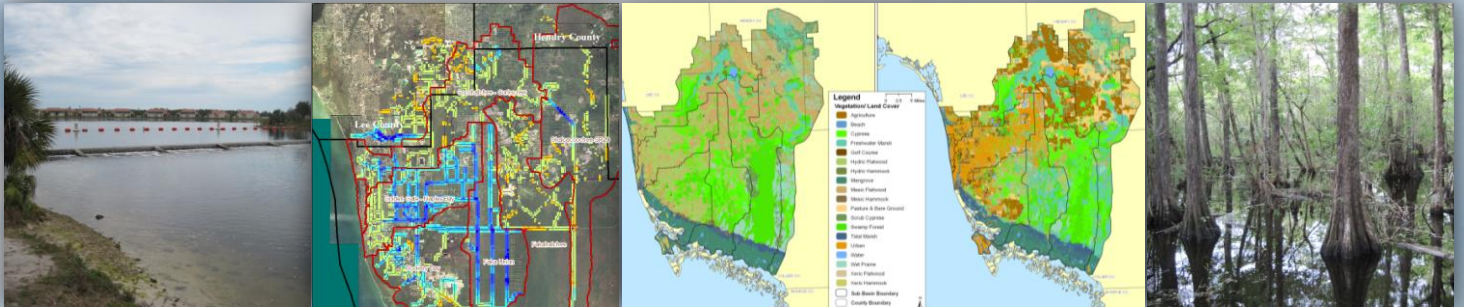


Collier County Watershed Model Update and Plan Development



Volume 3 Recommended Non-Structural Initiatives

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DRAFT
COLLIER COUNTY WATERSHED
MANAGEMENT PLAN
COLLIER COUNTY, FLORIDA

VOLUME 3: RECOMMENDED NON-STRUCTURAL INITIATIVES

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Acronyms and Abbreviations

| | |
|---------|---|
| ACSC | Area of Critical State Concern |
| ACSC-ST | Area of Critical State Concern – Special Treatment |
| BCC | Board of County Commissioners |
| BMP | Best Management Plan |
| CCME | Conservation Coastal Management Element |
| CCPC | Collier County Planning Commission |
| CCWMP | Collier County Watershed Management Plan |
| CDU | Community Development Unit |
| cfs | Cubic feet per second |
| CN | Curve Number |
| DCIA | Directly Connected Impervious Area |
| DEM | Digital Elevation Model |
| EAC | Environmental Advisory Council |
| ECM | Existing Conditions Model |
| EMC | Event Mean Concentration |
| ERP | Environmental Resource Permit |
| ERU | Equivalent Residential Unit |
| ET | Evapotranspiration |
| FDEP | Florida Department of Environmental Protection |
| FLUCCS | Florida Land Use, Land Cover Classification System |
| FLUE | Future Land Use Element |
| FLUM | Future Land Use Map |
| FPLOS | Flood Protection Level of Service |
| FRESP | Florida Ranchlands Environmental Services Project |
| GGAMP | Golden Gate Area Master Plan |
| GMP | Growth Management Plan |
| HOA | Homeowners Association |
| IWR | Impaired Waters Rule |
| LDC | Land Development Code |
| LID | Low Impact Development |
| MSTU | Municipal Services Taxing Unit |
| NEXRAD | High Resolution Radar |
| NGGE | Northern Golden Gates Estates |
| NGGEFRA | North Golden Gate Estates Flowway Restoration Area |
| NGGEFRP | North Golden Gate Estates Flowway Restoration Program |

| | |
|-------|---|
| NSM | Natural Systems Model |
| OFW | Outstanding Florida Water |
| PUD | Planned Unit Development |
| RFMU | Rural Fringe Mixed Use |
| RLSA | Rural Lands Stewardship Area |
| ROMA | Regional Offsite Mitigation Area |
| RSF | Residential Single Family |
| RWCA | Recyclable Water Containment Areas |
| SCS | Soil Conservation Service |
| SFWMD | South Florida Water Management District |
| ST | Special Treatment |
| SWFFS | Southwest Florida Feasibility Study |
| TDR | Transfer of Development Rights |
| TMDL | Total Maximum Daily Load |
| TN | Total Nitrogen |
| TP | Total Phosphorus |
| TSS | Total Suspended Solids |
| TTI | Ten Thousand Islands |
| UMAM | Uniform Mitigation Assessment Method |
| URF | Urban Residential Fringe |
| USACE | United States Army Corps of Engineers |
| WBID | Water body Identification Number |
| WMD | Water Management District |



1.0 Description of Recommended Non-structural Initiatives

The purpose of the non-structural initiatives is to formulate recommendations that would allow for the implementation of an environmentally sustainable management program to will guide future land development activities in Collier County.

General

Recommendations for structural and non-structural means of watershed management and improvement are the core of the Collier County Watershed Management Plan (CCWMP). Non-structural Best Management Practices (BMPs) focus on preserving and protecting natural features of the landscape and attempt to manage stormwater at its source. Their evaluation includes an analysis of the applicable regulatory framework. In this document, the recommended non-structural initiatives address issues that range from land development guidelines to water quality monitoring.

Volume 3 was prepared as a stand-alone document to describe the non-structural initiatives recommended for implementation as part of the watershed management plan. These non-structural, policy based initiatives are designed to bridge the gap between the improvements expected from structural projects and the long-term approaches needed to address water quantity, water quality, and ecological protection in Collier County as land development continues. The other 3 volumes prepared as part of this project are: a) Volume 1 presents a summary of existing conditions in the watersheds and estuaries and the performance measures developed for evaluating potential projects; b) Volume 2 is a stand-alone report that describes the structural best management practices (BMPs) recommended for implementation; and Volume 4 Volume 4 is a compilation of the individual technical memoranda completed to address existing conditions in the watershed and estuaries and presents the details of the analyses conducted as part of this project.

The purpose of the analyses presented herein is to formulate recommendations that would allow for the implementation of an environmentally sustainable management program. The implementation of that program will guide future land development activities in Collier County and it is of critical importance to control impacts in terms of water quantity, water quality, and ecological protection.

The program objectives are to:

- Promote more effective site planning and minimize water quantity and water quality anthropogenic impacts
- Promote preservation of the natural systems
- Help meet the County's regulatory requirements

Regulatory Background

In Florida, "Waters of the State" are protected per the Water Resources Act, Chapter 373 FS. The Act provides for the establishment of permit programs, including those related to surface water management systems and the Environmental Resource Permit (ERP) process. The ERP addresses issues of water quantity, water quality, and wetland protection. In Collier County the ERP process is implemented by the South Florida Water Management District (SFWMD) per the regulations codified in Title 40-E of the Florida Administrative Code (FAC). Regulations relate to water quantity, water quality, and wetland protection/mitigation.

In terms of water quality, minimum standards for Florida streams have been established depending on a stream designated use. Chapter 62-303 FAC defines the State water quality standards. The condition of a water body not meeting standards is referred to as "impairment".

The issues of Florida impaired water bodies came to light as part of the recent implementation of the Total

Maximum Daily Load (TMDL) program by the FDEP, which requires identification of water bodies that do not meet applicable State water quality standards. The process for identifying impaired water bodies is as described in the State’s Impaired Waters Rule Chapter (IWR) 62-303 FAC. As part of that process, FDEP determined that a large number of water bodies in the State are impaired or potentially impaired. Impairments are particularly prevalent for nutrients, which have been found to be the most common impairment parameter throughout Florida. FDEP has found several impaired water bodies in Collier County. A detailed evaluation of the TMDL issues was conducted as part of this project. Results are described in the Watershed Management Plan Technical Report.

Surface water management, also referred to as stormwater management, is also the responsibility of local governments, in this case Collier County. The County’s Growth Management Plan (GMP), Public Facilities Element, Drainage Sub-Element, indicates that “stormwater management refers to a set of comprehensive strategies for dealing with stormwater quantity and stormwater quality issues.” Goal 2 of the GMP Conservation and Coastal Management Element states that the County “shall complete the prioritization and begin the process of preparing Watershed Management Plans, which contain appropriate mechanisms to protect the County’s estuarine and wetland systems.” Regulations pertaining to stormwater management are included in various ordinances and the Land Development Code (LDC).

Recommended Non-Structural Initiatives

The existing conditions analysis conducted as part of the watershed management planning process helped assess the magnitude of the anthropogenic impacts in Collier County in terms of a) water quantity management including fresh water discharge patterns to the estuaries; b) water quality in the existing streams, canals, and estuaries, and c) natural system hydrology and habitat. It was concluded that, in spite of current regulations, the local environment has been subject to significant impact. That is consistent with evaluations conducted by the State of Florida, which have indicated that current permitting requirements are unable to comply with the State Water Policy (62-40.416) and control impacts of new development.

An important finding of the analysis of alternatives conducted as part of the watershed management plan was that the recommended structural watershed projects that were analyzed and proposed as part of the watershed management plan will not be enough to have a significantly effect on the restoration of the

currently affected environment. Therefore, implementation of non-structural initiatives is necessary to complement the structural watershed improvement measures. The proposed 13 non-structural initiatives are listed in **Table 3-1**. The following sections provide specific descriptions of the proposed initiatives.

Table 3-1
Recommended Non-Structural Initiatives

| Description |
|--|
| Low Impact Development (LID) Program |
| Stormwater Retrofit Program |
| Fee-Based Stormwater Utility Incentive Program |
| Allowable Maximum Site Discharges |
| Stormwater Runoff Volume Control |
| Verification of No Floodplain Impact |
| Flood Protection Levels of Service Criteria |
| Golden Gate Estates Transfer of Development Rights Program |
| Golden Gate Estates Watershed Mitigation Program |
| Modified Operations of Water Control Structures |
| Expanded Water Quality Monitoring Program |
| Additional Watershed Protection Programs |
| Stormwater Facilities Maintenance and Certification |



Initiative 1: Low Impact Development (LID) Program

Low Impact Development aims at minimizing the volume of runoff reaching the receiving water bodies and managing it as close as possible to where it is generated. Techniques defined as micro-controls are implemented in a dispersed fashion throughout a site.

General

This initiative proposes implementation of a Low Impact Development (LID) program that would apply to all new development in Collier County. LID is a well established approach to stormwater management that relies on hydrology-based site planning and design. LID aims at minimizing the volume of runoff and associated pollutant loads reaching the receiving water bodies and managing it as close as possible to where it is generated. Techniques defined as micro-controls are implemented in a dispersed fashion throughout a site. Following is a description of the program's background and recommended implementation strategy.

Current Collier County Runoff Treatment Requirement

The Collier County Growth Management Plan, Conservation and Coastal Management Element, Ordinance 2008-10, and the Land Development Code (LDC) Section 3.07.00, require that until the Watershed Management Plans are completed all new development and re-development projects meet 150 percent of the ERP water quality volumetric requirements. This interim requirement basically considers that all waters in the County should be held to the same standards as those applicable to Outstanding Florida Waters. This requirement also reflects the County's intention to provide additional protection to water quality beyond those provided by the State. The effectiveness of the County's stormwater treatment requirement was evaluated as part of this project. The results of the evaluation are described below.

Concurrently with the implementation of the TMDL program, FDEP conducted various studies to determine whether the existing technology-based design criteria for stormwater systems are helping meet State Water Policy (62-40.416), by which such systems should be designed to achieve at least 80 percent reduction of the average annual pollutant loads that would cause or contribute to violations of State water quality standards. FDEP's studies demonstrated that current design criteria for wet detention, which is the most common stormwater runoff treatment method in Collier County, generally meet the State Water Policy requirements for removal of total suspended solids (TSS). However, nutrient removal efficiencies amount to less than 70 and 45 percent for total phosphorus and total nitrogen, respectively. In addition, nutrient removal efficiency (nitrogen and phosphorus) decreases substantially after an initial detention time of about 14 to 20 days, which is a feature of the standard design. **Figure 3-1** shows schematically the components of a traditional wet detention pond. **Figures 3-2 and 3-3** show the relationship of detention time to removal efficiency of phosphorus and nitrogen, respectively.

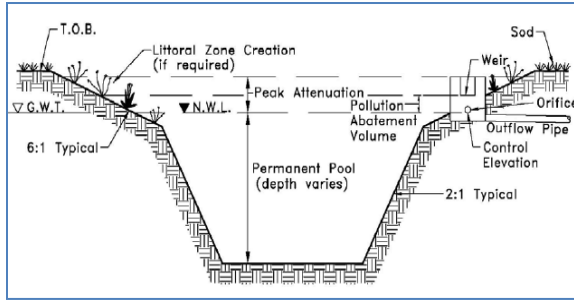


Figure 3-1. Schematic of Wet Detention Pond Components (from FDEP 2007)

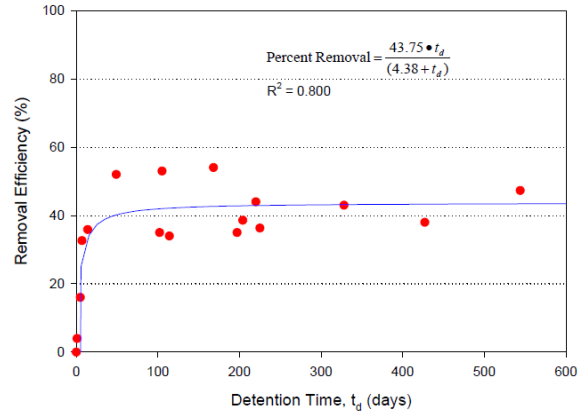


Figure 3-3. Removal Efficiency of TN in Wet Detention Ponds as a Function of Detention Time

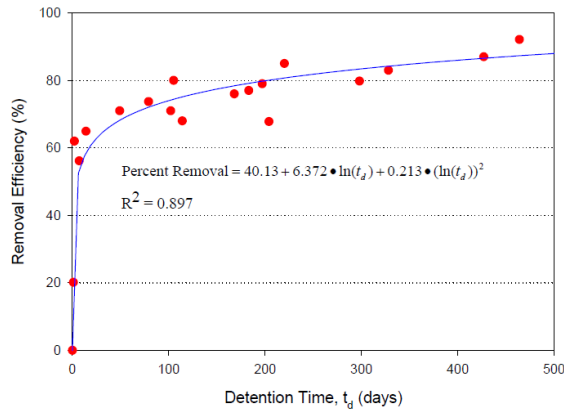


Figure 3-2. Removal Efficiency of TP in Wet Detention Ponds as a Function of Detention Time

Based on the removal characteristics of detention treatment facilities, it is likely that the County’s additional treatment volumetric requirement has contributed to a further reduction in the discharge of total suspended solids (TSS) to the County’s waters. However, it is also likely that small gains in nutrient removal are being achieved. In addition, the current practice of meeting the treatment requirement by simply increasing the volume of the treatment pool (pollution abatement volume), as opposed to increasing the size of the permanent pool further reduces the effectiveness of the treatment requirement. Research (FDEPD, 2007) has shown that treatment for nutrients occurs in the permanent pool.

Description of the Recommended LID Program

As described above, FDEP’s studies have concluded that the current design requirements for stormwater Best Management Practices (BMPs) are not adequate to meet State law. The agency also concluded that an update of the Florida Statewide Stormwater Treatment Rule was necessary and a draft new rule was developed. A main requirement of the drafted new rule is that post-development pollution loads should not exceed the pre-development loads. Pre-development is defined as the natural native landscape. This would make necessary the implementation of new approaches to remove the additional anthropogenic pollution load, including the implementation of treatment trains.

The application of the proposed FDEP stormwater rule would provide an effective approach to control water quality impacts of new development. However, it is unlikely it will be adopted in the near future. Therefore, it is safe to assume that the State current regulatory requirements would remain in place over the foreseeable future and that mitigation of growth impacts at the local level will be critical to achieve environmental protection goals.

It is recommended that a new approach based on the preservation of a site’s natural features be implemented to minimize pollution loads and help preserve the natural system. Such approach

should be consistent with the concept of Low Impact Development (LID). As indicated previously, LID aims at minimizing the volume of runoff reaching the receiving water bodies and managing it as close as possible to where it is generated. Techniques defined as micro-controls are implemented in a dispersed fashion throughout a site. The basic principle is to attempt to mimic pre-development hydrology by retaining or treating stormwater runoff close to the source thereby replicating the natural pathways. Examples of LID techniques include a) use of pervious pavement to minimize runoff volume, b) construction of rain gardens, localized infiltration areas, or created mini-wetland systems to treat stormwater runoff, c) minimizing directly connected impervious areas. Further descriptions of the LID concept are provided in Appendix A.

The proposed new approach **requires that the nutrient load associated with 50 percent of the basic ERP requirement be treated by LID.** SFWMD regulations for water quality establish that the basic runoff treatment requirement for new development is one inch of runoff over the developed area or 2.5 inches times the percentage of imperviousness, whichever is greater. The basic runoff treatment requirement described above applies to discharges to all water bodies considered to be Waters of the State, except for discharges into Outstanding Florida Waters (OFWs) or currently impaired water bodies. In those cases, the treatment requirement is 150 percent of the basic treatment criteria. The proposed LID treatment should be for the nutrient load generated by 0.5 inch of runoff over the developed area or 1.25 inches times the percentage of imperviousness, whichever is greater. Based on input from local stakeholders, it is proposed that the current 150% treatment be maintained and the LID approach be set as an additional land development requirement.

Application of the Recommended LID Program

In practice, the LID techniques applied to a particular development should be left at the discretion of the designer as conditions may vary substantially between sites. The techniques could be applied at the lot level or at the subdivision level. Because runoff reduction is the most

efficient method to reduce pollution loads, infiltration techniques should be considered when possible. From that standpoint it was estimated that for residential areas, based on typical lot designs for single-family homes under zoning categories RSF-3 through RSF-6, and assuming an average DCIA of 25 percent and an SCS curve number (CN) of 74 for the non-DCIA areas (a CN of 74 represents soils type C), the design storm event for LID design should be 1.5 inches, which represents approximately the 93th percentile event. This means that the nutrient pollutant load associated with 93 percent of the storms would be eliminated by LID if infiltration methods are used at a site. For parking facilities, assuming a 90 percent DCIA, the design event is 1.30 inches. This rainfall event represents approximately the 90th percentile.

It is recognized that the construction of infiltration systems is not always possible in areas of high water table elevations. In those cases, LID techniques may be limited to construction of localized dry detention areas whose storage capacity is recovered by installation of drain systems, or localized created wetland systems. Until the County establishes specific design criteria, the pollution removal calculations to design these facilities can be made based on best available literature data. Documents that could be used as reference to facilitate design include the “Stormwater Quality Applicant’s Handbook” developed by FDEP as part of the draft stormwater rule and the Sarasota County, Florida, LID manual. The FDEP handbook defines design criteria for numerous types of BMPs from retention basins and exfiltration trenches to swales, pervious pavement, and underground storage facilities. The Sarasota County manual focuses on detention with biofiltration and pervious pavement. The establishment and adoption of design criteria for various types of facilities may be conducted as part of the implementation of the overall initiative.

LID Cost Effectiveness

Although the concept and application of LID has been promoted and studied for over 20 years, it is still considered a new and emerging technology and there is some apprehension in the development community as to installation costs. This is particularly important at the initial stages

of an LID implementation program because construction costs for LID technologies are often site-specific and developers may see some increases in site assessment and design. Also, the development community may be concerned with long-term maintenance costs associated with LID techniques including on-site management of stormwater facilities. However, numerous studies (Foss 2005; Conservation Research Institute 2005; U.S. EPA 2005; Zickler 2004) have demonstrated that LID can compare favorably with conventional controls in a side-by-side analysis of installation and maintenance costs. LID costs may be higher in terms of installation of site specific technologies, but savings are accrued because of the reduced stormwater conveyance systems capacity needs and the reduced load of sediments to existing ponds, which eliminates the need of dredging to restore the facilities' treatment efficiency and aesthetic characteristics.

In summary, consistent with current research, the implementation of the proposed LID program is expected to be at worst cost neutral for the development community. The main benefit of implementing the proposed program is the achievement of countywide water quality improvements of the County's water bodies due to pollution load reductions.

Program Assessment within the State's Regulatory Framework

The proposed initiative was presented to, and discussed with, SFWMD staff to determine how it fits within the permitting process. It was determined that the program complements and enhances the ERP permitting process. For example, one of the limitations of the State permitting process occurs when pre-development pollutant loads exceed those anticipated for post-development. In that case, the State is unable to require post-development treatment beyond those allowed by current rules. The proposed County requirement is based totally on post-development conditions, which would eliminate the State's limitation.

LID Implementation Incentives

Although the implementation of the proposed LID program is likely not to increase development

costs, we believe incentives to land developers are necessary to help offset the perception that traditional designs are less expensive and perhaps more attractive to potential buyers than the proposed approach. Various incentives are proposed through changes in the Land Development Code (LDC). They are listed in **Table 3-2** by LDC chapter and refer mainly to modifications to road and parking design criteria.

An important recommendation is for the County to revisit the road width criteria to consider the average daily traffic (ADT) needs. A minimum road width for local streets is recommended to be set at 18 ft based on an ADT of less than 400.

That results in roads serving either 36 single family homes or 60 multi-family units. The proposed design is consistent with the [American Association of State Highway and Transportation Officials](#) (AASHTO) standards.

The off-site parking recommendations refer to modified requirements for minimum parking spaces, parking aisle widths, and general design features. The new design features would not diminish the safety or aesthetic characteristics of the parking facilities. It should be considered that many of the current design standards for parking lots were established years ago when cars were generally larger and more difficult to maneuver.

Table 3-2. Low Impact Development Incentives

| |
|---|
| <p>4.02.01 Dimensional standards for principle uses</p> <p>Allow 18-ft width on local roads having an ADT of 400 trips (36 single family homes). The recommended width is consistent with AASHTO standards.</p> |
| <p>4.04.00 Transportation System Standards</p> <ol style="list-style-type: none"> 1. Promote design of shallow swales on local roads, as long as maintenance procedures are clearly defined. 2. Allow road medians to be designed as depressed surfaces that can collect and treat road runoff |
| <p>4.05.02 Parking design standards</p> <ol style="list-style-type: none"> 1. Promote parking lots design using surfaces with pervious materials that promote water infiltration 2. Allow aisle width design to be reduced by 2 feet except for parallel parking 3. Allow grassed swale dividers along opposing parking spaces. Parking space depth reduced from 18 feet to 16.5 feet if wheel stop is located 0.5 foot from edge of swale |
| <p>4.05.04 Parking space requirements</p> <ol style="list-style-type: none"> 1. Modify the LDC to only address minimum counts for typical use/demand. Allow the developer or facility owner to provide what is believed necessary for peak use. 2. Reduce the minimum retail shop and store and department store parking requirement from 1 per 250 square feet to 1 per 500 square feet of indoor/outdoor retail area. 3. Allow for up to 25% grass spaces (or other suitable permeable pavement) for developments regardless of parking count. There should be at least 3 paved spaces (excluding handicap parking). Allow use of identified grassed areas for locating dry detention facilities. |
| <p>4.06.03 Landscaping requirements for vehicular use areas and rights-of-way</p> <ol style="list-style-type: none"> 1. Allow use of depressed landscape islands 2. Allow rows of parking spaces to contain 20 spaces, instead of 10, between islands if drainage is directed to grassed swale dividers 3. Allow swale divider area and grass parking areas to count as part of the off-parking interior vegetated areas. 4. Allow parking stalls to be up to 100 feet away from a tree. Allow one tree for every 500 square feet on interior landscaped area |
| <p>6.05.01 Stormwater management system requirements</p> <ol style="list-style-type: none"> 1. Allow in-ground percolation type retention systems to achieve water quality retention if designed per LID manual requirements |



Initiative 2: Stormwater Retrofit Program

The stormwater retrofit program would be funded using current stormwater utility revenues and will be complemented with funds available from State and Federal grants.

The implementation of the LID program will help control impacts of new development. However, restoration and protection of the existing natural system will require establishment of retrofit programs for existing development. It is recommended that the County establishes a program dedicated to fund stormwater retrofits. The program would be funded using current stormwater utility revenues and may be complemented with funds available from State and Federal grants such as the 319(h). The projects would be selected from a prioritized list to be developed by County staff. The project list would be flexible to accommodate changes due to funding sources, public preferences, and/or water quality improvement needs. It will be important for the County to keep track of any funded projects to receive the corresponding TMDL credit. The proposed initiative would aim to:

- Retrofit public facilities, including parking lots in public buildings such as the Government Center and public schools.
- Install local runoff treatment facilities in areas that lack treatment systems
- Retrofit private facilities by working with Municipal Services Taxing Units (MSTUs)

Retrofit Public Facilities

The County operates a number of public facilities that may benefit by incorporation of LID features. Parking lots, in particular, could be re-designed to route the drainage flows to depressed islands or grassed areas. It may also be possible to install pre-manufactured treatment systems in some locations (i.e. baffle boxes) as long as the systems are capable of removing target pollutants. This program not only will benefit the natural systems in the County, but would also provide opportunities for educating the community on

stormwater issues and would be an example of the County's commitment to environmental protection

Install Local Runoff Treatment Facilities

A retrofit program that may be considered by the County involves the acquisition of small parcels in areas where stormwater treatment is limited. The program would consist of converting those parcels to local runoff treatment facilities such as retention ponds or created wetlands. Stormwater runoff would be routed to these facilities prior to discharging into a canal. An area that would significantly benefit from this approach is Golden Gate Estates where more than 400 streets dead end at a drainage canal. It is estimated, for example, that a 5-acre lot can accommodate a 3 to 4-acre retention/detention pond or wetland system that would be able to treat a drainage area of approximate 50 to 70 acres. In addition to runoff treatment, these facilities can provide better wetland connectivity and improve the local habitat.

Retrofit private facilities by working with MSTUs

MSTUs are another mechanism available to provide incentives for implementing a stormwater retrofit management program. MSTUs are established by ordinance to assess benefiting properties typically for capital improvement projects such as paving, drainage, and stormwater projects. The MSTU programs encourage residents to financially participate in implementing capital improvement projects. To encourage residents to participate, the County would agree to pay a portion of a project's costs and assess the residents for the remaining amount. The residents' participation would occur in the form of annual assessments that could typically last between 5-10 years.



Initiative 3: Fee-Based Stormwater Utility Incentive Program

The financing of the stormwater utility may be changed to a fee-based system that in turn would be based on the volume of runoff discharged from each property. The goal would be to maintain the same revenue, but using a different fee structure.

Ordinance 2008-80 describes the funding mechanism for stormwater projects through the stormwater utility and states the County's commitment to properly fund the program. Funds are proceeds from 0.15 mills of ad valorem tax revenues, which are deposited into Fund 325. According to the Ordinance, the funding spans through, and including, fiscal year 2025.

Although the stormwater utility funds the stormwater program, it is not setup to allow implementation of an incentive program. It is recommended that the financing of the utility be changed to a fee-based system that in turn would be based on the volume of runoff discharged from each property. The goal would be to maintain the same revenue, but using a different fee structure.

Similar to other utilities in Florida, an annual fee could be established based on the concept of Equivalent Residential Units (ERUs), which represents the volume of runoff discharged from a "typical home" in the County. The fee for each user would depend on the number of ERUs. A "typical home" can be defined as a developed parcel with no stormwater controls. Credit should be provided to parcels, or entire developments, that have been designed to provide treatment of stormwater runoff through LID techniques.

The advantage of the proposed fee structure is that it can be used to provide incentives for both new development and retrofit of private property. For example, new developments that are designed per the LID concepts could use the stormwater fee structure to market sales of homes that pay a lower stormwater utility fee. The fee could also be used to provide credit to private property when retrofitting programs are implemented. Property owners would weigh the retrofitting costs with the benefit of a reduced stormwater fee.

It is recognized that the ERU fee structure sometimes results in large fees imposed on businesses that include large parking facilities. A credit system could be applied to the business sector to reduce the initial fee impact. However, the credit should be applicable within a defined time frame, i.e. 5 years, to further incentivize implementation of retrofitting programs.

Finally, although the benefit to Collier County may be small, it should be noted that the ERU fee structure allows collection of funds from federal facilities, which do not contribute to the ad valorem tax revenue.



Initiative 4: Allowable Maximum Site Discharges

Computer model results indicated that various segments of the primary and secondary drainage systems do not have the capacity to handle large storm events. In some cases, the canal banks are overtopped even during the 5-year design storm event.

Another water quantity-related recommendation pertains to the policies in the County's Growth Management Plan, Public Facilities Element, Drainage Sub-Element, that state that the drainage system should have adequate stormwater management capacity at the time a development permit is issued. Also, it indicates that the system has to be designed "so as to ensure that the final outlet point has adequate capacity to handle all discharges from the upstream portion of the watershed under conditions present at the time of design".

The County has established maximum allowable off-site discharges for many of the basins served by the drainage canal network. Ordinance 2007-11 establishes an allowable discharge of 0.15 cfs/acre for all areas in the County, except six basins and subbasins that are subject to specific discharge limitations. The ordinance also states that "allowable off-site discharge rates shall be computed using a storm event of 3-day duration and 25-year return frequency."

A hydraulic conveyance analysis was conducted as part of this project to determine the maximum flow that can be conveyed by the various drainage canal segments included in the MIKE SHE / MIKE 11 computer model.

Results indicated that various segments of the primary and secondary drainage systems do not have the capacity to handle large storm events. In some cases, the canal banks are overtopped even during the 5-year design storm event. A detailed description of the analysis is provided as part of the surface water quantity assessment in Volume 3. To check the current allowed maximum discharges, as required by the County ordinance, the maximum flow predicted by the computer model was divided by the extent of the drainage area to obtain the actual maximum allowable discharge rate associated with each canal segment. It was found that maximum discharges for many of the County basins needed updating. That was expected because the original limits were based on preliminary analyses.

Table 3-3 lists the recommended maximum discharges. It is recognized that the proposed new limits may represent a cost to new development in the affected basins. However, the limits should be viewed as simply a way to control for the additional flooding risk caused by new development. It must be noted that the established requirements do not aim at improving conditions by imposing requirements on new development. The new limitations simply maintain the existing status.

Table 3-3. Proposed Maximum Allowable Discharges by Basin

| Stormwater Subbasins | Current Maximum Allowable Discharge | Recommended Maximum Allowable Discharge |
|--|-------------------------------------|---|
| | cfs/acre | cfs/acre |
| 951 Canal Central Basin | 0.15 | 0.15 |
| 951 Canal North Basin | 0.15 | 0.11 |
| Airport Road North Canal Basin | 0.04 | 0.04 |
| Airport Road South Canal Basin | 0.06 | 0.06 |
| Barron River Canal Basin (North) | 0.15 | 0.15 |
| C-4 Basin | 0.15 | 0.11 |
| Cocohatchee River Canal Basin | 0.04 | 0.04 |
| Corkscrew Canal Basin | 0.15 | 0.04 |
| Cypress Canal Basin | 0.15 | 0.06 |
| East Branch Cocohatchee Basin | 0.15 | 0.15 |
| West Branch Cocohatchee Basin | 0.15 | 0.15 |
| Faka Union Canal Basin (North of I-75) | 0.15 | 0.09 |
| Gateway Triangle Basin | 0.15 | 0.15 |
| Gordon River Extension Basin | 0.15 | 0.09 |
| Green Canal Basin | 0.15 | 0.15 |
| Haldeman Creek Basin | 0.15 | 0.15 |
| Harvey Canal Basin | 0.15 | 0.11 |
| Henderson Creek Basin | 0.15 | 0.08 |
| I-75 Canal Basin | 0.15 | 0.06 |
| Imperial Drainage Outlet Basin | 0.15 | 0.12 |
| Island Walk Basin (aka Harvey Basin) | 0.055 | 0.055 |
| Lely Canal Basin | 0.06 | 0.06 |
| Lely Manor Canal Basin | 0.15 | 0.06 |
| Main Golden Gate Canal Basin | 0.15 | 0.04 |
| Miller Canal Basin (North of I-75) | 0.15 | 0.15 |
| Palm River Canal Basin | 0.15 | 0.13 |
| Pine Ridge Canal Basin | 0.15 | 0.13 |
| Upper Immokalee Basin | 0.15 | 0.15 |

0.15

Modified Discharge by Basin



Initiative 5: Stormwater Runoff Volume Control

This recommendation would have no impact on new development because the limiting storage condition is the allowable maximum discharge limit. The volume control requirement will simply represent a double check on potential impacts in the areas downstream from proposed developments.

Current ERP requirement is to mitigate post development peak stages for the 25-year/72-hour design storm event. The permitting process does not require verification of downstream impact in areas beyond those surrounding a proposed new development due to changes in discharge timing from pre-development conditions.

An approach that other Florida municipalities have adopted to control for these impacts is to limit both peak discharges and volumes to pre-development conditions. In addition to the established maximum allowable discharges for the County's canals (Ordinance 2007-11), it is recommended that the land development regulations be modified to require post-development volume mitigation not to exceed pre-development conditions for the 25-year/24-hour design storm event conditions. More stringent requirements for volume control using events with a larger duration or longer return period may be considered at a later date. This approach, combined with the current requirement that flood elevations are not exceeded anywhere in the watershed (Initiative 6), would ensure that the three hydrologic factors, water elevations, runoff volume, and timing of discharges, are maintained from pre-development conditions.

Analysis conducted as part of the watershed management plan development process have shown that this recommendation would have basically no impact on new development because the limiting condition in terms of required site storage capacity is the allowable maximum discharge limit. The volume control requirement will simply represent a double check on potential impacts in the areas downstream from proposed developments.



Initiative 6: Verification of No Floodplain Impact

It is critical that future development discharges are controlled such that the extent of the regulatory floodplain is not increased at any point along potentially affected canal systems,

It is critical that future development discharges are controlled such that the extent of the regulatory floodplain is not increased at any point along potentially affected canal systems, as floodplain impacts would have implications associated with the National Flood Insurance Program.

It is recommended that the County implements the requirement that each development permit includes a check of no impact upstream or downstream for the 100-year/72-hour design storm event.

Tools that can be used for this purpose include a) the Tomasello computer model that was developed by the County for floodplain management purposes, or b) a version of the existing conditions model (EAC) but modified using a smaller grid size, i.e. 500 ft to better define local conditions. It should be noted that the application of this recommendation would also require changing the LDC Section 3.07.02 from referencing “surrounding properties” to “any properties upstream or downstream” of a development.



Initiative 7: Flood Protection Levels of Service (FPLOS) Criteria

The proposed FPLOS criteria consider the type of road and the return period of the storm. This approach also allows distinguishing between nuisance flooding and hazard flooding.

Another aspect associated with water quantity is the flood protection levels of service (FPLOS). The FPLOS are a measure of the acceptable flooding depth along public roads that is considered not to pose a threat to the health and safety of the community. The more stringent the FPLOS criteria, the more expensive the drainage improvements needed to meet those criteria. In addition, the larger the drainage system, the greater the potential impact to the natural environment. Therefore, a balance must be achieved between risk, cost, and environmental impacts.

Collier County has defined FPLOS criteria (Ordinance 90-10) by which roads and parking lot travel ways must provide drainage and flood protection during the 25-year/72-hour storm event. Currently, there are four (4) defined FPLOS categories. They are listed in **Table 3-4**. County Ordinance Number 2007-11 indicates that 27 of the 37 defined drainage basins in Collier County have attained a FPLOS standard of "D", unacceptable. The other 10 defined basins are rated as FPLOS "C", substandard.

Table 3-4. Level of Service Definitions

| FPLOS | General Hydraulic Performance |
|-------|--|
| A | Excellent: Flow contained in drainage system with substantial water quality and/or water supply/recharge benefits |
| B | Adequate: Street flooding with significant water quality and/or water supply/recharge benefits |
| C | Substandard: Street and yard flooding with identifiable water quality and/or water supply/recharge benefits |
| D | Unacceptable: Street, yard, and structure flooding with limited or no water quality and/or water supply/recharge benefits |

Table 3-5 shows the proposed FPLOS criteria. The proposed criteria consider the type of road and the return period of the storm. This approach also allows distinguishing between nuisance flooding and hazard flooding.

Table 3-5. Proposed FPLOS Criteria for Collier County

| Roadways | Storm Return Period (years) | | |
|--|-----------------------------|----------|-----------|
| | 10 | 25 | 100 |
| A. Evacuation Routes | None | None | None |
| B. Arterials | None | None | 6 inches |
| C. Collectors | None | 6 inches | 9 inches |
| D. Neighborhood | 6 inches | 9 inches | 12 inches |
| Open Space (Flooding of open space is acceptable if it does not compromise public health and safety). | | | |

The proposed criteria were evaluated by applying it to the road system in the County. The first step was to classify the roads as evacuation routes, arterials, collectors, and neighborhood roads.

- **Evacuation Routes** are identified by Collier County based on emergency needs
- **Arterials** are high capacity urban roads that connect developed areas to freeways and evacuation routes.
- **Collectors** are low to moderate traffic roads that link local streets to arterial roads. Collectors also provide access the residential areas.
- **Neighborhood roads** are local roads within neighborhoods or other developed areas.

A roads shapefile was obtained from Collier County. Each road in the County was broken into segments at each intersection. For consistency with the model grid size, the maximum road segment length was set at 1500 feet (equal to size of model grid). Road surface elevations along each segment were extracted from the topographical Digital Elevation Model (DEM) which is based on a 5-foot grid. **Figure 3-4** shows the Collier County roads by road classification.

The MIKE SHE / MIKE 11 computer model was used to simulate the South Florida Water Management District (SFWMD) design storm events for the 10, 25, and 100-year return periods, all of 72-hour duration. Initial simulation conditions were made consistent with those used to develop the County's Federal Emergency Management Agency (FEMA) flood maps. The

difference between the water elevation as predicted by the model and the road surface elevation was calculated for each road segment. A segment was classified as failing if the difference between the water elevation and the road surface elevation exceeded the proposed FPLOS criteria.

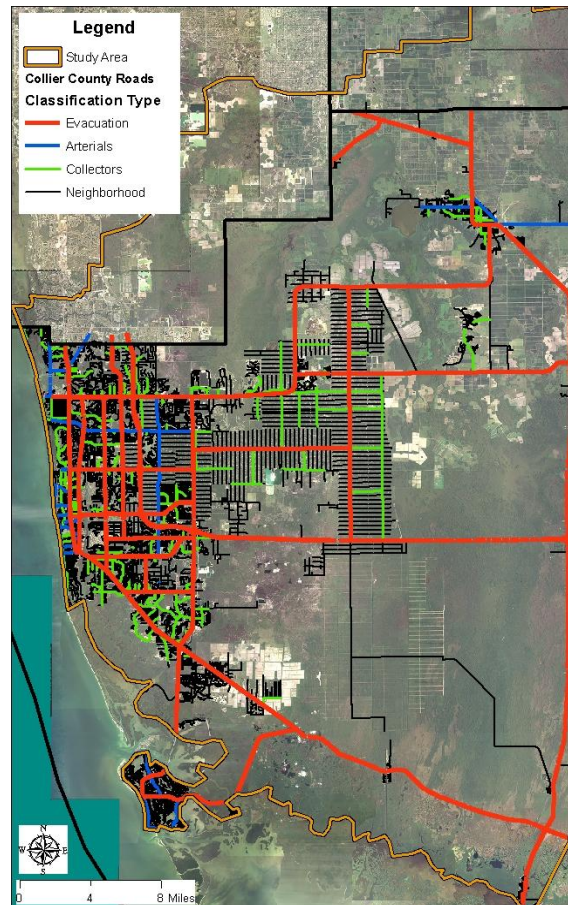


Figure 3-4. Roads by Road Classification

Results of the analysis indicate that the proposed FPLOS for the evacuation routes do not change significantly from the existing FPLOS results for the 25-year/72-hour storm. However, results also indicate that the criteria are not met along the evacuation routes even for the 10-yr/72-hr storm event conditions.

The failures occur along US-41 in the City of Naples and near the intersection with Airport Pulling Road. Failures are also predicted on Golden Gate Boulevard west of Airport Pulling Road and in the Golden Gate City area. In the northern Golden Gates Estates, Everglades Blvd is predicted to fail the proposed FPLOS during all storm events.

Results for the arterial roads analysis indicated that most road segments that fail 25-year design storm criteria also fail the 10-year storm criteria. However, several road segments, primarily along Vanderbilt Beach Rd and Logan Blvd, that fail the 25-year design storm criteria, pass the 100-year criteria. That is because the proposed 100-yr criteria allow six (6) inches of inundation above the road surface. The results suggest that the 25-year design storm should be used to support drainage design for arterial roads.

For collector and neighborhood roads, results indicated that the 10-year design storm should be used for drainage design purposes.



Initiative 8: Golden Gate Estates Transfer of Development Rights Program

It is recommended that Collier County establish the North Golden Gate Estates Flowway Restoration Program (NGGEFRP) and the corresponding North Golden Gate Estates Flowway Restoration Area (NGGEFRA) to preserve and thus protect from further degradation the ecological value and recharge function in the

identified areas

Objective

Certain portions of the North Golden Gate Estates basin, along with lands directly east of the Golden Gate Watershed, also within the Golden Gate Estates Subdivision (and falling within Faka Union Watershed) show high ecological restoration potential. Currently these areas have low population density, and land uses follow predominantly a single family low coverage semi-rural development pattern of one dwelling unit per 2.25 acres (or in the case of legal nonconforming lots, one dwelling unit per 1.2 acres). In fact, the North Golden Gate Estates Flowway Restoration Plan is currently under design. The purpose of that project is to restore “strategic areas of drained wetlands within Golden Gate Estates and north Belle Meade to allow storage and conveyance of stormwater runoff. The restoration of these wetlands will enhance flood management, water quality, wildlife habitat; add recreational area and green space; promote aquifer recharge; and provide opportunities as a potential mitigation area for wetland and stormwater impacts within the North Golden Gate Basin.”

The factors described above provide the opportunity to set aside or otherwise guide land development to protect environmentally valuable lands with a modification to the current Collier County Transfer of Development Rights (TDR) program.

The purpose of this chapter is to describe the potential modification of the current TDR program in Collier County as part of the watershed management plan local regulatory recommendations. At the outset, it should be understood that the potential TDR program is intended to be largely incentive based. It is

recognized that there are existing property rights and that any regulatory program designed to achieve or further the Watershed Management Plan Project objectives must be designed with full consideration of the impacts such regulations may have on those existing private property rights, including both federal (constitutional) rights, and the potential impacts of Florida’s “Bert J. Harris Private Property Rights Protection Act.”

General Description of TDR Programs

Often there are valid public policy reasons for limiting property rights on certain land, where the preservation or substantial preservation of such land is deemed to have a valid public purpose. Generally, this is regulated through zoning, and derives from a local government’s “police powers”¹. However, local governments must use caution when adopting new policy or zoning regulations that further limit or eliminate existing private property rights. If not, an unjust “Taking” can occur when the government acquires private property and fails to compensate an owner fairly. A taking can occur even without the actual taking of property title, such as when a government regulation substantially devalues a property. For many years TDR programs have been adopted throughout the Country (with varying degrees of success) as a means of compensating landowners who, for a valid public propose, have had their private property rights either fully or partially “taken” as a result of the local government action.

¹ The right of states to make laws governing public health, safety, welfare, and morals is granted by the Tenth Amendment to the US Constitution, which states, “The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the States respectively, or to the people.” State legislatures exercise their police power by enacting statutes to protect the public’s health, safety, welfare, and they also delegate much of their police power to local governments.

There are essentially two goals for TDR programs. The primary goal is to preserve some identified asset for public benefit. Examples include ecologically valuable land, open space, farmland, areas prone to flooding, areas necessary for groundwater recharge, waterfront areas, or historic structures. The areas that are the target of such preservation are generally called “Sending” lands. Lands to which such property rights may be transferred are generally referred to as “Receiving” lands.

The second goal of a TDR program is to compensate landowners in the Sending areas, for the loss of development rights on the Sending lands. This is accomplished through the ability to transfer these rights, or to sell these rights to another person or entity who can then use these rights within designated Receiving areas. The goal of compensating Sending land property owners is no less important than the first goal of preservation for primarily two reasons.

- If the program is purely voluntary, Sending land owners will not sell or transfer such rights unless the value they will receive for severing these rights provides sufficient incentive when compared to the rights they retain on the Sending lands and the goals of preserving the Sending lands and compensating the landowners will not be accomplished.
- If the TDR program includes a significant loss of the existing property rights on Sending lands, and such program is not viable and thus Sending land owners are not compensated for the loss of property rights, such landowners may then have a course of legal action for “Taking” claims against the agency, thereby jeopardizing the implementation of the entire program.

The Collier County Existing TDR Programs

In Collier County there are already several types of TDR programs in effect. Most follow the format of the traditional TDR program, but one of them,

the County’s Rural Lands Stewardship (RLSA) program is significantly different and is specifically excluded from the County’s general TDR provisions (Land Development Code (LDC) Section 2.03.07. D.4.a.iii.).

This analysis assumes that any TDR policies developed to advance the goals of the Watershed Management Plan will be in the form of a traditional TDR program. However, such policies would be distinct from policies that are presently applicable in various areas of Collier County. It should be noted that the LDC TDR provisions presently provide for transfers in three ways: a) from urban areas to urban areas; b) from Rural Fringe Mixed Use (RFMU) Sending lands to RFMU Receiving lands; and c) from Rural Fringe Mixed Use (RFMU) Sending lands to urban areas (limited to the Urban Residential Fringe (URF) subdistrict and to qualified urban infill areas. The applicable TDR provisions are as described below.

LDC Section 2.03.07. D.

4. *Transfer of Development Rights (TDR).*

a. *Purpose, Intent and Applicability.*

- i. **Purpose.** *The primary purpose of the TDR process is to establish an equitable method of protecting and conserving lands determined to have significant environmental value, including large connected wetland systems and significant areas of habitat for listed species; and to provide a viable mechanism for property owners of such environmentally valuable lands to recoup lost value and development potential which may be associated with the application of environmental preservation standards to such lands.*
- ii. **Intent.** *These TDR provisions are intended to accomplish the above stated purpose through an economically viable process of transferring development rights from less suitable non-RFMU sending areas and RFMU sending lands to more suitable non-RFMU receiving areas and RFMU receiving lands.*
- iii. **Applicability.** *These TDR provisions shall be applicable to those areas specifically identified in (b), (c) and (d) below. These TDR provisions shall not be applicable to the any transfer of development rights within the RLSA District.*

The existing Collier County TDR programs have not been utilized for a number of reasons. The urban to urban transfer has been rarely used as typically it is not necessary for a landowner to purchase a transferable urban TDR to accomplish the desired gross density on a project. In simple terms, there is no market for the urban to urban TDR program. As to the potential transfer from RFMU Sending to qualified urban infill areas, there has also been little use of this opportunity. The County's Future Land Use Element (FLUE) provides the following conditions related to Residential Infill (and the ability to transfer a TDR from the RFMU Sending Lands into the Urban Area):

Density Bonuses

d. Residential In-fill

To encourage residential in-fill in urban areas of existing development outside of the Coastal High Hazard Area, a maximum of 3 residential dwelling units per gross acre may be added if the following criteria are met:

- (a) The project is 20 acres or less in size;*
- (b) At time of development, the project will be served by central public water and sewer;*
- (c) The project is compatible with surrounding land uses;*
- (d) The property in question has no common site development plan with adjacent property;*
- (e) There is no common ownership with any adjacent parcels;*
- (f) The parcel in question was not created to take advantage of the in-fill residential density bonus and was created prior to the adoption of this provision in the Growth Management Plan on January 10, 1989;*
- (g) Of the maximum 3 additional units, one (1) dwelling unit per acre shall be transferred from Sending Lands; and*
- (h) Projects qualifying under this provision may increase the density administratively by a maximum of one dwelling unit per acre by transferring that additional density from Sending Lands.*

Again, based upon the fact that the Residential Infill provision has been rarely used, the additional requirement that at least one of the three additional bonus units must come from RFMU Sending lands (added in 2002), even

though a project could realize an increased density of up to one dwelling unit per gross acre administratively (without being required to rezone the property), creates a condition for which there is insufficient market demand for the urban infill provisions.

Collier County also provides for TDR to be transferred from RFMU Sending lands to RFMU Receiving lands. That program provides for a base TDR at a ratio of one TDR per 5 acres of Sending land, and also provides that for each base TDR a property owner also has the ability to secure an early entry TDR Bonus (still in effect) and a bonus for environmental restoration for the Sending lands and a bonus for deeding the Sending lands to a public land management/conservation agency. Although there have been several properties which have secured the base and early entry TDR bonuses, to date there has been no actual utilization of these TDRs in receiving lands.

Within the RFMU Subdistrict there are four distinct Receiving areas. The RFMU Receiving areas were chosen because they contained lower ecological value than other lands within the RFMU subdistrict and are situated such that they had or could relatively easily develop adequate access to the arterial transportation network and to other necessary public services such as public utilities. The Receiving area can be developed in two ways, either as a Rural Village, or as receiving lands located outside of a Rural Village. The maximum allowable density within a Rural Village is 3.0 units per gross acre and for Receiving lands located outside of a Rural Village the maximum density is 1.0 unit per gross acre. For a number of reasons, all generally related to the economic viability (that is potential return when compared to cost and potential risk), development of RFMU Receiving lands has not happened since the inception of the RFMU TDR program.

Since there has been no utilization of the TDR in designated RFMU Receiving areas, either in a Village or outside of a Village, again one must look to the market viability of the program.

Clearly any new or expanded TDR program must be designed so as to have a tangible market value, both to the Sending landowners, and to the owners or potential owners of Receiving lands.

Recommendation to Develop a TDR Program for the Northern Golden Gate Estates

It is recommended that Collier County establish the North Golden Gate Estates Flowway Restoration Program (NGGEFRP) and the corresponding North Golden Gate Estates Flowway Restoration Area (NGGEFRA) to preserve and thus protect from further degradation the ecological value and recharge function in the identified areas primarily within the north eastern portion of the Golden Gate Estates Subdivision.

The location of the NGGEFRA is shown in Figure 3-5. In addition to this area being used for the Floodway Restoration Plan, it includes significant portions of non-agricultural areas that have been identified in this study as “ecologically valuable lands”, as well as areas identified by the County for wellhead protection.

A major component of the NGGEFRP would be a TDR program designed to provide sufficient market attraction to not only accomplish the protection goals of the NGGEFRP (stated below), but also to provide enhanced incentives to promote development of the Rural Villages in all or some of the established RFMU Receiving lands. The TDR program would provide for the voluntary severing of residential development rights from the identified Sending lands in the NGGEFRA and allow the transfer of such rights to targeted Receiving lands.

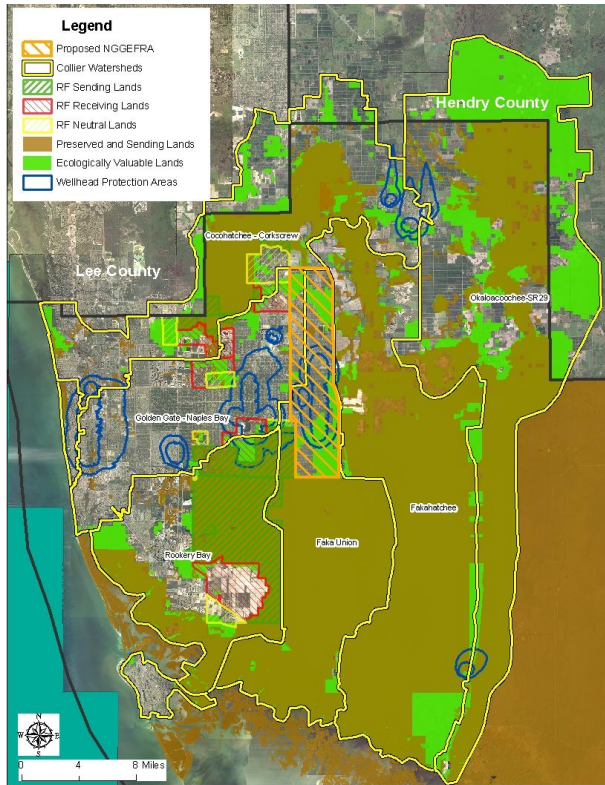


Figure 3-5. Location of the North Golden Gate Flowway Protection Area (NGGFPA)

Program Description and Recommended Elements

It is further recommended that the following elements be considered for inclusion in the program:

- Design the TDR program to be completely voluntary (with appropriate incentives).
- *Use the TDR program to incentivize aggregation of smaller parcels into a larger development tract.* If smaller parcels are aggregated and then clustered development is employed, the remaining undisturbed portions can then be protected while still allowing common passive recreation uses. In such cases, an incentive of some amount of increased density, for example 10 or 20 percent, could be considered. In effect, the “clustered development area” becomes a Receiving area, and is granted a density bonus for protecting the remaining undisturbed land. As an example, if several smaller parcels

containing the rights for 10 single family units are combined to create a large 20 acre development tract, and the single-family development is designed to be clustered such that the impact area is limited to a maximum of 10,000 square feet per unit, and a 20 percent bonus is granted bringing the density up to 12 units, then the overall impact area would not exceed 120,000 square feet or 2.75 acres. This would leave 17.25 acres of open space which could be used for passive recreation and at the same time for recharge and storm water management. Ideally the majority of this remainder area would be cleared of exotic vegetation and remain in its natural state with limited clearing permitted.

- Incentivize TDR transfers from the NGGEFRA to RFMU Receiving lands and further incentivize Rural Village development in all or some of the RFMU Receiving Areas. The TDRs generated from the NGGEFRA have the potential to provide additional market attraction for the RFMU Receiving lands. If designed properly, with sufficient bonus and/or multipliers, the TDR program can become more equitable for both owners of NGGEFRA Sending lands and owners or potential owners of RFMU Receiving lands. As stated by Dennis E. Gilkey, an individual with vast experience in Southwest Florida developing high quality large mixed-use master planned communities, “For a TDR program to work, it must first be market driven.”² Thus the program must achieve a marketable balance in terms of the cost to acquire necessary TDRs for use in Receiving areas and the compensation to Sending land owners for those TDRs.
- As previously stated, the maximum allowable density within a Rural Village is 3.0 units per

gross acre and for Receiving lands located outside of a Rural Village the maximum density is 1.0 unit per gross acre. To achieve these densities, one must purchase TDRs and TDR bonuses. Certainly it would be reasonable to allow additional density in these areas (for example an additional 1.0 units per in Receiving lands located outside of a Rural Village (for a total of 2.0 gross units per acre) and up to 5 units per acre in a Rural Village (for up to 5 units per gross acre)) if such increases were tied to TDRs and TDR bonus units derived from the High Recharge Sending lands. At least two of the identified RFMU Receiving lands areas are well suited in terms of existing access to the arterial network and extension of utility lines and service from existing County facilities. It is not enough just to allow additional density, but to ensure a viable market attraction and provide a balance in terms cost. This will require appropriate incentives to direct development to the Receiving areas.

- *Allow the transfer of TDRs and/or TDR bonus units from the NGGEFRA into the urban area under limited or general conditions.* For example, any project in the Urban Area qualifying as Urban Infill might then be able to increase its density by 1 or 2 units per gross acre by right (under certain identified conditions) through the acquisition and use of TDRs from the NGGEFRA Sending areas. Other opportunities for transfer to the urban area may also exist.
- Consider whether or not to expand the NGGEFRA to also include other lands in the general vicinity that also contain high ecologic and/or high recharge value. Of particular note is the fact that the data indicate high ecological value on the various “Neutral Lands” within the RFMU subdistrict. **Figure 3-5** also shows the location of adjacent Neutral Lands.

² *Transfer of Development Rights (TRDs) in Florida’s Rural Lands (and why they haven’t worked)*. Report prepared by Dennis E. Gilkey, Gilkey Organization, 2010)

Next Steps

- 1) Establish an Oversight Committee of 9 members to work with staff to develop the specifics of the TDR program. It is recommended that the committee have representation from the following stakeholder groups:
 - a. Landowners within the affected area (2 or 3 members)
 - b. Nongovernmental environmental organizations (2 members)
 - c. Golden Gate Estates Civic groups/organizations (2 members)
 - d. Land owners within the RFMU Subdistrict (2 members)
 - e. At least one a representative from the development industry.
- 2) Prepare a map or series of maps depicting the individual parcel boundaries within the targeted high recharge areas, primarily located in the North Golden Gate Estates Subdivision, to quantify the number of legal nonconforming and conforming parcels. Overlaying these maps on an aerial will allow quantification of the number of developed parcels as well as identification of the Sending lands boundaries.
- 3) Determine whether there is support to move forward with developing a TDR program for this area by bringing the concept of a TDR program to the Environmental Advisory Council (EAC) and Planning Commission (CCPC) for policy recommendation and then to the Board of County Commissioners (BCC) for policy direction.

changes to the RFMU subdistrict will require amendments to the County's Comprehensive Growth Management Plan (GMP), including amendments to the Golden Gate Area Master Plan (GGAMP), the Future Land Use Element (FLUE), Future Land Use Map (FLUM), and the Conservation and Coastal Management Element (CCME), at a minimum. These Plan amendments would then be followed by implementing LDC amendments.

Additional Considerations

It should be noted that the creation of a TDR program in the NGGEFRA and the attendant identification of Sending and Receiving areas and potential TDR bonuses, as well as potential



Initiative 9: Golden Gate Estates Watershed Mitigation Program

The Northern Golden Gate Estates (NGGE) has been identified as an area of particular interest, in regards to wetland mitigation practices. Golden Gate-Naples Bay is the only watershed that does not currently have a mitigation bank or ROMA within its boundaries.

Objective

Filling or dredging of wetlands requires state and federal permits, which often allow mitigation to occur outside of the functional watershed. Collier County and most other local governments have little direct authority to regulate wetland mitigation decisions. Therefore, non-regulatory incentives will be necessary in order to achieve wetland mitigation that is compatible with Collier County's objective to mitigate wetland impacts within the same functional watershed. This memorandum proposes mechanisms to incentivize mitigation of wetland impacts within the same functional watershed as the impacts.

Currently, regulations allow wetland impacts to be mitigated either on-site, at a permitted mitigation bank or at an authorized "regional offsite mitigation area" (ROMA). Mitigation banks are large (usually at least a square mile), privately-managed tracts of land that are awarded mitigation credits by restoring or enhancing wetlands on the site. ROMAs are generally government-operated mitigation sites, usually to generate mitigation credits needed either by the land-owning agency itself or by single-family homeowners. Mitigation service areas (the geographic limits within which impacts can be offset by purchasing credits at the bank or ROMA) for mitigation banks and ROMAs generally extend well beyond the functional watershed. This process allows permit applicants to select mitigation far away from the impact site. As a collective result of many individual impacts being mitigated far off-site, the wetland functions within a functional watershed, as defined for the Watershed Management Plan, could potentially be significantly diminished.

Wetland Permitting Programs

Two primary regulatory programs govern the issuance of wetland impact permits: the Environmental Resource Permit (ERP) program administered by the water management districts (WMD) and Florida Department of Environmental Protection (FDEP), and the Section 404 "dredge and fill" program of the federal Clean Water Act, administered by the U.S. Army Corps of Engineers (USACE). ERP permits are required for many types of activities beyond wetland impacts, including water quality and quantity for upland developments as well; however, for the purposes of this memorandum, only wetland regulations are covered herein.

ERP responsibility is divided between FDEP and each WMD in accordance with an operating agreement. The FDEP-SFWMD operating agreement gives FDEP the responsibility to review and issue ERP permits for several categories including solid waste, wastewater, hazardous waste, and potable water facilities; marina, seaport and docking facilities (other than those associated with land-based commercial and residential projects regulated by SFWMD); projects constructed, operated or maintained by SFWMD; navigational dredging by governmental entities; mining, and single-owner residential development up to 3 parcels, as long as each parcel contains only one dwelling unit (single-family home through quadruplex). SFWMD has the responsibility to review and issue ERP permits for all other regulated activities, including residential subdivisions, commercial developments, roads, and certain agricultural activities.

ERP rules exclude (by way of specific exemption or a noticed or no-noticed general permit) several types of activities from wetland impact and mitigation requirements, notably impacts to

isolated wetlands smaller than ½ acre; unavoidable filling of up to 4,000 square feet and clearing up to 6,000 square feet of a wetland for the purpose of constructing a single-family home; many agricultural and silvicultural activities; and most maintenance and repair activities, subject to certain BMP's.

On the federal side, USACE permits are required only for projects that deposit dredged or fill materials into non-isolated wetlands (i.e., wetlands not connected to navigable waters by way of other wetlands, ditches, flow-ways, streams, or canals). USACE rules provide similar exclusions from typical impact and mitigation criteria, except that the nationwide permit for single-family homes allows filling of up to ½ acre of non-tidal wetlands without mitigation (rather than the 4,000 square-foot limit in the ERP Noticed General Permit).

The general process and approach to proposed wetland impacts and mitigation is similar for all three regulatory agencies. An applicant, oftentimes with the assistance of a consultant, submits an application identifying the wetland location(s), along with quantification of the area and functional value of wetland impacts and mitigation. The functional value of a proposed wetland impact or mitigation plan is determined through the Uniform Mitigation Assessment Method (UMAM). UMAM quantifies the ecological value of a wetland based on its location (connectivity to other wetlands and natural resources), hydrology, water quality, vegetative composition, and acreage. Within the original application or subsequent submittals, the applicant must demonstrate that the proposed wetland impacts are permissible (i.e., low-quality, or unavoidable if higher-quality) and that the proposed mitigation offsets the proposed impact. The regulatory agency reviews proposed mitigation to determine whether it is the appropriate amount (i.e., UMAM value of the mitigation is equal to or greater than the UMAM value of the impact), type (e.g., a freshwater herbaceous impact generally must be offset by freshwater herbaceous mitigation), location, and has long-term assurance of success.

Agency rules and practices, particularly federal mitigation criteria, provide a general preference for mitigation via the purchase of mitigation

credits at a permitted mitigation bank or use of a ROMA whose mitigation service area includes the area of impact. In some circumstances, on-site wetland mitigation is permitted, due primarily to financial circumstances for single-family home owners and/or the high ecological value of an on-site wetland.

Wetland Mitigation Criteria and Practice in Collier County

Four mitigation areas are commonly used to offset impacts in Collier County: the Big Cypress Mitigation Bank located in southern Hendry County, Panther Island Mitigation Bank located in northern Collier County (in the Cocohatchee-Corkscrew functional watershed), Corkscrew Regional Mitigation Bank located in Lee County (adjacent to the Cocohatchee-Corkscrew functional watershed), and the Northern Golden Gate Estates ROMA located in the Picayune Strand State Forest (in the Rookery Bay functional watershed). The mitigation service area for a mitigation bank or ROMA generally is comprised of one or more of the regional drainage basins shown in **Figure 3-6**. The mitigation service areas for Big Cypress and Panther Island are identical: the entirety of Estero Bay, West Collier and East Collier regional drainage basins. The mitigation service area for the Corkscrew Regional Mitigation Bank consists of the West Collier, Estero Bay, and West Caloosahatchee regional drainage basins. The service area for the Northern Golden Gate Estates ROMA is single-family residential development within NGGE (note that this service area is defined both geographically and by type of wetland impact project).

Regulatory agencies and local governments have little authority to deny the use of one of these mitigation banks or ROMAs based on location of the impact, so long as the impact is within the same regional drainage basin and service area.

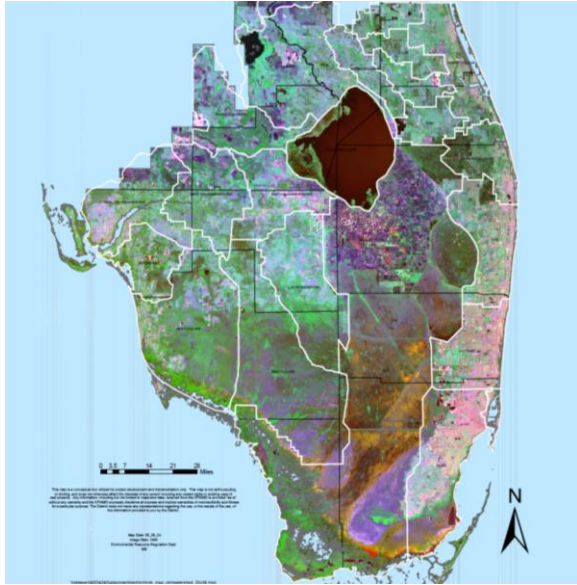


Figure 3-6. SFWMD Regional Drainage Basins

Mitigation can also occur at a mitigation bank in a different regional drainage basin within the mitigation service area, if the impact is to a lower-quality wetland (e.g., an impact to a melaleuca-infested wetland in the Estero Bay basin could be offset via the purchase of credits at the Panther Island Mitigation Bank located in the West Collier basin, since the Panther Island service area includes the Estero Bay basin). Wetland functions in areas with impacts are therefore transferred to other functional watersheds and regional drainage basins where mitigation banks are located. This conflicts with the extent of the functional watersheds as defined in the Watershed Management Plan. For example, impacts in the Rookery Bay functional watershed can be offset at the Panther Island Mitigation Bank located in the Cocohatchee-Corkscrew functional watershed, as both are contained within the larger West Collier regional drainage basin and the Panther Island Mitigation Bank service area defined by SFWMD.

Recommended Mitigation Strategy for the NGGE

The Northern Golden Gate Estates (NGGE) has been identified by several stakeholders as an area of particular interest, in regards to wetland impact and mitigation practices. Of the three primary functional watersheds reviewed in the Collier County Watershed Model Update, the Golden

Gate-Naples Bay watershed is the only one that does not currently have a mitigation bank or ROMA within its boundaries. These stakeholders have expressed a desire for mitigation within the functional Golden Gate-Naples Bay watershed, and more specifically within or adjacent to NGGE. Development of the single-family lots that dominate NGGE often requires no wetland mitigation because this type of development generally fills less than 4,000 square feet in wetlands. For those wetland lots that require more than 4,000 square feet of fill, on-site mitigation is generally not available or is insufficient. As a result, off-site mitigation is generally required through the purchase of mitigation bank credits at Big Cypress or Panther Island Mitigation Bank, or through funding or participation in ecological restoration activities at the NGGE ROMA. Consequently, NGGE is losing wetland ecological functions, including opportunities for stormwater retention and treatment.

In-Watershed NGGE Mitigation

No regulatory mechanisms exist that would require mitigation of NGGE impacts within the Golden Gate-Naples Bay Watershed. Further, no ROMA or mitigation bank is currently available within NGGE to offset wetland impacts. Additional incentives and opportunities must therefore be developed, if wetland mitigation is to occur within NGGE. Encouragement of mitigation within NGGE (and more broadly for other areas desiring in-watershed mitigation) requires several key elements: identification of site(s) that are available and can be restored to provide increased ecological value; development of restoration plans that meet state and federal criteria for permissible regional mitigation; and analysis of costs to determine how mitigation credits could be sold at a lower cost than currently available via existing mitigation options.

Ecological review, engineering assessment, UMAM analysis and land-ownership review would be necessary to determine the extent to which one or more wetland-restoration projects in this area can provide mitigation value by acquiring land, filling ditches, removing roads, restoring former hydrological connections, and/or managing vegetation. The ROMA would be established by permit and/or interagency agreements, including

a detailed plan providing assurance to the regulatory agencies (FDEP and/or SFWMD and/or USACE) that the necessary parcels will be acquired, projects will be constructed, and the land and projects will be managed in perpetuity. Credits would be released in accordance with a schedule, tied to accomplishment of project goals (acquisition of lands/easements, construction of projects, eradication of exotic vegetation, planting of native vegetation, achievement of hydrological criteria, etc.).

Regulatory approval of a ROMA within NGGE is not a likely impediment, to the extent that the mitigation would be designated for single-family residential development, similar to the current NGGE ROMA at Picayune Strand approved by FDEP. In fact, based on discussion with FDEP staff, it is possible for FDEP to develop a special "Noticed General Permit" specifically for NGGE that would provide for expedited review and approval of single-family wetland impacts mitigated within NGGE. Under this scenario, wetland restoration at the ROMA would ideally be funded by a mitigation fee required by FDEP and collected by the County or Soil and Water Conservation District. Alternative mechanisms to acquire parcels and/or construct projects within this phase could include transfer of development rights or in-kind services provided by permit applicants. If the mitigation would be used only for single-family residential projects, these costs could be subsidized if necessary.

Benefits of a single-family ROMA and Noticed General Permit within NGGE include quick permitting for single-family homeowners, and addressing two issues--loss of wetland functions and flooding-- that are inadequately addressed currently. The greatest impediments include the logistical effort necessary to assemble a thorough plan of acquisition, construction and management that is acceptable to the regulatory agencies and affected landowners; the potential necessity of County or other governmental subsidy to provide a financially viable option to homeowners; and future projects (e.g., large development planned to the east by Barron Collier or Collier Enterprises) that may restrict the ability of a mitigation project within NGGE to achieve hydrological restoration.

If mitigation is desired for other projects regulated by SFWMD and/or USACE (e.g., County

roads and other public works projects), there would be a higher level of requested detail, analysis and certainty of outcomes, including long-term protection and funding. Both SFWMD and USACE require a level of analysis and regulatory assurance for ROMA's that is substantially comparable to private mitigation banks. This would likely include establishment of a long-term funding mechanism (e.g., trust fund dedicated to long-term management and operation, funded by mitigation credit sales, separately from initial construction and restoration), dedication of conservation easements to SFWMD, and extensive analysis to demonstrate the project would achieve the projected ecological restoration goals.

Recommendation

Based on stakeholder comments and the results of landscape-level functional assessment, the sites most suited to provide regional mitigation within NGGE are Winchester Head, Horsepen Strand, and adjacent connecting wetland areas. These sites consist of current and former wetlands that have been ecologically degraded due to artificial drainage and/or loss of watershed area. A well-designed project would retain ecological functions as well as re-establish drainage patterns such that runoff would flow into these wetlands rather than be diverted into the Golden Gate canal network. Based on review of stakeholder input and other data, an ideal project would include public acquisition of fee simple or conservation and flowage easements over parcels; complete or partial filling of drainage ditches (constrained by the need to maintain existing levels of flood control); removal of roads; and installation of culverts and/or channels to restore watershed flows to these areas.

Due to the different requirements for single-family mitigation and public works mitigation, permitting would be most easily accomplished by separating the project into two phases: one phase permitted by FDEP for mitigation of single-family residential impacts, and the other phase permitted by SFWMD for mitigation of roads and other public works impacts. Funding and acquisition sources for the FDEP-permitted phase could include mitigation credit sales, TDRs, grants, and/or direct county funding.

The second phase, to be permitted by SFWMD to offset impacts associated with County public works projects, would be paid for via the public works projects. On the cost-analysis side, it should be noted that Lee County has determined that mitigation for public works projects on their County-owned lands is significantly less expensive than the purchase of private mitigation bank credits (from the same mitigation banks that currently provide mitigation for Collier County projects). Collier County currently pays wetland mitigation fees, generally via the purchase of wetland mitigation credits from private mitigation banks, at a rate of up to \$90,000 per credit (each credit offsets approximately 2–3 acres of wetland impacts). As with the FDEP permit, the SFWMD and USACE would require a detailed, supportable plan and measurable restoration in order to award and release mitigation credits.

Factors favoring this second, SFWMD- and ACOE-permitted phase of the ROMA include:

- Internal capture and/or reduction in mitigation costs;
- Dual-purpose regional wetland mitigation and stormwater attenuation;
- Regulatory precedent for wetland mitigation on County lands (the SFWMD has issued several permits to Lee County for this type of project);
- County-owned upland parcels in NGGE that could potentially be "swapped" with privately-owned wetland parcels, in order to acquire lands within the projects' footprint; and
- Upcoming statewide rules affecting water quality criteria and enabling water quality credit-trading.

Potential impediments include (in addition to the impediments listed for the FDEP phase above, which are also pertinent for this phase): the necessity of a reliable funding source within the County to accomplish the project objectives; potential SFWMD requirement for the County to acquire much of the land up-front; and potential

negative reaction by environmentalists concerned by the use of public lands to mitigate (i.e., incentivize) impacts.

Other Potential Mitigation Concepts

Other concepts to incentivize and fund in-watershed mitigation were also evaluated. These concepts, and rationale for not proposing them at this time, include:

- Offsite regional water quality mitigation banking. In this scenario, a mitigation project could generate water quality "credits," which would be sold to offset a portion of the water quality impacts for other projects, similar to wetland mitigation. This concept was not deemed feasible due to lack of regulatory guidance at this time. However, upcoming statewide implementation of a pilot water quality trading program by FDEP may provide a market for this type of approach in the future.
- Public-private wetland mitigation bank, located on County lands, with authorization to sell mitigation credits to any entity and a portion of the fees being returned to the County for a long-term management fund. The primary obstacle for this type of project is financial feasibility, due to current market conditions and two existing permitted mitigation banks in this area, which generate a surplus of mitigation credits.
- Adopt local Zoning and/or Comprehensive Plan requirements to retain habitat within the functional watershed. Rules of this nature may encounter significant opposition from developers and mitigation bankers, and would need to be structured in a manner to avoid directly regulating wetland impacts or endangered species' impacts exceeding local government authority.



Initiative 10: Modified Operations of Water Control Structures

It is recommended that Collier County work with the SFWMD to minimize baseflow by modifying water control structure operations where possible to reduce the difference between groundwater levels and the canal surface water elevation.

As discussed in the assessment of existing conditions, baseflow is a major source of excess flow to the estuaries and contributes to losses in groundwater storage. Computer modeling results indicate that the wetland area in the Okaloacoochee Slough, Camp Keais Strand, and the Corkscrew Swamp provides groundwater recharge on a year round basis. The analyses also indicate that large baseflow contributions to the canal network occur in the Golden Gate and Faka Union watersheds. It is expected that completion of the Picayune Strand Restoration Project will greatly reduce the baseflow contributions in the Faka Union watershed; therefore, the primary focus of this initiative is on structure operations in the Golden Gate-Naples Bay Watershed.

A comparison of baseflow during the wet and dry seasons in the Golden Gate-Naples Bay Watershed indicates that, as expected, substantially more baseflow occurs during the wet season than during the dry in terms of total volume. The water budget analysis showed that 8.51 inches of baseflow occurs in the Golden Gate-Naples Bay Watershed during the wet season compared to 4.27 inches during the dry season. However, baseflow contributes more than 70 percent of the dry season fresh water discharges to the canal network, compared to 50 percent during the wet season.

Figure 3-7 and **Figure 3-8** show the average wet season and dry season baseflow contributions in the Golden Gate-Naples Bay Watershed. It is interesting to note that during the dry season, recharge is predicted to occur in several locations immediately upstream of operable gates, or near shallow potable water supply well fields.

The greatest volume of dry season recharge occurs immediately north of the CR951-1 structure which includes a pump to divert water from the Golden Gate Main Canal into the CR951

Canal. Results also indicate that water pumped into the CR951 Canal is returning to the Golden Gate Main Canal via baseflow. Groundwater recharge influenced by pumping for potable water supply is also observed in the dry season near the GG-4 structure.

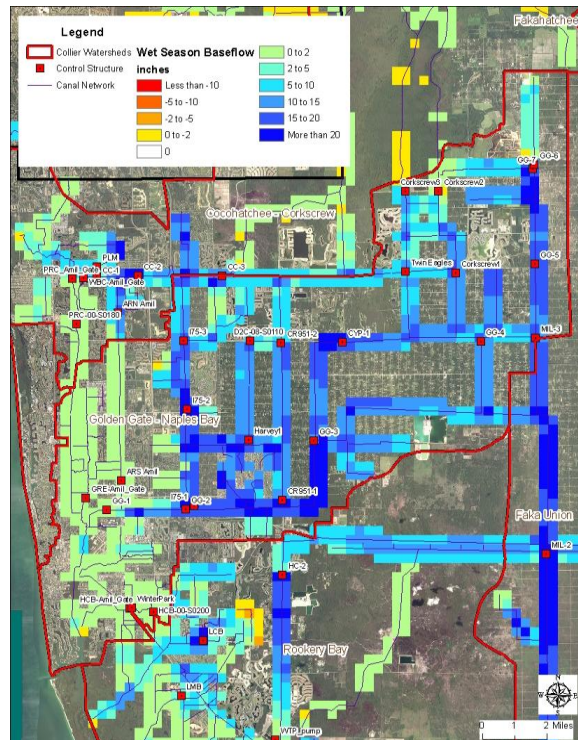


Figure 3-7. Average Wet Season Baseflow Contributions, Golden Gate Watershed

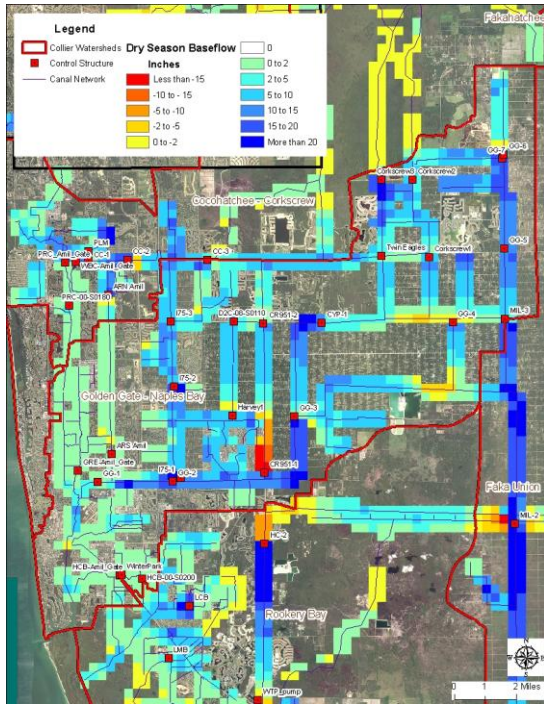


Figure 3-8. Average Dry Season Baseflow Contributions, Golden Gate Watershed

The analyses also show that the highest predicted baseflow values occurs immediately downstream of the operable structures and that baseflow decreases along the canal toward the next downstream structure. This is most evident along the Cypress Canal segment between structures CYP-1 and GG-3. This pattern of baseflow along the length of a canal segment is the result of staging water at different elevations upstream of each structure. Standard operating rules are defined by the SFWMD or by Collier County for each structure in the canal network.

These rules primarily rely upon the water levels upstream and downstream of the individual

structures and are designed to stage water at different elevations during the wet and dry seasons. During the wet season, the structures are operated to stage the canals at an elevation that is approximately one foot (1 ft) lower than the dry season.

The lower elevation, paired with higher groundwater elevations due to rainfall, leads to an increase in baseflow. The defined operations may contribute to the seasonal difference in baseflow upstream and downstream of the individual structures. **Figure 3-9** shows the typical relationship between baseflow and the difference in groundwater and canal water surface elevations in the Cypress Canal. The data clearly indicates that managing canal stage to more closely match groundwater elevations is an important tool for reducing the volume of baseflow entering the canal network.

It is recommended that Collier County work with the SFWMD to modify structure operations where possible to reduce the difference between groundwater levels and the canal surface water elevation. The potential range of operations is constrained by the design and physical limitations of the structures and may limit the ability to stage water at a seasonally higher elevation within the canal network.

Therefore, design of new and replacement structures should consider seasonal groundwater head elevation data. The ability to more closely match canal stage and the groundwater head elevation will have long-term benefits to the estuaries by reducing baseflow to the canal network.

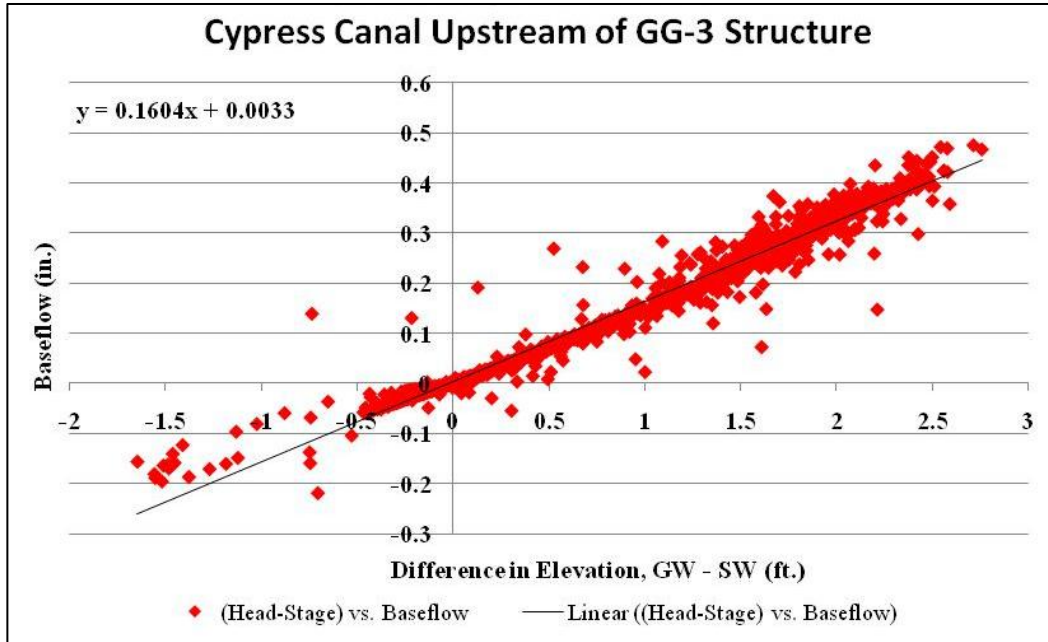


Figure 3-9. Relationship of Baseflow and (Head-Stage) Elevation Difference



Initiative 11: Water Quality Monitoring Program

The main objective of the recommended improvements to the surface water monitoring program is to better define water quality conditions in the estuaries and along the canal network.

Existing Monitoring Programs

Surface water monitoring stations in Collier County are managed by multiple agencies. Each agency has different objectives and goals. The City of Naples surface water monitoring stations are located in the estuarine systems and track the long-term health of the estuaries. Similarly, Collier County and the FDEP monitor the Wiggins Pass estuarine system, whereas the Rookery Bay National Estuarine Research Reserve monitors the Rookery Bay and Ten Thousand Island estuaries.

The South Florida Water Management District (SFWMD) manages most of the inland surface water monitoring stations. Many of the stations are located near watershed outfalls and track water quality leaving the watershed and entering the estuary system. Other sampling stations are co-located at operational structures within the managed canal network. Some of the stations in the Immokalee area are likely used to identify potential sources of nutrient loading to Lake Trafford, but in general, the surface water monitoring programs do not seek to identify the loading contributions from specific land use or sub-drainage areas.

Groundwater monitoring includes the Water Table and Lower Tamiami Aquifers. The monitoring wells are fairly well distributed across the county; however, many of the wells have not been sampled recently and do not provide current information.

As with the existing surface water monitoring programs, the groundwater wells are sampled by different agencies to meet different objectives. As an example, many of the wells located near the coast in the Cocohatchee-Corkscrew, Golden Gate-Naples Bay, and Rookery Bay watersheds are installed at locations where reuse water is used for irrigation. These wells are typically sampled two or three times per year and track

groundwater water quality at or adjacent to irrigated lands. These wells do not measure off-site background concentrations or provide opportunities to assess regional groundwater quality trends.

Review of the reported groundwater data also indicated that there was no consistency in frequency of sampling, or in the analytical tests completed for each sample. As an example, the wells in the Picayune Strand State Restoration Project area have only been sampled once for analytical data, although the wells are monitored frequently for head elevation. These wells are also some of the few where DO results have been reported.

Recommended Monitoring Plan

The recommended monitoring plan includes three monitoring areas, surface water, groundwater, and wet weather discharges. They are described below. More detailed descriptions are provided in a technical memorandum prepared as part of this project.

Surface Water Monitoring

The main objective of the recommended improvements to the surface water monitoring program is to better define water quality conditions in the estuaries and along the canal network.

Estuarine Water Quality Monitoring

The number of existing estuarine monitoring stations is generally adequate to track water quality in the estuaries. However, several stations in the Rookery Bay watershed are located in landlocked areas or areas strongly affected by stormwater treatment systems. It is recommended that these locations be moved to locations that better represent actual estuarine conditions.

Canal Network Monitoring

There are adequate surface water sampling stations to measure nutrient contributions at the discharge from the Cocohatchee-Corkscrew, Golden Gate-Naples Bay, and Faka Union, Fakahatchee, and Okaloacoochee-SR29 watersheds into the receiving estuaries. However, it would be beneficial to establish permanent monitoring stations at the discharge points into the Rookery Bay Estuary. Potential locations include the Lely Canal Basin, the Lely Manor Basin, and the main canals in the agricultural lands located in the southeast portion of the watershed.

In addition, it would be beneficial to establish additional monitoring stations upstream in the Golden Gate and Cocohatchee watersheds to establish trends and potentially identify drainage areas that contribute high concentrations of contaminants. These stations would be located adjacent to existing water control structures.

Recommended additional locations for permanent monitoring stations are listed in **Table 3-6**. These stations should be sampled quarterly and analyzed at least for nutrients and metals.

Groundwater Monitoring

The overall objective of the expansion of the groundwater monitoring program is to achieve a

better distribution in the monitoring well network. Better distribution of the wells will help define background levels of potential contaminants and allow the County to better understand the distribution of contaminants in groundwater. A goal is to improve the understanding of how land management practices affect groundwater quality.

Table 3-7 shows proposed locations of additional permanent monitoring wells. These wells are all located in the Water Table and Lower Tamiami aquifers and will provide better information about the distribution of contaminants in groundwater.

New monitoring well locations were identified based on the results of the groundwater pollutant loading analysis conducted as part of this project. That analysis identified areas with potentially high concentrations of nitrogen, phosphorus, and iron that require better data to confirm predicted results and to fill gaps where available data is outdated or where no data is available. In some case, installation of new monitoring wells is necessary. In other cases, existing wells can be redeveloped. Samples should be collected on a quarterly basis. Also FDEP recommends that monitoring wells be installed near Lake Trafford to assess groundwater contributions to the lake system.

Table 3-6. Proposed Permanent Surface Water Monitoring Stations

| Watershed | Branch | Location | Comment |
|------------------------|------------------------|----------------------------------|--|
| Cocohatchee-Corkscrew | Cocohatchee Canal | Upstream-Cocohatchee 3 Structure | Measure of contributions to Cocohatchee Canal between Twin Eagles and Coco 3 |
| Golden Gate-Naples Bay | Cocohatchee Canal | Twin Eagles Structure | Measure of contributions to Cocohatchee Canal from upstream of Twin Eagles |
| Golden Gate-Naples Bay | I-75 Canal | I-75 Canal Structure 1 | Measure of contributions from I-75 Canal to Golden Gate Main Canal |
| Golden Gate-Naples Bay | Gordon River Extension | Pine Ridge Road | Measure of contributions to Gordon River Extension from upstream of Pine Ridge Rd. |
| Golden Gate-Naples Bay | Cypress Canal | Cypress 1 Structure | Measure of contributions to Golden Gate Main Canal upstream of Cyp-1 Structure |
| Rookery Bay | Lely Canal | US 41 | Measure of contributions from Lely Canal to Rookery Bay |
| Rookery Bay | Lely Manor Canal | US 41 | Measure of contributions from Lely Manor to Rookery Bay |
| Rookery Bay | US 41 Canal | Near Belle Meade | Measure of contributions from agricultural lands to Rookery Bay |
| Faka Union | Miller Canal | Upstream-Miller 3 Structure | Sample when gate is open |

Table 3-7. Proposed Groundwater Monitoring Stations

| Watershed | Location | Comment |
|-------------------------|--|--|
| Cocohatchee – Corkscrew | North of Lake Trafford | Proposed by FDEP to monitor groundwater around Lake Trafford |
| Cocohatchee – Corkscrew | East of Lake Trafford | Proposed by FDEP to monitor groundwater around Lake Trafford |
| Cocohatchee – Corkscrew | West of Lake Trafford | Proposed by FDEP to monitor groundwater around Lake Trafford |
| Cocohatchee – Corkscrew | East of US 41 near Imperial Golf Course Blvd | Well to verify extent of potential hot spot for TN and TP |
| Rookery Bay | North side of US 41 near Willough at Naples Hospital | Well to verify extent of potential hot spot for TN and TP |
| Rookery Bay | North of US 41 along Greenway Rd. | No data since 1980's. Well to monitor effect of agricultural and urban development |
| Rookery Bay | North of US 41 along 6L Farm Rd. | No data since 1980's. Well to monitor effect of agricultural development |
| Rookery Bay | Near proposed extension of Wilson Blvd. | Well to verify elevated iron concentrations |
| Faka Union | Everglades Blvd south of I-75 | Use existing SGT well for background data |
| Okaloacoochee-SR29 | Keri Road east of SR 29 | Evaluate water quality at County boundary |

Wet Weather Event Sampling Program

The pollutant loading analysis conducted as part of the watershed management plan was based on rainfall event mean concentrations (EMCs) used in the Southwest Florida Feasibility Study (SWFFS). Although the SWFFS was the best available information, better site specific data is necessary to assess nutrient loads from specific land uses such as single family residential and agriculture. These land uses vary in design characteristics as well as pollution control features.

It is recommended that a one-time sampling program be established to measure EMCs at specified locations.

The program would rely upon installation of automated sampling devices to collect samples during storm events from the areas listed below:

- One site to monitor runoff from residential development designed with curb and gutter
- One site to monitor runoff from a residential development designed with shallow roadside swales
- One site to monitor runoff from a golf course
- One site to monitor runoff from a commercial parking lot
- Two sites to monitor runoff from agricultural lands

Automated samplers should be installed at each location to obtain a minimum of 4 wet season samples and 4 dry season samples.

Monitoring Plan Cost Estimate

Cost estimates were prepared for each of the monitoring strategies. **Table 3-8** describes the

assumptions made for each recommended type of monitoring and includes the total estimated cost. The cost assumes that all work would be completed by contractors, not by county staff.

Table 3-8. Estimated Annual Cost of Proposed Monitoring Plan

| Monitoring Component | Assumptions | Estimated Annual Cost |
|--|---|--|
| Surface Water Monitoring | <ul style="list-style-type: none"> - Eight new permanent stations at existing structures - Quarterly sampling - Analyzed for nutrients and metals | \$32,000 |
| Storm Event Monitoring (wet and dry seasons) | <ul style="list-style-type: none"> - Six temporary monitoring stations - Eight samples per site - Automated samplers are rented - Analyzed for nutrients and metals | \$150,000 (Includes equipment rental of \$55,000) |
| Groundwater Monitoring | <ul style="list-style-type: none"> - Wells in Water Table and Lower Tamiami - FDEP constructs 3 new monitoring wells - County constructs 4 new monitoring wells - County redevelops 4 existing wells - Quarterly sampling - Analyzed for nutrients and metals | \$55,000 (Includes installation and redevelopment cost of \$15,000) |



Initiative 12: Additional Watershed Protection Programs

It is recommended that Collier County partner with the SFWMD as well as Lee and Hendry counties to provide incentives to agricultural land owners to install and manage Recyclable Water Containment Areas (RWCAs).

Various approaches are recommended for implementation to protect land that is considered of important environmental value. Those approaches are described below.

Recyclable Water Containment Areas

Description of the Program. Many of the agricultural lands in the northeastern parts of the county are predicted to contribute significant amounts of nutrients to surrounding wetlands and canals.

RWCAs are a relatively new concept proposed by the University of Florida, Southwest Florida Research and Education Center as a means of incorporating the agricultural community into regional environmental restoration efforts for mutual benefit (Hanlon 2005). RWCAs have been proposed as a method of inland water storage and treatment as either an alternative, or a compliment to large scale above ground storage reservoirs for the purpose of water impoundment.

RWCAs are temporary shallow water impoundments constructed on private crop lands that provide the south Florida community selected ecosystem services in exchange for compensation that would be less than that incurred if the state were to provide that service. Water stored in the RWCAs would not be available for municipal water supply or agricultural irrigation. The goal is total loss of the stored water to both evapotranspiration (ET) and infiltration. The RWCAs allow for groundwater recharge and nutrient sequestration. An RWCA would operate as a contractual agreement between government agencies and members of the private sector.

A similar program, the Florida Ranchlands Environmental Services Project (FRESP) (<http://www.fresp.org/>), is already under development by the South Florida Water Management District (SFWMD) for the Lake Okeechobee basin²¹.

RWCAs would store non-urban runoff and stormwater drainage from cropped fields and, similar to standard agricultural impoundments, would be surrounded by a low perimeter berm and seepage ditch. Land within a participating watershed would be selected for water containment. This selected land would persist as a containment area for an agreed time period, usually five (5) years. Water within the impoundment would be retained at a depth of no greater than two feet and a weir structure feeding into a drainage system would bleed down excess water should the depth exceed two feet (Hanlon 2005). Transplanting or seeding of wetland plants is encouraged to maximize the productivity of the retention area while inundated.

When maintained properly, RWCAs provide a variety of environmental services. In return, the land owner through contractual agreement is provided compensation for the use of land and maintenance of the water containment area. The provided storage helps to slow flows to the coast, recharge groundwater, improve water and soil quality through nutrient sequestration and particulate settling, create temporary wetland habitat, and sequesters carbon in the form of senesced plant matter (Hanlon 2009). To participate in an RWCA program, soil properties in the land proposed as a RWCA would have to be tested for elevated nutrient levels and deemed safe for water storage and capable of nutrient sorption (Hurt et al. 2004).

Recommendation. It is recommended that Collier County partner with the SFWMD as well as Lee and Hendry counties to continue providing incentives to agricultural land owners to install and manage RWCAs. This program is currently being pursued within the areas in the Rural Lands Stewardship program area of Collier County, but outside of the Stewardship Sending Lands program.

It is recommended that this program be extended to the agricultural areas used for production of row crops in Collier, Lee, and Hendry counties (**Figure 3-10**). One location includes the agricultural lands in the Rookery Bay watershed because runoff from these lands flow quickly to the estuary system. Also, other lands to be considered for this program are those in Lee and Hendry counties that drain into watersheds in Collier County. Potential locations for RWCAs considered for this program are those in Lee and Hendry counties that drain into watersheds in Collier County.

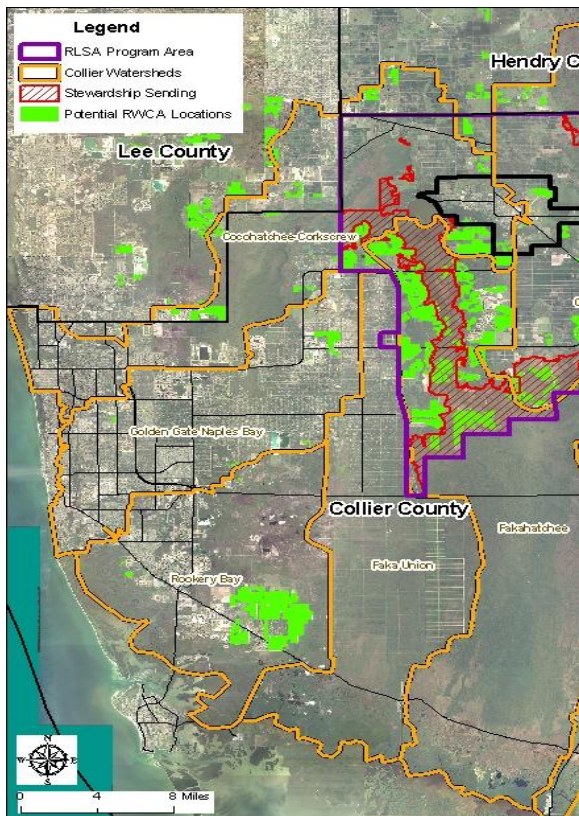


Figure 3-10 Potential Locations for Recyclable Water Containment Areas

Evaluation of Rural Fringe Neutral Lands

There are several areas in the Golden Gate – Naples Bay and Rookery Bay watersheds that have high ecological value and are defined as “Neutral” lands within the Rural Fringe Mixed Use District (RFMU). **Figure 3-11** shows the location of the RFMU Neutral lands. Two of the RFMU Neutral land areas are located within existing planned urban developments (PUDs). However, the other RFMU Neutral lands are located outside of existing PUDs.

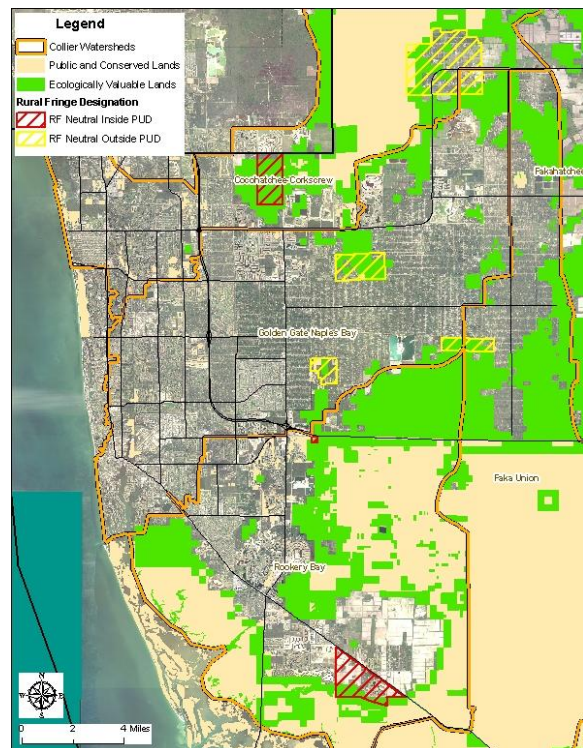


Figure 3-11 Rural Fringe Neutral Lands

Recommendation. Section 3.05.07 of the Land Development Code currently requires that 60 percent of the native vegetation present, not to exceed 45 percent of the total site area shall be preserved in Neutral lands. It is recommended that the designation for the Neutral lands, located outside of the PUDs be reconsidered. It may be appropriate to reclassify the areas as Rural Fringe Sending Lands and increase the required percentage of native vegetation preservation.

One of these areas located in the Cocohatchee – Corkscrew watershed adjacent to the Corkscrew Regional Ecosystem Watersheds. Reclassification of this area would reduce the potential impact of future development on the adjacent wetland systems and help offset the loss of ecologically valuable lands in the RFMU receiving area immediately to the south.

The other RFMU neutral areas outside the PUDs are located in the Golden Gate Estates. The reclassification of these areas would help reduce the density of future development in the Golden Gate Estates and lessen the impact of build-out conditions on the canal network.

Land Acquisition

The Southwest Florida Feasibility Study evaluated multiple projects along the State Road 29 corridor designed to increase connectivity between the Big Cypress National Preserve and the Fakahatchee Strand Preserve State Park. There are several large tracts of land in this area that remain in private ownership. The location of these tracts is shown in **Figure 3-12**. Most of these private lands are wetlands that have high ecologic value. These lands are located within Areas of Critical State Concern. This designation limits development per the regulations in section 4.02.14 – Design Standards for Developments in the ST and ACSC-ST Districts. However, it is recommended that Collier County support the purchase of these lands by State or Federal agencies in order to ensure long-term protection of these lands and to provide the increased interaction between the preserved lands.

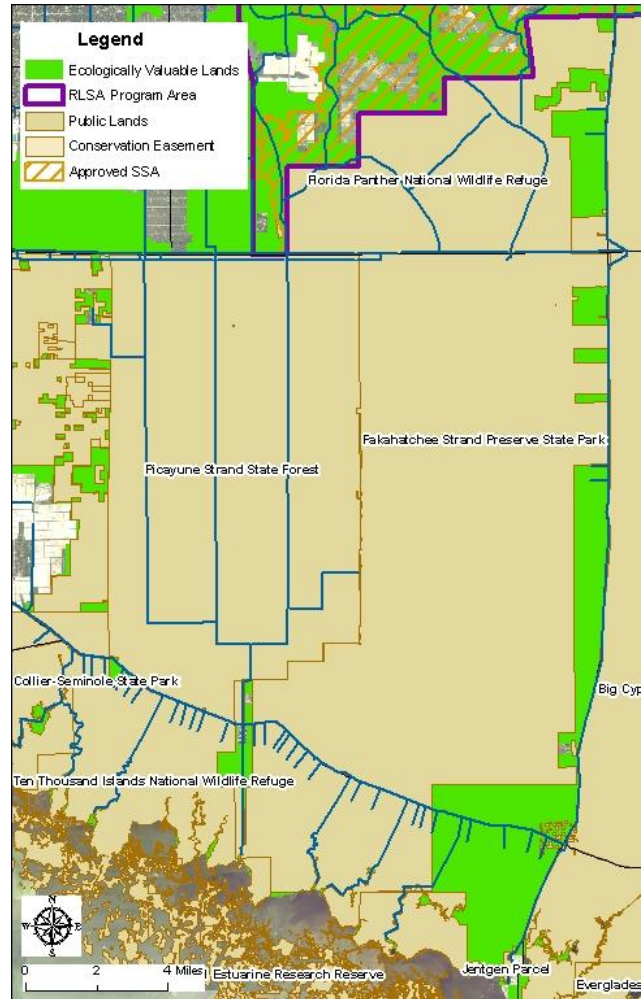


Figure 3-12. Ecologically Valuable Lands along the State Road 29 Corridor

Modifications of Preservation Standards

Section 3.05.07 establishes the preservation standards for single family residences and for lands that are outside the RFMU and RLSA districts. These standards require that a specified percentage of native vegetation be preserved and that preservation areas shall be interconnected to maintain wildlife corridors. The Preservation Standards currently exempt single family residences including a large portion of the Golden Gate Estates. This area is characterized by small wetland features and flowways that have been fractured by infrastructure installed in the 1960s.

It is recommended that the Preservation Standards exception for single family residences be lifted in those areas that include local wetland systems and historic flowways. In addition, incentives should be provided to encourage the consolidation of nonconforming lots into lots that meet minimum size requirements. It is also recommended that the required preservation percentage of native vegetation be re-evaluated for all development categories in order to reduce off-site impacts of future development.



Initiative 13: Stormwater System Maintenance and Certification

The purpose of this recommendation is to insure that all stormwater management systems within the jurisdiction of the Collier County Government are regularly inspected so that facilities operate as originally designed.

General

Maintenance is critical to proper operation of stormwater the stormwater system. This is particularly important to maintain the pollution removal efficiency of runoff treatment facilities. Improperly maintained facilities can increase the discharge of pollutants downstream, increase the risk of flooding, increase the instability of downstream channels, and lead to aesthetic and nuisance problems. In addition, poor maintenance of wet detention ponds, the most common treatment system in Collier County, can lead to unpleasant odors, nuisance insects, and algae blooms.

The Growth Management Plan and the Board of County Commissioners of Collier County have directed that every stormwater management system in Collier County must be properly operated, regularly inspected, and constantly maintained such that it functions as originally designed.

Operation, Inspection, and Maintenance Responsibility

In Collier County, many different types of entities are responsible for the varied parts of the stormwater system. Operations and maintenance activities of the primary and secondary drainage systems that serve multiple private entities are the responsibility of governmental agencies. These agencies are responsible for scheduled inspections and scheduled maintenance of those systems and for unexpected (not scheduled) repairs.

In addition to those systems, there are independent quasi-governmental agencies such as Community Development Districts (CDD) and Municipal Servicing Taxing Units (MSTU) that are responsible for maintaining large portions of the stormwater system. These types of entities generally hire private firms to conduct the work. Funds are raised through their taxing authority.

Legally established entities such as Homeowner Associations (HOAs) may also retain the responsibility for the operation and maintenance (O & M) of their stormwater management systems through legal documentation such as plats or surface water management permits granted through the South Florida Water Management District (SFWMD). HOAs and similar entities may also hire private engineers on an as-needed basis. For some of these entities a basis for generating revenues exists, such as a vote of the membership at a noticed meeting.

The owners of Commercial and Industrial zoned sites are responsible for the operation and maintenance of their systems. Since the site owner has his/her own source of O&M revenue, hiring an engineer or contractor is at his/her discretion.

There are locations that fall outside any of the sites mentioned. These locations may not be commercial or industrially zoned areas and may not have an organization entity to handle their O&M. An example is the older platted residential subdivisions. These types of sites are the most difficult to manage since there is no formal chain of responsibility and no means of generating revenue. However areas that were approved and

permitted to earlier standards must still comply with the provisions of this ordinance. These older subdivisions and projects will need to create O&M entities to insure that inspections and necessary repairs are done as required.

Current Inspection and Certification Programs

All permitted systems are initially inspected and approved for operation by Collier County. Also, in some cases portions of the systems are accepted by Collier County for maintenance. The SFWMD also manages a pond certification program by which pond operators are required to submit an annual pond certification prepared by a licensed professional engineer during the first 5 years of operation. Although these programs help maintain the facilities in good operation in the period following construction, a certification program is necessary to track operation of the stormwater systems over their design life.

Types and Scheduling of Inspections

The purpose of this recommendation is to insure that all stormwater management systems within the jurisdiction of the Collier County Government are regularly inspected so that facilities operate as originally designed. It is not the intention of this ordinance to implicate any third party for liability as a result of any action, or lack of such action, by the responsible maintenance entity. The following inspections and subsequent maintenance actions for every stormwater system in Collier County should be performed on the following regular schedule:

1. Within 60-days of June 1st each year a substantially competent pre-designated representative of the Agency, District, HOA, owner, or other entity shall visually review the components of the entire stormwater system. The intent is to notice any malfunctions, abnormalities, or potential problems from an above ground visual inspection. Also, water quality conditions in the outfalls of detention ponds will be inspected to determine if actions such as installation of an aeration system are necessary. Observations shall be noted in a log book that is kept on site in the management

office or other commonly known location. Problems and potential problems must be reported to the responsible authority immediately and provisions for repair must be commenced as soon as physical conditions allow. The Agency, District, HOA or other managing entity will retain copies of the reports on site in the log book for a minimum of five years.

2. At each 5-year interval the Agency, District, HOA, owner, or other entity responsible for the O&M of the stormwater system shall submit a standard County Stormwater System Inspection Checklist (to be prepared concurrently with the ordinance) to the Collier County Floodplain Management Office, along with copies of the log book for the past 5 years.
3. At each 10-year interval, inspections will include a measurement of the accumulated sediment. A minimum of one measurement per acre will be required.

The Checklist must be completed, signed, and sealed by Professional Engineer licensed in the State of Florida, or other "Stormwater Inspection Professional" approved by Collier County because of their experience or training.

Personnel Authorized to Conduct the Inspections

Annual inspections must be conducted by a competent pre-designated representative, not necessarily a Professional Engineer. The County may establish a training course to provide certification. As part of that program setup, the County will specify the minimum qualifications of individuals that may attend the certification course. Collier County will also accept the judgment of the maintenance entity in designating this person for the yearly walkthrough inspection. Five year Inspections must be conducted by a licensed Engineer or County approved Stormwater Inspection Professional



2.0 Regulatory Framework Implementation Schedule and Cost

Implementation of the Watershed Management Plan recommendations will require amendments to various Elements and Sub-Elements of the County's Comprehensive Growth Management Plan (GMP).

Implementation of the Watershed Management Plan recommendations, including but not limited to the recommended Water Quality and Low Impact Development (LID) program, water quantity and flood protection policies, monitoring programs, the TDR/Mitigation Area, and any additional protection programs will require amendments to various Elements and Sub-Elements of the County's Comprehensive Growth Management Plan (GMP), including amendments to the Golden Gate Area Master Plan (GGAMP), the Future Land Use Element (FLUE), Future Land Use Map (FLUM), and the Conservation and Coastal Management Element (CCME), the Drainage Sub-Element, and potentially other Elements and Sub-Elements.

These Plan amendments would then be followed by implementing Land Development Code (LDC) amendments to the degree necessary. **Table 3-9** shows the tasks and an estimated schedule necessary to establish the regulatory framework needed to implement the recommended initiatives. It also shows an estimate of the cost associated with County staff time required to participate in the process. It is noted that the regulatory process at the State level is in flux at the time of preparing this estimate. Rule 9-J5 (which implements much of the Comprehensive Planning process) has been repealed. It is likely that whatever new procedures and rules are adopted, they will be more streamlined and less costly. This estimate is based upon current and known procedures, but can be revised when new procedures are established.

Table 3-9. Tasks, schedule, and Cost Associated with Establishment of the Regulatory Framework

| Task | Days to Complete | Projected Hours | Project Cost** |
|---|------------------|-----------------|----------------|
| Policy Discussion Regarding Proposed Watershed Plan and related GMP and LDC amendments (before EAC, CCPC, and BCC) | 90 | 60 | \$7,200 |
| Creation of TDR Oversight Committee and Committee Work Period*** | 360 | 720 | \$86,400 |
| Preparation of final draft GMP amendments for public hearings before EAC, CCPC, BCC (Transmittal Hearings) and Transmittal Hearings | 150 | 400 | \$48,000 |
| DCA Review and issuance of Objection Recommendation and Comment (ORC) Report (issued 60 days after completion determination) | 70 | 30 | \$3,600 |
| County review of ORC and Adjustments to address Objections (and Recommendations and Comments). Revisions as necessary and Adoption hearings before EAC, CCPC,BCC); Begin to Draft LDDC Amendments | 120 | 300 | \$36,000 |
| Final Preparation of LDC Amendments | 60 | 240 | \$28,800 |
| LDC Amendment final draft and hearings (again, EAC, CCPC,BCC) | 100 | 200 | \$24,000 |
| Total Estimated Staff Time, Hours, and Cost for Completion (Including TDR Oversight Committee Review Period) | 1,000 | 1,950 | \$234,000 |
| Total Estimated Staff Time, Hours, and Cost for Completion (Excluding TDR Oversight Committee Review Period) | 640 | 1,230 | \$147,600 |

*Cost to a developer and/or homeowner have not been estimated at this time as the details of any proposed regulations are unknown. For example, costs will need to be weighed against any available incentives. Once draft LDC amendment language is developed, detailed estimated fiscal impact associated with a proposed regulation can be estimated (in fact this is required, as a part of the LDC amendment process).

**Cost is estimates at \$80.00 per hour for senior level staff plus%50 cost for benefits and overhead (Total \$120.00/hour). Total estimated hours with TDR Oversight support equals 1950 , plus or minus 1.0 FTE over 33 months (or about .35 FTEs per year).

***Oversight Committee as proposed is limited in Scope (to TDR Program) thus other proposed amendments may not be subject the Committee Review Period (Estimate for Oversight Committee work increased to 360 days based upon DSAC discussion).

Appendix 3-A

Low Impact Development Approach

Appendix 3-A

The Low Impact Development (LID) Approach

Research has shown the watershed imperviousness has a direct relationship with stream degradation (MWCG 1995). In addition, as indicated previously, exclusive reliance on conventional BMPs is not allowing streams to meet water quality standards. Therefore, a new approach based on the preservation of a site's natural features has been found to be an effective way to minimize pollution loads and help preserve the natural system.

LID is a well established approach to stormwater management that relies on hydrology-based site planning and design. LID aims at minimizing the volume of runoff reaching the receiving water bodies and managing it as close as possible to where it is generated. Techniques defined as micro-controls are implemented in a dispersed fashion throughout a site. The basic principle is to attempt to mimic pre-development hydrology by detaining and infiltrating rainwater close to the source thereby replicating the natural pathways. LID techniques are often more cost effective than the conventional stormwater management approach that relies primarily on fast drainage through storm drains, ditches and/or canals that take runoff to central detention facilities or to open water bodies.

1.1 Framework

Meeting water quality standards and addressing the water surplus/deficit issues affecting the natural system requires application of a variety of new tools and approaches that need to be grounded on a common framework consisting of the following main elements:

Hydrology Centric Site Planning. Site design should consider maintaining the natural site's hydrology, or helping restore hydrologic conditions if previously impacted. The objective should be the protection of hydrologically beneficial assets such as soils, native vegetation, wetlands, and natural drainage patterns. Hydrology centric site planning typically results in better site layout and reduced development costs.

Water Quality Improvement. The Florida stormwater treatment rule is specifically aimed at reducing the input of nutrients to receiving waters. Nutrient load reduction is most effectively attained by both reducing runoff volume and reducing sources of nitrogen and phosphorus. If stormwater runoff treatment is necessary, controls should be based on appropriate unit processes for pollution removal, particularly nitrogen and phosphorus, that considers the chemical characteristics of the pollutants.

Habitat Protection. Runoff reduction and water quality improvement have a direct beneficial effect on natural habitat. Site development should strive to preserve and/or restore natural resources on site such as wetlands and native vegetation on site.

Effective Land Use. Collier County is not yet as urbanized as other neighboring counties but development pressure is mounting. Comprehensive planning at the county level and judicious site planning at the development level allows effective deployment of new infrastructure,

reduced maintenance needs, enhanced community aesthetics, and access to natural resources for recreation.

Whole-Life Cost-Effectiveness. The implementation of a stormwater management program should consider the costs of development in terms of both construction and operation and maintenance (O&M), as well as the potential gains associated with the environmental and social benefits to the community.

Enhanced Aesthetics: Planning and engineering measures for stormwater control should be blended into streetscapes and landscapes and become assets to the community.

1.2 Implementation Techniques

LID implementation techniques are divided into three categories: planning, stormwater controls, and pollution prevention. Following is a description of these categories, along with the techniques that we believe can be implemented in Collier County.

Planning Techniques. At the site level, planning techniques are aimed at taking advantage of existing assets, especially those that help maintain the hydrology of the site and minimize runoff volume through maximization of the hydrologic performance. These techniques include:

- Promote site design based on natural hydrologic patterns by conserving / restoring such features as drainageways, wetlands, stream corridors, riparian buffers, and forested areas.
- Maximize the extent of pervious areas and areas of absorbent landscape, while minimizing paved areas.
- Disconnect impervious surfaces from conveyance systems so that runoff discharges to on-site pervious areas.
- Manage runoff close to where it is generated by creating micro-controls adjacent to paved areas
- Protect areas of permeable soils.
- Design multiple storage systems throughout the site to maximize the assimilative capacity and create redundancy.
- Minimize site disturbance during construction. Research (Gregory, 2004) has shown that to maintain predevelopment infiltration rates, identified areas within a subdivision, or specific areas within a lot, should be left undisturbed because even a small degree of compaction of imported soils has been found to drastically reduce infiltration capacity.
- Protect native vegetation existing on site. Conserve as much as possible of existing trees and shrubs

- Use native species in landscaping plans and providing sufficient top soil to promote healthy plant development and minimize chemical application needs as well as irrigation needs
- Substitute turf with native species consistent with Florida-Friendly Landscaping guidelines
- Promote cluster development practices with higher densities that reduce road length and utility footprint.
- Apply road width requirements that are consistent with actual average daily traffic needs based on the number of homes served.

Stormwater Controls Techniques. From its inception, the application of LID recognized that, depending on specific site characteristics, a versatile set of controls is needed for effective stormwater management. These techniques belong to a broad array of engineered features aimed at mitigating anthropogenic impacts in terms of both water quantity and quality. Key objectives are to minimize the volume of runoff discharged into the public collection system and design the stormwater controls in a way that is consistent with the chemical unit processes associated with the pollutants of interest. Disperse deployment of micro-controls throughout the site is emphasized, but the stormwater management strategy can also include end-of-pipe devices such as detention basins and constructed wetlands.

The strategy to treat stormwater is summarized below:

- Runoff segregation.** Rain that falls on roofs should not be allowed to come in contact with fertilizers and other ground-level pollutants.
- Stormwater controls in series.** Stormwater controls should be installed in series to obtain incremental treatment levels. It should be noted that the upstream-most controls provide the largest removal, when properly sized. The removal efficiency of additional controls downstream is much less because the influent concentrations have been reduced. Stormwater controls in series benefits system redundancy.
- Bioretention.** Roof runoff should be directed to bioretention areas located in the fill pads devoted to building construction. Pad configuration may have to be slightly modified to locate the bioretention facilities at sufficient distance from the buildings. The bioretention facilities should be designed to exfiltrate the water into the surficial aquifer. Stormwater planters around buildings can also be used to treat roof runoff. The filter media in the bioretention facilities shall be engineered for nutrient removal. Guidelines have been provided in the 2008 publication *Alternative Stormwater Sorption Media for the Control of Nutrients* by Marty Wanielista and Ni-Bing Chang, researchers for the Stormwater Management Academy of the University of Central Florida. From the findings of this publication, it is possible that limestone material from site excavation can be used as a component of the engineered media.
- Filter strips.** As implementation of imperviousness disconnection, filter strips should be added to receive runoff from paved areas and discharge it to bioretention facilities, vegetated swales, or other stormwater controls.

- e) **Surface depression.** Design absorbent landscape areas as depressions that temporarily store stormwater and allow it to infiltrate. The drainage properties of these areas should be designed so that they infiltrate the water without becoming a nuisance.
- f) **Permeable pavement.** Permeable asphalt or concrete should be used in parking lots as much as possible. In combination with conventional pavement for high traffic surfaces, permeable pavement is an effective way to retain runoff. The gravel reservoir below the pavement stores the water and exfiltrates it through the bottom. If drainage through the bottom is limited by the fill material, perforated pipes can be used to drain the reservoir. Several studies of permeable pavement systems are available on the University of Central Florida (UCF) Stormwater Management Academy's website <http://stormwater.ucf.edu>.
- g) **Conveyance in vegetated swales.** Provide vegetated swales between building pads and along streets and driveways. The swales should use the engineered filter media described above. Check dams should be used to enhance infiltration.
- h) **Pocket wetlands.** Distribute pocket wetlands through the site, in series with other stormwater controls, to receive up to 10 acres of areas drained by swales. Pocket wetlands can also receive drainage from pervious pavement to restore the storage in the gravel bed.
- i) **Central treatment facility. Performance of conventional** stormwater treatment facilities such as detention ponds can be enhanced with littoral shelves; settling basins or phyto-zones; wetland areas, especially upstream of outfalls; and internal berms to lengthen the flow path. Floating wetlands can also be deployed. These central facilities need to be stocked with fish to control mosquitoes.
- j) **Stormwater harvesting.** Runoff stored in a detention facility can be used as a source of irrigation water. In addition to reductions of pollutant loads to surface waters, stormwater harvesting can reduce potable water use.

Other LID stormwater controls can be applied depending on the nature of the site and can lead to innovative solutions. The following are examples of these other alternatives:

- Vegetated roofs absorb rainwater and the excess can be directed to stormwater planters or bioretention facilities as described above. Vegetated roofs provide additional benefits in roof membrane longevity and cooling energy savings. These systems are most commonly deployed in large buildings with flat roofs.
- Rain barrels and cisterns can be used to collect runoff from conventional roofs. The water could be used later for irrigation but if not used, it must be drained from the cisterns to provide storage for the next rain event.

Pollution Prevention Techniques. These techniques are aimed at minimizing pollutant loads and include the following:

- Enforce fertilizer management ordinances

- Designate elements of landscaping (e.g., vegetated swales, bioretention facilities, and surface depressions planted with absorbent landscape) as stormwater management devices where no chemicals shall be applied
- Educate homeowners about impacts on water quality of excessive chemical applications. A tool available for this purpose is the Florida Yards and Neighborhood handbook.

Collier County Watershed Model Update and Plan Development

