

# **COMPREHENSIVE EVERGLADES RESTORATION PLAN CENTRAL AND SOUTHERN FLORIDA PROJECT**



## **E.1 REGIONAL ECONOMIC IMPACT (ECONOMICS DATA COLLECTION WORK PLAN)**

### **EVERGLADES AGRICULTURAL AREA STORAGE RESERVOIRS – PHASE 1**



**US Army Corps of Engineers  
Jacksonville District**



**South Florida Water  
Management District**



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*(SFWMD Consultant Task 4.1.3.1)*

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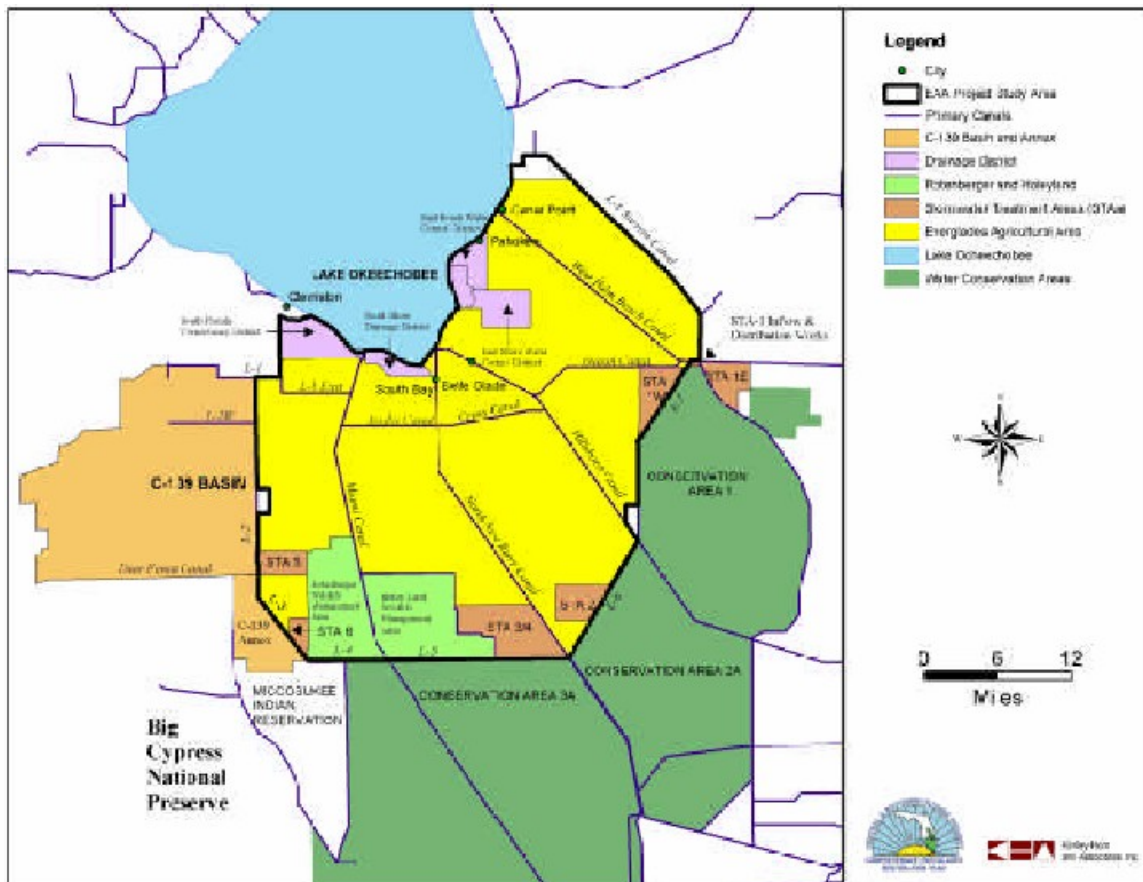
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## E.1 Regional Economic Impact

### E.1.1 Introduction

The Everglades Agricultural Area (EAA) Storage Reservoir – Phase 1 Project Implementation Report (PIR) requires flood control analyses of the EAA project study area. The limits of the EAA project study area and associated sub-basins are outlined in Section B.1.1 Basin and Sub-basin Delineation. The overall limits of the EAA project area are shown in Figure E.1.1. The required flood control analyses include evaluation of average annual economic flood damage assessments of existing and future conditions based on flood routings of storm events with 2-, 5-, 10-, 25-, 50-, and 100-year return periods, as well as the Standard Project Flood (SPF), in accordance with the U.S. Army Corps of Engineers (USACE) Engineering Regulation 1105-2-100. An understanding of previous flooding, sub-basin delineation, existing land use and production practices, property value, and damage relationships are critical to effectively assess the economic flood damages in the EAA Basin.



**Figure E.1.1 – Everglades Agricultural Area Storage Reservoirs Project Study Area**

The South Florida Water Management District (District) and USACE Project Managers formed a Model Steering Committee (MSC) to provide guidance throughout the EAA Basin modeling activities. A list of the MSC members and participants is included in

Attachment E.1.1. The MSC provided direction on methodologies to be implemented in establishing rainfall amounts, spatial distributions, and temporal distributions for each of the flood routing storm events to be modeled in assessing economic flood damage in the EAA Basin.

The flood control analysis will be composed of three parts: data collection, flood damage assessment, and documentation. The Consultant shall have primary responsibility for data collection and documentation, with support from the lead economist and the remainder of the PDT. When the assembly of the data is complete, the data will be provided to the Project Manager for forwarding to the USACE.

The USACE will utilize the data to perform an assessment of existing flood damages in the EAA. The Consultant will assist the USACE as necessary by providing clarification of the data and/or descriptions of data collection methods. The Consultant will also maintain communications with the USACE during the evaluation to insure familiarity with the evaluation methodology, assumptions, results, and conclusions. USACE will provide the results of the evaluation in brief written summaries of the methodology, assumptions, results, and conclusions. The Project Manager will forward the USACE assessment to the Consultant when it is complete.

### **E.1.2 Data Collection**

In order to assess flood damages within the EAA, extensive information regarding existing conditions is needed. Data that contributes to a meaningful flood damage assessment includes an existing land use map, farm and urban land delineation, land use characteristics such as crop-specific production practices and urban density, flood proneness, flood simulation results, and extent of flood damage.

The breadth and depth of data to be collected for flood damage assessment is extremely variable. The scope of the existing task involves collecting information only as stated in the corresponding sections herein. Data from other deliverables, new data to be collected under this task, and data considered out of scope are described.

#### **E.1.2.1 Data Input from Other Appendices**

A considerable amount of data needed has already been collected and summarized in prior Consultant report deliverables. The following sections describe key data that have already been collected.

##### **E.1.2.1.1 40E-63 Farm Basin Delineation**

The available data that were used to delineate major basin and sub-basin boundaries within the EAA watershed were obtained from the District. The following list describes the available information and data:

1. District drainage basin boundary GIS coverage
2. Everglades Regulatory Program permit (Chapter 40E-63 FAC) GIS coverages
3. Atlas of the Everglades Agricultural Area Surface Water Management Basins (Richard M. Cooper 1989)
4. Atlas of Surface Water Management Basin in the Everglades (Richard M. Cooper and Joanny Roy, 1991)

The current major basin and sub-basin boundary delineations within the EAA watershed are included in three District GIS coverages: *dbasins*, *f-dsub*, and *stas*. The available metadata for these three coverages is limited and not well documented. Below is a brief description of the available information for each of these coverages used to compile the 40E-63 farm basin delineation.

1. *dbasins*

This is a polygon coverage of District drainage basins. These are the standard boundaries that have been used for many years. The District recognizes that local projects have updated some of the boundaries. However, those updates have not been collected into a single database and have not been updated into this coverage. Jim Lane of the District Data Management derived these drainage-basin boundaries many years ago. They were reviewed and updated around 1989 by the Water Resources Division, and converted to Arc/Info format in 1991, and there has been little or no change since then. The District Water Resources Division is currently updating these boundaries within the limits of the EAA, but this work is not anticipated to be completed until the first quarter of Year 2003.

2. *f-dsub*

This is a polygon coverage of the farm boundaries located in the EAA. These farm boundaries are covered under the Everglades Regulatory Program, Chapter 40E-63, F.A.C. The areas associated with each polygon relate to the regulated areas as described in the Everglades Regulatory Program. These areas tend to remain static. However, there have been annual differences in the total permit areas, typically the result of areas being converted from agricultural production to STA's. The latest revision date of most of these farm sub-basins is December 13, 1994, with a few sub-basins revised as late as June 17, 2000.

3. *stas*

This is a polygon coverage of the existing and proposed footprint of the six Stormwater Treatment Areas (STAs) within the EAA.

Figure E.1.2 on the following page depicts the basin and sub-basin delineations in the EAA. Additional information regarding the 40E-63 Basin Delineation is available in Attachment B.1.1.

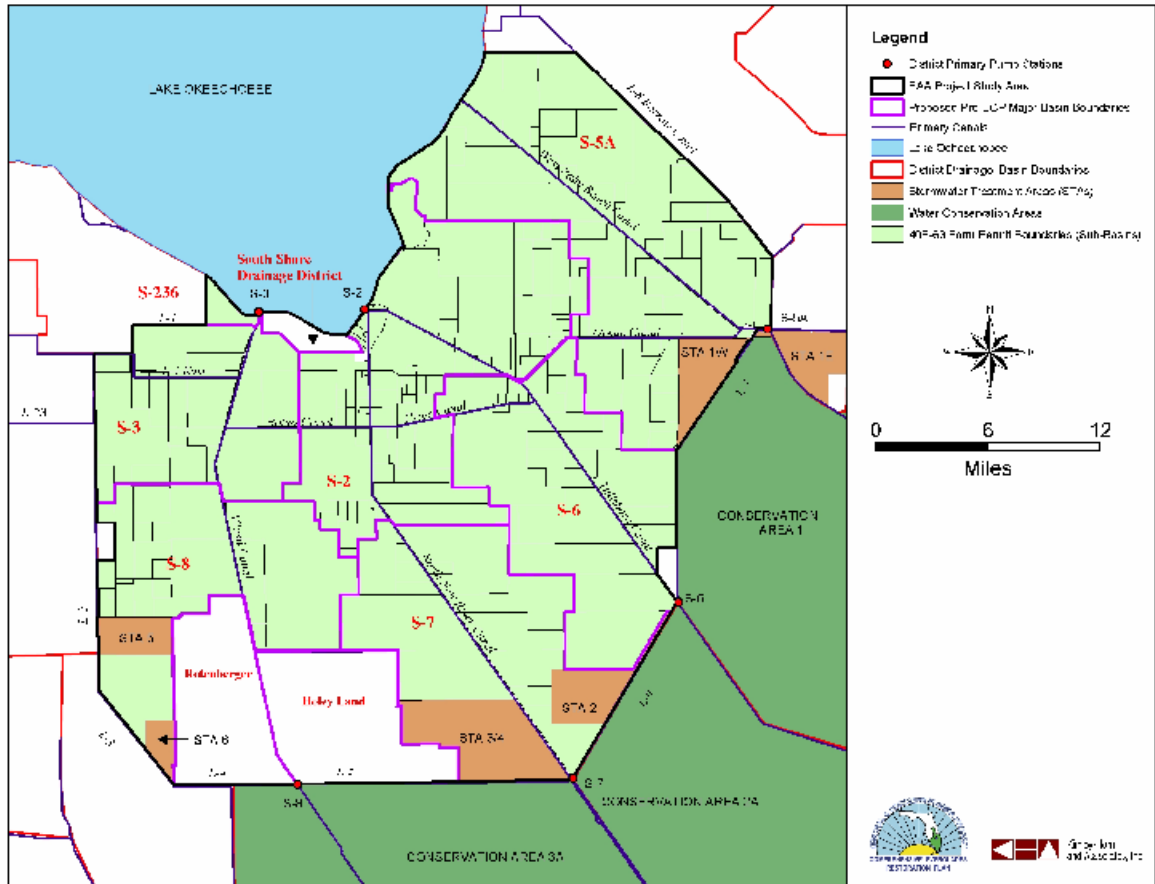


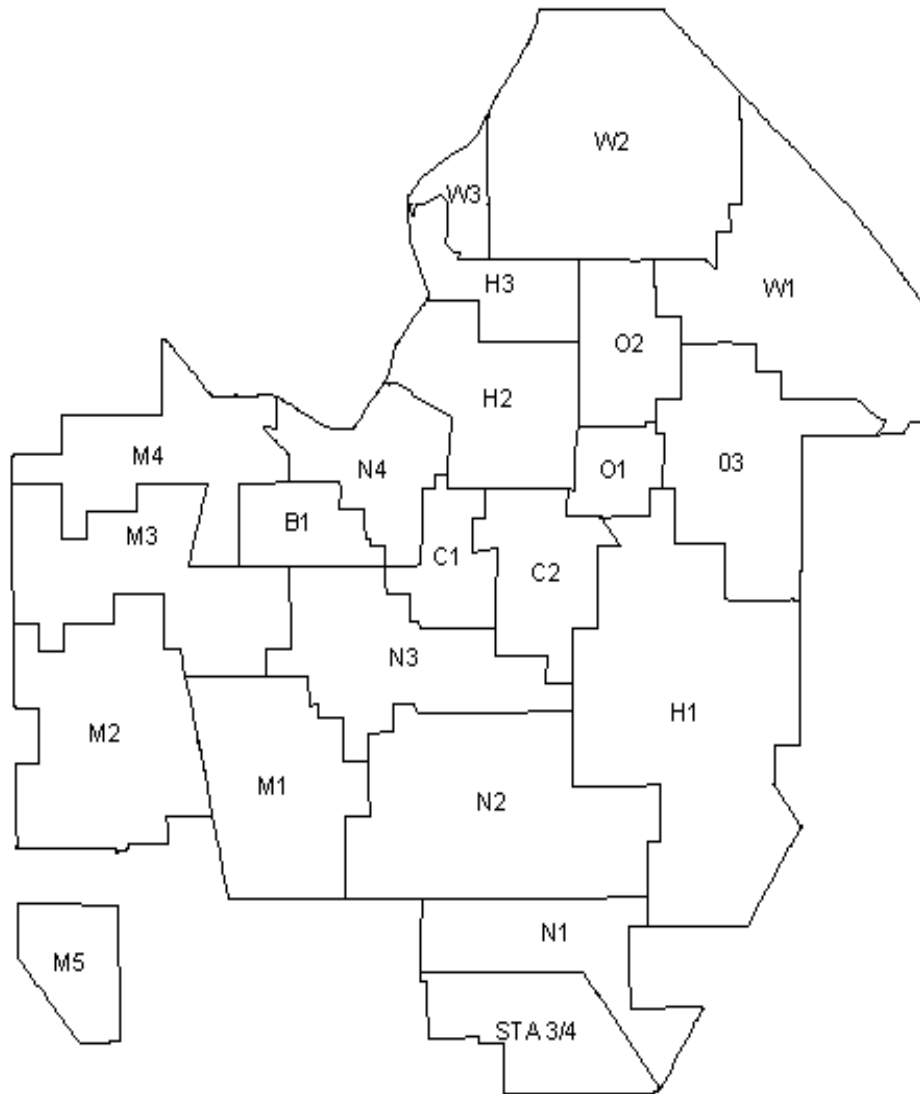
Figure E.1.2 - EAA Watershed Major Basin and Sub-basin Boundaries

### E.1.2.1.2 Modeling Sub-Basin Delineation

In order to link the surface water and canal hydraulics components of the sub-regional model, it is necessary to identify a finite number of specific nodes. These nodes are assigned characteristics of pumps and water control structures. They will simulate the drainage and irrigation flows in/out of the primary canal system. Each EAA farm basin is associated with one of 22 modeling basins which were coded according to the major canal receiving those farms' discharge. The agricultural basins were named sequentially and by the first letter of the major receiving canal. The boundaries generally follow farm boundary lines and only farms that have multiple structures that discharge to more than one primary canal are divided. Figure E.1.3 shows the extent of the 22 Modeling Basin Breakdown of the EAA. See Attachment B.2.2.2 for a detailed description of the 22 Modeling Basins and their corresponding pump capacities.

### E.1.2.1.3 Building Structure Locations in Urban Areas

Digital orthophoto quadrangles maps (DOQQs) were used to digitally locate each structure in the urban areas of the EAA. Structures such as single family homes, mobile homes, and commercial buildings were identified with points on top of the parcel coverage.



**Figure E.1.3 – 22 Agricultural Basin Breakdown**

**E.1.2.1.4 Urban Area Boundaries**

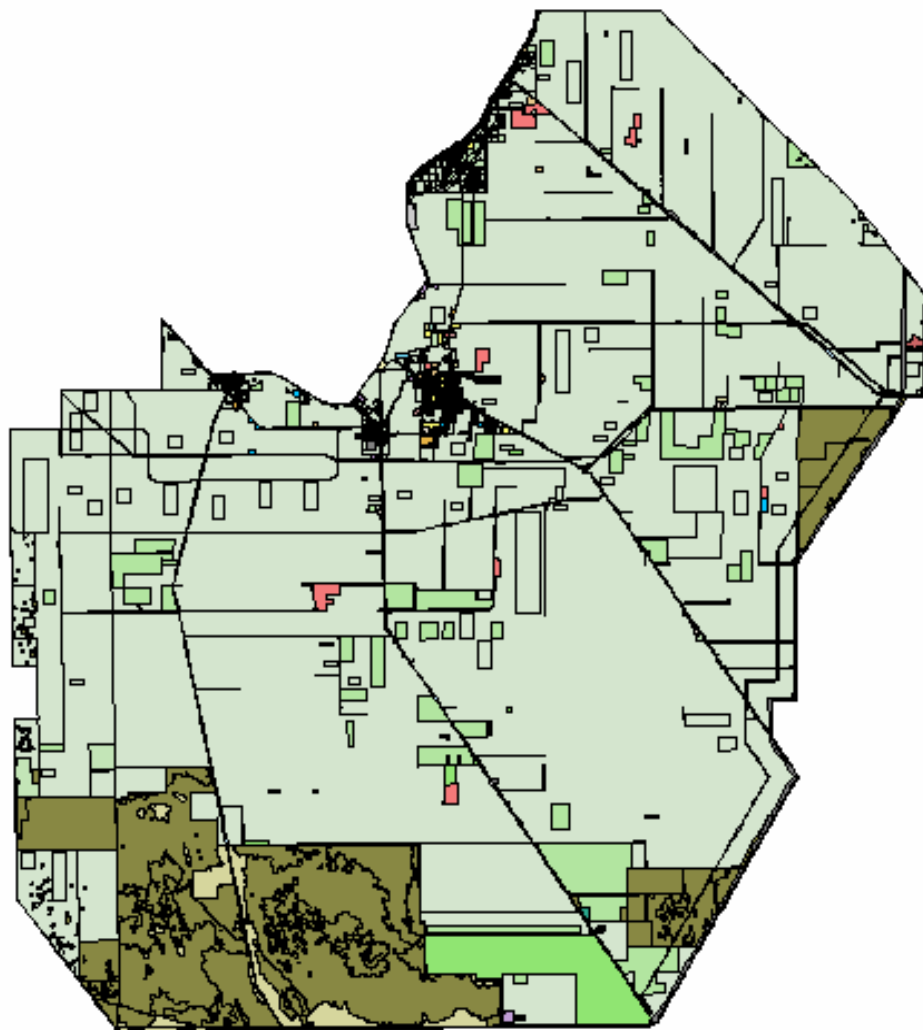
The Palm Beach and Hendry County Property Assessor GIS database was provided by SFWMD and used along with the DOQQ's. These DOQQ'S were used to identify the urban area boundaries.

**E.1.2.1.5 1999 Land Use**

Figure E.1.4 depicts the 1999 land use map of the project area. The SFWMD last mapped the EAA in 1995 as a part of their district wide mapping effort. This was done using a modified version of the Florida Department of Transportation (FDOT) Florida Land Use/Land Cover Classification System (FLUCCS). The 1995 mapping information

was provided by the SFWMD as the base-map for which information is to be compiled and updated. The 1995 base map was modified to reflect the year 1999 land uses.

The inventory of sub-basin data involved a review of 40E-63 permits by farm permit number and a review of active water use permits. This inventory information was used to identify the "target" acreage of each land use for each farm. In addition, the KHA team conducted a flight over the EAA project area to determine locations of sod farm operations for ACAD digitizing. The LULC2000 landuse map already had crop acreages identified. As a final step, the difference in the LULC2000 map and the aerial-identified sod farm operations with the target crop acreages for each farm was calculated to determine which crops needed more representation in each farm. The additional acreage needed was distributed among each respective farm by digitizing a polygon to represent the determined area for each crop. The current Florida Department of Transportation (FDOT) Florida Land Use/Land Cover Classification System (FLUCCS) was used to designate the land use of each polygon of the EAA for Levels 1, 2, &3. The land use map will be useful in determining the area of each respective crop prone to flood damage in various flood scenarios.



**Figure E.1.4 – EAA Land Use Map**

**E.1.2.1.6 Existing Conditions Flood Simulation Results**

Hydrologic model simulations will provide the basis to develop a characterization of the existing level of flood protection by primary basin within the EAA. This characterization will:

- 1) Provide information to be included in the PIR/EIS in the Inventory of Existing Conditions section;
- 2) Assist in the formulation of alternative plans;
- 3) Serve as the basis of comparison for each alternative plan to be evaluated in detail during subsequent planning work.

The hydrologic modeling/methodology will produce flood depths and durations for a limited seasonality, partial duration series computation of flood damages based on the seasonality of crops typically found in each representative sub-basin. The hydrologic information will then be used to estimate average annual flood damages for each sub-basin, as well as for the EAA in total. See Table E.1.1 for a summary of routing storm events for which flood simulations will be performed.

**Table E.1.1  
EAA Basin Economic Flood Damage Assessment Flood Routing Storm Events**

Storm Event Return Period	Storm Event Duration
2-year	1-day
2-year	3-day
2-year	5-day
5-year	1-day
5-year	3-day
5-year	5-day
10-year	1-day
10-year	3-day
10-year	5-day
25-year	1-day
25-year	3-day
25-year	5-day
50-year	1-day
50-year	3-day
50-year	5-day
100-year	1-day
100-year	3-day
100-year	5-day
SPF	1-day
SPF	3-day
SPF	5-day

A summary of the maximum rainfall amounts derived from this analysis is summarized in Table 11 of Technical Publication EMA 390. This summary is duplicated in Table E.1.2.

**Table E.1.2**  
**Rainfall Maximum Ranges for Storm Events with 2-, 5-, 10-, 25-, 50, and 100-year Return Period and One-, Three- and Five-Day Duration**

Duration	One-day		Three-day		Five-day	
	Rainfall (inches)		Rainfall (inches)		Rainfall (inches)	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
2-year	2.6	5.0	3.4	6.6	3.7	6.9
5-year	3.7	8.8	4.9	8.9	5.7	10.0
10-year	4.5	11.4	6.2	11.5	7.1	12.4
25-year	5.3	15.1	7.2	15.4	8.9	16.6
50-year	5.7	17.8	8.1	18.9	10.1	21.2
100-year	6.0	21.0	8.9	22.8	11.0	26.6

The maximum rainfall ranges documented in this table were derived from available rainfall data within the District boundary for the period of record of January 1, 1900 to December 31, 1999. The rainfall data available in the District's DBHYDRO database for rainfall stations in the vicinity of the EAA Basin for the period of record of January 1, 2000 to September 30, 2002 were evaluated to determine if the rainfall frequency analysis documented in Technical Publication EMA 390 needed to be updated.

Based on the previous work performed by the District and USACE, it was concluded that the rainfall maximum depths outlined in Technical Publication EMA 390 should be used for the storm events with 2-, 5-, 10-, 25-, 50-, and 100-year return period and one-, three- and five-day duration, and the USACE EM 1110-2-1411 maximum depths should be used for the SPF storm events with one-, three- and five-day durations.

Antecedent rainfall conditions will consist of a twelve month time series. Two series will be selected so that design rain events can be simulated in both the dry and wet "seasons." As a result, the flood simulations will be performed for a total of 42 events (7 return intervals x 3 durations x 2 seasons).

#### **E.1.2.1.7 Aerial Photography**

DOQQ'S were obtained from the District in six-meter and one-meter resolutions. The six-meter resolution photos were useful for general/big picture over view of the project site without using too much computer resource. The one-meter photos were used for detailed mapping, identification, and delineation needed for both land use and building structure locations and urban area boundary determinations.

#### **E.1.2.2 Data Collection (Consultant Task 4.1.3.2)**

In addition to data already collected and summarized in previous Consultant report deliverables, more information is needed before a flood damage assessment can be

performed. The following sections describe key data that are to be collected under this task.

**E.1.2.2.1 Tax Parcels**

The Palm Beach and Hendry County Property Assessor GIS database as provided by SFWMD will be used to derive land and structure values. The tax parcel information will be used to determine the typical building value for the various residential land use classifications. Content value will be estimated as a percent of structural value.

**E.1.2.2.2 Agricultural Production Practices**

Two to three meetings with growers and Agricultural Agents will be conducted to confirm agricultural production practices. Specifically, information regarding crop rotation, cultivation, percent in production vs. fallow or infrastructure, and harvest quantity of crops will be collected. Information about spatial layout, root zone depths, and bedding heights will also be collected. The percentages of early planters, mid-season planters, and late season planters within a growing season will be estimated. A range of patterns will be determined and the most typical pattern for each crop will be established.

**E.1.2.2.3 Growing Seasons by Major Crop Type**

The analysis will focus on the most significant crops in terms of production area in the EAA. The growing season timing of plantings, replants, growth, and harvesting for each crop will be documented from meetings with growers and Agricultural Agents and review of IFAS publications. A look-up table will depict the typical month to month status for each land use considered.

**E.1.2.2.4 Identify Flood Prone Areas**

A total of three to four meetings will be held with growers, city officials, and 298 districts to assess which areas are flood prone, the magnitude, location, and any dollar amounts in flood damage by area.

**E.1.2.3 Data Collection under Additional Scope of Work if Required**

The tasks mentioned under the data input from other deliverables and data collection under Task 4.3.2 sections are considered necessary to establishing a flood damage assessment to a level of acceptable detail. However, additional types of data, though not necessary, could be beneficial to performing a more comprehensive assessment. The following items describe optional data that are not in the existing task scope.

Interpretation of natural ground elevations associated with building structures and collection of building finished floor elevations. Damage assessments may be fine-tuned by determining flood depth and duration of building structures. The natural ground elevations may help indicate the flood proneness and flood characteristics of building structures which will help assess the extent of building damage. A better understanding of the extent of building damage will provide a more realistic assessment on the resulting damage value. In a similar way, building finished floor elevations will help indicate the flood proneness and characteristics of building structures and the resulting value of damage. A better understanding of the extent of building damage will result.

Quality/quantity assessments of lawns, pavements, or shrubs. An inventory of existing landscaping characteristics may help refine the damage value assessment of these areas. A sample area may be reviewed to determine an actual variability in landscaping quality, quantity and dollar value.

Determination of number of vehicles in the EAA. Vehicular damage value may be more accurately assessed if the number and type of vehicles in the area is known. The relative magnitude and importance of vehicular damage to other damages in the EAA will dictate the degree of detail and assumptions made. The average number of vehicles for each residence classification and average automobile value could be used as general indicators.

Calculation of emergency costs associated with storm evacuations. In the event of large storm events, special measures may be used for emergency storm evacuations. The number of structures involved, time and materials used to implement these emergency storm evacuations as well as damaged property resulting from improper evacuation implementation may be considered. Alternate cost of lodging during home repair and emergency evacuation could also be considered.

Agricultural and Urban Damage Relationships. The National Resource Conservation Service (NRCS) could be requested to assess the damage relationships and production costs at updated price levels. Additional damage relationships might include costs of restoring land to pre-flood conditions, including elimination of weed infestation, removal of rocks or other debris, regrading soil, increased cultivation costs, and long-term or temporary crop yield reductions. Information detailing existing condition of infrastructure and associated potential damages such as sewer, water, electrical/utility, roadway, or bridge will not be collected.

### **E.1.3 Data Formatting/Structure**

A template for the collected data will contain information by farm basin indicating the land use acreage, productive land use acreage, the related agricultural basin designation, flood duration, and crop status. The storm event and month is indicated at the top left of the database. A separate table will represent each storm event and each month/landuse pattern. Due to crop rotation, the land use can vary on any given farm during the harvesting and planting season from September to May.

We would expect little changes in land use during June, July and August because the fields are "too wet to plow." This means that each farm potentially has 9 different land use patterns. The number of land use patterns may be further reduced if certain months are found to be identical to each other. The Rainfall Frequency report identifies seven storm events that will be modeled (2-, 5-, 10-, 25-, 50-, 100-year, and SPF). The antecedent moisture conditions can be selected appropriate for the month being evaluated.

For any given farm there will be potentially 189 different scenarios (9 monthly land use x 7 design storms x 3 durations). Evaluated over 22 agricultural basins this would produce 4,158 scenarios. For the 207 farms identified in the Inventory of Sub-Basin Data there could be up to 39,123 scenarios.

Not each of the 189 scenarios will be critical in terms of flood damage. Selecting the worse case duration scenario in terms of flood duration and depth for each storm frequency can reduce the number of scenarios. The resulting number of scenarios would be 54 for each farm, 1,188 scenarios over the 22 agricultural basins, and 11,178 scenarios across the 207 farms.

The farm basin field represents the 40E-63 Permit number. The Ag. Basin field indicates which of the 22 agricultural basins the farm is associated with. The structure count column will indicate the quantity of structures in each 40E-63 Basin. Seven landuse categories will be utilized for flood assessment purposes. Five specific land uses account for over 96% of the total 207 farm basin area. Another landuse category, “Flood Sensitive Landuses” will contain the remaining landuses that are flood sensitive but represent a relatively small percentage of the EAA area. The term “Flood Tolerant” contains those landuses that are relatively insensitive to flooding.

The specific land uses to be considered for flood damage assessment are as follows:

- Sugar cane
- Sod
- Row crops
- Fallow
- Improved pasture

Flood Sensitive Landuse will consist of the following FLUCCS Level 3 classifications”

- Roads & highways
- Industrial
- Citrus
- High, medium, and low Density-Single Family
- Field crops
- Railroads & railyards
- Institutional
- Brazilian pepper
- Airports
- Light Industry
- Commercial & sales
- Mobile home units
- Tree nurseries
- High density – multiple dwelling
- Rock quarries
- Unimproved pasture

Flood Tolerant Landuse will consist of the following FLUCCS Level 3 classifications:

- Freshwater marsh
- Mixed wetlands
- Electric power transmission
- Spoil areas
- Streams & waterways

- Reservoirs
- Borrow areas
- Wet prairies

For each of the seven landuse categories, a set of three columns will be repeated; gross acres, production acres, and crop status. For agricultural land, the gross area reflects production, fallow, and infrastructure acreage. For residential/ commercial land, the gross and production areas would be the same value. The crop status will indicate the stage of growth. The crop status at the time of flooding could influence the flood damage value.

Flood elevation refers to the maximum water stage for the corresponding area and storm. Flood depth is the height of water above the root zone or building finish floors, depending on the land use type. The flood duration will pertain to either the amount of time the water table is above the root zone or above the finish floor elevation.

The percent of area flooded will be determined from the hydrologic model at the agricultural basin level. Each farm will be assigned a flood depth, duration, and percent flooded based on the corresponding Agricultural Basin values. Those farms that are in more than one agricultural basin will be assigned a flood depth, duration, and percent flooded based on an area-weighted average of the corresponding agricultural basin values. The percent area flooded can be applied to each landuse area of the farm for a typical scenario. For a worse case scenario, the amount of flooded area will be applied in each respective 40E-63 basin in order of the land with the highest flood damage cost per area first within that basin.

Figure E.1.5 below demonstrates the format of the data collection summary and deliverable end-product.

Storm event: 10-year, 1-day; Month/Crop Landuse Pattern: October									
Farm Basin	Ag. Basin Designation	Structure Count	Landuse****			Flood Elevation	Flood Depth	Flood Duration	% of Area Flooded
			Gross Acres	Production Acres	Crop Status	ft	inches	hrs	

\*\*\*\* Repeat columns for each land use considered. 1 row per farm basin.

**Figure E.1.5 – Sample Data Template**

## References

Cooper, Richard M. 1989. An Atlas of the Everglades Agricultural Area Surface Water Management Basins. Technical Memorandum DRE-274. SFWMD.

Cooper, Richard M. and Joanne Roy, 1991. An Atlas of Surface Water Management Basins in the Everglades: The Conservation Areas and Everglades National Park. Technical Memorandum DRE-300. SFWMD.

Knisel W. G, 1980. CREAMS: A field-scale model for chemicals, runoff, and erosion from agricultural management systems. Conservation Research Report No. 26. USDA, Washington, DC.

Pathak, Chandra S. 2001. Frequency Analysis of Daily Rainfall Maxima for Central and South Florida. Technical Publication EMA 390. District.

South Florida Water Management District, 2000. Environmental Resources Permit Information Manual, Volume IV, District.

Trimble, Paul . 1990. Frequency Analysis of One and Three-Day Maxima for Central and South Florida. Technical Memorandum DRE 291. District.

USACE, 1965. Standard Project Flood Determinations, EM 1110-2-1411. Office of Chief of Engineers, Washington, DC.

USACE, 2000. Hydrologic Modeling System HEC-HMS, Technical Reference Manual CPD-74, Hydrologic Engineering Center, Davis California.

USACE, 2000. Planning Guidance Notebook, ER 1105-2-100. Department of the Army, Army Corps of Engineers, Washington, DC.