4.0 HYDRAULIC/HYDROLOGIC MODEL METHODOLOGY

To evaluate flooding problems that had previously been identified in the 1965 Master Plan, identify new flooding problems brought on by development in subsequent years, and to evaluate potential solutions for these problems, flood routing models were created for existing conditions and proposed conditions. The software selected for this modeling was Advanced Interconnected Channel and Pond Routing ("ICPR") Version 3.10 (© 2002, Streamline Technologies, Inc.). This software package is widely accepted for flood studies and permitting use by SWFWMD and other regulatory agencies in Florida.

Since the project to prepare this update of the 1965 Master Plan is roughly coincidental with the design of the Downtown Stormwater Capital Improvements Project (CIP), two separate models were developed at the same time. The first model covers only the downtown area and nearby areas that ultimately discharge to the pond located at Irvin Park, and is a subset of the second model, which covers the entire Dade City study area covered by this master plan update.

The downtown area model was used to finalize the design of the CIP, and the results were submitted in support of the ERP application with SWFWMD and the drainage connection permit application with FDOT. The full model was used to evaluate conditions throughout Dade City, and to determine conceptual-level alternatives for addressing identified flooding problems. For both models, existing conditions as well as proposed conditions were simulated.

4.1 General Methodology and Database Development

Model development for this project and the downtown CIP project was begun by extensive use of GIS data (current aerial imagery, topographic data coverages for city limits, land use types, soils data, etc) to divide the respective areas into a series of basins which could be input into ICPR. The topographic data used was 2-foot LIDAR data from SWFWMD – this data was also used to create a digital elevation model (DEM) for further analysis of the project areas. Data on the soil types in the area was provided by SWFWMD as well, while city limit and land use data were obtained from Pasco County. The City of Dade City provided information on storm sewer structures present within the city limits.

Once initial basins were established, AMEC personnel made a series of field visits to verify the structure data provided, and to update and edit it as required. This inventory has already been delivered to the City Public Works Department as an initial project deliverable.

Stormwater structures that were identified as key elements to be used in modeling were given more thorough review in order to accurately verify critical dimensions, assess structure condition, and to estimate elevations to a degree necessary to accurately model the study areas. Data collected from these field visits was input into the models.

Once key structures were identified and input into the model, a review of available plans for construction jobs within the study areas was made to refine the data input to the model. The plans that were made available were for the following projects.

- FDOT milling and resurfacing along State Road 533 (US Highway 301 Bypass), between the north and south junctions with US Highway 301.
- FDOT milling and resurfacing along State Road 39 (7^{th} Street), between the north and south junctions with US Highway 301.
- FDOT milling and resurfacing along State Road 52 (Meridian Avenue), between 21^{st} Street and State Road 533.
- City of Dade City Rails to Trails project.
- East Pasco County Government Center.
- City of Dade City Howard Avenue Drainage Improvement Project.
- City of Dade City Hendley Avenue Drainage Improvements.
- City of Dade City Main Avenue Drainage Improvements.

City Public Works Department personnel provided the pump specifications data for the stormwater lift station located at the Florida Avenue crossing of the multi-purpose recreational trail. Technical data for the stormwater lift station located at the Pasco Cogeneration Plant was provided by Plant personnel. Several attempts were made to contact the Pasco County Housing Authority to get technical data for the stormwater lift stations under their control, but there was no response to these queries.

The final source for model input data was as-built plans for relatively recent construction projects that were permitted by SWFWMD. These projects within the study area were identified by using GIS data maintained by SWFWMD. Once the permit numbers for these projects were determined, AMEC staff reviewed the Files of Record at SWFWMD and obtained copies of the required data from these files.

4.2 Hydrology

The hydrology of a basin is defined as its runoff response to rainfall within the basin. There are many factors that determine this response, including the size of the basin and the topography within it, the distribution and depth of the rainfall received the soil types present within the basin, and the amount and type of development within the basin. The presence of storm sewer systems, manmade conveyances such as canals or drainage ditches, and retention ponds and other stormwater control structures also affect the amount of runoff moving through a watershed.

ICPR allows for runoff volume calculations to be determined using the methodology developed by the US Soil Conservation Service (SCS) and outlined in Technical Release 55 (*Urban Hydrology for Small Watersheds*, Natural Resources Conservation Service, June 1986). This method is widely used by stormwater management professionals as it is relatively simple to determine the parameters required to calculate runoff volumes for individual basins, and because it generally yields good results. This methodology was used for modeling the Dade City downtown area, and the entire study area covered by this report. The hydrology parameters, and their development, are discussed below.

4.2.1 Curve Number (CN)

The curve numbers for the basins were determined using three main methods.

- Summing up the total area within the basin of different types of land cover and soil types and then calculating a composite CN using values from TR-55. This is the most rigorous method and yields the best results, especially with basins containing a large variety of different soil and land use types. This method was used for all but a very small number of relatively homogeneous basins.

  GIS aerial imagery was used to calculate an average area of buildings within a basin, as well as a total number of buildings within the basin, to determine the total area of impervious surface. Total area of roadways and driveways within individual basins were determined in the same way, but these values were used to calculate the percentage of directly connected impervious area (DCIA) within the basins. This is discussed in further detail below.

- Using calculated composite curve numbers found in TR-55 for various land uses, and then calculating a composite CN from these composites. This requires that accurate land use and soil data be available, and works best when a basin is relatively homogeneous (few different land use and soil types present). This method was used on a handful of basins that were medium-density residential land use types.

- For basins located in the downtown area, in particular the areas of Pasco Avenue and Meridian Avenue between 7th Street and 5th Street, as well as basins consisting of roadway segments of the US Highway 301 Bypass that reported to individual inlets, basins were assumed to be completely impervious and were assigned maximum curve number values of 98.

A very important component of total runoff volume generated by a basin with a large amount of urban development is DCIA, which is expressed as a percentage of the total area of the basin. This is defined as impervious surfaces within a basin that allow for uninterrupted flow to the basin"s storm sewer system and then to the outfall point for the basin, or runoff that does not flow over a pervious surface as it makes its way to the basin outfall point. In a heavily urban area, studies have shown that almost all runoff generated by a basin is that coming from DCIA. It is important to note that curve number calculations for a basin only include those portions of the basin that are not considered as DCIA and DCIA is treated separately in the ICPR model.

Typically, areas to be considered as DCIA are roadways with curb and gutter and/or inlet storm sewer systems, building rooftops with downspout drainage directed toward these roadways, driveways and parking lots with connections to the roadways, stormwater ponds and other reservoirs, etc. In a residential neighborhood, the usual practice is to consider the driveway and front of house roof drainage to be DCIA, while back of roof drainage and runoff from sheds, pool decks and other outbuildings is considered as impervious surface to be included in the calculation of the composite curve number for an area.

The above method was followed in the development of the Dade City models. The downtown and US Highway 301 Bypass areas noted above were assumed to be completely comprised of DCIA, and were assigned values of 100 percent. All ponds and other surface water bodies were also assumed to be 100% DCIA.

4.2.2 Time of Concentration

The time of concentration for a basin is defined as the amount of time required for runoff originating at the point of the basin that is most hydraulically distant from its discharge point to reach that point. The methodology for calculating this parameter is also detailed in TR-55 and was followed for the development of the Dade City models.

Under the TR-55 method, stormwater runoff over a surface experiences up to three separate flow conditions.

- Sheet Flow – water flows in a "sheet" like fashion over the entire surface, with the velocity of flow determined by the slope of the surface and the type of ground cover. This flow pattern is observed for a maximum distance of approximately 300 feet.

- Shallow Concentrated Flow – after the first 300 feet of travel, stormwater runoff tends to become concentrated into a "channelized" flow pattern that follows natural undulations and other low lying features on the surface. The primary factors in determining the flow velocity of shallow concentrated flow are the slope of the surface and the presence (or lack of) a paved surface over which runoff flows.

- Channel Flow – this represents the flow of runoff that has reached a manmade conveyance, such as a ditch, canal or pipe system. The flow velocity in this section is determined by application of Manning"s Equation, or another similar empirical formula. Not all basins will have these structures within them, and in this case shallow concentrated flow is assumed until the runoff reaches the outfall point for the basin.

Times of concentration for the basins were calculated by coding the formulas and methods outlined in TR-55 into a spreadsheet, and using GIS LIDAR and aerial imagery data to determine the flow paths of the most hydraulically distant points, as well as the slopes and distances for each type of flow described above. The minimum time of concentration used for any basin was 10 minutes.

4.2.3 Rainfall Depth and Distribution

ICPR contains an extensive library of simulated rainfall events, and allows for direct entry of total depth of rainfall for all storms within the library. Various regulatory agencies require different simulated rainfall events before issuing construction permits, and modeling storms of varying magnitude is critical for both establishing existing levels of service for an area, and for designing improvements meant to achieve a given level of service.

Storms are identified by duration and return period, with the depth of rainfall associated with each storm determined by extensive statistical analysis of historical rainfall patterns for an area. Duration is the measure of time (in hours) over which the rainfall occurs, while the return period (measured in years) is a measure of the frequency (on an annualized basis) at which a storm of particular intensity is expected to occur. As an example, a "100-year storm" is one with a one percent chance of occurring within any given year. This data is compiled and maintained by the various regulatory agencies charged with permitting construction projects.

For the purpose of obtaining the construction permit for the downtown CIP, and for determining existing and target levels of service, 24-hour duration storms for return periods of 2.33 years (the “mean annual storm”), 5 years, 10 years, 25 years, 50 years and 100 years were simulated. The rainfall depths associated with these storms are given in **Table 4.1** below.

Table 4.1
Rainfall Depths for Simulated 24-Hour Storm Events

RETURN PERIOD	RAINFALL DEPTH
2.33 Years	4.75”
5 Years	5.75”
10 Years	7.00”
25 Years	8.50”
50 Years	9.50”
100 Years	12.00”

The FDOT requires that a critical storm analysis for existing conditions be completed to issue permits authorizing connections to their drainage system. This process is used to identify the storm with the most significant impact to the FDOT system and to design the connecting system to that critical level of service. In FDOT District Seven (of which Pasco County is a part) this analysis requires a battery of 35 storms of varying durations and return periods be simulated using the Rational Runoff method. These storms are summarized in **Table 4.2** below.

An advantage of using this critical storm event analysis is that it uses shorter duration, high intensity rainfall events that may be more realistic to occur during a given year. As is noted later in this report, this is particularly useful for the downtown area analysis due to the lack of flood storage and the area‟s sensitivity to stormwater runoff peak rate.

Table 4.2
Rainfall Depths for Simulated FDOT Storm Events

RETURN PERIOD	STORM DURATION				
	1 Hour	2 Hour	4 Hour	8 Hour	24 Hour
2 Years	2.3”	2.8”	3.4”	4.2”	5.8”
3 Years	2.5”	3.2”	3.8”	4.8”	6.5”
5 Years	2.8”	3.5”	4.3”	5.3”	7.6”
10 Years	3.1”	4.2”	5.0”	6.2”	8.8”
25 Years	3.6”	4.7”	5.8”	7.3”	10.5”
50 Years	4.1”	5.3”	6.4”	8.0”	11.5”
100 Years	4.5”	6.0”	7.3”	9.2”	13.0”

4.3 Hydraulics

The hydraulics of a stormwater model are those elements which represent storage within the modeled system, as well as elements that serve to route runoff through the system until it reaches the boundary condition at the ultimate discharge point for the model. In ICPR these elements are represented by nodes and links. The nodes are established at basins, junctions and other areas of particular interest within the modeled area, and are connected to one another by links. Links used in the Dade City models include pipes, channels, pond control structures, weirs, overland features (roadway crowns, low-lying areas, etc.) that serve to allow water to move through the modeled system, and rating curves which represent the various stormwater lift stations that are present.

For the majority of nodes that have some capacity to retain and store stormwater runoff, stage-area relationships were developed in GIS using the developed basin boundaries and the digital elevation model created from the SWFWMD topographic LIDAR data. For the Irvin Pond, these relationships were developed from survey data and proposed excavation and embankment contours imported into or drawn in AutoCAD. Many nodes present in the model, particularly those representing portions of the downtown area and portions of the roadways, have no significant storage capacity and thus no stage-area data was entered for them.

Pipe, weir and control structure dimensions and elevations were taken from plans when available. Due to the size of the study area, it was not possible to survey or to take extensive measurements in the field of all stormwater structures and other drainage features included in the study area. However, these measurements were taken in areas judged as critical, and this field measurement data was used in conjunction with elevations determined from the Light Detection and Ranging (LIDAR) and digital elevation model (DEM), to provide dimensions and estimates of elevations. In other, non-critical areas, the DEM data was used along with best engineering judgment to estimate elevations of drainage features. Overland weir links representing surface drainage features were derived from the DEM data, when plan elevations were not available. All elevations were established in the North American Vertical Datum of 1988 (NAVD‟88).

In an attempt to calibrate the model to observed flooding conditions in the downtown area, rainfall information from Tropical Storm (TS) Debby (June 2012) was obtained using NEXRAD rainfall data. High water conditions observed along the US Highway 301 Bypass were obtained from this storm event and compared with the ICPR model using the TS Debby rainfall data. The model over predicted the peak stage along the highway by over 6”, therefore an infiltration node was added to the model to account for the large pervious area located to the north that is inundated during significant storm events. This area consists predominantly of well drained soils therefore a moderate infiltration rate was used in the model. The revised model results predicted peak stages adjacent to the highway to within (above) 0.3‟ of the observed peak stages and this was considered acceptable considering the limited amount of high water mark observations throughout the downtown area for this storm event.

Model calibration for the Beauchamp ponds (17th Street) was performed using a combination of trash lines observed from Tropical Storm Debby (described above) as well as a September 2004 storm described in Section 6.1. Starting water table elevations differed for the two storms since they occurred at different times during the wet season.

4.4 Boundary Conditions

The ultimate discharge point for all subwatersheds included in the Dade City study area is the Duck Lake System, which is part of the Withlacoochee River floodplain. The Duck Lake system consists of numerous manmade and natural lakes connected by wetlands and canal systems, with low sandy berms serving to isolate portions of the system from other portions during dry periods. This area was extensively studied and modeled during the 1980s, as part of a comprehensive stormwater management master plan for the watershed that was co-developed by SWFWMD and Pasco County in 1987.

The Duck Lake System is almost completely separated from the Dade City study by the presence of the CSX Transportation right-of-way, which runs in a southeast-to-northwest direction parallel to the alignment of County Road 35A (Old Lakeland Highway) and the US Highway 301 Bypass in the vicinity of Dade City. The railroad bed elevation is very high compared to the adjacent area, and connects the Dade City stormwater system to the Duck Lake System at only a few cross drain structures under the railroad alignment. Therefore, the alignment effectively serves as a dam, severely impeding the movement of drainage flows between the two systems.

The 1987 Duck Lake Master Plan identified the major cause of flooding within the Duck Lake System as flood waves developing along the Withlacoochee River during major storm events. These waves, or peaks in flood elevation, create backwatering to the Duck Lake system and through the culverts leading to the Dade City system. This results in very high tailwater conditions when the Withlacoochee is running near peak flood stage.

The typical practice for modeling a stormwater system is to establish the tailwater at the 100-year flood elevation for the area. However, in the case of Dade City, this elevation is 77.2± feet NAVD, which would result in much of the study area being several feet underwater when any simulation begins. This was judged as being impractical as it would not yield useful results for the majority of storm events and would reduce the potential of finding drainage bottlenecks within the conveyance systems. Additionally, the comparison of existing verses conceptual future flood control projects could be less useful. Therefore, the tailwater condition for the model was established at the seasonal high water table elevation of 68.3 ft. NAVD previously determined by AMEC staff for the purpose of updating this master plan, and for the purpose of obtaining the SWFWMD permit for the downtown CIP. For FDOT permitting, the seasonal high water table elevation was used as a boundary condition for existing conditions; however, for proposed conditions, FDOT requires that the tailwater be established at the elevation of the proposed weir for the retrofitted Irvin pond, (69.8 ft. NAVD).

5.0 FLOODING LEVEL OF SERVICE DESIGNATIONS

The City of Dade City Comprehensive Plan, Infrastructure Element contains definitions for Stormwater Drainage level of service (LOS) designations (**Table 5.1**). According to these definitions, a storm return period and duration (i.e. 25-year/24-hour) is used as the criteria for the LOS rating. The flood level designations contained in the Comprehensive Plan are Excellent, Good, Satisfactory, Poor and Unsatisfactory with Excellent being the highest level and Unsatisfactory being the lowest. These criteria are somewhat subjective and quantitative criteria by which to assign LOS designations could be useful.

Table 5.1
City of Dade City Comprehensive Plan
Stormwater Drainage LOS Standards

Rating	Stormwater Drainage Level of Service
Excellent	No flooding or property damage during significant 25 year- 24 hour storm event
Good	Only very minor flooding and no property damage during significant 25 year- 24 hour storm event
Satisfactory	Periodic minor flooding for a few hours and no property damage during a 25 year- 24 hour storm event or a 10 year- 1 hour storm event
Poor	Chronic flooding and minor property damage (yards, not building flooding) during a 25 year- 24 hour storm event
Unsatisfactory	Chronic flooding and minor property damage and disruption of traffic flow during a 25 year- 24 hour storm event

The Comprehensive Plan identified the majority of the City as having a "Satisfactory" rating for stormwater drainage under existing conditions with 3 exclusions. The excluded areas include the Whitehouse Avenue area, the Howard Avenue area and the Tank Lake area. These three areas generally match up with the areas designated as Area 1, Area 2 and Area 3, respectively, of this report. The City of Dade City has a goal of achieving a consistent stormwater drainage level of service Citywide. As such, this goal must be definable and clearly understood. **Table 5.2** attempts to take the Comprehensive Plan definitions for Stormwater Drainage LOS, interpret them and present them in a manner that achieves the goal stated herein. The Stormwater Master Plan uses these designations throughout this report to allow for comparison of the stormwater drainage ratings for existing problem areas as well as for the conditions after a concept capital improvement project is implemented.

It is important to note that there are some conditions where physical or environmental constraints prohibit the achievement of the level of service goals. As an example, flooding associated with the backwater effects of the Withlacoochee River will continue to impact roads and properties in the southern and eastern portions of the City. The flood stage associated with the Withlacoochee River cannot practically be altered by any efforts of the City; therefore the existing LOS will continue to remain in effect. It is expected that any redevelopment of infrastructure within those areas of the City would be implemented compliant with current regulations and codes and the LOS for those elements would change at that time.

Table 5.2
Level of Service Definition Interpretations

Comprehensive Plan Rating	City Comprehensive Plan Definitions	Master Plan Interpretation- LOS Description	Master Plan Interpretation- LOS Rating
Excellent	No flooding or property damage during significant 25 year- 24 hour storm event	No flooding	A
Good	Only very minor flooding and no property damage during significant 25 year- 24 hour storm event	Street flooding is 3" or less above the crown	B
Satisfactory	Periodic minor flooding for a few hours and no property damage during a 25 year- 24 hour storm event or a 10 year- 1 hour storm event	Street flooding is more than 3” above the crown of road, but less than 6”	C
Poor	Chronic flooding and minor property damage (yards, not building flooding) during a 25 year- 24 hour storm event	Street flooding is more than 6” above the crown of road, but less than 12”	D
Unsatisfactory	Chronic flooding and minor property damage and disruption of traffic flow during a 25 year- 24 hour storm event	Structure flooding; Street flooding is more than 12” above the crown of road	F

The LOS standards discussed to this point are typically associated with systems in lower-lying areas where water tends to collect and where flow velocities are typically not high. Since flooding in the City"s downtown area has more of a flow velocity component to it, the current LOS standards fail to address this issue. As an example, three inches of standing water over the centerline of a roadway is passable by vehicular traffic and is an annoyance to pedestrians. However, when there is 3 inches of water over one of the downtown streets, this means there is approximately 6 inches of water depth near the curb line. Since the downtown area is built on a sloped land surface, there is movement of the stormwater along the streets and sidewalks. This movement of water is rapid and can potentially be dangerous particularly to pedestrians. In addition, waves caused by traffic movement can cause property damage to parked vehicles and structures due to their close proximity to the roadways. In consideration of these facts, it is prudent for the City to consider a modified version of the LOS standards presented in **Table 5.2** to apply to the downtown and other areas of town where appropriate. Based on the modeling analyses conducted for the downtown area, the addition of a design storm event using the rational methodology is recommended as part of the City"s standard. The 10 year- 1 hour storm was previously mentioned in the City"s Comprehensive Plan and Drainage LOS and it is recommended that the Comprehensive Plan be modified to incorporate this design storm fully into the LOS definition.

Table 5.3
Drainage Level of Service for Downtown and Business Areas[1]

Comprehensive Plan Rating	City Comprehensive Plan Definitions	Master Plan Interpretation- LOS Description	Master Plan Interpretation- LOS Rating
Excellent	No flooding or property damage during significant 25 year- 24 hour storm event or a 10 year- 1 hour storm event	No flooding	A
Good	Only very minor flooding and no property damage during a 25 year- 24 hour storm event or a 10 year- 1 hour storm event	Street flooding is 3" or less above the curb line	B
Satisfactory	Periodic minor flooding and no property damage during a 25 year- 24 hour storm event or a 10 year- 1 hour storm event	Street flooding is 3" or less above the crown	C
Poor	Chronic flooding and disruption of traffic flow during a 25 year- 24 hour storm event or a 10 year- 1 hour storm event	Street flooding is more than 3” above the crown of road, but less than 6”	D
Unsatisfactory	Chronic flooding and minor property damage and disruption of traffic flow during a 25 year- 24 hour storm event or a 10 year- 1 hour storm event	Structure flooding; Street flooding is more than 6” above the crown of road.	F

[1] This drainage LOS standard is to apply to lands having sufficient topography to shed water quickly and that flood waters recede within a matter of minutes after the end of the storm. The criteria is meant for highly impervious areas such as the City's downtown core area where shallow flood depths move with sufficient velocity that safety to pedestrians or property damage from waves becomes an issue.

The “Satisfactory” LOS or an equivalent LOS rating of “C” is considered the goal of the City based on the adopted Comprehensive Plan. The goal of any stormwater capital improvement projects proposed in this Stormwater Master Plan is therefore to achieve this LOS rating and to accommodate a 25 Year- 24 Hour design storm (8.5”) to the level of protection shown in **Table 5.2**. For the downtown area and other similar sections of the City, the levels of protection standards shown in **Table 5.3** are recommended and are used in this report**.**

6.0 SUMMARY OF MODELING RESULTS – EXISTING CONDITIONS

The design storm events simulated in the developed stormwater models are listed below. Please refer to **Table 4.1** for rainfall amounts associated with these storms.

- 2.33-Year, 24 Storm Event (Mean Annual Storm Event)
- 5-Year, 24-Hour Storm Event
- 10-Year, 24-Hour Storm Event
- 25-Year, 24-Hour Storm Event
- 50-Year, 24-Hour Storm Event
- 100-Year, 24-Hour Storm Event

For the downtown area, the 2-Year, 1-Hour and 10-Year, 1-Hour design storm events were used to provide an assessment of short intense rainfall events. The results of the existing conditions modeling are briefly summarized below for each of the four subwatersheds evaluated for this report.

6.1 Area 1 Subwatershed

Area 1A - West of 17^{th} Street

As previously discussed in Chapter 3, this area is isolated from the rest of the subwatershed under most conditions, with the low point at two interconnected ponds located at the southeast and northeast corners of the intersection of 17^{th} Street and Beauchamp Avenue. The ponds have a nominal top-of-berm elevation between 72.0 and 72.5 ft. NAVD, with a low point elevation on Beauchamp Avenue of 74.3± feet NAVD. The lowest roadway elevation on 17^{th} Street in the vicinity of the ponds is 78.8± feet NAVD.

Peak flood stages for this area for the design storms are summarized in **Table 6.1** below.

Table 6.1
Peak Flood Stages – East of 17th Street

STORM EVENT	PEAK STAGE, FT. NAVD	LEVEL OF SERVICE (BEAUCHAMP AVE.)
2.33-Year, 24-Hour	73.93	-
5-Year, 24-Hour	74.86	-
10-Year, 24-Hour	76.03	-
25-Year, 24-Hour	77.44	F
50-Year, 24-Hour	78.31	-
100-Year, 24-Hour	79.9	-

Because this area is isolated from the rest of the study area, early attempts to model it resulted in unrealistically high peak stages being predicted by ICPR. To yield more realistic results, the Perc Pack feature in ICPR was used to simulate infiltration into the ground at the ponds located on the north and south sides of the intersection of Beauchamp Avenue and 17th Street. According to City Public Works personnel, structure flooding to a depth of approximately 6 inches to 1 foot above floor elevation was noted at the abandoned duplex structure located at 37293 Beauchamp Avenue during the 2004 hurricane season. AMEC field staff determined the floor elevation of this structure (approximately 77.0 ft. NAVD), and this elevation, along with rainfall data for a 48 hour period spanning September 4 through September 6, 2004 (8.13 Inches) was used to adjust the infiltration parameters in ICPR and calibrate the model.

Beauchamp Avenue between 15th Street and 17th Street can be expected to experience substantial flooding in the area between the two ponds and on the adjacent properties under almost all major storm events – the severity of this flooding would be highly dependent on such factors as the initial water level within the ponds, as well as antecedent moisture conditions in the soil. Therefore flooding problems are only expected in wetter than normal years. The presence of large oak trees in the area suggests, however, that flooding is relatively short- lived as excess runoff is removed via infiltration through the well-drained sandy soils.

The ICPR modeling suggests that minor, short-lived street flooding occurs near the intersection of 17th Street and Goldenrod Court, to the east of the ponds, for the 25-year, 24-hour and larger storm events. Minor structure flooding may occur in this location with the 100-year, 24-hour rainfall event. The previously noted duplex floods as well for the 25-year, 24-hour and above storm events.

Area 1B - 14th Street and 15th Street between Main Avenue and North Avenue

Please refer to **Table 6.2** below for a summary of peak modeled stages. The most significant areas of concern are the backyard channel that runs south-to-north between Davis Avenue and North Avenue, between 15th Street and Osceola Street, as well as North Avenue between 15th Street and 14th Street.

Table 6.2
Peak Flood Stages – 14th Street and 15th Street Area

STORM EVENT	PEAK STAGE, FT. NAVD	LEVEL OF SERVICE
2.33-Year, 24-Hour	73.4	-
5-Year, 24-Hour	73.6	-
10-Year, 24-Hour	73.9	-
25-Year, 24-Hour	74.1	D
50-Year, 24-Hour	74.1	-
100-Year, 24-Hour	74.5	-

Street flooding of a short segment of North Avenue occurs at elevation 73.3±feet NAVD. Topography in the neighborhood is such that most yards do not flood in the neighborhood, however there has been flooding on the south side of Davis Avenue. 14th Street does not flood under the modeled design storm event considered.

Area 1C - Tommytown Area

Peak flood stages are summarized in **Table 6.3** below.

Table 6.3
Peak Flood Stages – Tommytown Area

STORM EVENT	PEAK STAGE, FT. NAVD	LEVEL OF SERVICE
2.33-Year, 24-Hour	71.4	-
5-Year, 24-Hour	71.8	-
10-Year, 24-Hour	72.4	-
25-Year, 24-Hour	73.0	F
50-Year, 24-Hour	73.4	-
100-Year, 24-Hour	74.5	-

The potential for flooding in this area is the highest at the Pasco County Housing Authority complex located along Acorn Loop which explains why the PCHA installed the stormwater lift stations. Oakview Circle located on the east side of 14th Street has a low road elevation of 72“± NAVD in the cul-de-sac area and is subject to flooding. Flooding of the 14th Street roadway in this area does not occur under any modeled storm event.

It should be noted that no data was provided for the PCHA-owned lift station at the Acorn Loop property. It is our understanding that this lift station is manually controlled, and that it is turned on by PCHA staff whenever any significant rainfall occurs in the Dade City area. This lift station removes water from the pond located at the southeast corner of the property and discharges it to the ditch across 14th Street, where it is eventually discharged to the pond located on the City-owned property at Whitehouse Avenue by means of another lift station. No data was made available for either of these PCHA lift stations.

During Tropical Storm Debby, which dumped 8 inches in 24 hours according to NEXRAD rainfall data, the Dade Oaks Apartments complex was inundated with floodwaters and it took a significant amount of time to pump the excess waters out to where the floodwaters were at a manageable level.

Area 1D - Whitehouse Avenue Area

Peak flood stages are summarized in **Table 6.4** below.

Table 6.4
Peak Flood Stages – Whitehouse Avenue Area

STORM EVENT	PEAK STAGE, FT. NAVD	LEVEL OF SERVICE 10TH Street/11TH Street
2.33-Year, 24-Hour	73.5	-
5-Year, 24-Hour	73.9	-
10-Year, 24-Hour	74.4	-
25-Year, 24-Hour	74.8	F
50-Year, 24-Hour	75.2	-
100-Year, 24-Hour	75.5	-

Flooding of Whitehouse Avenue in the vicinity of 11th Street occurs at a peak stage of 73.0± ft. NAVD, and flooding in the vicinity of 10th Street occurs at stages below 72.0± ft. NAVD. Two significant items of interest were noted by the modeling results for this portion of the subwatershed.

1. Only a minimal exchange of floodwaters was observed between the Whitehouse Avenue pond and the large wetland area to the west of the pond, which is the northerly part of the Cox Elementary School parcel. This lack of flow exchange is due to the presence of a relatively high berm (elevation above 75.0 ft NAVD) between these two features. This berm is the remnant of the railroad bed for the old Seaboard Air Line railroad.
2. A significant amount of flow was observed coming into the Whitehouse Avenue pond from the FDOT right-of-way for State Road 39 and State Road 533, located immediately east of this area. This flow enters the pond through

a 24” cross drain underneath 8th Street just south of the Dade Village Shopping Center and then enters a ditch which runs along the south side of the shopping center property. This ditch discharges to a small storm sewer system which conveys runoff to the Whitehouse pond. This appears to be a designed outfall from the roadways to the east based on the lower invert at the ditch than at the highway.

The FDOT right-of-way and the railroad bed noted above effectively create hydraulic “high points” on either side of the 10th Street ditch system. This limits flood relief during periods of high stages as a result of rainfall events.

Area 1E - FDOT Right-of-Way and Pasco Cogeneration Lift Station

Peak flood stages are summarized in **Table 6.5** below.

Table 6.5
Peak Flood Stages – FDOT Right-of-Way

STORM EVENT	PEAK STAGE, FT. NAVD	LEVEL OF SERVICE SR 533/ 7TH Street
2.33-Year, 24-Hour	74.4	-
5-Year, 24-Hour	74.8	-
10-Year, 24-Hour	75.3	-
25-Year, 24-Hour	76.0	A/A
50-Year, 24-Hour	76.3	-
100-Year, 24-Hour	77.4	-

The right-of-way for State Road 533 does not flood under any of the modeled design storm events. A small section of 7th Street (currently operated by the City) will flood during the 100 Year design storm event however it is estimated only 1 southbound lane should be affected (based on elevations from the Lidar coverage). Roadway flooding in this area occurs at Citrus Country Drive (Old State Road 23) in the vicinity of the Pasco Cogeneration Plant. This plant maintains an automated stormwater lift station to discharge stormwater easterly under the CSX tracks and into the Dade City Canal system.

6.2 Area 2 Subwatershed

Downtown Area

Street flooding is estimated to occur at numerous locations throughout the downtown area under all simulated storm events. Peak stages at key locations are given in **Table 6.6** below. The listed design storms vary slightly in this table with the 2 Year- 1 Hour design storm (2.3 inches of rain in 1 hour) and the 10 Year- 1 Hour design storm (4.2 inches of rain in 1 hour) considered. Assessment of flooding from these storms is more practical because they represent more critical storm events for the downtown conditions which include limited storage and greater sensitivity to stormwater runoff rate. It is noted the City has adopted the 10 Year- 1 Hour design storm event in its LOS standards as noted in Chapter 5.

Table 6.6
Peak Stages- Downtown Area

LOCATION	SURFACE FLOODING ELEV. (FT. NAVD)	PEAK STAGE (FT.NAVD)					
		2.33Y/24H STORM	5Y/24H STORM	10Y/24H STORM	25Y/24H STORM	2Y/1H STORM	10Y/1H STORM
Pasco Ave & 7th St.	97.66	97.9	98.0	98.0	98.0	98.0	98.0
6th Street between Pasco Ave. & Meridian Ave.	92.76	92.6	92.8	93.1	93.4	92.7	93.1
Meridian Ave. between 6th St. & 7th St.	92.40	92.3	92.8	93.1	93.4	92.7	93.1
Meridian Ave. & 5th St.	92.30	92.3	92.8	93.1	93.4	92.7	92.8
Live Oak Ave. & 6th St.	87.00	87.6	87.7	87.8	87.8	87.6	87.8
Live Oak Ave. & 5th St.	86.00	86.1	86.2	86.2	86.3	86.2	86.2
7th St. & Madill Ave.	79.00	77.5	78.9	79.6	79.9	79.3	79.8
6th St. & Madill Ave.	75.70	75.1	75.5	76.4	76.6	75.0	75.6

Note:
Surface flooding elevation is the estimated roadway centerline elevation using, in most cases, the aerial digital elevation model which has a potential error of 0.3' ±. Only in locations of the topographic survey for the downtown area was the roadway centerline obtained to topographic survey standards.

The intent of using the 1-2 hour design storms is evident by review of the predicted flood depths along Pasco Avenue, Meridian Avenue and 7th Street. Similar conditions have been observed during rainfall events observed during the course of this project. Flooding within the downtown Dade City area is reported as a chronic problem, and the downtown CIP, discussed in more detail in later sections of this report, has been proposed to help alleviate the flooding. A summary of the estimated levels of service for downtown areas is noted in **Table 6.7**.

Table 6.7
Level of Service for Downtown Area

LOCATION	LEVEL OF SERVICE RATING (25 YR- 24 HR DESIGN STORM)	LEVEL OF SERVICE RATING (10 YR- 1 HR DESIGN STORM)
Pasco Ave & 7th St.	D	D
6th Street between Pasco Ave. & Meridian Ave.	F	D
Meridian Ave. between 6th St. & 7th St.	F	F
Live Oak Ave. & 6th St.	F	F
Live Oak Ave. & 5th St.	C	C
7th St. & Madill Ave.	F	F

6.3 Areas 3 and 4 Subwatersheds

No street or other flooding was observed under existing conditions with any simulated storm event in these areas based on the level of detail of the model in those areas. This is consistent with the lack of any documented complaints received by the City from property owners within these subwatersheds. It is noted that the actual Tank Lake receiving system (topographic low) is not included within the limits of the model. Flooding based on flood conditions of the Withlacoochee River were not modeled in this report but will impact portions of the areas within problem Areas 3 and 4.

The City has received complaints regarding several dead end canals located near Ferguson Avenue due to the stagnant water that exists at these locations. In 2001, URS provided alternatives to the City on filling these areas. It was noted in the 2001 report that the City had met with SWFWMD and that the District indicated floodplain compensation would be required. AMEC was not able to confirm a seasonal high water table (SHWT) elevation for these areas and the following recommendations hinge on that the assumption that the canals are dug below the SHWT. Assuming SWFWMD would not claim these areas as jurisdictional areas requiring mitigation, fill could be placed below the seasonal high water table elevation and not adversely affect the floodplain. The fill could be graded such that stormwater would be able to flow positively toward the adjacent lake system.

The current downtown improvement CIP may result in floodplain compensation and may be potentially available for use toward these areas if, indeed, fill is placed within the floodplain to accomplish the above improvements.

7.0 EXISTING ENVIRONMENTAL REGULATIONS AND EXISTING WATER QUALITY CONDITIONS

Since the time that the 1965 Master Plan was prepared, many environmental regulations have been adopted at the State and federal level. This section briefly describes the regulations applicable to storm water and also addresses the water quality ratings/condition of surface waters within or immediately adjacent to the City limits.

7.1 Federal Regulations of Stormwater

The Federal Water Pollution Control Act (FWPCA) of 1948 was amended in 1972 and then in 1977 and became known as the Clean Water Act (CWA). The intent of the CWA was to restore and maintain the chemical, physical and biological integrity of waters of the United States. The CWA is under the regulatory authority of the Environmental Protection Agency (EPA).

The 1972 amendments to the FWPCA resulting in the establishment of the National Pollutant Discharge Elimination System (NPDES) permit program to control pollutant discharges from point sources. This was primarily focused on industrial point sources and municipal sewage discharges, which at the time had limited treatment requirements prior to discharge to U.S. Waters (USW).

As the quality and extent of discharges from industrial and municipal wastewater plants were improved throughout the country, the emphasis on pollution control turned to stormwater discharges. The EPA funded a number of studies under the National Urban Runoff Program to study the characteristics of urban stormwater runoff from Municipal Separate Storm Sewer Systems (MS4s). The studies showed that urban stormwater contained many of the same pollutant constituents associated with the two regulated discharges noted above. Many of the observed stormwater concentrations exceeded the water quality standards established by EPA for surface waters. In 1987, Congress authorized EPA to regulate a select high priority group of stormwater discharges as classified below:

1. Facilities already covered by an NPDES permit;
2. Facilities engaged in industrial activity;
3. Large MS4s (>250,000 population);
4. Medium MS4s (100,000 < population < 250,000);
5. Facilities deemed "significant contributors" of pollutants to USW and contributing to violations of water quality standards.

The stormwater application rule was published in the federal register on November 16, 1990. The "stormwater implementation rule" of April 1992 was subsequently published in the Federal Register and it described the steps for implementation of the NPDES MS4 permitting program. The high priority groups are known as "Phase I" entities and Pasco County, FDOT and the incorporated places (cities) within Pasco County including Dade City were noticed as being regulated by this rule. Large (>5 acres) construction activities were included for regulation under the Phase I rules. It is noted that since 1992, additional categories of stormwater discharges are now regulated under NPDES including the following:

- “Light” industrial activities (see Multi-Sector Industrial NPDES permits);
- “Small” construction activities (>1 acre<5 acres);
- “Small” MS4s (<100,000 population).

EPA authorized the State of Florida via the Florida Department of Environmental Protection (FDEP) to implement the NPDES stormwater permitting program. The specific MS4 permit requirements that have the greatest impact to the City‟s management of stormwater are discussed in Chapter 9 of this report.

Part of the federal CWA established the Total Maximum Daily Load (TMDL) process to guide the application of state water quality standards to individual water bodies. Water quality standards are established to protect the beneficial uses of USW which may include protection for aquatic life, protection for drinking water quality, protection for ensuring the waters are fishable and swimmable, etc. A TMDL is defined as the maximum pollutant loading that a water body can receive and still meet water quality standards. EPA‟s TMDL process establishes an assessment and planning framework for identifying pollutant load reductions or other required actions needed to attain water quality standards. The TMDL process generally consists of the following three steps:

1. Every state must identify and prepare a list (“303(d) list”) of water bodies or water body segments that do not or are not expected to meet State water quality standards after applying existing required controls.
2. Every state must prioritize the water bodies on the 303(d) list for TMDL development.
3. Every state must develop a TMDL for every water body on the 303(d) list. The State of Florida has a process for listing impaired waters and TMDL development and implementation and it is established under Chapter 99-223, Laws of Florida.

Perhaps the most important element of a TMDL is that addresses all significant pollutant contributors to an impaired water body. This includes stormwater point sources such as the City‟s MS4 discharges. An established TMDL will specify individual pollutant load allocations to the various sources and will specify a required reduction of those sources, when required. The City must maintain constant involvement in the State‟s TMDL program to ensure it provides as much input to FDEP as possible regarding any proposed TMDL that may require a reduction in the pollutant load from the City‟s MS4 system.

7.2 State of Florida Regulations of Stormwater

The State of Florida initially enacted stormwater regulations in 1979 through Chapter 17-4.248, FAC and later in 1982 through Chapter 17-25, FAC which today is encompassed under Chapter 62-25, FAC. The regulations included technology-based standards such as retaining ½ inch of stormwater runoff from a newly developed site for dry retention systems. The State indicates that there is a presumption of compliance with State Water Quality standards (WQS) when a designed stormwater system meets the adopted technology based standards.

Many water quality monitoring studies have been conducted since 1982 and there is clear evidence that the State"s current technology based standards do not result in compliance with WQS. FDEP is currently working on updating the technology based standards and most recently published a draft to that effect with the *Environmental Resource Permit Stormwater Quality Applicant's Handbook* (FDEP and the Water Management Districts, March 2010). Although FDEP has not adopted any new regulations inclusive of this modified technology based standards, the methodology has been adopted as "best available technology" and is required to be used when a new/altered stormwater discharge is proposed in 303(d) listed waters.

7.3 Southwest Florida Water Management District (SWFWMD) Regulations of Stormwater

In 1984, the SWFWMD began to require permits for stormwater quantity on new development to control downstream flooding. New development would have to evaluate what the peak rate of discharge of stormwater was from a site in pre-improvement conditions (allowable rate) and would have to control the post development rate to the allowable rate. This regulation was directed at controlling downstream flooding due to the addition of imperviousness and stormwater conveyance systems that remove flood waters in a rapid manner on newly developed sites. The regulatory design storm is the 25 year- 24 hour design storm which is a rainfall event of approximately 8.5 inches. This regulation applies to "open" basins where the receiving system is not landlocked with any discharge downstream. For "landlocked" or "closed" basins, the criteria includes not discharging any more volume in post-development than pre-development for a 100 year design storm (12± inches in 24 hours).

This permitting program was initially referred to as "Management and Storage of Surface Waters" or MSSW permitting, however today it is known as "Environmental Resource Permitting" (ERP). The ERP program includes permitting of new development (or altering existing systems) for wetlands impacts, flood design permitting as noted above and water quality permitting as described in the following paragraph.

Since SWFWMD was permitting new development inclusive of the Dade City area, the FDEP authorized SWFWMD to provide water quality permitting under Chapter 17-25, FAC. Initially SWFWMD permitted only "exemption notices" for dry retention systems however FDEP gradually authorized SWFWMD to permit non-dry retention systems and the ERP program eventually incorporated water quality regulations, in conformance to the State requirements. The current SWFWMD regulation is adopted as Chapter 40D-4, 40D-40 and 40D-400, FAC. Today, FDEP only serves as the storm water quality permitting agency for a select few projects in which FDEP is already the permitting lead or SWFWMD is the permit applicant.

7.4 City of Dade City Stormwater Regulations

The City of Dade City has slightly different stormwater management criteria from those of the Water Management District. **Table 7.1** provides a summary of the City"s stormwater regulations as well as those of the SWFWMD.

Table 7.1
Summary of City and Water Management District Criteria

Location of New Stormwater Management System	Criteria for Discharge in a "Closed" Drainage Basin	Criteria for Discharge in a "Open" Drainage Basin	Applicable Code & Conditions
City of Dade City Regulations			
Open Basin or Closed Basin	-25 Year Storm of Maximum Intensity for major facilities in accordance with good engineering principles -10 Year Storm of Maximum Intensity for all other water management facilities	-25 Year Storm of Maximum Intensity for major facilities in accordance with good engineering principles -10 Year Storm of Maximum Intensity for all other water management facilities	8.064 Note: Receiving system is a lake or a canal or stream with an avg. daily flow of less than 5 cubic feet per second (cfs). City Engineer decides which drainage ways are major and what are "accepted engineering principles"
Drainage Basin of Special Concern (DBSC)- Closed Basin	-Post-development peak discharge rate shall not exceed the pre-development peak discharge rate for a 2, 10, 25, and 100 year return frequency storm event of 24 hours. - Post development runoff volume shall not exceed pre development runoff volume for a 100 Year- 10 Day storm event. - There shall be no net loss of storage volume from the most restrictive of: a. FEMA established floodplain storage volume; b. Storage volume below the elevation of a recorded County or City observed	N/A	Ordinance No. 2008-0989 Note: Tank Lake is currently the only designated DBSC.

Location of New Stormwater Management System	Criteria for Discharge in a "Closed" Drainage Basin	Criteria for Discharge in a "Open" Drainage Basin	Applicable Code & Conditions
	flooding; c. Calculated ponding based on a 100 Year return frequency, 10 day storm event; or d. A more critical event standard defined in a City or SWFWMD approved study for the applicable drainage basin. - The minimum habitable finished floor elevation shall be above the highest elevation established by the following criteria: a. Applicable sections of the Land Development Code; b. Recorded County or City observed flooding elevation plus one foot; c. Calculated elevation based upon a 100 year return frequency, 10 day duration storm event plus one foot; or d. A more critical event standard defined in a City or SWFWMD approved study for the applicable drainage basin plus one foot.		
Drainage Basin of Special Concern (DBSC)- Open Basin	N/A	-Post-development peak discharge rate shall not exceed the pre-development peak discharge rate for a 2,	Ordinance No. 2008-0989 Note: There are no currently designated Open Basin DBSCs.

Location of New Stormwater Management System	Criteria for Discharge in a "Closed" Drainage Basin	Criteria for Discharge in a "Open" Drainage Basin	Applicable Code & Conditions
		10, 25, and 100 year return frequency storm event of 24 hours. - There shall be no net loss of storage volume from the most restrictive of: a. FEMA established floodplain storage volume; b. Storage volume below the elevation of a recorded County or City observed flooding; c. Calculated ponding based on a 100 Year return frequency, 10 day storm event; or d. A more critical event standard defined in a City or SWFWMD approved study for the applicable drainage basin. - The minimum habitable finished floor elevation shall be above the highest elevation	

Location of New Stormwater Management System	Criteria for Discharge in a "Closed" Drainage Basin	Criteria for Discharge in a "Open" Drainage Basin	Applicable Code & Conditions
		established by the following criteria: a. Articles IV, VII and XI of the Land Development Code; b. Recorded County or City observed high water elevation plus one foot; c. Calculated ponding elevation based upon a 100 year return frequency, 10 day duration storm event plus one foot; or d. A more critical event standard defined in a City or SWFWMD approved study for the applicable drainage basin plus one foot.	
Water Quality Treatment	- 1 inch of retention unless treating less can still meet the City standard	- 1 inch of retention unless treating less can still meet the City standard	8.064
Southwest Florida Water Management District Regulations			
Open Basin	N/A	-Post-development peak discharge rate shall not exceed the pre-	Chapter Four, Part B Basis of Review

Location of New Stormwater Management System	Criteria for Discharge in a "Closed" Drainage Basin	Criteria for Discharge in a "Open" Drainage Basin	Applicable Code & Conditions
		development peak discharge rate for a 25 Year return frequency storm event of 24 hours (unless historical evidence of past flooding or the physical capacity of the downstream conveyance or receiving waters indicates that the conditions for issuance will not be met without consideration of storm events of different frequency or duration).	
Closed Basin	-Post-development discharge volume shall not exceed the pre-development discharge volume for a 100 year return frequency storm event of 24 hours (unless historical evidence of past flooding or the physical capacity of the downstream conveyance or receiving waters indicates that the conditions for issuance will not be met without consideration of storm events of different frequency or duration).	N/A	Chapter Four, Part B Basis of Review
Water Quality Treatment	- Dry retention design shall treat one	- Dry retention design	Chapter Five, Part B Basis of

Location of New Stormwater Management System	Criteria for Discharge in a "Closed" Drainage Basin	Criteria for Discharge in a "Open" Drainage Basin	Applicable Code & Conditions
	inch of runoff (or as an option for projects or project subunits with drainage areas less than 100 acres, shall treat ½ inch of runoff. - Wet detention design shall treat one inch of runoff from the contributing drainage basin.	shall treat one inch of runoff (or as an option for projects or project subunits with drainage areas less than 100 acres, shall treat ½ inch of runoff. - Wet detention design shall treat one inch of runoff from the contributing drainage basin.	Review

7.5 Current Water Quality Conditions in the Dade City Area

There are limited named and monitored surface water bodies within the immediate City boundaries. A manmade ditch located at the northeast portions of the City known as the Dade City Canal has been studied by the regulatory agencies in the past due to the point source discharges at that location from the former Lykes Pasco citrus processing operations. The EPA established a Total Maximum Daily Load (TMDL) in March 2007 for Total Nitrogen, Total Phosphorus and Biochemical Oxygen Demand for this "water body" which is denoted as Water Body Identification (WBID) #1399. The EPA TMDL requires a 70% reduction in loads for the noted parameters from all discharges to this water body. This reduction requirement applies to the City‟s MS4 discharges as well. It is noted that the primary City MS4 discharges to the Dade City Canal include the existing culvert serving the downtown drainage system and discharging easterly from Irvin pond as well as a 36" culvert discharge into the FDOT US Highway 301 storm sewer near the Cogen Plant pump station.

Due to the change in operations at the Dade City Business Center where the Lykes Pasco plant operated, the flows in the canal has virtually ceased with the primary flows being due to non-process storm water and non-contact cooling water. It is anticipated that this may result in the State changing the impairment status of this water body segment during the next cycle of assessments. In July 2011, Applied Technology & Management, on behalf of Pasco County, submitted a Water Segment Assessment for WBID 1399 to FDEP and EPA recommending that the TMDL be withdrawn. In July 2012, FDEP approved Pasco County‟s "TMDL Prioritization Report" associated with its MS4 permit. In that letter, FDEP agreed that the data and model used in the development of the TMDL for the Dade City Canal is no longer valid. FDEP will not require any special controls for discharges to this water segment. The City, therefore, must control the pollutants in its stormwater discharges to WBID 1399 and to any receiving waters to the maximum extent practicable as required by its NPDES MS4 permit. This is further discussed in Section 9 of the report.

8.0 POLLUTANT LOADING MODELING

The City has four MS4 outfalls that discharge to a wetland or other water feature area and are therefore likely claimed by the State as Waters of the State (WOS). Estimating the storm water pollutant loading from the City‟s major outfalls is required by the MS4 permit. It provides the City with the opportunity to compare pollutant loads every permit cycle to ascertain how well the City‟s stormwater management plan is in reducing pollutant loads. A major outfall is a circular pipe having a diameter of 36 inches or greater or a non-circular pipe or outfall conveyance having a drainage area of over 50 acres. Additionally, if a City outfall receives drainage from areas zoned for industrial activity and the City outfall diameter is 12" or greater for circular pipes or the City outfall is a non-circular conveyance but has a drainage area of over 2 acres, it is classified as a major outfall.

The City also has a piped discharge to the FDOT MS4 which discharges to the Pasco Cogeneration facility‟s stormwater lift station located at the Dade City Business Park. The Cogeneration facility‟s outfall is a privately operated stormwater system receiving drainage from industrial areas as well as municipal areas and FDOT highway runoff. This outfall discharges to the Dade City Canal which flows northwesterly toward the Withlacoochee River floodplain.

A summary of the City‟s outfalls that have been documented to date are listed in **Table 8.1** below. The outfalls are also shown in **Appendix B**.

Table 8.1
City of Dade City Outfalls

Outfall	Location	Notes
#1	Irvin pond outfall east of the City WWTP- Pipe of varying dimensions discharges easterly to a jurisdictional ditch	Major outfall
#2	36" Pipe located southwest of the Pasco Cogeneration facility- discharges to US Highway 301 and SR 533 drainage.	This is considered a discharge to another MS4. There is industrial land use within the drainage area.
#5	Dixie Avenue just East of Ft King Rd. (17^{th} St.)- 18" CMP outfalls toward a wetland	Non-major outfall
#6	South end of the Rails to Trails approximately ½ mile south of Granada Avenue- ditch to wetlands	Major outfall
#7	East end of Sunset Avenue- paved ditch to Shadow Lake	Non-major outfall

Note:
Outfall numbering is based on the inventory from the previous MS4 permit. Outfalls #3 and #4 are not discharges to USW and are removed from the inventory.

The estimated pollutant loading is based on Event Mean Concentration (EMC) methodology. Specifically, AMEC used the EMC methodology described in FDEP"s Evaluation of Current Stormwater Design Criteria in the State of Florida (June 2007, Harper & Baker, ERD). The EMC methodology assigns average pollutant concentrations to various land use categories. Further refinement of EMC values has occurred since that time and is documented in the *Environmental Resource Permit Stormwater Quality Applicant's Handbook* (FDEP and the State Water Management Districts, Draft- March 2010). A summary of the EMC values used for the analysis is included in **Appendix B**.

The methodology requires that the runoff volume generated for a land surface is composed of runoff from pervious and non-DCIA areas plus runoff from the directly connected impervious areas (DCIA). AMEC estimated the pervious and non-DCIA areas within the drainage areas using aerial topography. For the drainage area associated with Outfall #1, a significant portion of the impervious areas are directly connected to the roadway and therefore the drainage conveyance system. The following equations provide a simplified summary of the computation of the annual pollutant load estimate for a given watershed using this pollutant loading methodology:

1. Runoff volume calculation:

   $R = (P * C / 12) * A$

   Where:

   R = Runoff volume (acre-feet per year)

   P = Annual rainfall depth (inches) (51"/Year from June 2007 FDEP Report, Appendix A.3)

   C = Mean runoff coefficient (using non-DCIA curve number, %DCIA and methodology of June 2007 FDEP Report, Appendix C, Meteorological Zone 4)

   A = Study area (acres)

2. Annual pollutant loads (pounds per year)

   $L = 2.72 * R * C$

   Where:

   L = Annual pollutant load lb/year)

   C = Event mean concentration of the pollutant (mg/l)

   From Table B-2, Appendix B)

2.72 = Conversion factor (from mg/l to lb/acre-foot)

8.1. Pollutant Load Estimation Variables

Pollutant load estimates are directly related to the runoff volume "R" from a given drainage catchment area. In estimating the runoff volume, review of the Hydrologic Soil Group coverage for given areas was used to predict the runoff condition for the soils in the area. In well drained areas, the Hydrologic Soil Group was rated as HSG-A and the corresponding value from NRCS Technical Release 55, Table 2-2a was used. When there is a high degree of "directly connected impervious area" (DCIA), the effective runoff coefficient is greater. DCIA areas are those impervious areas which are hydraulically connected to the storm water conveyance system, stormwater treatment system, or directly to the water body segment. This is the case in much of the downtown area which is unfortunate since the majority of downtown is developed over well drained HSG-A soils.

Pollutant loading estimates for the major outfalls were computed and are included in **Appendix B**. **Table B-1A** summarizes the estimated loads from Outfall #1. The EMC"s used in the calculations are summarized in **Table B-2.** Adjustments for the pollutant loads leaving Outfall #1 based on the existing characteristics of Irvin pond are summarized in **Table B-3**. Estimated pollutant loads from Outfall #6 are included in **Table B-4**. A summary of the estimated pollutant loads from the major outfalls is repeated in **Table 8.2** below.

Table 8.2
Outfall Pollutant Load Estimates Summary

Outfall ID	TN (Lbs/Yr)	TP (Lbs/Yr)	BOD (Lbs/Yr)	TSS (Lbs/Yr)	Total Cu (Lbs/Yr)	Total Pb (Lbs/Yr)	Total Zn (Lbs/Yr)
#1	672.5	60.2	1385.5	7504	2.4	0.7	12.2
#6	595.5	101.5	3076	17014	5.8	1.6	26.6

9.0 EXISTING CONDITIONS WATER QUALITY LEVEL OF SERVICE

The City of Dade City has very limited natural surface waters within the City limits and instead has some natural wetland areas as well as a few manmade canals and water features. As such, the City does not rely on such features from an economic standpoint. Therefore in assessing a so called "water quality level of service" (WQLOS), one alternative is to review the existing regulatory requirements and assess the WQLOS in that regard. The primary requirement under which the City is currently regulated is the City"s MS4 permit, FLS000032-003, issued by FDEP on November 29, 2011.

The City"s MS4 Permit defines what the City"s Stormwater Management Program (SWMP) must achieve. The permit stipulates "The SWMP shall include controls necessary to effectively prohibit the discharge of non-stormwater into the MS4 and reduce the discharge of pollutants from the MS4 to the Maximum Extent Practicable (MEP)." The permit then goes on to read "Implementation of BMPs consistent with the provisions of the stormwater management program required pursuant to this permit constitutes compliance with the standard of reducing pollutants to the MEP." Therefore the City must satisfy the various specific requirements listed in Part III of the MS4 permit to remain in compliance with the regulation. Since the MS4 permit is aimed at helping the City to protect its receiving waters, it behooves the City to assess where it currently discharges into receiving waters and what components of the SWMP have the greatest impact on the quality of stormwater discharged at these locations. A conceptual water quality level of service rating system is included in **Table 9.1** below.

Table 9.1
Water Quality Level of Service

Status of SWMP	Concept Water Quality Level of Service	TMDL with City MS4 Load Reduction Status	Comments
SWMP fully implemented & evaluated per permit	A	TMDL is met or is eliminated.	This is the target for all SWMP programs.
SWMP fully implemented & evaluated per permit	B	TMDL not met for MS4	This is a realistic level for most MS4 operators to reach, particularly when storm water is not the primary cause of the water body impairment.
SWMP not fully implemented & evaluated per permit	C	TMDL not met for MS4	This is the "starting point" for most MS4 operators until a fair comparison of pollutant load trends have been made.
SWMP not implemented and permit violations exist	F		This applies to MS4 operators not attempting to comply with the permit.

The City of Dade City is currently implementing its SWMP per the MS4 permit. The City contributes stormwater to the Dade City Canal which has a 70% load reduction requirement for Total Nitrogen, Total Phosphorus and Biochemical Oxygen Demand (BOD). This TMDL was tied to former industrial operations that have virtually ceased and flows have significantly been reduced. As noted in Section 7.5 of this report, FDEP will not require any special controls for discharges to this water segment.

The City‟s stormwater outfalls were previously identified in this report. These outfalls discharge stormwater and the associated pollutants to various receiving systems. The City is currently in the process of implementing the requirements of the Cycle 3 MS4 permit. **Table 9.2** provides a generalized summary of the primary stormwater pollutant sources and the current and potential BMPs that may be implemented to reduce the City‟s pollutant loads to the maximum extent practicable. The potential BMPs are discussed in detail in Chapter 10.

During the course of this study, no information was identified on previous pollutant load calculations for the City outfalls. The City of Dade City is therefore currently in the position of evaluating the effectiveness of its SWMP. As such, the City"s water quality LOS is a "C" based on the above concept ratings. As the City implements its Cycle 3 permit and develops information to confirm reductions in its MS4 pollutant loadings, it can be anticipated that the City"s water quality LOS would be upgraded to a "B".

Table 9.2
Stormwater Outfalls and Management Practices within the Associated Drainage Areas

Characteristics & Management Strategies	Stormwater Outfall Identification Number				
	#1	#2 (Discharge)	#5	#6	#7
Drainage Basin Characteristics	Downtown/ highly commercialized	Residential/commercial/ industrial	Residential/ commercial	Residential	Residential
Nature of Discharge	Outfall from pond	Discharges to private pumping system	Culvert discharge to grade prior to entry into marsh	Howard Ave. Pond/pumped system to Long Ditch w/ ditch block	Concrete ditch to Marsh
In TMDL WBID?	Yes- 1399 Dade City Canal (EPA) However FDEP has designated the data and modeling for this TMDL as invalid and will not pursue special controls by the MS4 operators.	Yes- 1399 Dade City Canal (EPA) However FDEP has designated the data and modeling for this TMDL as invalid and will not pursue special controls by the MS4 operators.	No	No	No
Structural BMP Present?	For entire basin (Irvin pond)	For portion of drainage basin (Public Works pond)	No	For portion of drainage basin (Howard Avenue Pond); ditch block along ditch.	No
Potential Additional Future Structural BMP	Yes- 1. Concept flood control for Area #2- Improve Irvin pond with downtown drainage improvements.	Yes- 1. Concept flood control for Area #1 within watershed; 2. Concept 2nd Generation baffle box for DCIA near outfall	Re-grade roadside ditch for storage and pollutant removal of particulates and associated pollutants.	Enhance sediment collection at the Howard Avenue pond in conjunction with concept flood control for Area #2. Assess potential for additional ditch block/detention features in ditch.	Small sediment traps at end of ditch.
Current Primary Source Control BMPs	1.Street sweeping- weekly 2. Public education	1.Street Sweeping- weekly 2. Public education	1. Street sweeping- occasionally where curb/gutter exists. 2. Public education	1.Street sweeping- occasionally 2. Public education	1.Street sweeping- occasionally 2. Public education

Note: Ultimate Receiving Water for all Outfalls- Withlacoochee River