Adjustments	1	L.S.	$14,850	**$15,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$59,400	**$60,000**
TOTAL					**$450,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

O. Bel Aire Section 6 Sub-basin

Location

Bel Aire Section 6 Sub Basin is located south of Cutler Ridge Drive (S.W. 200th street, west of S.W. 101st Avenue and lays on the eastern side of South Florida Water Management District (SFWMD) canal C-1N. Bel Aire Section 6 sub-basin is also part of the C-1 Basin.

Existing and Future Conditions

Figure 28 shows existing conditions for Bel Aire Section 6 sub-basin. The sub-basin consists of approximately 13.5 acres of existing detached single family development with approximately 2,080 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins with pipe connections to outfalls into the SFWMD canal C-1N. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions adjacent to the sub-basin. The location of these observed deficiencies can be seen in *Figure 28.* The sub-basin area was modeled together with the Bel Aire Section 5.2 sub-basin within the area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 4.9 feet to a high of approximately 6.2 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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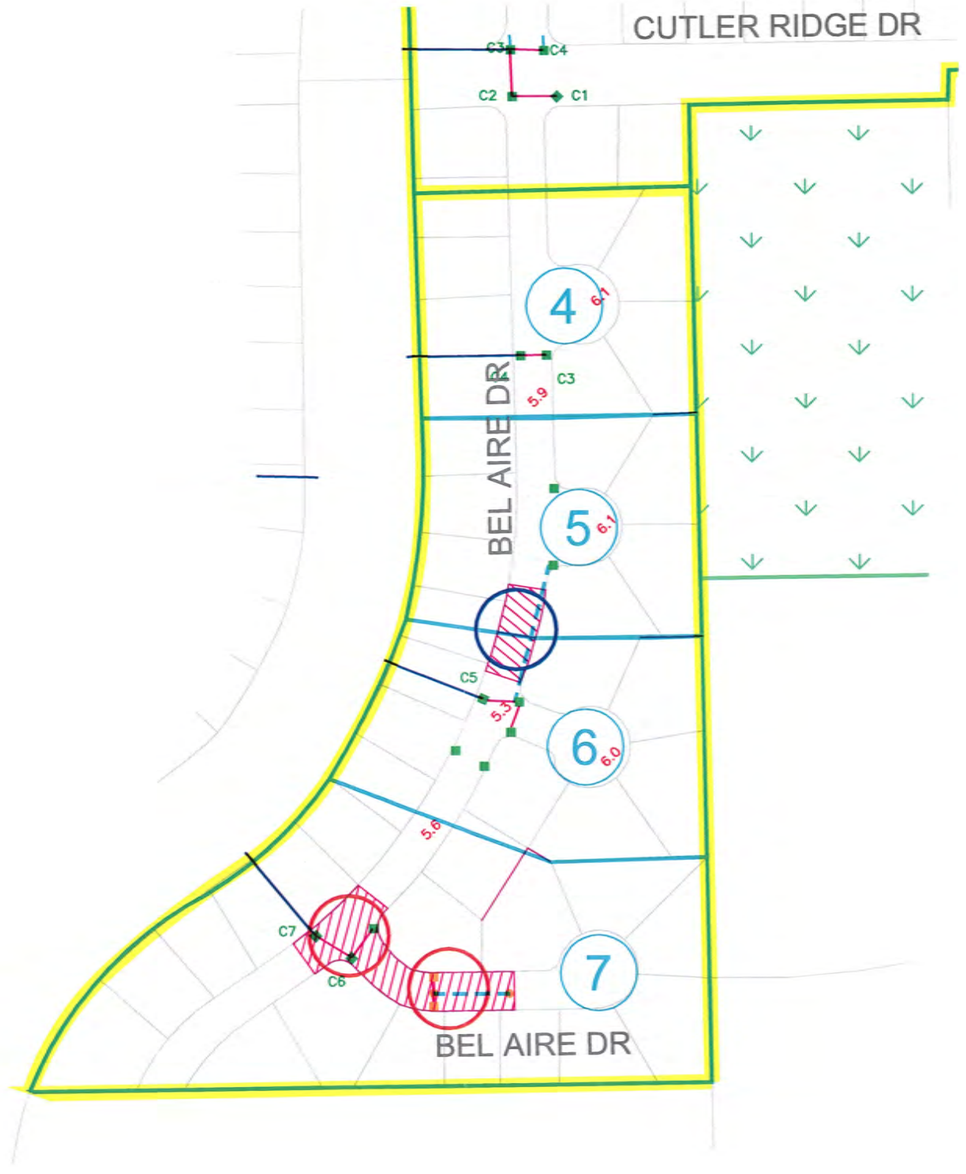
KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-ADD 2 CATCH BASINS
-ADD 14 CONCRETE APRON
-ADD 240 LF FRENCH DRAIN
-ADD 25 LF 18" PIPE
-ADD 2 MANHOLES
-RE-GRADE 2,680 SY OF R/W



AREA 4 PROPOSED MODIFICATIONS

-ADD 2 CONCRETE APRONS

AREA 5 PROPOSED MODIFICATIONS

-ADD 2 CONCRETE APRONS
-RE-GRADE 360 SY OF R/W
-ADD 75 LF OF FRECH DRAIN

AREA 6 PROPOSED MODIFICATIONS

-ADD 5 CONCRETE APRONS
-RE-GRADE 320 SY OF R/W
-ADD 65 LF OF FRENCH DRAIN
-REPLACE 1 CATCH BASIN WITH WEIR STRUCTURE

AREA 7 PROPOSED MODIFICATIONS

-ADD 5 CONCRETE APRONS
-RE-GRADE 2000 SY OF R/W
-ADD 2 CATCH BASINS
-ADD 2 MANHOLE
-ADD 100 LF FRENCH DRAIN
-ADD 25 LF OF 18" PIPE
-REPLACE 1 CATCH BASIN WITH WEIR STRUCTURE

Drawing name: J:\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 28 BEL AIRE SEC 6 SUB-BA
FIG 28 BEL AIRE SEC 6 Feb 28, 2008 6:07pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

BEL AIRE SEC 6 SUB-BASIN

FIGURE 28

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 40. Bel Aire Section 6 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*Yes*	*Yes*	*Yes*	*Yes*
2	*Yes*	*No*	*Yes*	*Yes*	*No*
3	*Yes*	*Yes*	*Yes*	*Yes*	*No*
4	*No*	*Yes*	*Yes*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not connect to an outfall to the canal.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 28.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 42* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 41. Bel Aire 6 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	8.86	8.21	0.65	92.7%
Total Nitrogen (TN)	69.78	62.45	7.33	89.5%
Total Suspended Solids (TSS)	836.45	757.41	79.04	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 42. Bel Aire 6 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$19,500	**$20,000**
2	Remove Existing Structure	2	Ea.	$500	**$1,000**
3	Inlet Pavement (7' x 7')	14	Ea.	$800	**$12,000**
4	Swale Inlet (Type C - P Bottom)	2	Ea.	$3,000	**$6,000**
5	Manhole	2	Ea.	$3,500	**$7,000**
6	Inlet Protection	14	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	150	L.F.	$12	**$2,000**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	25	L.F.	$50	**$2,000**
10	French Drain	240	L.F.	$120	**$29,000**
11	Weir Structure	2	Ea.	$6,000	**$12,000**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	353	S.Y.	$40	**$15,000**
14	Regrading	2,680	S.Y.	$40	**$108,000**
15	Utility Adjustments	1	L.S.	$9,750	**$10,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$39,000	**$39,000**
TOTAL					**$310,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Budget for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

P. Port Royale Section 5 Sub-Basin

Location

Port Royal Section 5 Sub-Basin is located in the northwestern corner of the Town limits of Cutler Bay, east of South Dixie Hwy, south of Quail Roost Drive (SW 186th Street), north of Broad Channel Drive and west of Lenaire Drive. Port Royale Section 5 is also part of the C-1 Basin.

Existing and Future Conditions

Figure 29 shows existing conditions for Port Royal Section 5. The sub-basin consists of approximately 13.08 acres of existing detached single family development with approximately 1918 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins with pipe connections to outfalls into canals within Basin C-1. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding along SW 100th Avenue in multiple locations within this sub-basin. The location of these observed deficiencies can be seen in *Figure 29.* The sub-basin area was modeled together with the other sub-basins within the Port Royal Section 5 area of the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 6.96 feet to a high of approximately 14.52 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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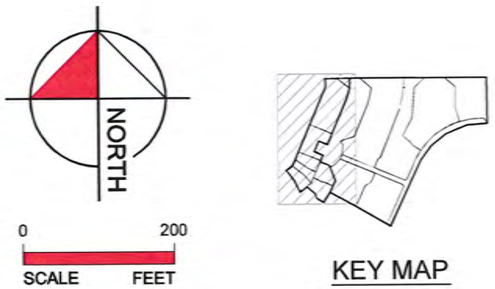


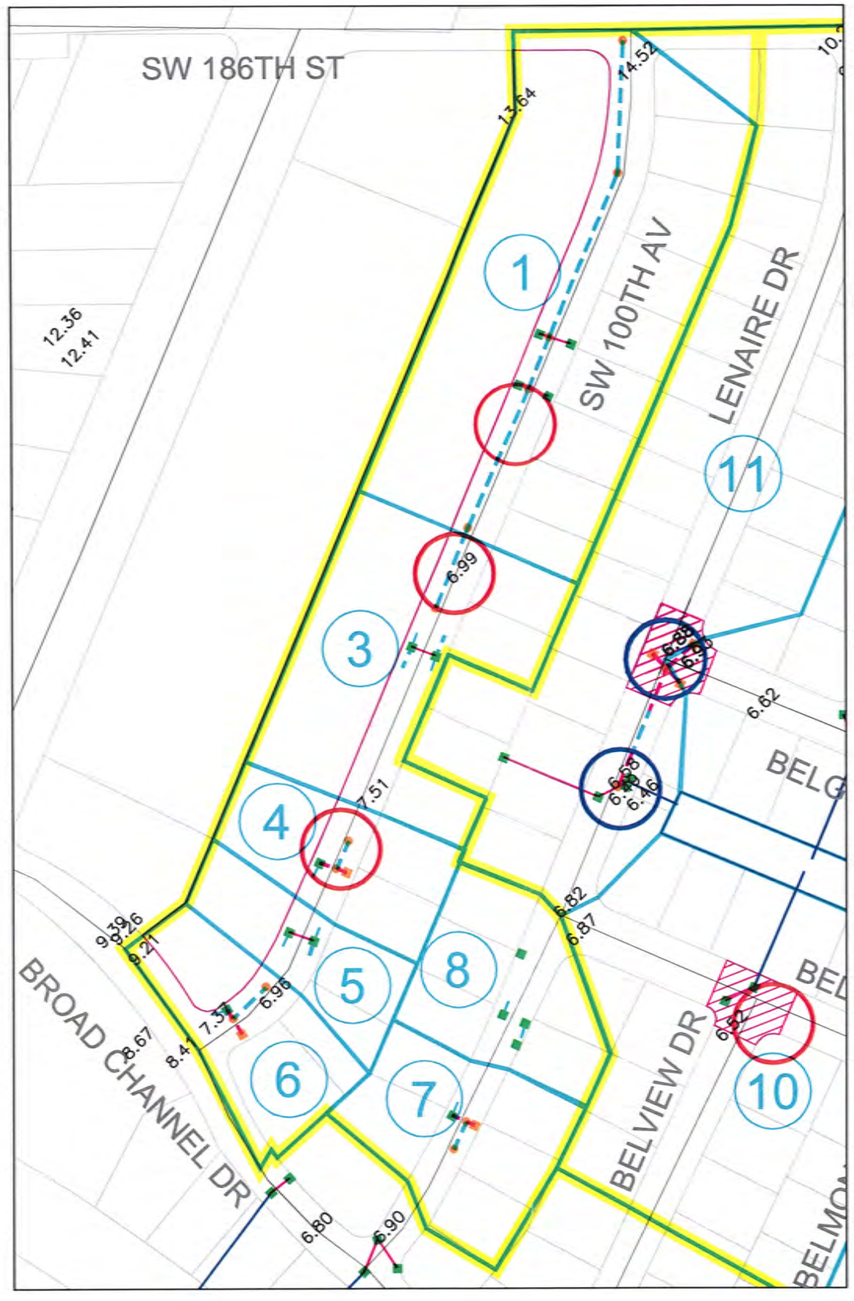
KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-ADD 3 CATCH BASINS (2 CURB INLETS)
-ADD 18 CONCRETE APRON
-ADD 940 LF FRENCH DRAIN
-ADD 105 LF 18" PIPE
-ADD 12 MANHOLES
-CORE DRILL 3 EXISTING INLETS



AREA 1 PROPOSED MODIFICATIONS

-ADD 720 LF FRENCH DRAIN
-ADD 6 MANHOLES
-VERIFY LOW POINT LOCATED AT CATCH BASINS

AREA 3 PROPOSED MODIFICATIONS

-ADD 60 LF FRENCH DRAIN
-VERIFY LOW POINT LOCATED AT CATCH BASINS

AREA 4 PROPOSED MODIFICATIONS

-ADD 1 CATCH BASIN (CURB INLET)
-ADD 35 LF 18" PIPE
-CORE DRILL EXISTING INLET
-ADD 40 LF FRENCH DRAIN
-ADD 2 MANHOLES

AREA 5 PROPOSED MODIFICATIONS

-ADD 20 LF FRENCH DRAIN

AREA 6 PROPOSED MODIFICATIONS

-ADD 1 CATCH BASIN (CURB INLET)
-ADD 35 LF 18" PIPE
-ADD 60 LF FRENCH DRAIN
-ADD 2 MANHOLES

AREA 7 PROPOSED MODIFICATIONS

-ADD 1 CATCH BASIN
-ADD 1 CONCRETE APRON
-ADD 35 LF 18" PIPE
-CORE DRILL EXISTING INLET
-ADD 40 LF FRENCH DRAIN
-ADD 2 MANHOLE

AREA 8 PROPOSED MODIFICATIONS

-NO MODIFICATIONS REQUIRED

Drawing name: H:\civ_jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTY\FIG 29 PORT ROYALE SEC-5 SUB-Ba...dwg FIG 29 PORT ROYALE SEC 5 SUB-BASIN Feb 28, 2008 6:10pm by jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

PORT ROYALE SEC 5 SUB-BASIN

FIGURE 29

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 43. Port Royal Section 5 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*Yes*	*No*	*Yes*	*Yes*	*Yes*
2	*Yes*	*No*	*Yes*	*Yes*	*Yes*
3	*Yes*	*No*	*Yes*	*Yes*	*Yes*
4	*Yes*	*No*	*Yes*	*Yes*	*Yes*
5	*Yes*	*No*	*Yes*	*Yes*	*Yes*
6	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
7	*Yes*	*No*	*Yes*	*Yes*	*Yes*
8	*Yes*	*No*	*Yes*	*Yes*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains and/or outfalls have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales, French drains, and outfalls is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: Some areas of this drainage sub-basin do not have an outfall.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 29.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 45* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 44. Port Royale Section 5 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	7.77	7.20	0.57	92.7%
Total Nitrogen (TN)	61.21	54.79	6.43	89.5%
Total Suspended Solids (TSS)	733.79	664.45	69.34	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 45. Port Royale Section 5 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$22,600	**$23,000**
2	Remove Existing Structure	0	Ea.	$500	**$0**
3	Inlet Pavement (7' x 7')	19	Ea.	$800	**$16,000**
4	Swale Inlet (Type C - P Bottom)	1	Ea.	$3,000	**$3,000**
5	Curb Inlet (Type 6 - P Bottom)	2	Ea.	$2,500	**$5,000**
6	Manhole	12	Ea.	$2,000	**$24,000**
7	Inlet Protection	19	Ea.	$30	**$1,000**
8	Floating Turbidity Barrier	0	L.F.	$12	**$0**
9	Core Drill Existing Inlets	3	Ea.	$500	**$2,000**
10	18" HDPE Pipe	105	L.F.	$50	**$6,000**
11	French Drain	940	L.F.	$120	**$113,000**
12	Weir Structure	0	Ea.	$6,000	**$0**
13	Concrete Endwall	0	Ea.	$3,000	**$0**
14	Roadway Restoration	1,393	S.Y.	$40	**$56,000**
15	Regrading	0	S.Y.	$40	**$0**
16	Utility Adjustments	1	L.S.	$11,300	**$12,000**
17	Professional Services	1	L.S.	$50,000	**$50,000**
18	Contingency	1	L.S.	$45,200	**$46,000**
TOTAL					**$360,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

Q. Pine Tree Manor Section 3 Sub-basin

Location

Pine Tree Manor Section 3 Sub-basin is located north of Cutler Ridge Drive (SW 200th Street), west of Gulfstream Road (SW 97th Avenue), and east of Marlin Road and is part of the C-1 Basin.

Existing and Future Conditions

Figure 30 shows existing conditions for Pine Tree Manor Section 3 Sub-basin. The sub-basin consists of approximately 21.0 acres of existing detached single family development with approximately 5,200 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed flooding across the roadway and localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 30.* The sub-basin area was modeled together with the Cutler Ridge Section 5 sub-basin located within the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 7.1 feet to a high of approximately 8.3 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development conditions will not vary significantly from the existing conditions.

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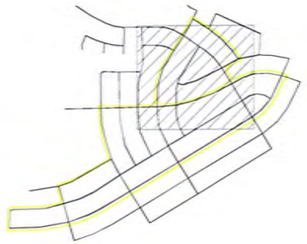
SCALE FEET



KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

AREA 15 PROPOSED MODIFICATIONS

-ADD 2 CATCH BASINS
-ADD 2 CONCRETE APRONS
-ADD 2 MANHOLES
-ADD 130 LF FRENCH DRAIN
-ADD 40 LF 18" PIPE

AREA 16 PROPOSED MODIFICATIONS

-ADD 9 CONCRETE APRONS
-ADD 5 CATCH BASIN
-ADD 4 MANHOLE
-ADD 220 LF 18" PIPE
-ADD 250 LF OF FRENCH DRAIN
-RE-GRADE 2550 SY OF R/W

SUMMARY OF PROPOSED MODIFICATIONS

-ADD 7 CATCH BASINS
-ADD 11 CONCRETE APRONS
-ADD 6 MANHOLES
-ADD 260 LF 18" PIPE
-ADD 380 LF FRENCH DRAIN
-RE-GRADE 2550 SY OF R/W

Drawing name: H:\...\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 30 PINE TREE MANOR SEC 3.dwg FIG 30 PINE TREE MANOR SEC 3 Feb 28, 2008 6:13pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

PINE TREE MANOR SEC 3 SUB-BASIN

FIGURE 30

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

Table 46. Pine Tree Manor Section 3 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*No*	*No*	*No*	*Yes*	*No*
2	*Yes*	*No*	*No*	*Yes*	*No*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales and French drains is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: All areas of this drainage sub-basin do not connect to an outfall to a canal or lake.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 30.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and pollution retardant baffles to protect the French drains and weir structures should be installed

prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 48* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 47. Pine Tree Manor Section 3 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	1174.73	98.00	12.44	92.7%
Total Nitrogen (TN)	1063.72	87.71	11.52	89.5%
Total Suspended Solids (TSS)	111.01	10.29	0.97	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 48. Pine Tree Manor Section 3 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	(USD)	Total (USD)
1	Mobilization/ Clearing and Grubbing	1	L.S.	$24,800	**$25,000**
2	Remove Existing Structure	0	Ea.	$500	**$0**
3	Inlet Pavement (7' x 7')	11	Ea.	$800	**$9,000**
4	Swale Inlet (Type C - P Bottom)	7	Ea.	$3,000	**$21,000**
5	Manhole	6	Ea.	$3,500	**$21,000**
6	Inlet Protection	11	Ea.	$30	**$1,000**
7	Floating Turbidity Barrier	0	L.F.	$12	**$0**
8	Core Drill Existing Inlets	0	Ea.	$500	**$0**
9	18" HDPE Pipe	260	L.F.	$50	**$13,000**
10	French Drain	380	L.F.	$120	**$46,000**
11	Weir Structure	0	Ea.	$6,000	**$0**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	853	S.Y.	$40	**$35,000**
14	Regrading	2,550	S.Y.	$40	**$102,000**
15	Utility Adjustments	1	L.S.	$12,400	**$13,000**
16	Professional Services	1	L.S.	$50,000	**$50,000**
17	Contingency	1	L.S.	$49,600	**$50,000**
TOTAL					**$390,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

R. Cutler Ridge Section 5 Sub-basin

Location

Cutler Ridge Section 5 Sub-basin is located north of Caribbean Boulevard, south of Cutler Ridge Drive (SW 200th Street), east of South Florida Water Management District (SFWMD) canal C-1N and west of Marlin Road and is part of the C-1 Basin.

Existing and Future Conditions

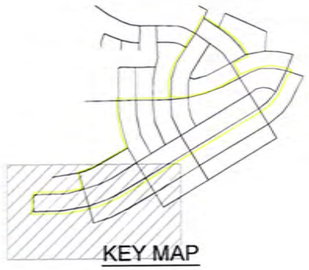
Figure 31 shows existing conditions for Cutler Ridge Section 5 Sub-basin. The sub-basin consists of approximately 76.1 acres of existing detached single family development with approximately 18,500 linear feet of roadway. The drainage system in this sub-basin is a hybrid system consisting of isolated French drains and catch basins. Roadside swales also provide some water quality pre-treatment and storage of roadway run-off.

KHA observed localized ponding in the roadway in multiple locations within this sub-basin. In addition, the Town of Cutler Bay has received complaints regarding drainage conditions within the sub-basin. The location of these observed deficiencies can be seen in *Figure 31.* The sub-basin area was modeled together with the Pine Tree Manor Section 3 sub-basin located within the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, the elevation of existing roads ranges from a low of approximately 7.3 feet to a high of approximately 10.3 feet NGVD. It was assumed that building finish elevations are 1.5 feet above crown of road elevations. Pervious area elevations were assumed to range from 0.5 feet below the minimum roadway elevation in the roadside swales to 0.5 feet below the finish floor elevations. Since the area is already developed, it is anticipated that future development will not vary significantly from the existing conditions.

Performance Goals Analysis

Based on the detailed hydrologic and hydraulic calculations for this sub-basin, which can be found in Appendix C, the majority of the modeled drainage areas within the sub-basin do not currently meet the Town of Cutler Bay performance goals. The table below shows the performance of the basin versus performance goals. "Yes" means the given drainage area within the sub-basin meets the performance goal, and "No" means that the given drainage area within the sub-basin does not meet the performance goal.

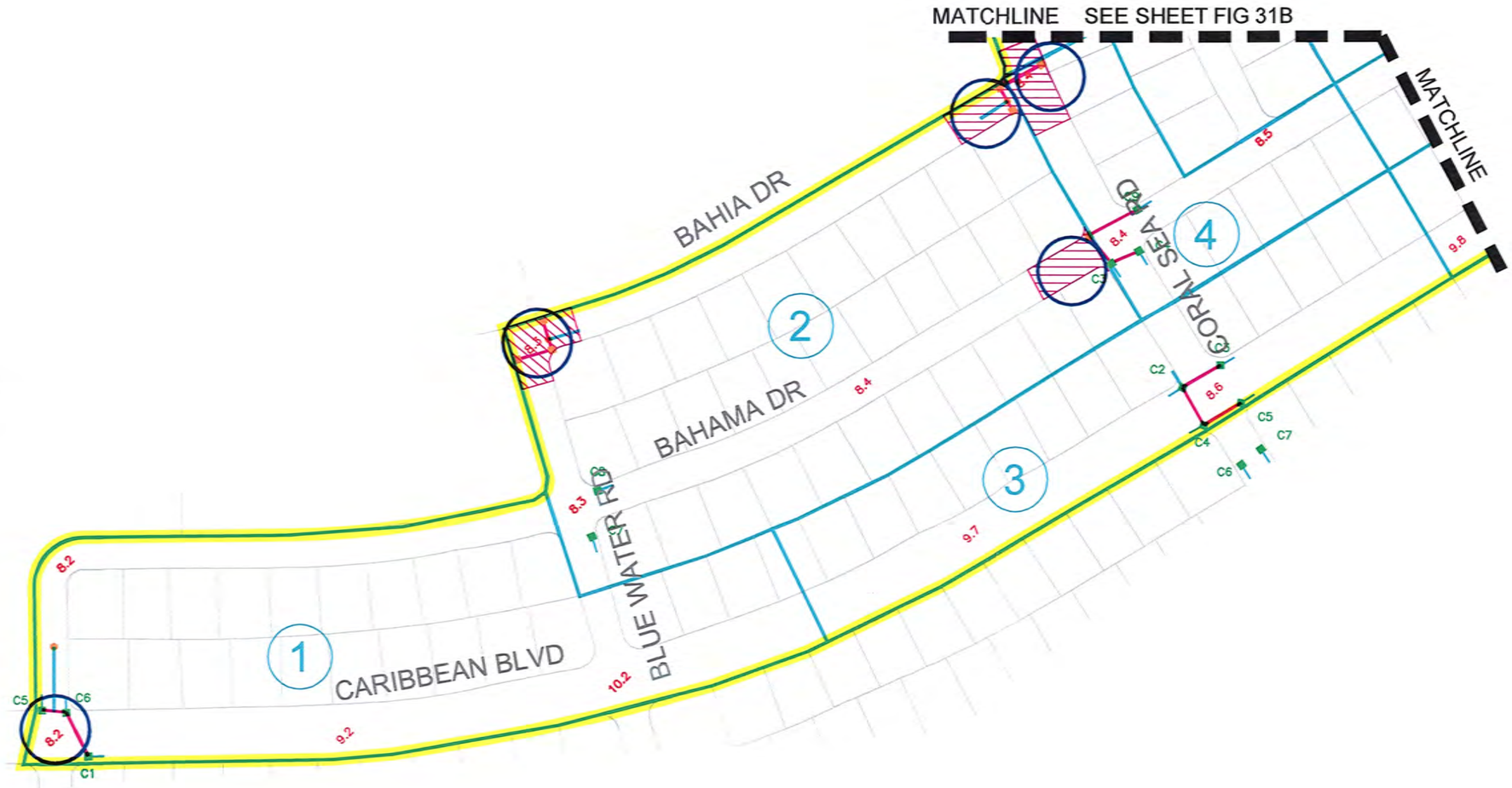


LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

SUMMARY OF PROPOSED MODIFICATIONS

-ADD 21 CATCH BASINS
-ADD 56 CONCRETE APRON
-ADD 455 LF FRENCH DRAIN
-ADD 2,140 LF 18" PIPE
-ADD 10 MANHOLES
-CORE DRILL 43 EXISTING INLETS
-RE-GRADE 14,655 SY OF R/W



AREA 1 PROPOSED MODIFICATIONS

-ADD 100 LF FRENCH DRAIN
-ADD 2 MANHOLES
-ADD 3 CONCRETE APRONS
-ADD 110 LF 18" PIPE
-CORE DRILL 3 EXISTING INLETS

AREA 2 PROPOSED MODIFICATIONS

-ADD 100 LF FRENCH DRAIN
-ADD 110 LF 18" PIPE
-ADD 5 CATCH BASINS
-ADD 2 MANHOLES
-ADD 7 CONCRETE APRONS
-RE-GRADE 2200 SY OF R/W

AREA 3 PROPOSED MODIFICATIONS

-ADD 30 LF FRENCH DRAIN
-ADD 200 LF OF 18" PIPE
-ADD 4 CONCRETE APRONS
-CORE DRILL 7 EXISITNG INLETS

AREA 4 PROPOSED MODIFICATIONS

-ADD 2 CATCH BASINS
-ADD 210 LF 0F 18" PIPE
-RE-GRADE 730 SY OF R/W
-ADD 5 CONCRETE APRONS
-CORE DRILL 4 EXISTING INLETS

Drawing name: H:\...\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPTVFIG 31A-31B CUTLER RIDGE SEC 5 WEST.dwg FIG 31A CUTLER RIDGE SEC 5 WEST Feb 28, 2008 6:16pm by: jairo.castro

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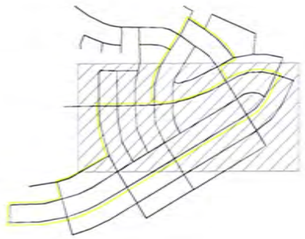
TOWN OF CUTLER BAY STORMWATER MASTER PLAN

CUTLER RIDGE SEC 5 WEST SUB-BASIN

FIGURE 31A



KEY MAP

LEGEND

- EXIST./PROP. OUTFALL PIPE
- EXIST./PROP. DRAINAGE PIPE
- EXIST./PROP. FRENCH DRAIN
- AREA DELINEATION
- SUB-BASIN GROUP
- EXIST./PROP. CATCH BASIN
- EXIST./PROP. MANHOLE
- PROP. REGRADING
- 6.56 EXISTING ELEVATIONS
- # AREA NUMBER
- KHA OBSERVED PONDING
- KHA OBSERVED FLOODING
- TOWN COMPLAINT LOCATIONS

AREA 5 PROPOSED MODIFICATIONS

-ADD 4 CONCRETE APRONS
-RE-GRADE 1800 SY OF R/W
-ADD 190 LF OF 18" PIPE
-CORE DRILL 6 EXISTING INLETS

AREA 6 PROPOSED MODIFICATIONS

-ADD 4 CONCRETE APRONS
-RE-GRADE 1500 SY OF R/W
-ADD 1 CATCH BASIN
-ADD 190 LF OF 18" PIPE
-CORE DRILL 5 EXISTING INLETS

AREA 7 PROPOSED MODIFICATIONS

-ADD 3 CATCH BASINS
-ADD 4 CONCRETE APRONS
-ADD 45 LF FRENCH DRAIN
-ADD 165 LF 18" PIPE
-CORE DRILL 6 EXISTING INLETS

AREA 8 PROPOSED MODIFICATIONS

-ADD 4 CONCRETE APRONS
-RE-GRADE 1800 SY OF R/W
-ADD 1 CATCH BASIN
-ADD 210 LF OF 18" PIPE
-CORE DRILL 5 EXISTING INLETS

AREA 9 PROPOSED MODIFICATIONS

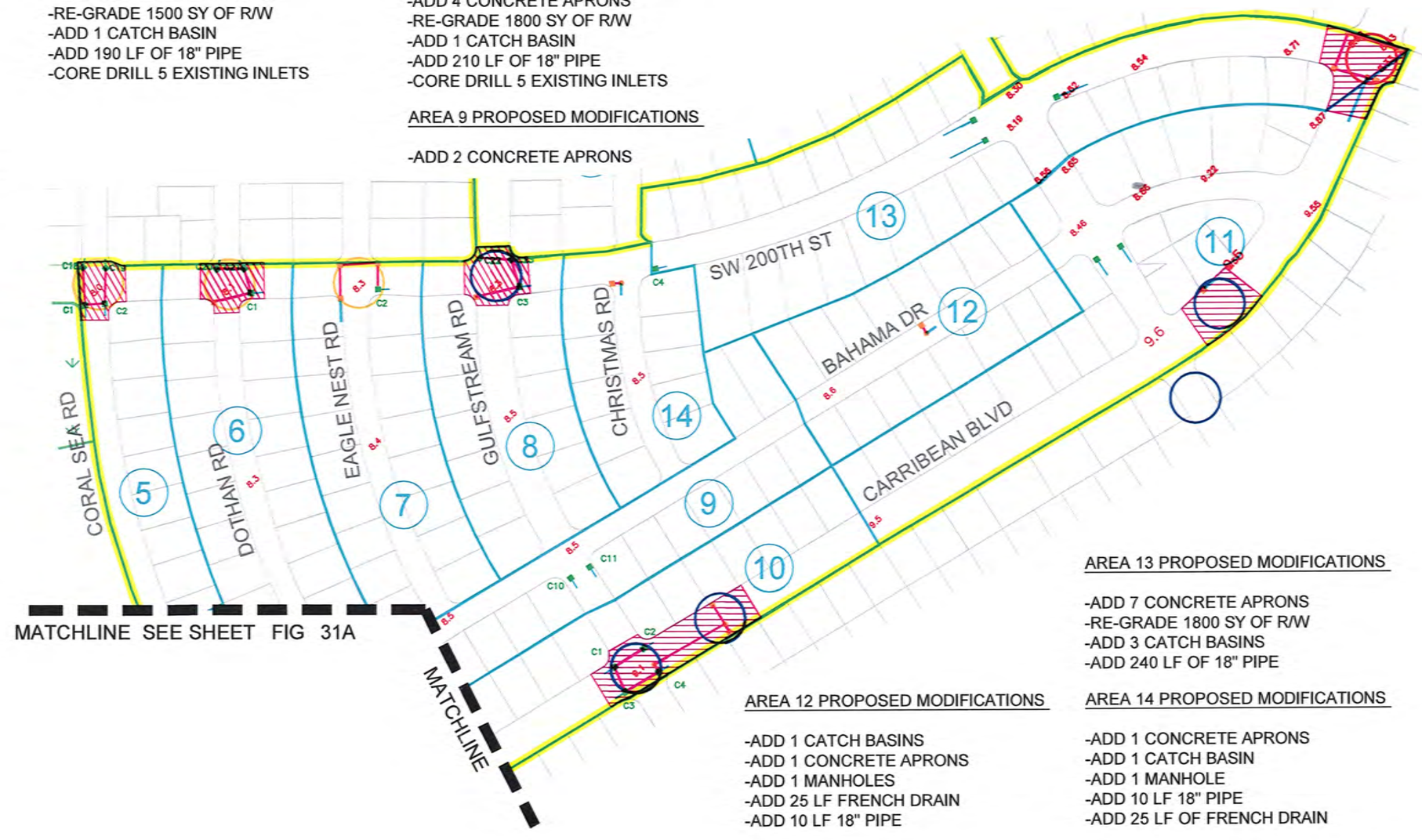
-ADD 2 CONCRETE APRONS

AREA 10 PROPOSED MODIFICATIONS

-ADD 6 CONCRETE APRONS
-RE-GRADE 3275 SY OF R/W
-ADD 2 CATCH BASINS
-ADD 2 MANHOLES
-ADD 465 LF OF 18" PIPE
-CORE DRILL 7 EXISTING INLETS

AREA 11 PROPOSED MODIFICATIONS

-ADD 2 CATCH BASINS
-ADD 4 CONCRETE APRONS
-ADD 2 MANHOLES
-ADD 130 LF FRENCH DRAIN
-ADD 30 LF 18" PIPE
-RE-GRADE 1550 SY OF R/W



AREA 13 PROPOSED MODIFICATIONS

-ADD 7 CONCRETE APRONS
-RE-GRADE 1800 SY OF R/W
-ADD 3 CATCH BASINS
-ADD 240 LF OF 18" PIPE

AREA 12 PROPOSED MODIFICATIONS

-ADD 1 CATCH BASINS
-ADD 1 CONCRETE APRONS
-ADD 1 MANHOLES
-ADD 25 LF FRENCH DRAIN
-ADD 10 LF 18" PIPE

AREA 14 PROPOSED MODIFICATIONS

-ADD 1 CONCRETE APRONS
-ADD 1 CATCH BASIN
-ADD 1 MANHOLE
-ADD 10 LF 18" PIPE
-ADD 25 LF OF FRENCH DRAIN

Drawing name: H:\...\jobs\043145000-Cutler Bay Stormwater MP\CADD\CIVIL\CONCEPT\FIG 31A-31B CUTLER RIDGE SEC 5 EAST-WEST.dwg FIG 31B CUTLER RIDGE SEC 5 EAST Feb 28, 2008 6:16pm by: jairo.castro

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TOWN OF CUTLER BAY STORMWATER MASTER PLAN

CUTLER RIDGE SEC 5 EAST SUB-BASIN

FIGURE 31B

Table 49. Cutler Ridge Section 5 Sub-basin – Performance Goal Analysis

Sub-basin Area	Water Quality	5-Year Storm	10-Year Storm	100-Year Storm	No Observed Flooding or Complaints
1	*Yes*	*No*	*No*	*Yes*	*No*
2	*Yes*	*No*	*No*	*Yes*	*No*
3	*Yes*	*No*	*No*	*Yes*	*Yes*
4	*Yes*	*Yes*	*Yes*	*Yes*	*No*
5	*Yes*	*Yes*	*Yes*	*Yes*	*No*
6	*Yes*	*No*	*Yes*	*Yes*	*No*
7	*Yes*	*No*	*No*	*Yes*	*No*
8	*Yes*	*Yes*	*Yes*	*Yes*	*No*
9	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
10	*Yes*	*Yes*	*No*	*Yes*	*No*
11	*Yes*	*No*	*No*	*Yes*	*No*
12	*No*	*No*	*No*	*Yes*	*Yes*
13	*Yes*	*Yes*	*No*	*Yes*	*No*
14	*No*	*No*	*No*	*Yes*	*Yes*

Storm Drainage Deficiencies

Maintenance: Several basins in this sub-basin were observed to be filled with debris and sediment blocking or highly restricting flow. The French drains have most likely been adversely impacted due to lack of maintenance.

Inadequate Drainage Infrastructure: Based on the hydrologic and hydraulic calculations for this sub-basin, the existing drainage infrastructure does not discharge adequate runoff to meet the desired performance criteria. The capacity of the existing swales and French drains is not sufficient to discharge the volume of runoff outlined in the performance criteria during the modeled storm events. Improvements to drainage infrastructure will be needed to address these inadequacies.

Lack of Positive Outfall: All areas of this drainage sub-basin do not connect to an outfall to a canal or lake.

Recommended Drainage Improvements

Maintenance: Clean and flush all sediment and debris from catch basins, pipe, and French drains.

Capital Improvements: Install the additional infrastructure depicted in *Figure 31.* Existing catch basins should be modified or reconstructed as required to provide sediment traps (sumps) and

pollution retardant baffles to protect the French drains and weir structures should be installed prior to each outfall to restrict the discharge of pollutants to the lake. In addition, additional French drain, catch basins, and manholes are proposed to provide water quality and water quantity treatment. Finally, concrete aprons can be installed around each of the catch basins to ensure that roadway runoff flow is not impeded by landscaping around the catch basins. The budget for these capital improvements is shown in *Table 51* on the following page.

Environmental Impact of Proposed Improvements

A full analysis of the estimated pollutant loading for existing, future and proposed conditions was prepared for the priority sub-basins utilizing a spreadsheet developed for this purpose which can be found in Appendix C. The table below shows how the proposed improvements will result in a significant reduction in the pollutant load contribution from this sub-basin to the lake for three major pollutants.

Table 50. Cutler Ridge Section 5 Sub-basin – Pollutant Loading Analysis

Pollutant	Existing Load (kg/yr)	Reduction (kg/yr)	Proposed Load (kg/yr)	Percentage Reduction
Total Phosphorous (TP)	45.38	42.05	3.34	92.7%
Total Nitrogen (TN)	357.55	320.01	37.54	89.5%
Total Suspended Solids (TSS)	4286.04	3881.01	405.03	90.6%

TP, TN and TSS are not the only pollutants in stormwater runoff. However, reducing these major pollutants typically correlates well to increases in dissolved oxygen levels and reductions in nitrogen compounds, phosphorous compounds, petroleum byproducts and heavy metals such as copper, lead, zinc and cadmium. The source of TP and TN is typically fertilizer and organic material (such as leaves and bird droppings) that find their way into the stormwater system. Allowing these nutrients to enter surface water allows for growth of algae and other aquatic organisms. Excessive aquatic organism growth depletes oxygen levels leading to a less favorable environment for fish and aquatic life. TSS refers to organic and inorganic sediment and debris. Reducing TSS loading decreases sedimentation. Since TSS includes petroleum byproducts and heavy metals, these pollutant loadings are also reduced when total suspended solids loading is reduced.

Table 51. Cutler Ridge Section 5 Sub-basin Capital Improvement Budget

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ Clearing and Grubbing	1	L.S.	$105,500	**$106,000**
2	Remove Existing Structure	0	Ea.	$500	**$0**
3	Inlet Pavement (7' x 7')	56	Ea.	$800	**$45,000**
4	Swale Inlet (Type C - P Bottom)	21	Ea.	$3,000	**$63,000**
5	Manhole	10	Ea.	$3,500	**$35,000**
6	Inlet Protection	56	Ea.	$30	**$2,000**
7	Floating Turbidity Barrier	0	L.F.	$12	**$0**
8	Core Drill Existing Inlets	43	Ea.	$500	**$22,000**
9	18" HDPE Pipe	2140	L.F.	$50	**$107,000**
10	French Drain	455	L.F.	$120	**$55,000**
11	Weir Structure	0	Ea.	$6,000	**$0**
12	Concrete Endwall	0	Ea.	$3,000	**$0**
13	Roadway Restoration	3,460	S.Y.	$40	**$139,000**
14	Regrading	14,655	S.Y.	$40	**$587,000**
15	Utility Adjustments	1	L.S.	$52,750	**$53,000**
16	Professional Services	1	L.S.	$158,250	**$159,000**
17	Contingency	1	L.S.	$211,000	**$211,000**
TOTAL					**$1,580,000**

Notes

1. Costs do not include inflation or interest costs. See CIP Summary for inflation adjusted budget.
2. Sequence of improvements should be coordinated with roadway CIP.

V. CAPITAL IMPROVEMENT PROGRAM

A. Background

Kimley-Horn prepared CIP budgets for the recommended improvements in each of the priority sub-basins to assist the Town in prioritizing and setting budgets required to plan, construct, operate, and maintain the Town's stormwater infrastructure. The CIP is intended to provide the basis for an expenditure budget for the Town's Stormwater Utility.

The proposed CIP is based on the findings of the assessment of existing drainage conditions within the Town and the detailed analysis of the 17 drainage sub-basins which were identified as priority basins. Two components of the CIP were identified: the operation and maintenance component and the capital improvements component.

The operation and maintenance component is based on the general assessment of the existing drainage conditions within the Town limits. The recommended operation and maintenance procedures are identified in this report, and the preliminary budget estimates are based on the implementation of these procedures on an annual basis.

The capital improvement component is based on the findings of the analysis of the 17 priority sub-basins. Recommended improvements to achieve the stated performance goals were identified for each sub-basin and were quantified based on the available data. Preliminary opinions of probable costs (preliminary budgets) were prepared for each sub-basin. Based on the preliminary budgets, the priority sub-basin improvements were grouped and phased to provide alternate five-year and ten-year capital improvement programs. The following is a detailed explanation and summary of each component of the CIP.

B. Operation and Maintenance Plan

The implementation of an operation and maintenance plan will allow the Town to maintain the integrity of its stormwater management system and ensure that it continues to operate at design capacity. An operation and maintenance plan will also prepare the Town to comply with the National Pollutant Discharge Elimination System (NPDES) as required by state and federal regulations. The Town has adopted Resolution 07-19 to become a co-permittee under the

Municipal Separate Storm Sewer Systems (MS4) permit for Miami-Dade County. The majority of the MS4 permit requirements are directly related to operation and maintenance of the stormwater infrastructure with particular emphasis on water quality pre-treatment. Periodic observations, routine maintenance, and general improvements are also required. This section of the Stormwater Master Plan is not intended to serve as a complete operation and maintenance manual, but to provide enough information to allocate sufficient budget to stormwater infrastructure operations and maintenance costs.

Inspecting and Maintaining Swales

Grassed swales play an important role in the storage, disposal, and water quality treatment of runoff from many of the roadways located in the Town of Cutler Bay. Consistent mowing of such features promotes stormwater retention and efficient percolation. The Town is responsible for maintaining swales and medians within public roadways and parking lots. Individual business owners and residents are mandated through local codes to maintain their facilities. Under the MS4 permit, the Town will be required to inspect all swales located within the Town twice per year for signs that they are not performing as designed. If inspections yield unsatisfactory results, maintenance activities such as sediment removal or restoring sod in the swales may be required. It is anticipated that swales will require restoration maintenance once every five years.

Inspecting and Maintaining Exfiltration Trench and Pipe Systems

Exfiltration trench (French drain) is important in the storage, disposal, and water quality treatment of stormwater runoff. Maintenance of exfiltration trench includes removing the sediment, oil, and grease that accumulate in the bottom of the catch basins attached to exfiltration trench and pipes to reduce the amount of these pollutants entering the pipe system and adversely impacting the exfiltration or outfall rate. Even with removal of sediment from the catch basins, over time sediment will build up in drainage pipes. Therefore, the pipes should be cleaned and flushed on a regular basis. Pipe flushing is typically performed in conjunction with catch basin cleaning and can be contracted out on an as-needed basis. During this activity, a high-pressure water hose is inserted into the pipe network. This process flushes debris into the catch basin where it can then be removed. Under the MS4 permit, the Town will be required to inspect all exfiltration trench operated by the Town twice per year. If inspections yield unsatisfactory results, maintenance activities such as sediment removal from catch basins and pipe flushing will be required. It is anticipated that sediment will need to be removed from the Town catch basins once every two years and drainage pipes will need to be cleaned and flushed once every five years.

Updating Maps and Inventories of Stormwater Management Infrastructure

As part of this Stormwater Master Plan, a GIS map of the drainage infrastructure located within the Town was created using information obtained from Miami-Dade County. It is recommended that this map be updated regularly to reflect the installation of new drainage infrastructure. An updated map of drainage outfalls is required to be submitted annually under the MS4 permit.

Implementing Roadway Litter Control and Street Sweeping Programs

Street sweeping and litter control programs are recommended to reduce the amount of debris entering the stormwater management system. This activity cleans intake structures, reduces debris deposition within the pipe network, and enhances the aesthetics of the Town. Generally, street sweeping is a positive maintenance activity that provides measurable benefits. Because pollutants such as hydrocarbons and metals adhere to dirt particles, removing this dirt from the street system will remove these pollutants before they are allowed to discharge into the Town's drainage system.

Complying with Public Outreach and Education Requirements

Public outreach activities and education required under the MS4 permit include:

- Providing education related to the application of pesticides, fertilizers, and herbicides
- Publicizing the Miami-Dade County pollution complaint hotline
- Instructing the public on the proper disposal of used motor oil, leftover hazardous household products, and lead acid batteries
- Conducting erosion control training for construction site inspectors and contractors

If the Town decides to become a member of the National Flood Insurance Program Community Rating System (CRS), it can receive credit for public outreach programs dedicated to informing the public about the risks of flooding and steps people can take to protect themselves and their property. Additionally property owners within the Town can receive a discount on flood insurance if the Town becomes a member of the CRS. The more credit the Town receives in the CRS, the higher the flood insurance discount.

Conducting Inspections and Monitoring Activities

Under the MS4 permit, the Town is required to conduct inspections of the following activities:

- Evaluating, monitoring, and inspecting waste treatment, storage, and disposal facilities
- Implementing an inspection program to detect illicit discharges and illegal connections to the stormwater management system

- Maintaining a citizen complaint log documenting illicit discharges
- Identifying and maintaining a GIS database of areas served by septic systems and advising the local health department of potential violations if constituents common to wastewater contamination due to malfunctioning septic tank systems are discovered
- Advising the appropriate utility owner of potential violation if constituents common to wastewater contamination are found in areas served by sanitary sewer systems
- Inspecting industrial and high risk facilities for illegal discharges into the MS4
- Requiring new construction sites to obtain NPDES permits from Department of Environmental Protection (DEP) prior to land clearing
- Monitoring water quality in the canals

Some of the tasks listed under this item can be performed by DERM. However, it will be the Town's responsibility to show that inspections and appropriate monitoring have been conducted. It is recommended that the Town continues to coordinate in becoming a co-permittees on the Miami-Dade County MS4 permit and enter into an agreement with Miami-Dade County to provide water quality monitoring in the canals. The County charges municipalities an annual fee for this service based on the number of outfalls located within the municipal boundaries. For the Town of Cutler Bay which has 69 outfalls, the estimated fee for 2007-2008 is $6,750.

Minor Repairs and Improvements

The final task conducted to maintain the stormwater collection system is routine improvements and repairs. This task covers a significant spectrum of activities ranging from the repair of collapsed pipes and manholes to the replacement of catch basin grates. Maintenance activities are performed in response to an immediate problem using the best methods available. These tasks often can not be foreseen or scheduled.

Operation and Maintenance Costs

Table 52 summarizes a budget of the annual cost associated with operation and maintenance of the stormwater infrastructure within the Town of Cutler Bay. As the maintenance activities are initiated, we recommend utilizing the database of GIS information to track and schedule the maintenance and inspection activities. This process will identify the date and time that a system was last maintained and will also provide a tool to identify the next scheduled maintenance.

Two of the budget line items provide personnel to oversee the operation and maintenance of the stormwater system. These items are "Professional Services" and "Stormwater Utility

Administration". The professional services item will include the preparation and oversight of contracting services such as pipe and inlet cleaning and street sweeping. The stormwater utility administration item includes general administration, clerical support, and program planning.

Because the Town adopted Resolution No. 07-18 assuming responsibility for the drainage system, a revenue source was identified to offset the costs associated with its operation and maintenance. The implementation of a stormwater utility will provide the Town with this revenue source. Procedures for implementing a Stormwater Utility within the Town of Cutler Bay were the topic of the Stormwater Utility Management Report.

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Table 52. Operation and Maintenance Budget

Item	Description	Sub-total
1	Catch Basin, Manhole & Exfiltration Trench Inspection and Cleaning	**$100,000**
2	Exfiltration Trench Cleaning / Pipe Flushing	**$65,000**
3	Street Sweeping and Litter Collection	**$70,000**
4	NPDES Permit Fees / DERM Monitoring	**$7,000**
5	Canal Maintenance / Joint Project Agreement with Miami-Dade County	**$107,000**
6	Swale Maintenance and Litter Program	**$80,000**
7	WASD Fee Collection	**$120,000**
8	Professional Services - Engineering and Legal	**$60,000**
9	Series 1992 and 2004 Stormawater Bonds, debt service	**$194,000**
10	Stormwater Utility Administration	**$117,000**
11	NPDES and FEMA Reports and Activities	**$15,000**
12	Minor Repairs and Improvements and Contingency	**$50,000**
13	Establish the Community Rating System (CRS) - FEMA Program	**$30,000**
14	Public Outreach and Workshops (NPDES and CRS)	**$15,000**
15	Staff Training (NPDES, CRS, and Stormwater)	**$5,000**
TOTAL		**$1,040,000**

C. Drainage Capital Projects

The Capital Improvement Program is based on the results of the analysis of the 17 priority sub-basins. Recommended improvements to achieve the stated performance goals were identified for each basin. The recommended improvements were quantified based on the available data and preliminary opinions of probable costs (preliminary budgets) were prepared for each basin. Prior to each individual project being implemented, professional services such as surveying, engineering, and permitting will be required and are included within the budgets. The budget figures were developed by reviewing recent costs from similar projects. The CIP budgets are based on 2007 dollars.

The following assumptions have been made in the formulation of the budgets for the drainage improvements:

1. The budgets include the recommended improvements identified in the analysis of the 17 priority sub-basins.
2. Projects were grouped by sub-basin.
3. The budgets include restoration of the roadway impacted by the proposed trenching, but do not include any additional roadway resurfacing. It is assumed that roadway resurfacing will be completed concurrently with the proposed drainage projects, but that the Town will have a separate roadway resurfacing budget.
4. The budgets do not include any costs of obtaining construction easements. A budget of $25,000 is included for obtaining easements when a new outfall is proposed.
5. The budgets include a 10 % allowance for mobilization and maintenance of traffic.
6. The budgets include a 20 % contingency for each project. A relatively high contingency value is used, due to the age and level of coverage of the survey and geotechnical data available to prepare the conceptual design for the projects.
7. The budgets include a minimum of $60,000 or 20 % of construction cost allowance for surveying, engineering, permitting, and construction phase assistance (site observations during construction).
8. The budgets include landscape costs to replace sod only. No budget for additional landscape improvements or restoration is included.

The budgetary numbers are an opinion of probable construction costs in the current marketplace. Unit pricing for similar projects constructed in Miami-Dade County was used as the basis for the construction budget. Based on the preliminary budgets, the proposed priority sub-basin improvements were grouped and phased to provide the alternative five-year and ten-year capital improvement programs.

Table 53 shows the priority ranking for the capital improvement projects. Each project was given a score between 1 and 5 in the categories of Observed Flooding, and Complaints. Scores were calculated for the categories of Hydraulic Analysis, Roadway Conditions, and Traffic Volumes. The basis for the calculated category scores are detailed below. The scores were then totaled and the projects were ranked from highest to lowest.

Table 53. Sub-basin Prioritization Matrix.

Priority Ranking	Sub-basin Name	Hydraulic Analysis	Water Quality Treatment	Observed Flooding	Complaints	Traffic Volumes	Total Score
1	SW 87th Avenue*	5	5	5	5	3	23
2	SW 97th Avenue*	5	5	5	5	3	23
3	Saga Bay 1.3	5	5	5	1	1	17
4	Saga Bay 1.5	5	5	5	1	1	17
5	Bel Aire Sec. 1.2	5	5	3	2	1	16
6	Bel Aire Sec. 5.2	4	5	4	1	1	15
7	Saga Bay 1.4	5	5	2	1	1	14
8	Saga Bay 1.1	4	5	1	3	1	14
9	Saga Bay 1.7	5	5	1	1	1	13
10	Pine Tree Manor Sec. 3	5	3	2	2	1	13
11	Cutler Ridge Sec. 5	3	2	2	4	1	12
12	Port Royale Sec. 5	4	1	3	1	1	12
13	Bel Aire Sec. 1.1	1	4	3	3	1	12
14	Saga Bay 1.8	4	4	1	1	1	11
15	Saga Bay 1.6	5	3	1	1	1	11
16	Saga Bay 1.2	2	2	4	1	1	10
17	Bel Aire Sec. 6	2	3	2	1	1	9

*Maintained by Miami-Dade County – Proposed improvements to be negotiated with County

Hydrologic and Hydraulic Analysis

1 = All water quantity performance goals met in future condition analysis.

2 = Future condition water quantity performance goals failed in less than 1/3 of drainage areas.

3 = Future condition water quantity performance goals failed in 1/3 to 1/2 of drainage areas.

4 = Future condition water quantity performance goals failed in 1/2 to all but one drainage area.

5 = Future condition water quantity performance goals failed in all of the drainage areas.

Water Quality Treatment

1 = All water quality performance goals met in future condition analysis.

2 = Future condition water quality performance goals failed in less than 1/3 of drainage areas.

3 = Future condition water quality performance goals failed in 1/3 to 1/2 of drainage areas.

4 = Future condition water quality performance goals failed in 1/2 to all but one drainage area.

5 = Future condition water quality performance goals failed in all of the drainage areas.

Complaints Scoring

1 = No complaints were reported by the Town of Cutler Bay.

2 = One complaint was reported by the Town of Cutler Bay.

3 = Two complaints were reported by the Town of Cutler Bay.

4 = Three complaints were reported by the Town of Cutler Bay.

5 = More than three complaints were reported by the Town of Cutler Bay.

Observed Flooding Scoring

1 = KHA did not observe flooding across the roadway in the sub-basin.

2 = KHA observed flooding across the roadway at one location in the sub-basin.

3 = KHA observed flooding across the roadway at two locations in the sub-basin.

4 = KHA observed flooding across the roadway at three locations in the sub-basin.

5 = KHA observed flooding across the roadway at more than three locations in the sub-basin.

Traffic Volumes

The ratings for this category are based on percentage of roadway length classified as local, collector, or arterial roadways according to the Town's Growth Management Plan.

1 = The majority of roadways in sub-basin are local roadways.

3 = The majority of roadways in sub-basin are collector roadways.

5 = The majority of roadways in sub-basin are arterial roadways.

The ten-year CIP summary is contained in *Table 54*. Please note that although the SW 97th Avenue Sub-basin and the SW 87th Avenue Sub-basin have the highest priority ranking scores due to a high number of citizen complaints and high traffic volumes, they are projected to be implemented in the 3rd and 4th years of the CIP due to the need to negotiate with Miami-Dade County in order to complete work in County right-of-way. The tables at the end of each of the individual sub-basin sections detail the budgets for the recommended drainage improvements for each sub-basin. *Table 52* details the operations and maintenance budget. The projects are recommended to be coordinated with the roadway CIP project scheduling to insure that the drainage improvements are complete before or at the same time as the roadway improvements in the same area. This may require some adjustment to the roadway CIP schedule.

Table 54. Ten-Year Capital Improvement Program Budget

PROJECT	FY 08-09	FY 09-10	FY 10-11	FY 11-12	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	TOTAL
SW 87th Avenue			$1,124,550								$1,124,550
SW 97th Avenue				$1,389,150							$1,389,150
Bel Aire Sec. 1.1									$1,211,513		$1,211,513
Bel Aire Sec. 1.2	$660,000										$660,000
Bel Aire Sec. 5.2					$546,978						$546,978
Bel Aire Sec. 6										$480,912	$480,912
Port Royale Sec. 5								$531,884			$531,884
Pine Tree Manor Sec.3						$497,750					$497,750
Cutler Ridge Sec. 5							$1,058,676	$1,111,609			$2,170,285
Saga Bay 1.1					$972,405						$972,405
Saga Bay 1.2										$449,885	$449,885
Saga Bay 1.3	$500,000										$500,000
Saga Bay 1.4						$191,442					$191,442
Saga Bay 1.5		$1,081,500									$1,081,500
Saga Bay 1.6									$263,726		$263,726
Saga Bay 1.7						$855,109					$855,109
Saga Bay 1.8										$372,319	$372,319
Operation & Maintenance Budget	$1,040,000	$1,065,000	$1,090,000	$1,115,000	$1,140,000	$1,165,000	$1,190,000	$1,215,000	$1,240,000	$1,265,000	$11,525,000
TOTAL	**$2,200,000**	**$2,146,500**	**$2,214,550**	**$2,504,150**	**$2,659,383**	**$2,709,301**	**$2,248,676**	**$2,858,493**	**$2,715,239**	**$2,568,116**	**$24,824,407**

Notes

1. Easements for outfalls must be verified and additional easements may be required.
2. Capital costs include escalation due to inflation of 5% per year.
3. Operation and maintenance budget includes $25,000 annual escalation due to inflation.
4. Sequence of improvements should be coordinated with roadway CIP.

Appendices