



**Northwest Florida Water Management District
Scoping Report for the Coastal Remapping Study of Northwest Florida
MAS6/FY2009**

December 1, 2009
(Revised 12/22/10)

I. Background

As part of the Federal Emergency Management Agency's (FEMA) Map Modernization Program, (MMP) administered by the Northwest Florida Water Management District (NFWFMD), the objective of the Coastal Remapping Study Project is to develop more accurate flood hazard maps of coastal areas in Escambia, Santa Rosa, Okaloosa, Walton, Bay and Gulf Counties.

The new detailed coastal remapping study includes development and use of an ADvanced CIRCulation model (ADCIRC) covering the upland areas and a wave model called Simulating Waves Nearshore (SWAN) to simulate storm surge and waves born from Hurricanes, tropical storms and other meteorological events. Attachment A includes a more technically detailed scoping document (TSOW) covering the development and use of data and models for this study. Refinements or new elements added to the document (TSOW) will be posted online at: NWFMWDfloodmaps.com.

The ADCIRC model and the SWAN model were selected for the surge modeling from the list of FEMA approved models. The ADCIRC model mesh planned to be developed for this area will be quite a bit more detailed and provides considerably greater resolution (approximately 2,000,000 computational points spaced at a minimum of 30 meters apart) than in the early 1980's when similar but much coarser models were developed for this area. The SWAN wave model is used to accurately depict the component of flooding caused by near shore wave energy in addition to the surge component of flooding. Both the ADCIRC and SWAN models will also be developed for Alabama as a cooperative effort between NFWFMD and the State of Alabama. These models are further supported by newly acquired detailed elevation data obtained from a relatively new technology called Light Detection and Ranging (LiDAR). A seamless digital elevation model (DEM) of the land elevations has been developed for the current area of study (see Attachment B). ADCIRC and SWAN model meshes as well as a seamless digital terrain model (DTM) that will incorporate Bathymetry and the LiDAR are currently under development. Once the models development and testing are complete they will be run 100's of times utilizing synthetic storm data statistically derived from historical hurricane storm characteristic data for the area. The model will be run on a high performance computing cluster at the University of Central Florida (UCF) that has the capability to simulate a storm surge event in a couple of hours. The model results will be flood elevations caused by storm surge and waves. The model computed mean water levels will be used to statistically determine the FEMA required 10, 50, 100, and 500-year flood elevations. The 100-year elevations will be mapped to revise FEMA coastal flood maps in a digital format.

Once mapped, the new flood elevation data and flood maps will be made available to the general public through the internet in a digital format as well as on paper maps so they may better understand where coastal flooding is expected to occur. An effort to help plan and implement an outreach program for the general public prior to map adoption is being coordinated with the mapping communities' flood plain administrator. The primary goal of these maps is to provide a better understanding of flooding risk to the public and communities impacted, as well as all other end users of the maps. Furthermore, these maps, once adopted by the local governments, will be utilized by the National Flood Insurance Program (NFIP) to more accurately rate flood insurance issued in coastal areas.

The existing Flood Insurance Study (FIS) reports will also require revisions to incorporate the new flood data, the vertical datum change (if necessary), and the incorporation of any Letter of Map Changes (LOMCs) (<http://www.nwfwmdfloodmaps.com/pdf/2009/LOMC-Combined.pdf>) issued since the date of the effective Flood Insurance Rate Maps (FIRMs). Additionally, outreach efforts have been proposed to take place throughout the remapping process which hopefully will be funded as part of this scope of work for the coastal areas. If warranted, these studies may instead result in the issuance of a new FIS as this is a thorough restudy and significant changes to the study methodology are proposed.

All QA/QC activities identified in MAS6 FY09 will be required to follow Procedure Memorandum 35. This includes a submittal of a QA/QC plan by NFWFMD's contractor for approval prior to initiation of the required QA/QC process.

Table 1: Statistical Information

Statistical Data	Gulf County	Bay County	Walton County	Okaloosa County	Santa Rosa County	Escambia County	Total
County Area (mi²) #	555	764	1,058	936	1017	662	4,991
Study Area (mi²)	521	472	336	177	341	220	2,640~
Population							
County #	15,667	163,946	53,837	179,693	150,053	302,939	866,135
Density (people / mi ²) +	24	194	38	183	116	445	N/A
Growth (% / year)	2.19	1.33	4.08	0.67	3.43	0.36	1.30
% of Total State	0.001	0.009	0.003	0.010	0.008	0.017	N/A
Flood Insurance							
Number of Policies *	1,701	35,098	17,910	23,479	11,939	19,155	109,282
Number of Claims (Since 1978) *	747	5,469	2,672	7,187	6,723	13,599	36,397
Total Paid (Since 1978) *	\$11,929,147	\$179,840,701	\$53,375,617	\$258,190,401	\$417,879,075	\$596,637,889	\$1,517,852,830
Repetitive Losses							
Number of Losses ^	140	946	671	1,424	1,755	3,872	8,808
Number of Properties %	140	937	646	1,419	1,753	3,857	8,752
Total Rep Loss %	\$3,142,992	\$32,034,654	\$26,712,825	\$123,357,259	\$91,930,802	\$260,848,893	\$538,027,425
Declared Disasters since 1998&	11	11	7	9	8	9	N/A
Number of LOMC^	319	324	277	572	98	184	1,774

SOURCE: U.S. Census Bureau, 2008 estimate; does not include summer seasonal population

^ SOURCE: Federal Emergency Management Agency, Repetitive Losses/BCX Claims 2009

* SOURCE: Federal Emergency Management Agency, NFIP Policy & Claims Report 2009

% SOURCE: Federal Emergency Management Agency, CTP Community Scoping Report

& SOURCE: Federal Emergency Management Agency, Major Disaster Declarations

~ This value includes area outside the coastal counties boundary

II. Meetings and 44 CFR Part 66 Compliance:

Three scoping meetings were held for all the mapping communities within Coastal Remapping Study area in Northwest Florida. Attendees included community officials from all the study area counties, NFWFMD, representatives from URS & Dewberry, and FEMA. The three meetings were held October 21, 2009 covering Escambia and Santa Rosa Counties, FL., in Milton, FL, October 22, 2009 covering Bay, Gulf and Walton Counties, FL., in Panama City, FL, and November 3, 2009 covering Okaloosa County, FL. in Fort Walton Beach, Florida. All of the communities within the coastal area of these counties were invited to attend. The few communities that did not attend will be provided via a certified letter a copy of the scoping document and information on where to obtain future updates of the NFWFMD study plans. NFWFMD staff will also follow up to invite any of the community officials who may wish to meet as necessary to better understand the project scope. A brief summary of the meetings follow:

- NFWFMD provided an introduction to the coastal project and an overview of the coastal study plans. The coastal modeling process was briefly described to include:
 - Seamless Terrain-Bathy data set,
 - ADCIRC Mesh creation,
 - SWAN grid (wave setup component),
 - Tidal verification,
 - Historic storm hindcasting,
 - Production runs,
 - Statistical Analysis for return periods.
- The NFWFMD handed out a draft coastal scoping report for review and comment. Contained within the draft coastal scoping report in the appendix is the technical scope of work submitted to FEMA as a proposal for the restudy. It contains the technical aspects of the restudy. It will be updated and revised as necessary to reflect any changes (approved by FEMA) and be located on the NFWFMD's flood map website (www.nfwfmdfloodmaps.com).
- The NFWFMD provided maps to the meeting participants to review and mark up at the meeting. This was an exercise designed to encourage the meeting participants to mark coastal areas for transect placement where more detail may be desired. The transect locations identified by the communities were intended to be a preliminary step before the final layout of formal transects locations by the NFWFMD contractors. The formal transects were described as those where "boots will be on the ground" to collect field data along them. It was also explained that in addition to the formal transects there will be many more transects auto-distributed using LiDAR data to come up with a much denser set of transect locations for mapping purposes.
- The list of communities and the point of contacts are listed below:

Name	Organization	Phone Number
Russell Barry	Okaloosa County Public Works	850.689.5772
Zam Fedorak	Okaloosa County Public Works	850.689.5772
Mike Ruzowski	Okaloosa County Public Works	850.651.7523
Sherry Reed	Okaloosa County Public Works	850.689.7917
Jeff Littrell	Okaloosa County Water & Sewer	850.651.7172
Jason Autrey	Okaloosa County Public Works	850.689.5772
Pinky Bradley	City of Mary Esther	850.243.3566
Jerrick Saquibal	NWFWM	850.539.5999
Ron Bartel	NWFWM	850.539.5999
Henrietta Williams	FEMA Region IV	770.220.5311
Juan Lemos	Escambia County Long Range Planning	850.595.3467
Karen Thornhill	Santa Rosa County Development Services	850.981.7029
Rhonda Royels	Santa Rosa County Development Services	850.981.7024
Timothy Day	Escambia County Development Services	850.595.1144
David Hill	City of Pensacola	850.595.1461
Mary Ann Vance	Santa Rosa County Planning & Zoning	850.981.7081
Charlie Gonalez	Escambia County GIS	850.595.3598
Tim Tolbert	Santa Rosa County	850.981.7013
Chris Sammelmann	Walton County	850.267.1955
David Richardson	Gulf County Planning	850.227.9562
Scott Warner	Gulf County GIS	850.229.6145
Al Shortt	City of Panama City Beach	850.233.5100
Neil Fravel	City of Panama City	850.872.3015
Jennifer Aldridge	City of Panama City	850.872.3004
Josei Cyr	Bay County	850.248.8301
Tita Sckoloff	Bay County Planning Department	850.248.8250

Part 66 compliance:

The Cooperating Technical Partner (CTP) has begun and has on record its Case file and docket? X YES NO

The CTP has written record of its initial contact made to the local communities affected by this map modernization project? X YES NO

The CTP has written record of its request for additional flood study data and base information from the local communities? X YES NO

III. NFIP Compliance

- a) Have you obtained all the communities’ ordinances to review for compliance? Yes
- b) Have you checked with the community and determine if they can adopt a digital product, proof copy, or will they need the official paper copy from MSC to adopt? Yes, official paper copy from MSC.
- c) Have you ensured that local floodplain administrators were in attendance? Yes

IV. Project Overview

The study area boundaries are generally defined as the coastal area below an elevation of 10 meters (32 feet) and generally has an upper limit within an area that would be expected to be inundated by a Category 5 storm (see Attachment B). The study team assembled by the NFWFMD will develop appropriate modeling tools that will cover an eight-county coastal area in the Western Panhandle of Florida and Alabama. The team members and the point of contact for each entity are:

- 1) NFWFMD - Ron Bartel (primary point of contact)
- 2) University of Central Florida (UCF) - Scott Hagen
- 3) University of Florida (UF) - Don Slinn
- 4) Ocean Weather, Inc. - Andrew Cox
- 5) Risk Engineering - Gabriel Toro
- 6) URS - Robert Johnston
- 7) Dewberry - Jeff Gangai

URS/Dewberry is under a continuing services contract for flood hazard mapping with the NFWFMD and all others except for UCF are subcontractors with URS/Dewberry. UCF is contracted separately with the NFWFMD. The team was assembled based on the past experience and expertise in dealing with similar Northern Gulf Coast studies extending at least from Mississippi to the Big Bend area of Florida. Others who may have very specialized Coastal Science and Engineering expertise may need to be added as subcontractors as the study progresses.

The UCF effort will include development of a storm surge water elevation modeling analysis from up to 600 synthetic storms for Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf

Counties in Florida and Baldwin and Mobile Counties in Alabama (these Florida and Alabama counties are henceforth defined as the “subject area”). Major modeling tasks will include: 1) Development of a DTM and ADCIRC mesh; 2) ADCIRC model development and storm surge validation; and 3) Model Production runs.

An overview map of existing study information and LOMCs is located at the link www.NFWWMDfloodmaps.com/lomc. There are no levees in the study area that need to be included in the analysis.

All data listed in Table 5 were identified and reviewed by the NFWWMD. Additional technical backup data available from the Flood Insurance Study report and for the LOMCs have been received from FEMA. This information is stored in NFWWMD’s headquarter office.

Table 2: Current Coastal Study Information

ID Number	Flooding Source	Reach Limits	Reach Length	Detailed Analysis or Approximate Study	If Detailed, Current Hydrologic Methodology	If Detailed, Current Hydraulic Methodology	Coastal or Riverine
	Gulf of Mexico, Perdido Bay, Pensacola, Escambia Bay, Santa Rosa Sound, Choctawhatchee Bay, St. Andrew Bay, St. Joseph Bay	Escambia County, FL through Gulf County, FL (see Attachment A)	1,197 Miles of exposed shoreline to bays & gulf of mexico	Both	N/A	N/A	Coastal

Table 3A: Coastal Flooding Sources to be Studied

ID Number	Change to Reach Limits	Change to Reach Length	Technical Justification	Detailed Coastal						Redelineation	
				Stillwater	Setup	Wave Runup	Wave Height	Back of Dune Determination	Erosion	With Back of Dune Determination	Without Back of Dune Determination
	Same as Table 2	Same as Table 2	*	x	x	x	x	x	x		

*** Technical Justification**

The new detailed Coastal Remapping Study, including storm surge analysis and overland wave height analysis will involve new and existing methodologies including LiDAR-based topography, new aerial digital ortho photos, statistical analyses using appropriate Joint

Probability Methods (JPM) for storm analyses, Planetary Boundary Layer (PBL) hurricane wind model, SWAN 2-D wave model, ADvanced CIRCulation model (ADCIRC) 2-D hydrodynamic model, Wave Height for Flood Insurance Study (WHAFIS) 1-D overland wave model, and Digital Flood Insurance Rate Map (DFIRM) mapping. These analyses will be used to update the coastal hazard information and mapping depicted in FEMA’s FISs and FIRMs for the Florida Panhandle region. The storm surge study will be performed for the Coastal Remapping Study area with a single storm surge model. The overland wave height analysis will be subdivided by county or separate study reaches.

Riverine flooding is not included in this study and therefore the information normally provided in Tables 3B, 3C and 3D do not apply, except for the length of coastline reported in Table 3C. Gutter lines will be drawn around the coastal dominated flooding sources. In most cases it is expected that the gutter lines will fall within the lower reaches of the major river floodplains, which are in conservation.

Table 3B: Riverine Flooding Sources to be Studied

ID Number	Change to Reach Limits	Change to Reach Length	Detailed Riverine		New Limited Detailed Study	Redelin-eation of SFHAs Using Effective Profiles	Refine/ Establish Zone A	Technical Justification
			Hydrology	Hydraulics				
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 3C: Total Stream Mile Counts by Type of Study

	Coastal	Detailed	Limited Detailed	Approximate	Redelineation	Verified Digital Conversion
Effective Flood Insurance Study	1,197	N/A	N/A	N/A		
Updated Effective Studies	1,197/1,197	N/A	N/A	N/A	N/A	N/A
New Studies Identified	0	N/A	N/A	N/A		

Table 3D: National Metrics

Item	Description	Value
Floodplain Boundary Standards (FPBS)	N/A	N/A
New, Validated, or Updated Engineering (NVUE)	N/A	N/A
Area	N/A	N/A
Population	N/A	N/A

Table 4: Partner Contributions

Product	Units	# of Units	\$/unit	Total Contribution
Digital Orthophotos to be used as base maps	Sq. Miles	2640	\$100	\$264,000
Topography – LiDAR/DEM & QA/QC	Sq. Miles	2640	\$350	\$924,000
(Actual Cost of LiDAR Acquisition)	County-Wide	Actual Cost		\$1,445,052
ADCIRC Surge Model	Study Area	Actual	\$360,000	\$360,000
Approximate Total (Blue Book)				\$1,548,000

**Based on draft revised Blue Book values (Version 2.0, January 2009)*

The ADCIRC model that is to be used in this study will be developed by modifying an existing model grid that includes areas of the Florida Panhandle and Big Bend area. This already existing model has been developed for other studies and has performed well for surge analysis.

NFWFMD coordinated with local GIS departments and other government agencies to receive and evaluate available data sets. Table 5 lists the data sets collected in the Coastal Remapping Study area.

Table 5: GIS data layers available

GIS data available	Source (ie, State, Local, Federal)	Acquisition Date	Vertical Datum	Horizontal Datum	Use Restrictions?
Cadastral Data	Local	April, 2007	NA	NAD83	None
Hydrography	NHD (Federal)	November, 2007	NA	NAD83	None
Flood Hazard Information	Q3 Data (Federal)	1996	NA	NAD83	None
	GeoReferenced FIRMs (Federal)	August, 2005			
	Single Loss Data (Federal)	June, 2002			
	Rep Loss Data (Federal)	November, 2007			
	No Loss Data (Federal)	November,			

		2007			
	Panel Index (Federal)	June, 2002			
County Boundary Data	State	2001	NA	NAD83	None
Municipal Boundary	County	May, 2006	NA	NAD83	None
Digital Orthophoto	State	Winter, 2006 & Spring, 2007	NA	NAD83	None
Publicly Owned Lands Data	State	March, 2008	NA	NAD83	None
Transportation Data	State	March, 2008	NA	NAD83	None
Elevation Data	National Elevation Data (Federal)	1999 publication date, but data is from Quads of various dates	NAVD 1988	NAD 83	None
	USGS Contours (Federal data compiled under a State contract)	09/01/2004 publication date, but data is from Quads of various dates	NGVD 1929	NAD83	None
	Benchmark Data (Compiled by the State, but original data source may be Federal or State)	May, 2006 but individual benchmarks were taken over time	NAVD 1988	NAD83	None
	LiDAR Data	2008	NAVD 1988	NAD83	None

The proposed draft paneling and transect layout for the Coastal Remapping Study area can be found in Attachment F.

NWFWMD hydrologists and planners evaluated the need for updated flood information in regions of highly populated/developed areas. This was accomplished through the review of the Land Use data, the local watercourse data, and the existing digital effective data for the Coastal Remapping Study area. See Attachment C for a map showing the land use and Attachment D for a map showing public lands in the Coastal Remapping Study area.

National Digital Elevation and Digital Ortho Program Project Tracking System: After the elevation and imagery data is obtained the following project tracking systems should be updated with the following required information.

National Digital Elevation Program (NDEP) Project Tracking System

[\(https://hazards.fema.gov/metadata/NDEP/\)](https://hazards.fema.gov/metadata/NDEP/)

- Data Collection Status: Complete, In work, Planned, or Proposed.

- Vertical Datum: should be NAVD88
- Vertical Accuracy: RMSE per FEMA G&S App-A
- Approx. Planned Posting Spacing: smallest dist. Between points in gridded elevation dataset
- Elevation Data Model: e.g., mass point/breaklines, regular grid, etc.
- Data Collection Method: e.g., cartographic, photogrammatic, LiDAR
- Surface Mapped: usually bare earth
- Use restrictions

National Digital Orthophoto Program (NDOP) Project Tracking System

[\(https://hazards.fema.gov/metadata/NDOP/\)](https://hazards.fema.gov/metadata/NDOP/)

- Data Collection Status: Complete, In work, Planned, or Proposed.
- Image Resolution:
- Vertical Accuracy: in meters
- Data format:
- Image Bands:
- Leaf Condition: on/off
- Grid System:
- UTM Zone:
- Horizontal Datum:
- Use restrictions:

V: Project Status

The development of a digital terrain model and ADCIRC mesh (Phase I) is underway and will be completed within nine months of contract initiation, provided a timely delivery of the required datasets. SWAN model grid development has also begun. For outreach an effort has begun for planning, coordinating, and design of a web site as well as other outreach activities. A layout of draft transects has been completed as provided in Appendix F. This Scoping document and the TSOW (attached) along with any future updates will be available at:

www.NWFWMDfloodmaps.com.

A detailed project schedule which was dependent upon negotiations with study team contractors is currently being updated and will be posted along with the Mapping Information Platform baseline data when complete.

VI. Project Funding

There are no changes in the original Mapping Activity Statement (MAS) funding/leverage table which is located at: <http://www.nwfwmdfloodmaps.com/pdf/FY09MAS6NWFWMDFINAL.pdf> and addresses project funding.

VII. Proposed Resolution to Outstanding Issues Identified in the Mapping Activity Statement

All of the coastal area including previously unstudied coastal areas in Northwest Florida will be studied with new data and modern analysis tools previously unavailable.

VIII. Unmet Needs

Unmet needs are those areas identified for study during the scoping process, but were not selected due to funding limitations. No unmet needs are anticipated immediately following completion of the work proposed in this SOW which covers all of the coastal restudy area.

IX. Summary

In summary, Coastal Remapping Study with applicable databases will be developed for Escambia, Santa Rosa, Okaloosa, Walton, Bay and Gulf Counties for a total amount of \$4,820,000. This includes a detailed model development and coastal restudy for the coastline extending from Gulf County, Florida through to Alabama. The \$4,820,000 for the Coastal Remapping Study will cover the costs of the following mapping activities:

- Scoping process
- Initial Outreach planning and coordination activities
- North American Vertical Datum of 1988 (NAVD 88) will be used
- New/updated coastal flood hazard analysis for the coastal areas in this study
- Conversion of manual flood themes on the effective FIRM for the study area and Incorporated Areas to a digital flood theme.
- Overlay of existing FIRM flood themes and new flood themes for the proposed study areas identified in Tables 3A and 3B onto an orthophoto map which will be used as the base map for the Countywide DFIRM product
- Perform error checking on current flood maps where irregularities in the effective areas exist within the study area.
- Incorporation of LOMCs issued since the date of the effective FIRMs
- Application of new or updates of existing DFIRM graphic and data base specifications as appropriate
- Preliminary DFIRM and FIS report preparation and distribution
- Post preliminary processing

All of the above activities will have an independent QA/QC performed to ensure that the products being produced meet the *FEMA Guidelines and Specifications for Flood Hazard Mapping Partners*. *This independent technical review will be conducted by URS Corporation.*

ATTACHMENTS

Attachment A: Technical Scope of Work (TSOW)

Attachment B: Coastal Study Area Maps

- Category 5 Storm Surge (SLOSH) and Region below 10 Meters
- DFIRM Flood Data for the Coastal Restudy Areas

Attachment C: 2004 Land Use for the Coastal Restudy

Attachment D: Public Lands and those in Conservation Use for the Coastal Restudy Counties

Attachment E: Storm Surge (SLOSH) for the Coastal Restudy Counties

Attachment F: Coastal Study Area Paneling Scheme & Transects

ATTACHMENT A
(Updated 08/20/2010)
COASTAL MODELING AND DFIRM PRODUCTION
TECHNICAL SCOPE OF WORK (TSOW)
FOR
COASTAL NORTHWEST FLORIDA



OCTOBER 08, 2009

INTRODUCTION

A new detailed coastal remapping study including storm surge analysis and overland wave height analysis is proposed to be performed by the NFWFMD, in cooperation with FEMA and the Alabama Department of Economic and Community Affairs Office of Water Resources (OWR). This will include storm surge water elevation modeling analysis for Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf Counties in Florida and Baldwin and Mobile Counties in Alabama. This study will involve new and existing methodologies such as LIDAR-based topography, new aerial digital ortho-photos, PBL hurricane wind modeling, SWAN 2D wave modeling, ADCIRC 2D hydrodynamic modeling and statistical analysis using the JPM. This study would also include WHAFIS 1D overland wave modeling, coastal hazard mapping, and DFIRM production. These analyses will be used to update the coastal hazard information and mapping depicted in FEMA's FISs and FIRMs for the counties identified above. The storm surge study will be performed for the coastline of eight (8) counties resulting in a single storm surge modeling effort. The overland wave height analysis will be subdivided by county or separate study reaches. Alternative 2D overland wave analysis will also be considered to check for improved accuracy if additional FEMA funding is made available for development of a 2D overland model.

To complete this project through the mapping phase, it is estimated the work would take up to 36 months from the start of the initial data collection efforts and storm surge mesh development. The final objective of this scope of work at the end of this period is to produce updated DFIRMs covering the coastal areas of Escambia, Santa Rosa, Okaloosa, Walton, Bay and Gulf Counties in Florida. This Scope of Work includes internal contractor QA/QC procedures with reviews by the NFWFMD. If necessary, a panel of experts will be assembled to provide external review on specific problem areas that may be identified related to coastal issues. The decision to form an expert panel will be at the discretion of the NFWFMD and will be based on their judgment of project progress as outlined herein. If special problem areas develop, they will also be documented in Special Problem Reports (SPRs) to FEMA. As new methods and

procedures in Florida or other states in the Gulf of Mexico and Atlantic region are introduced, documented and accepted by FEMA, consideration to use them will be made. The new methods or procedures would be employed to produce DFIRMs at lower costs without sacrificing accuracy, and likely would be used to enhance map accuracy and detail. The study should take full advantage of current or modified draft versions of the FEMA guidelines and Procedure Memorandums for producing DFIRMs in the Atlantic and Gulf coasts, with the intent to reduce the project duration and costs.

The work will be carried out by contractors currently certified and qualified to perform coastal mapping by the NFWFMD. Additional capabilities may include specialty teams recognized in the areas of statistics, hurricane meteorology, and hydrodynamic model development. Further specialized expertise will be obtained from several academic institutions involved in coastal hazards analysis, hydrodynamic modeling and model development. Thus, the “project team” will include continuing services contractors, recognized experts in the field of coastal modeling, university research expertise as well as NFWFMD hydrologists and engineers. Currently, the team members and principle contacts of each team member are:

- 1) NFWFMD - Ron Bartel, Project Management and Oversight
- 2) UCF - Scott Hagen, ADCIRC Surge Modeling, Digital Terrain Model Development
- 3) University of Florida (UF) - Don Slinn, SWAN Modeling
- 4) Ocean Weather, Inc - Andrew Cox, Wind Field Modeling
- 5) Risk Engineering - Gabriel Toro, Storm Characterization and Probability Analysis
- 6) URS - Robert Johnston, QA/QC and Mapping
- 7) Dewberry - Jeff Gangai, Technical Oversight and Mapping
- 8) AECOM – David Divoky, Special Problems Technical Review

INTEGRATED WATERSHED MANAGEMENT

This study will apply an integrated watershed management approach as a general tactic for the development of flood hazard maps. Some of the benefits of this tactic are reduced study costs, enhancement of data sources, and increased longevity or continued use of study products by multiple parties. Such tactics include the use of recently developed models, data mining or leverage of existing water resources data

from local sources, and obtaining in-kind support from the map user communities. Local level uses of the study data or its by-products add greater “buy in” to the program and, in turn, provide greater incentive for local governments as well as the NFWFMD to actively participate in the development of the program.

MODELING AND MAPPING ASSUMPTIONS

The project development team has examined a number of solutions to expedite the ADCIRC mesh development and to save computer run-time costs by carefully designing as well as eliminating unneeded mesh resolution. These savings should be applied to the study effort as it gets underway.

Within this study, the potential benefits of a 2D overland wave analysis are being investigated. Currently, the 1D WHAFIS overland wave model is being used to estimate the overland wave conditions associated with the 1% annual chance mean water elevation. With the increase in wave modeling technology over the past decade it may be able to extend the overland wave modeling analysis to 2D, with possible improvements in accuracy. During this study, the 2D modeling approach will be applied and compared to the 1D WHAFIS analysis. The results of the comparison will be documented in a separate report and used to determine the potential benefits of 2D overland wave analysis. The assumptions for cost estimate are that these recently developed approaches will be utilized when they are more cost effective, affordable within current budget constraints, and accepted. The final cost estimates, methods, and modeling assumptions as stated in this document form the basis of this scope of work which will be formally submitted to FEMA as a deliverable under a Cooperating Technical Agreement MAS and as an attachment to the scope of work presented to NFWFMD coastal communities for review.

Recent FEMA coastal flooding studies in Texas, Louisiana, and Mississippi have set many new precedents, which have changed study methods and procedures in many ways from what are defined in the current FEMA Guidance Document (Appendix D and 2007 update) and the draft *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update*. Therefore, at the outset of this project, the study team has reviewed this scope

of work to ensure it minimally is a written plan that includes the newest policies and procedures that are now expected by FEMA. The project scope, schedule and budget have been adjusted accordingly and are included in the final scoping document prepared for submittal, review, and acceptance by the FEMA Project Officer. The final approach may be altered somewhat as NFWFMD contractors prepare more detailed scopes of work and put in the latest advances developed and proven for coastal modeling by ongoing efforts elsewhere. The latest advances when adopted will be subject to FEMA review for approval, included in updates of this scoping document. Any proposed changes to the scope or approaches will not be implemented until they are reviewed and approved by FEMA. This document and future updates will be published on the NFWFMD web site: NFWFMDfloodmaps.com.

Completion of this project requires several major tasks. Storm Surge and Wave Model development, model production runs to simulate surge, wave set up and overland waves, and mapping and DFIRM Production, as well as outreach, are the primary ones. The initial task of Storm Surge and Wave Set-Up Modeling covering the entire study area will be developed under a Florida MAS. Overland wave modeling, mapping, DFIRM production, and outreach will be carried out through separate MAS documents developed for each state. There are some potential cost savings which may be realized by slightly reducing the number of map panels and automated distribution or redistribution of coastal transects. There are, for example, coastal barriers which are in conservation in Okaloosa County and not inhabited as well as bay area where a high density of map panels are unnecessary where it will be possible to reduce production costs. The developed paneling scheme will also be more efficient because the flood maps will be developed and accessible through a GIS environment. Also, the automated processes for transect development allow for a much higher density of transects and utilize LiDAR data. Any changes to the transaction location and map panel distribution that deviate from the Guidelines and Specifications and Procedure Memoranda will be submitted to FEMA in a Special Problem Report (SPR) and will not be implemented until approved by FEMA.

1.0 STORM SURGE AND WAVE SETUP MODELS DEVELOPMENT

Detailed coastal study for FEMA flood hazard mapping requires development of a 2D surge model coupled with a wave model. The ADCIRC and SWAN models have been selected for the modeling analysis from FEMA's list of approved software for.

Development of the models for this study will cover all of the Alabama Coast in Mobile and Baldwin counties and the Western panhandle of Northwest Florida from Gulf County to Escambia County, Florida. There are several steps that are necessary for model development including construction of a seamless digital terrain model, development of a detailed ADCIRC model mesh, determination of geospatial friction coefficients, validation of the ADCIRC model and validation of the SWAN model. Once the models are developed, they are then used in a production mode to simulate 100's of synthetic storms needed to establish the surface water elevation statistics needed for mapping.

1.10 TERRAIN AND BATHYMETRIC DATA PROCESSING

LiDAR data has been collected for both states and is currently available or being processed to be combined with existing data for all the coastal counties in the Florida Panhandle and Alabama (Figure 1). Adequate offshore data is available from the National Oceanic and Atmospheric Administration (NOAA) bathymetric surveys and stored on the Geophysical Data System (GEODAS) database. Additional data sources, currently under investigation, include the United States Army Corps of Engineers (USACE) shelf data acquired with LiDAR. The USACE also maintains a survey database of shoreline structures (e.g., jetties, groins, and revetments) around inlets and bridges. All the identified datasets are being evaluated by NFWFMD and its contractors and, as appropriate, will be used for each county in the study area. The project team, as defined earlier, is also evaluating the terrain and bathymetric data and as necessary will correct them to build a seamless set tied to a standardized datum. The bathymetry and topographic datasets will be then merged together with the shoreline, to produce a separate seamless DTM for the entire study area. No other data collection is anticipated for DTM development. This task is ongoing and will be completed before the mesh development task. Statistical characterization of storms will

be performed concurrent with the DTM development and aid in understanding the upper limit and extent of the storm surge boundary. This effort will include but not be limited to the following tasks:

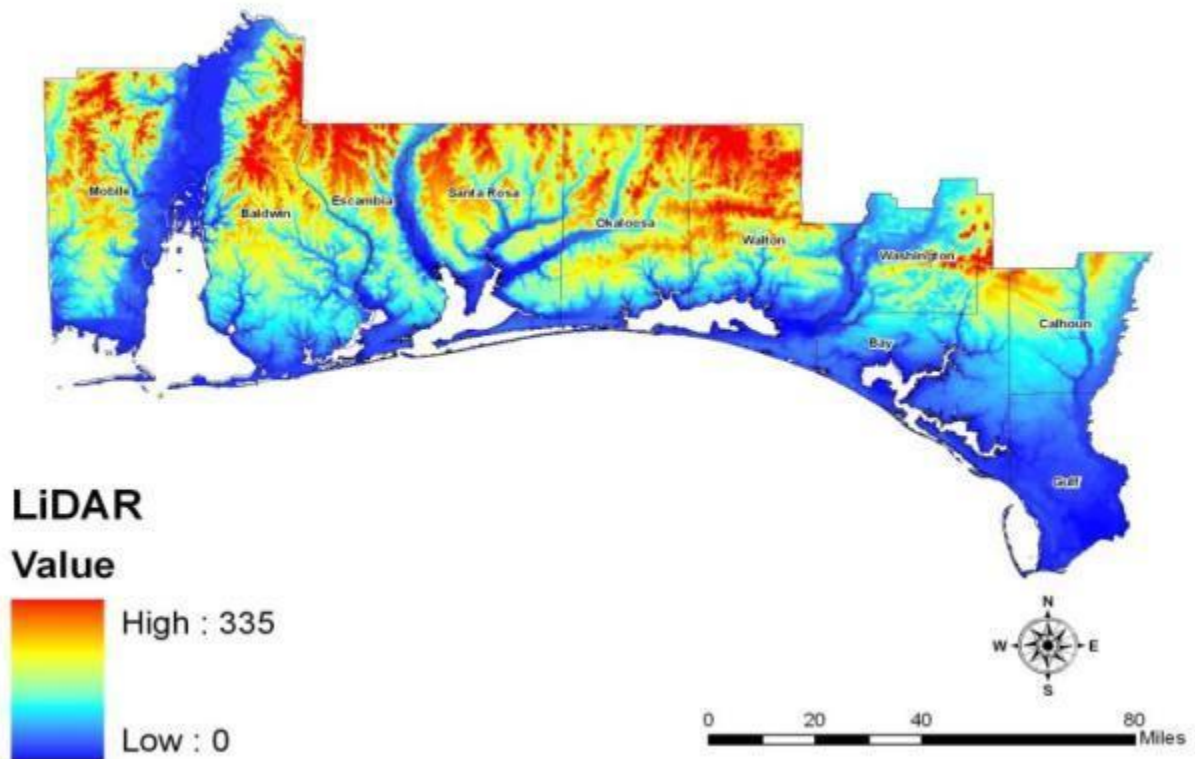
- Conduct field reconnaissance prior to final scope development to familiarize the study team with the varying coastal conditions and local topographic and structural features that will control flows.
- Conduct field reconnaissance to identify the type and nature of the vegetation and building obstructions, and document unique coastal features that need to be considered in the surge modeling (seawalls, levees, bluffs, inlets, and river confluences).
- Conduct limited bathymetric surveys of the river mouth areas where depth data is sparse.
- Obtain available data from the USACE Mobile District office on ADCIRC surge modeling and LiDAR/SHOALS surveys. Obtain available data from State of Florida's Beaches and Shores Resource Center, community data, and other state agencies including the Florida Department of Transportation (FDOT) and Alabama Department of Transportation (ALDOT).
- Review digital elevation data from various sources (NOAA, NFWFMD, OWR, FEMA, State of Alabama, State of Florida, USACE, and USGS) which is available to enhance the DTM.

Most of the initial field reconnaissance task was completed during the scoping phase of this project. NFWFMD watercraft and land based vehicles were used for the field reconnaissance work covering the entire study area in detail. A primary purpose of the field work was to identify, describe and measure flow controlling structures including bridges, culverts, causeways, etc. and familiarize the project team with the entire study area. It will also be necessary to have information about the depths and cross-sections of most streams. For the purpose of this proposal, we assume that adequate data of this nature will be available from existing sources, such as existing river flood studies, DOT crossing surveys, and navigation/nautical charts. The available data has been reviewed and appears to be sufficient however; deficiencies, if found during the course

of DTM and/or model mesh development, will be identified and, as necessary, a decision will be made to make adjustments for additional field work and schedule.

FIGURE 1

**ALABAMA and NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
LiDAR COVERAGE for STUDY AREA**



1.20 MESH DEVELOPMENT

ADCIRC model mesh development which follows DTM development has begun and will include extraction of vertical features, identification of roadways, riverbanks and other poly-lines that are identified within the DTM and should be fixed within the mesh. All surface characteristics (including Manning's n, wind-reduction factors, and canopy assignments) are planned to be done as a part of a Model Testing and Validation tasks which are aligned with the developed model mesh. Thus, because the final set of

surface characteristics are produced after the model mesh is developed and following model testing, some minor adjustments in the mesh may occur.

Existing ADCIRC meshes have already been created or used for the Gulf of Mexico by the USACE, FEMA, NOAA, UCF, Florida State University (FSU), and others. The most recent model and mesh developed prior to this study was by NOAA (represented by Figure 2).

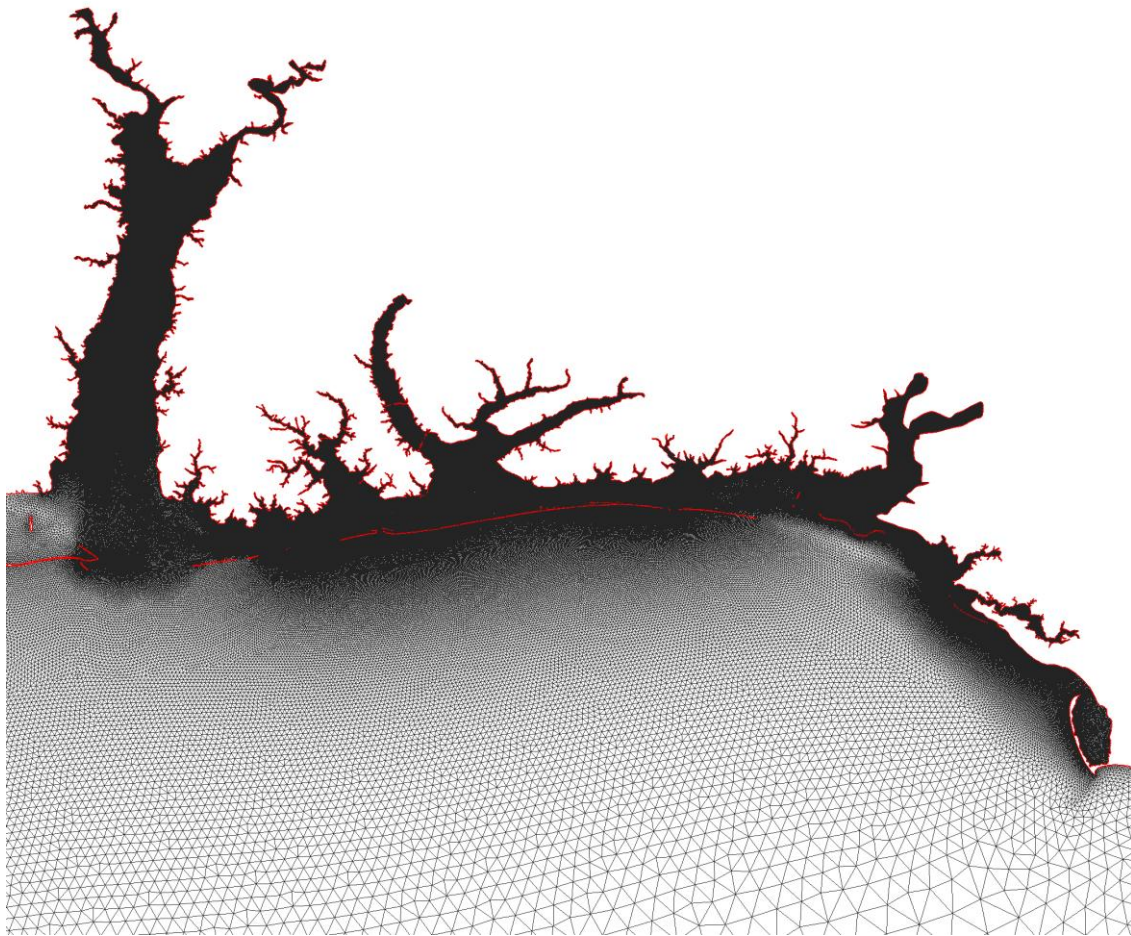


Figure 2. Overland Model Mesh Developed by NOAA covering the Study Area.

This mesh extends overland up to the 15-meter contour and covers an area west to Mobile County, AL and east to Gulf County, FL. The project team will use the existing NOAA model(s) to extract useful data and perform some initial tests to understand the system to be modeled and later if it should prove useful for other purposes. The NFWFMD and UCF will decide further uses of this existing model after it is further

evaluated and tested. It may, for example, be useful as a coarser grid model for making the initial run for model production as discussed below. It may also be used to initially evaluate the maximum water levels to be expected from extreme hurricanes.

However, UCF will ultimately develop a new ADCIRC model mesh for this study that will take advantage of a recently developed technique to extract vertical features from the newly developed DTM previously discussed above. This technique proved invaluable in the development of a stable, accurate mesh for the storm surge model employed in Franklin, Wakulla and Jefferson counties, Florida. The model mesh will minimally cover an area that covers the landward extent of surge defined by a Category 5 hurricane as delineated by Sea, Lake, Overland, Surge from Hurricanes (SLOSH) model maps and somewhat higher up to the 10 to 15 meter (32 to 48 feet) elevation (see figure 3).

On the west end, the mesh will coincide with the mesh developed for the FEMA sponsored Mississippi model study (western model). On the east end, the mesh will align with the Franklin, Wakulla and Jefferson County model developed for the NFWFMD's FEMA study (eastern model). This important step will help to ensure consistency between FEMA flood insurance rate maps adjacent to the subject area. However, the mesh resolution will be relaxed further east and west and coarser on either end of the model domain.

The contractors involved with model mesh development will address how consistency between the eastern and western models should be accomplished and checked using actual storm data. Statistical data sets previously accomplished will be used as a check and to assure that the model mesh will produce the same or similar mean water elevations. The NFWFMD and its contractors will also check the model results for consistency with the models previously applied adjacent to the study area.

It is now estimated that an initial detailed mesh for the entire study area may contain in excess of 3,000,000 mesh nodes. Nonetheless, since the model developed will also be used to perform the production runs, the project team will ensure that the time to run all the production runs remains reasonable and cost efficient in order to produce reliable results to cover the 500-year return period boundaries. The final mesh will meet QA/QC

requirements with appropriate documentation to explain how the final mesh was developed.

The project team shall ensure that the mesh is accurately interpolated to the terrain and bathymetric data providing an accurate representation of the morphological features represented in the data set. Once the mesh is finalized and QA/QC review completed, it will be submitted along with the topographic and bathymetry data to FEMA for review.

1.30 GEOSPATIAL FRICTION COEFFICIENTS

This task will begin with the determination of surface characteristics, including Manning's n (a bottom roughness parameter used in the calculation of bottom drag), wind-reduction factors (to modify the marine-based PBL winds to account for land features), and canopy assignments (to reduce wind stress when the vegetation canopy would restrict wind from reaching the water surface). Surface characteristics will be derived from landcover representations including the National Landcover Database, GAP data and Florida Fish & Wildlife Conservation Commission (FFWCC) landcover data. Additional consideration will be given to databases and maps covering submerged and aquatic vegetation.

1.40 ADCIRC MODEL ASTRONOMIC TIDE AND STORM SURGE VALIDATION

The study team will perform astronomic tide simulations and a series of hurricane storm surge runs with tides, wave forces and wind/pressure forcing to validate the overall model. Simulated astronomic tides and hurricane storm surge shall be compared against verified tidal constituents maintained by NOAA, tidal elevation hydrographs and high water marks in order to ensure that the model is reasonably reproducing the hydrodynamic behavior of the study area. This effort will include, but not be limited to, the following tasks:

- Include and test the developed surface characteristics.
- Apply the ADCIRC model in astronomic tide simulations and validate with NOAA station data.

- Acquire the historical hurricane wind field datasets from OceanWeather Inc. (OWI) (if necessary) and incorporate existing data (as appropriate) for the storm surge modeling effort.
- Test the ADCIRC model stability under conditions of hurricane storm surge.
- Apply the ADCIRC model in storm surge simulations for the entire coastal reach.

Several storms shall be run over the study areas in order to verify that the mesh and the models correctly represent water elevations and wave heights associated with the selected historical events. Results of the storm surge and wave modeling hindcasts, as well as any revision to the meshes may, as requested, be submitted to FEMA for review. This task includes but is not limited to:

- Providing results that show comparisons between model simulated and observed high water mark data from past events.
- Providing results that show model data comparisons with observed tidal gage data which were collected during the storm as well as during non storm astronomic tidal periods.

1.50 VALIDATION STORM DATA ORGANIZATION AND SELECTION

As previously discussed a set of storms shall be identified from the storms pulled out from the NOAA database to be run for model testing and subsequent validation (computed versus measured result comparisons) for both surge and wave modeling. Such storms will likely include Hurricanes Katrina (2005), Opal (1995), Ivan (2004), and Dennis (2005) because they have the best meteorological records of wind, pressure, surge, and waves. No less than four historic hurricane events will be selected to validate the ADCIRC model as well as the SWAN model. Hurricanes Ivan, Katrina, Opal, and Dennis are also likely candidates because of the amount of data available documenting them and they are relatively recent events which have impacted the “current” conditions of the coastline. In general, the validation storms selected are those that have impacted a large area of the coastline being studied as well as ones having an adequate amount of historic measured data to validate a model against. This task includes:

- Review available validation data sets connected with historic storms and provide a QA/QC review of these data.
- Provide a final list of historic storms and corresponding data sets for validating the models.

1.60 SWAN MODEL DEVELOPMENT AND CALIBRATION

New state-of-the-art methods will be used for the determination of wave setup over the open water portions of the study area. A 2D wave model will be run concurrently with the surge model. By doing so, the amount of wave setup due to wave breaking can be determined and mean water levels (inclusive of wave setup) can be calculated. The approach outlined below utilizes a conventional approach as was developed recently for the State of Mississippi.

Wave setup modeling includes calculation of the wave setup and wave fields across the study area. This initial subtask involves model development and testing. Utilizing the present capabilities of ADCIRC, the project team will perform 2D wave modeling using the SWAN model developed by Delft Hydraulics. Offshore boundary conditions shall be developed to use as forcing for the nearshore wave modeling. The 2D wave modeling will determine radiation stresses that will be input into ADCIRC in order to provide mean water elevation accounting for wave setup. Based on coastal shoreline reaches and geometry, an estimated total of 20 separate 2D SWAN grids will be needed to conduct the nearshore wave modeling. Results from the SWAN model will also be used to determine starting wave conditions for the transects modeled during the coastal hazard analyses.

Model development includes preliminary SWAN model grid development and layout, SWAN script development for nested grids and winds, calibration and testing with historical storms, inclusion of final topographic and bathymetric data sets, optimization and testing on portable computing platforms.

A procedure that accounts for the generation of the boundary conditions, the runs of the 2D wave model, the validation of the results against historic data, and the coupling process between the wave and the storm surge models shall be established. Model results will be compared against several calibration data sets and no less than four validation storms. Model results will be presented and provided in an acceptable format to the project study team. All model data and model run data will be archived and stored as necessary.

2.0 MODEL PRODUCTION

To develop revised 10%, 2%, 1% and 0.2% annual chance mean water elevations for each study area, the project team will conduct hurricane and tropical storm surge modeling using ADCIRC, a 2-D hydrodynamic model commonly used for storm surge simulations. As discussed in more detail below, this study will rely on the PBL-generated wind and pressure field data, offshore wave data, SWAN 2-D wave modeling and a statistical analysis of the model results using the appropriate JPM. The coastal mean water elevations will then be used for the overland wave analysis and hazard mapping process described in the next section.

The latest developments of ADCIRC modeling will be used by the project team to conduct storm surge modeling and QA/QC the results. This modeling will require preliminary model setup time and daily concurrent execution of ADCIRC and SWAN model runs, followed by concurrent model preparations and starts. This current scope calls for running the ADCIRC model twice for each model production run. It is not clear at this time if the initial modeling run is necessary and following FEMA guidance expected to be forthcoming the initial run requirement may be dropped. The current scope also relies on model runs and results made previously for Mississippi and east of Gulf County, FL in order to maintain consistency between coastal reaches. The results of those studies will be used as guidance in conducting this study. Also, the results of this study will be compared to those at the shared boundaries to access consistency.

The model production run process currently involves an initial ADCIRC model run followed by post-processing of ADCIRC model output for further use in subsequent ADCIRC with SWAN wave modeling/coupling runs and subsequent WHAFIS modeling. The highly iterative process of making ADCIRC production runs is the most critical and most expensive component of the study, and requires many months of computer time during the pre-run and production run phases. The storm surge study also includes a number of sub-tasks. All procedures and deliverables will be in compliance with the QA/QC section given later in this document. It is particularly important that the initial ADCIRC and SWAN models developed go through the QA/QC process prior to model production as well as afterwards during production. The actual number of model runs to be undertaken at any one time is dependent on length of shoreline and whether or not the storms maximums are adequately achieved to represent the 10%, 2%, 1% and 0.2% annual chance mean water elevations over the shoreline segment studied. It is estimated that for the eight county shoreline length, a sufficient level of accuracy will be achieved within 600 model production runs. If the study team is unable to achieve a sufficient level of accuracy within the 600 model production run limit and current budget limitations, it will consider alternate methods for estimating the 10% and 2% annual chance mean water levels.

2.10 DEVELOPMENT OF JOINT PROBABILITY METHOD STATISTICS AND SYNTHETIC TRACKS

The NFWFMD contractors will perform a JPM statistical analysis to develop synthetic storms and tracks to be run for production.

This task includes definition of Coastline Capture Zone and Compilation of Data over a selected historic period. To define a Capture Zone for the collection of hurricane data and the calculation of hurricane parameters at a minimum the zone will extend no more than 400 km from either end of the area under investigation. This zone will be limited to the storms that originate in the Gulf of Mexico or enter the Gulf of Mexico from the Caribbean, and may also include storms that have crossed (east to west) the Florida peninsula and enter the Gulf of Mexico. Storms that only make landfall once on the Atlantic Ocean shorelines will not be used in this study. The exact dimensions of this

capture zone are of little importance because distant storms will be given a low weight and will have a minimal effect on the calculations. The widely accepted Chouinard's kernel approach will be used for weighting storms and developing the storm statistics. This approach follows a statistically fitting procedure to account for the rate of occurrence and the spatial variation of the intensity of land falling storms along the Northwestern Gulf Coast.

The proprietary Tropical Parameter Database (TROP) or equivalent files provided by OWI, will be used to calculate the storm characteristics (ΔP , R_p , forward velocity V_f , heading, landfall coordinates, etc.) at landfall for each storm in this dataset during the period 1947-2005). The simplified coastline geometry developed by Dr. David Levinson's group at NOAA, or a similar coastline used in NWS38, will be utilized to define the coastal crossings and as the reference coastline for other tasks in this study.

Statistical comparisons to investigate the implications of choosing alternative beginning dates for the Period of Record for the statistical calculations will be performed as necessary. Owing to well-documented limitations of the data prior to 1940, it is anticipated that the Period of Record will be defined as beginning in the 1940's, as has been done in most recent surge studies in the Gulf of Mexico.

In addition a list of shore-crossing storm parameters (landfall date-time and coordinates, ΔP , R_p , forward velocity V_f , heading, etc.) at the shore crossings for individual historical storms that fall within the Capture Zone and Period of Record defined above will be provided. Also, a brief report will be prepared to explain the data sources, methods and procedures used to establish the spatial extent of the Capture Zone and the Period of Record.

The Statistical Analysis for Development of Probabilistic Model for hurricane occurrence and characteristics will include performing a statistical analysis to estimate the parameters of a probabilistic model of hurricane frequency and characteristics at landfall. This model consists of the following elements: annual rate of hurricanes with ΔP above a certain threshold, probability distribution of ΔP (given that it exceeds the threshold), and the conditional distributions of R_p , forward velocity V_f , heading, and

Holland B, given ΔP . As in recent probabilistic surge studies, this work will focus on the conditions at landfall. This effort will include consideration of alternative probability distributions for ΔP . Adjustments to the approach may be necessary, to accommodate the shape of the NE Gulf of Mexico coast.

The statistical analysis also requires investigating the temporal variation of ΔP and other key storm parameters, considering storms that make landfall within the Capture Zone. Based on these comparisons, the temporal schemes used in the Mississippi or Louisiana studies may be adopted or modified.

The Development and Validation of Synthetic Storms and Associated Rates will involve using the probabilistic model developed above to generate 1,000 to 2,000 combinations of storm parameters at landfall (and their associated rates) to properly represent the flooding from all possible combination of parameters. These storms will be used in a large series of SLOSH model runs to develop the Reference-JPM storm surge analysis.

The Quadrature JPM-OS method will be used to develop a more compact JPM-OS representation of the storm population, which will consist of an estimated 600 combinations of storm parameters. This will involve performing the SLOSH runs for these storms and comparing the resulting values to those obtained with the Reference-JPM set. The final number of storms or other elements of the formulation will be determined when the right combination of accuracy and efficiency is achieved. The goal for this project will be to achieve results for the 10%, 2%, 1% and 0.2% annual chance events with approximately 600 synthetic storms. If a significant amount of additional synthetic storms is required, consideration will be given to not include or simply interpolate the 10-year return period in order to meet the target of approximately 600 synthetic storms.

Following the previous step, a set of approximately 600 synthetic storms will be developed. In addition to the parameters at landfall, these synthetic storms will incorporate representative track geometries and temporal variations in key parameters. The synthetic tracks will be laid out in a uniform spacing across the study area and will be based on the parameters and landfalling locations of the historic storms.

2.20 SLOSH RUNS FOR JPM ANALYSIS

The SLOSH model will be used to support the statistical analysis being performed for the JPM. In order to reduce the number of production runs needed in the JPM analysis, it is necessary to investigate the important storm parameters, combination of parameters and storm tracks that influence the return periods. Existing and the most recently available (SLOSH) models will be used to make up a large series of approximately 4,000 individual storm runs to determine the resulting effects on surge elevations. SLOSH is being used due to its ease of setup and ability to run each storm very quickly. The tracks will be laid out uniformly across the study area for the SLOSH runs. Model results will provide the initial JPM combination of storm parameters to run as well as the tracks for further analysis. Once the production set of synthetic storms is reduced to approximately 600 storms or less, SLOSH will be run again with these storms to compare back to the original set to assure the correct set of production storms has been selected for determining the surge elevation return periods.

Historical storms will be used to determine key statistical hurricane parameters that will be used to develop a suite of synthetic hurricane tracks whose spacing will be a function of the storm size (e.g. radius to maximum winds). Using the probabilistic model developed above 1,000 to 2,000 combinations of storm parameters at landfall (and their associated rates) will be generated to properly represent the flooding from all possible combination of parameters. These storms will be used in a large series of SLOSH model runs to develop the Reference-JPM storm surge analysis. The Quadrature JPM-OS method will be used to develop a more compact JPM-OS representation of the storm population, which will consist of up to 600 combinations of storm parameters. SLOSH runs will be performed for these storms and compare the resulting values to those obtained with the Reference-JPM set. The number of storms will be adjusted or other elements of the formulation adjusted until the right combination of accuracy and efficiency is achieved. Based on the parameter combinations obtained in the previous step, a set of synthetic storms will be developed. In addition to the parameters at landfall, these synthetic storms will incorporate representative track geometries and temporal variations in key parameters.

The effective FISs shall also be reviewed in order to identify the most destructive storms that had been part of the historic record at the time of those studies. These data will be updated to include all storms up to the most recent. To update the FIS, the study team will review the NOAA/NWS (National Weather Service) and North Atlantic hurricane database (HURDAT) that lists all the tropical events that have impacted the study area. The most significant historical storms that are characteristic of 10%, 2%, 1% and .2% annual chance will also be used to compare and test for reasonableness

This effort will include, but not be limited to, the following tasks:

- Using the SLOSH model to validate the storm parameter selection.
- Develop probability distributions for all relevant storm parameters that will be applied in the ADCIRC model.
- Apply appropriate statistical modeling approaches and compare this to long-term tide records where available.

2.30 WIND/PRESSURE MODELING

Wind and pressure fields shall be developed for each synthetic track. Sensitivity studies of the key storm parameters shall be performed before the final generation of the synthetic wind and pressure fields in order to ensure that the data are suitable for a FEMA study. Wind and pressure fields will also be developed for the historic storms chosen to hindcast and validate the ADCIRC model. These synthetic storms will be used during production run to drive the SWAN 2D and ADCIRC models. The effort will use the previously developed detailed ADCIRC grid scheme, and the NWS HURDAT hurricane database wind field data modeled by OWI. Up to 600 simulations will be run and results statistically analyzed using an appropriate JPM (e.g. Optimum Sampling) in order to obtain mean water level return periods.

2.40 SWAN MODELING

The calibrated and verified wave setup model SWAN version 40.51 will be designed to provide wave forces for approximately 600 historical hurricanes (production runs) in

addition to calculating the wave fields in the open ocean as well as open water (bay area behind the barrier islands). Wind fields produced by OWI, and previously utilized for FEMA studies, will be used. The model, model data, and results will be archived in a format specified by the project study team and the necessary wave forces will be stored for passage to the ADCIRC model. A final report will be prepared to document the SWAN model results. All model results and reporting will be submitted to NFWFMD and FEMA as required.

2.50 ADCIRC MODELING

This effort assumes the use of a cluster high-speed parallel processor computer system and the ADCIRC 2DDI version 46.58 (it is possible that a more recent version will be used; however, it will be subject to NFWFMD approval, provided the new version is consistent with FEMA modeling guidelines). Wind fields produced by OWI, and previously utilized for FEMA studies, will be used and ADCIRC will be manually coupled with the SWAN model results. The open coast shoreline reach as well as back areas for the eight counties would be modeled all at once. This will require a significant total number of production runs. This will be resolved in more detail through the joint probability methodology task, but it is dictated by the storm meteorology for the region, optimum sampling techniques for statistical sensitivity, and nature of the probability results (storm direction, central pressure, Holland-B parameter, and radius of maximum winds) all of which can directly affect the number of storm paths needed for the synthetic storm population. However, it is assumed that a total synthetic storm population of approximately 600 runs or less will be needed for the production run phase(s) to cover the coastline of the eight-county area. The number of synthetic storms may be adjusted once the analysis of the storm parameters for the study area is made. The production runs will be performed as follows:

As outlined in Task 2.40 above the 2D SWAN wave model shall be run on grids covering the Florida panhandle and Alabama regions with water levels input from an existing low resolution mesh (or higher resolution mesh developed above) ADCIRC model for the set of storms selected for final production runs. The wave radiation stress

gradients obtained through the SWAN model are then passed as input to the high resolution ADCIRC simulations to obtain a set of mean water Elevations (that include wave setup). As necessary, a separate independent team of experts will evaluate these results following specific QA/QC standards. Before releasing data to the next phase, these results may also, if requested, be provided to FEMA for review.

Thus, the ADCIRC model will be run for the number of synthetic storms as determined above in order to provide SWELs that are inclusive of wave setup. As necessary, a separate independent team of experts will evaluate these results following specific QA/QC standards. Before releasing data to the next phase, these results will also be provided to FEMA and/or the National Service Provider (NSP) for review. For each synthetic storm, graphics will be generated which will be decided upon by the project study team and approved prior to conducting the production phase. The specific data review requirements will be determined prior to model production runs but will include review of wind and pressure fields, SWEL, and SWEL + waves as required for the study. Model data will be provided in a usable and acceptable format to the NFWFMD and FEMA which will be utilized for statistical analysis and final report preparation. If necessary, the project team shall also produce a lower resolution station grid layout where the results of the storm surge modeling may be extracted to perform the frequency analysis. All necessary model and run data will be copied onto a long-term storage device to be provided to FEMA in acceptable format as part of an Interim Data Submittal and at the end of the project. The results will also be archived with appropriate documentation as required by FEMA and NFWFMD. Tentative data formats are standard mesh files for the ADCIRC and SWAN grids, and the digital input created by OWI files for the wind fields. Simulated outputs will be provided in the raw fort.* file formats as generated by the ADCIRC model.

2.60 RETURN PERIOD ANALYSIS

The peak storm surge elevation generated by each storm at each station (or model node) will be analyzed using the appropriate JPM to determine return periods (i.e. 1, 10, 50, 100-year) for the 10%, 2%, 1%, and 0.2% annual chance mean water elevations.

The standard deviations of the “error terms” associated with omitted storm parameters, limitations in the storm parameterization, lack of skill of the hydrodynamic model, tidal effects, etc. will be quantified. The tides will be integrated into the uncertainly term used in the frequency analysis. The frequency analysis will be performed twice: on the set of results accounting for surge plus wave setup and on the set of results accounting for surge only. Results from the 2D wave model will also be extracted at the starting location of each transect to obtain the 1% starting wave conditions for the overland wave height analyses. The summary of mean water results from the production runs as well as the results of the frequency analysis will be submitted as requested by FEMA for review.

This Phase will require but not be limited to the following tasks:

- Using results from ADCIRC and the appropriate statistical approach, determine the magnitude and extent of the coastal mean water elevation revisions necessary for the entire coastal shoreline.
- On the order of several hundred thousand output points will be distributed over the model mesh to support the joint probability method analysis. Calculated maximum water levels, surge only and surge plus wave setup, at this large number of locations on the grid will be stored for development of stage-frequency relationships.
- Calculate the 10%, 2%, 1% and 0.2% annual chance mean water elevations at numerous locations along the coast, bays, and inland areas for surge only and surge plus wave setup datasets. The density and number of points will be sufficient to permit accurate delineation of the flood elevations. The points utilized will be the highest density possible. A practical limit of spacing between points will be considered. Stage frequency points will be dense where the elevations are changing rapidly and can be farther apart where the surge is gradually varying.

OVERLAND WAVE HEIGHT ANALYSIS AND MAPPING

3.0 WHAFIS, REDELINEATION, AND DFIRM PRODUCTION

The project team will conduct updated detailed coastal flood analyses for each of the counties, including new storm-induced erosion assessments, updates to primary frontal dune determinations (as needed), 1-dimensional overland wave height modeling, and wave runup modeling (as needed), as well as mapping of the coastal flood hazard zones and base flood elevations. The following milestones will be accomplished in this process:

3.01 LAYOUT OF TRANSECT LOCATIONS

This task includes layout of published and mapping coastal analysis transect locations in each of the six Florida coastal counties. The transect layout for coastal hazards analysis and subsequent floodplain delineation is determined by physical factors such as changes in topography, bathymetry, shoreline orientation and land cover data, in addition to societal factors such as variations in development and density. The base map will be used to determine the appropriate placement for hazard modeling transects within each of the Florida counties.

First, the layout of the published transects will be made. These are the transects that will be the primary focus of the detailed modeling and will represent the major changing conditions along the coastline, such as topographic changes or land use changes. The published transect layout will be used in the field reconnaissance to verify placements and direct the coastal modeling team to focused areas. It is estimated that as many as 300 of these transects may be needed to adequately cover the coastal area being studied in northwest Florida. These initial transect layouts will also consider the comments collected at the scoping meetings to ensure adequate coverage of sensitive floodplain management areas. Knowledge gained from the storm surge field reconnaissance will also be used in determining suitable published transect locations.

Subsequent to field reconnaissance, the transect layout is finalized and the transect layout is submitted for FEMA review. A draft transect layout is also submitted in the

Scoping Report of which this TSOW is a part. Once review comments are implemented, the “mapping transects” or unpublished transects will be generated at a higher density in between published transect locations. These transects support detailed hazard mapping by eliminating large areas of undefined hazard changes that typically involve interpolation of results. After the mapping transects are complete, elevation data are extracted from the topographic base and populated into the modeling.

Deliverables:

- A. Published transect location map(s) covering the six Florida counties;
- B. Published and mapping transect location GIS layers;

3.10 FIELD SURVEY AND RECONNAISSANCE

This task involves basic field data collection. The project team will conduct detailed field reconnaissance of the coastal areas for each of the counties to determine conditions along the floodplain(s) such as, types and numbers of hydraulic and/or flood control structures, apparent maintenance or condition of existing hydraulic structures, locations of transects to be evaluated for wave modeling (including fetch areas and obstruction areas, such as marsh, building, and vegetation information), and other parameters needed for the coastal storm surge and wave study. Interviews will be conducted with various federal, state and local officials regarding available storm and field measured data and records of past flooding events. Detailed LiDAR data sets, digital aerial photography, and available on the ground drive by video will also be reviewed as part of this reconnaissance task. All data collected and assembled for development of the overland wave modeling task will be digitally cataloged and recorded in an appropriate electronic file transfer format for later use as necessary and to document the study area current conditions.

3.20 WHAFIS ANALYSES AND FLOODPLAIN MAPPING

The project team will follow Appendix D of FEMA’s “*Guidance for Coastal Flooding Analyses and Mapping*” (2003) and the draft *Atlantic Ocean and Gulf of Mexico Coastal*

Guidelines Update, February 2007, when performing the coastal analyses. Coastal modeling preprocessing tools, using a GIS environment, will be used to automate some of the modeling inputs such as identifying the transect layout, processing mean water elevations, performing dune erosions, and running WHAFIS 4.0 and RUNUP 2.0 models. Preliminary layout of coastal transects and areas requiring detailed overland wave analysis will be delineated early during the formal FEMA scoping process. Prior to proceeding with WHAFIS, the project team will also consider implementation of a 2D overland wave modeling approach if available and acceptable by FEMA. As currently planned, the coastal flood hazard analyses will be 1D and require an evaluation of erosion, computation of overland wave heights, and computation of wave runup described as follows:

3.30 EROSION AND PFD DETERMINATION

In accordance with National Flood Insurance Program (NFIP) regulations, an assessment of storm-induced beach and dune erosion will be performed using the 540 sq ft rule, as computed using FEMA's Coastal Hazard Analysis Modeling Program (CHAMP) or other FEMA acceptable software. As needed and required, the landward limit of the existing primary frontal dune (PFD) will be evaluated and updated, using the LiDAR data, in order to determine the inland extension of the VE Zones at the landward toe of the dunes. If still valid as identified and delineated, the primary frontal dune will remain in its current position for VE Zone mapping purposes.

3.40 OVERLAND WAVE HEIGHT ANALYSES

The WHAFIS model will be applied for each transect using the physical attributes (vegetation, profile, obstructions, etc.) identified during the field reconnaissance as input to the model. The 1% annual chance wave height and period will be extracted from the SWAN modeling results conducted for the surge modeling and applied at the offshore end of each transect as the initial conditions. The WHAFIS model will simulate the propagation of the offshore wave onto and over the transect fetch, adjusting the wave

height and period according to the wave energy equations, yielding a wave height profile along the transect. The simulated wave height will account for the characteristics along the transect.

3.50 WAVE RUNUP 2%

The final draft *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update, February 2007* establishes the need for higher wave runup elevations. The concept of the 2% wave runup (versus the mean wave runup previously calculated for FEMA studies) is introduced as the highest 2% of wave runups impacting the shoreline during the 100-year event. If high dunes or bluffs exist, their steeper profiles may cause wave runup to be greater than the calculated wave crest. RUNUP 2.0, TAW method and the SPM method will be used to calculate runup for each study area, as appropriate.

3.60 HAZARD MAPPING

The flood hazard zones and Base Flood Elevations (BFEs) will be mapped and interpolated between each transect based upon detailed topographic information and cultural features (vegetation and floodplain development). Work maps showing the delineated flood zones will be submitted to FEMA for their review.

To accomplish these evaluations this effort will require, but not be limited to, the following tasks:

- Review previous wave studies, and identify existing coastal flood hazard data and specific problem areas to be resolved by the new detailed study of storm surge, wave, and erosion hazards.
- Field reconnaissance and transect site inspections data will be used for respective representative coastal reaches of the shoreline being studied by detailed methods to ensure that the modeling matches the site characteristics.
- Detailed assessments of the deepwater storm wave characteristics and wave transformation to the shorelines will need to be addressed, provided that the appropriate methods and models are available.

- Use the SWAN and ADCIRC results for wave radiation stress calculation for the wave setup depth to be added to the 100-year mean water elevations for each specific coastal reach.
- Use and apply the FEMA CHAMP for all detailed coastal assessments and modeling analyses for storm-induced erosion profile adjustments, wave height analyses using WHAFIS 4.0, 2% wave runup using RUNUP 2.0 (mean values converted to 2% runup), and primary frontal dune VE Zone mapping around the entire reach of open coast and inland bay shoreline locations. There may also be non-standard storm-induced erosion assessments required due to the unique inland bay shoreline and beach formations in some areas, which may require an additional level of effort that would need to be agreed upon before application.
- Identify distinct special flood hazard boundaries for hazard areas and respective BFEs or depth of flooding for each zone by using the agreed upon base map, topographic data source, and results of the coastal hazard assessments for each transect,
- Interpolation of flood hazard zone and BFE mapping between each transect based upon detailed topographic information, cultural features (vegetation and floodplain development), and effects of coastal flood protection structures using a method that meets the specific criteria from the draft *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update, February 2007*.
- Determine the location and delineate the Limit of Moderate Wave Action (LiMWA). The LiMWA is an advisory delineation required by FEMA Procedure Memorandum 50. It is the location along each modeled transect where a 1.5 ft wave height occurs. The location of the LiMWA will be determined from the WHAFIS modeling results.
- Determination of final BFE's for areas affected by both riverine and coastal flooding based on methods described in the draft *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update, February 2007 and Procedure Memoranda*.

3.70 PRELIMINARY DFIRM PRODUCTION (TASK C.3 AND C.3.1)

Utilizing the base map, topographic data, floodplain delineations, and results of the coastal wave analysis for each transect, the special flood hazard boundaries for the 100-year storm will be incorporated on DFIRM panels over a six (6) county coastal area (Escambia, Santa Rosa, Okaloosa, Walton, Bay and Gulf Counties). Initial estimates indicate there are 380 panels in Florida covering the coastal area in need of study. There are some potential cost saving measures that will be addressed during the scoping phase such as reduction of the number of map panels. Specifically, there are coastal barriers which are in conservation and not inhabited; in these areas the map scale could be reduced. The developed paneling scheme may also be more efficient because the flood maps will be developed and accessible through a GIS environment. Map production may also be staged over time to better accommodate the budget allocated for panel production.

3.80 POST PRELIMINARY DFIRM PRODUCTION

This effort assumes a preliminary map and report production for an estimated total of 380 coastal map panels, with Digital Orthophoto Quarter-Quadrangle (DOQQ) base maps and county-wide mapping schemes. Support includes submittal to FEMA and local governments for review through final adoption. Also, minimum post-prelim support has been provided by FEMA to NFWFMD for appeal resolution.

4.0 OUTREACH

An outreach plan has been developed and is being implemented. The plan is available at:

[http:// www.nfwmdfloodmaps.com/pdf/NFWFMD Business Plan Revision.pdf](http://www.nfwmdfloodmaps.com/pdf/NFWFMD_Business_Plan_Revision.pdf)

A key element of detailed coastal restudy outreach will be to take full advantage of the relationships the NFWFMD has with local communities and the fostering of those relationships through the most recent role the NFWFMD has had as the CTP for the FEMA Map Modernization program. Continuation of the outreach program developed through Map Modernization will allow for a familiar face approach to be taken and allow

for outreach to be tailored according to the voice and specific needs of the coastal communities involved in this study.

Outreach was discussed during the initial scoping meeting to determine community interests as well as identification of existing data, including publicly available bathymetry and topographic data, aerial photography, previous coastal studies, high water marks and historic flooding information, and other readily available documentation. The efforts of local governments who want to directly participate in this activity will be used as leverage toward the outreach effort. Further discussions with each community to identify their level of participation and how they want to reach their public and stakeholders will continue throughout the coastal study. The two basic approaches that are desirable and supported thus far include outreach meetings and web based support.

4.10 OUTREACH MEETINGS

Where possible, the NFWFMD will leverage or enlist the support of local governments who wish to participate and be heavily involved in outreach activities. Local government offices within the coastal area will be leveraged as the meeting places for these meetings. The project team will discuss the interests in local communities to develop the meeting format and help decide how to best reach the public. Each community will be encouraged to develop their own outreach activities in addition to those afforded by the NFWFMD. Meeting materials, such as an agenda, maps, study area limit maps, and any other supporting materials or handouts, will be produced by the project team. Scheduling of meetings will include invitations to FEMA Regional staff, project team members, community representatives, and other stakeholders to discuss the proposed Scope of Work, available data, data requirements and general coordination requirements for the project. New specific points of contact, along with those already established, will be used to expedite communications during the project. Discussions on expectations of each agency and FEMA will be documented.

The project team will be available for all scheduled meetings and prepare meeting minutes after each meeting.

4.20 WEB BASED OUTREACH ACTIVITIES

During the study, the District will periodically update its web site NFWMDfoodmaps.com to keep the general public informed on the overall coastal study progress. The internet is the single most effective outreach tool in northwest Florida for reaching and exposing the general public to flood hazard studies. The NFWMD and its contractor have recommended a number of ways to enhance FEMA's and NFWMD's internet outreach capabilities which include the design of a mapping portal anyone may use and online video education for viewing by the general public. Current activities that are ongoing for the development of these capabilities include organization and collection of data for the mapping portal, website layout and design.

At the completion of preliminary DFIRMs, the NFWMD will advertize that they are available to the general public in an electronic format for the general public to review. The project team will also conduct or facilitate Preliminary DFIRM Community Coordination (PDCC) meetings. These will be tailored to provide detailed guidance to each of the communities regarding public review process, timeframes, commenting, and appeal of DFIRM deliverables. The District will also work with the communities beforehand and during the PDCC meetings to determine what they would like to see as an effort to reach the public on a community by community basis. The NFWMD has also obtained additional RISK map funding from FEMA in order to fully support web based coastal outreach (see <http://www.nfwmdfloodmaps.com/pdf/FloodInfoWebAppSOW.pdf>) capabilities to insure the general public is reached and to maximize the exposure or public access to the results of this study. A web based outreach program was identified during scoping meetings as the single most effective way to reach the general public from the outset of the study through final map adoption and beyond.

5.0 QUALITY ASSURANCE / QUALITY CONTROL AND TECHNICAL REPORTING

5.10 PROJECT QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

The primary standards for quality assurance and quality control (QA/QC) which apply to this TSOW are described in the NFWFMD quality control plan which is developed and updated by the NFWFMD contractors. The QA/QC standards to be utilized are approved by the NFWFMD and are also outlined in the MASs under the CTP agreement the NFWFMD has with FEMA. In general, the FEMA *Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix D: Guidance for Coastal Flooding Analyses and Mapping, April 2003* as well as the *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update, February 2007*, will be used. However, through recent Gulf of Mexico studies completed post hurricane Katrina as well as ongoing new coastal studies, it is reasonable to assume that the FEMA guidelines will again be updated in the near future. Any new updates will be addressed by this SOW when they occur through agreement between NFWFMD and FEMA. Where QA/QC procedures may otherwise deviate from the published FEMA documents, internal QA/QC procedures will be adopted and documented before project work is submitted for final review and approval. FEMA will be given the opportunity and has the ultimate responsibility to identify and approve new QA/QC standards when they do deviate from the existing ones. The quality assurance plan for coastal studies by NFWFMD may be found online at NFWFMDfloodmaps.com.

The primary QA/QC process will be to establish independent QA/QC teams within the project team and to have the work reviewed according to current accepted engineering practice. The independent review team will be selected from URS staff. URS has a QA/QC oversight and project management role in the project but are not directly involved in the initial study efforts and therefore are independent. In the case that URS is directly involved in a technical analysis then the QA/QC roles are reversed. The UCF contractor also functions as a study contractor and URS or Dewberry may function to perform independent reviews of their work. The NFWFMD also has access to other Coastal Engineers for specific independent reviews which include Watershed Concepts

(AECOM) and Taylor Engineering as well as major Universities within and outside of Florida.

Dr. Chris Reed of URS will be the primary person implementing the QA/QC procedures. He will, as directed by the NFWFMD as necessary and when appropriate enlist others with URS and with FEMA Coastal Map Modernization experience. When necessary, the NFWFMD and OWR, in coordination with FEMA reviews, will prescribe QA/QC reviewers or review panels with an appropriate technical background to perform QA/QC work. The following is a list of the activities for which NFWFMD will require QA/QC to be independently performed:

- Terrain and Bathymetric Data Processing
- Develop/Refine ADCIRC Mesh
- 2-Dimensional Wave Modeling
- Tidal Calibration
- Storm Selection
- Storms Hindcasts and Validation
- Wind and Pressure Field Determination
- SLOSH analysis used to support JPM analysis
- Production Runs
- Statistical Analysis including JPM analysis
- Erosion and PFD Determination
- Overland Wave Height Analysis
- Wave Runup 2%
- Floodplain Mapping
- DFIRM database and products

In addition to following FEMA QA/QC guidelines each individual QA/QC task will be documented in a scope of work issued in a task order by the NFWFMD. The individual scope of work for each QA/QC task will be inserted into the SOW as well. The final deliverable for each QA/QC task will be a final QA/QC report.

5.20 TECHNICAL SUPPORT DATA NOTEBOOK (TSDN)

The documentation produced from this flood hazard mapping project will be appropriately organized into the TSDN. The project team will maintain this TSDN throughout the life of the project and compile a comprehensive set of deliverables for each of the tasks performed. The storm surge analysis included in the TSDN will be

developed in an electronic coastal documentation notebook for the entire storm surge study. This will include the digital data of terrain and bathymetry data, final refined meshes, selected storms and storm parameters selections, wind and pressure fields, tidal calibration results, ADCIRC model and 2-D wave model results, frequency analysis, final mean water elevations, and associated digital products. For the overland wave modeling and mapping, the digital data will include the WHAFIS and RUNUP input and output files, a CHAMP database with modeling input parameters and erosion calculations, and digital GIS linework of the hazard mapping with workmaps. The TSDN will also include all documentation of the QA/QC process. All final documentation developed will also be uploaded to FEMA's Mapping Information Platform (MIP).

There will be a total of five (5) submittals to FEMA following the guidelines as follows:

Intermediate Submission No. 1 – Scoping and Data Review

Intermediate Submission No. 2 – Storm Surge Model Calibration and Storm Selection

Intermediate Submission No. 3 – Storm Surge Runs and Flood Frequency Analysis

Intermediate Submission No. 4 – Nearshore Hydraulics

Intermediate Submission No. 5 – Draft Flood Hazard Mapping

The TSDN developed with funding for this project will be made available to Alabama agencies so that they can include it within their TSDN for related projects involving their coastal counties.

6.0 PROJECT MANAGEMENT, ADMINISTRATION, AND SCOPING

The project management task includes a scoping task which has been used to refine this scope of work and the project schedule. NFWFMD has completed most of the scoping task related to mapping the Florida Panhandle as well as the scoping task for modeling the entire coastal study area. OWR is responsible for development of the initial scoping task for the mapping part of the Alabama coast. NFWFMD has assembled a team of qualified contractors for ADCIRC and SWAN model development and model production runs required through the model development and production

tasks and will be the lead for these project management tasks. Subsequent to the initial modeling work NFWFMD and OWR will be the lead project managers for completion of outreach tasks for the respective counties in each state's jurisdiction.

The specific project management activities by NFWFMD described in this task relate to all the project management, project coordination, and related activities necessary to carry out all the activities described in this TSOW. NFWFMD will contract some of the project management tasks to Dewberry who has been selected as the lead contractor from the URS/Dewberry team to perform coastal project management work as needed. Related project management tasks are described below:

6.10 PROJECT BUDGETING, PURCHASING, INVOICING, AND MANAGEMENT OF CONTRACTORS

This task is the primary responsibility of the NFWFMD and is based on the total funding available through FEMA grants as well as the NFWFMD. Total funding for the Coastal Restudy project will be dependent on completion of successful negotiations with NFWFMD continuing service contractors and university contractors for the tasks they would be requested to undertake. Each contractor, when requested, will be expected to complete detailed scoping documents along with a corresponding cost estimate and schedule subject to NFWFMD review and approval. When the details of the proposed scopes would substantively change this TSOW they will be submitted to FEMA for review and the TSOW would subsequently be modified.

It is estimated that the initial two phases (I, II) of funding required for ADCIRC modeling and SWAN wave setup modeling over the entire study area including Alabama to be completed by NFWFMD contractors would require \$2,673,000 in funding. This includes initial data collection through model production runs as well as initial scoping, outreach and project management tasks. Note that there are no contingencies currently built into this estimate. The mapping and DFIRM production tasks and outreach and project management funding needed for the Florida portion is estimated at \$2,147,000. As currently envisioned, the priority order for funding will be to complete the western-

most panels of the study area first, although there are currently sufficient funds available to complete all of the coastal County map panels in NW Florida at about the same time.

6.20 COORDINATION, MEETING ATTENDANCE AND PREPARATION

NWFWMD with assistance from Dewberry will coordinate project activities on a regular basis. Conference calls may occur as often as on a weekly basis to discuss the status of the project and updates to NWFWMD. At a minimum five (5) project coordination meetings will be held.

6.30 PROJECT SCHEDULING AND UPDATES OF SCHEDULE

NWFWMD with assistance from Dewberry will develop scheduling tools. These tools will be utilized to initially plan the project schedule and then dynamically evaluate the work flow of the project as it occurs. NWFWMD recognizes that the project schedule is contingent on the results of the study as they occur and therefore there may be opportunities to finish some activities sooner than originally planned or unanticipated delays may occur. Periodic updates of schedule and adjustments will be made based on feedback from the project study team members. Periodic calls as needed among study team members will be made to discuss project progress and other task coordination issues. Project meetings will also be scheduled by the NWFWMD when needed and to make them as productive as possible. Overall project milestones and updates will be reported to NWFWMD in a table format which, following review by NWFWMD, will be reported to FEMA on a monthly basis and used to update the MIP as necessary.

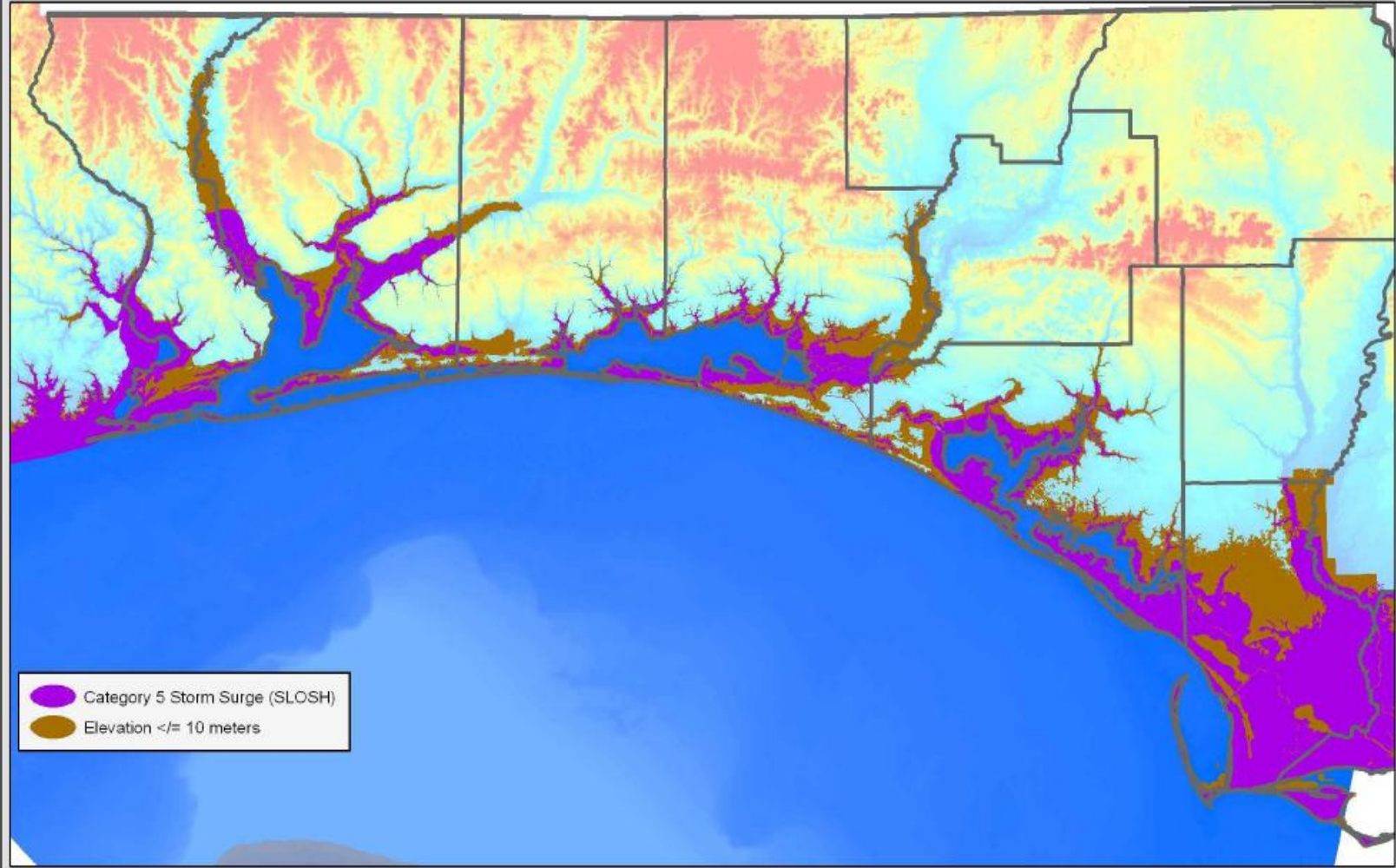
The project schedule for this study as determined through negotiated contracts with consultants and universities indicates an estimated 36-month study duration. However, the duration of this study may need to be extended with 2-3 months of float because of uncertainties mentioned previously. It should be noted that several issues may also arise during the review of each phase that, depending upon the level of effort required to address reviews, can dramatically alter final schedules. These can include technical appeals which are not accounted for in this estimate.

6.40 DATA MANAGEMENT AND WEB BASED SHARE POINT

NWFWMD and its contractors have developed and will continue to manage internal FTP and related web based sites necessary for exchange of draft and working data and documents among the project team. The web sites will be used and maintained throughout the study until complete. Formally reviewed approved final data and documentation will be uploaded to FEMA's MIP.

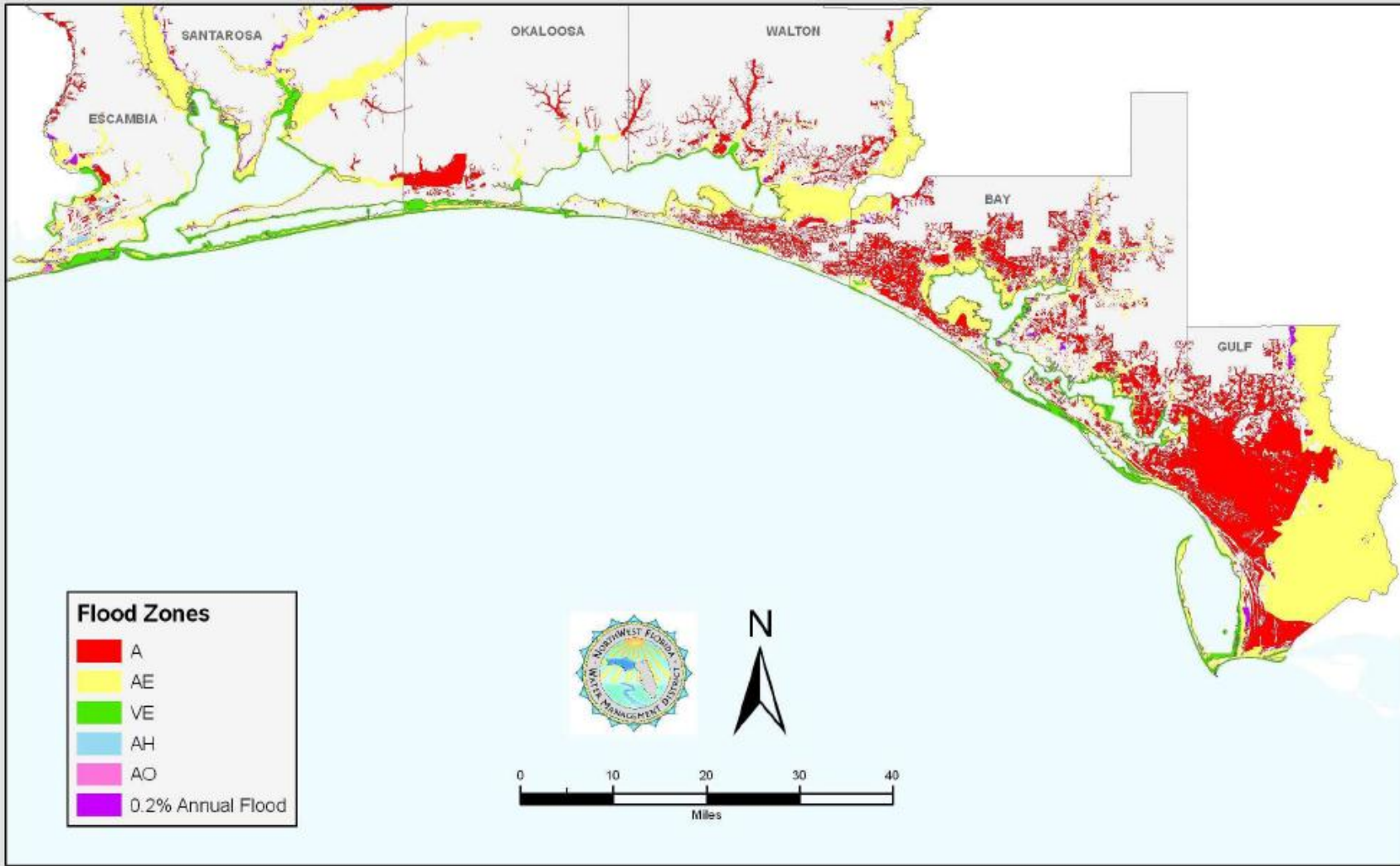
Attachment B

Category 5 Storm Surge (SLOSH) and Region Below 10 Meters



Attachment B (continued)

DFIRM Flood Data for the Coastal Restudy Areas



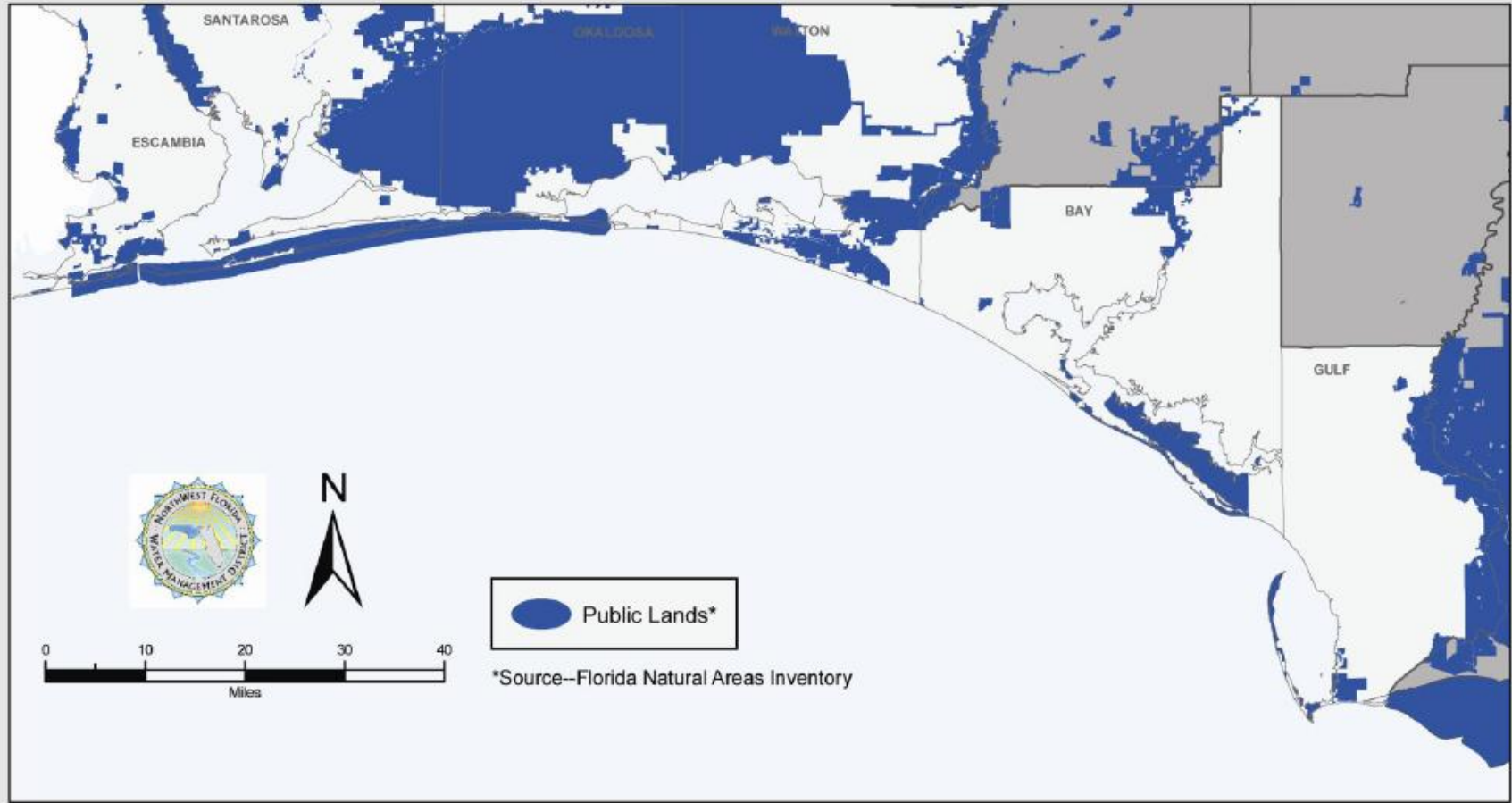
Attachment C

2004 Land Use for the Coastal Restudy



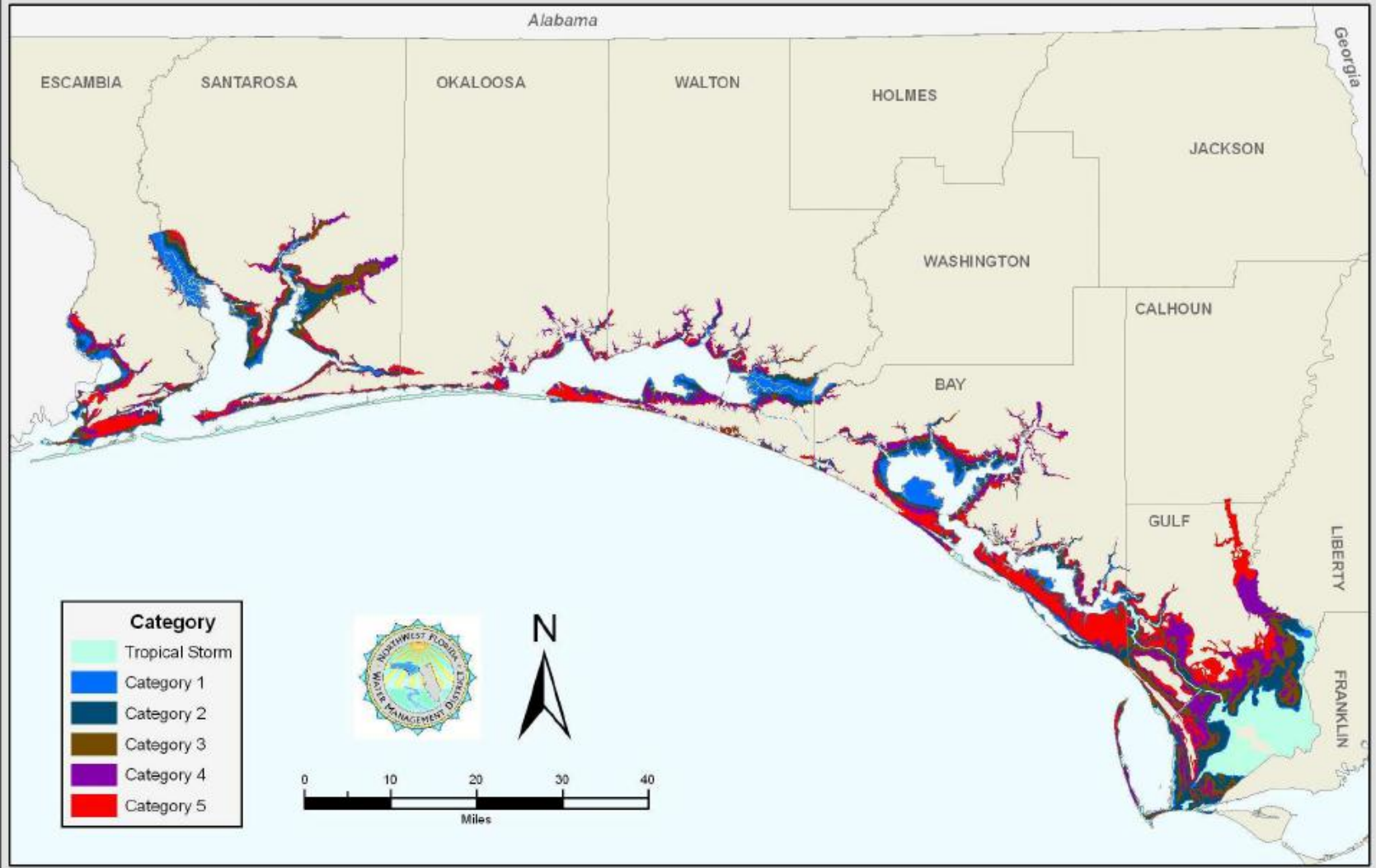
Attachment D

Public Lands and Those in Conservation Use for the Coastal Restudy



Attachment E

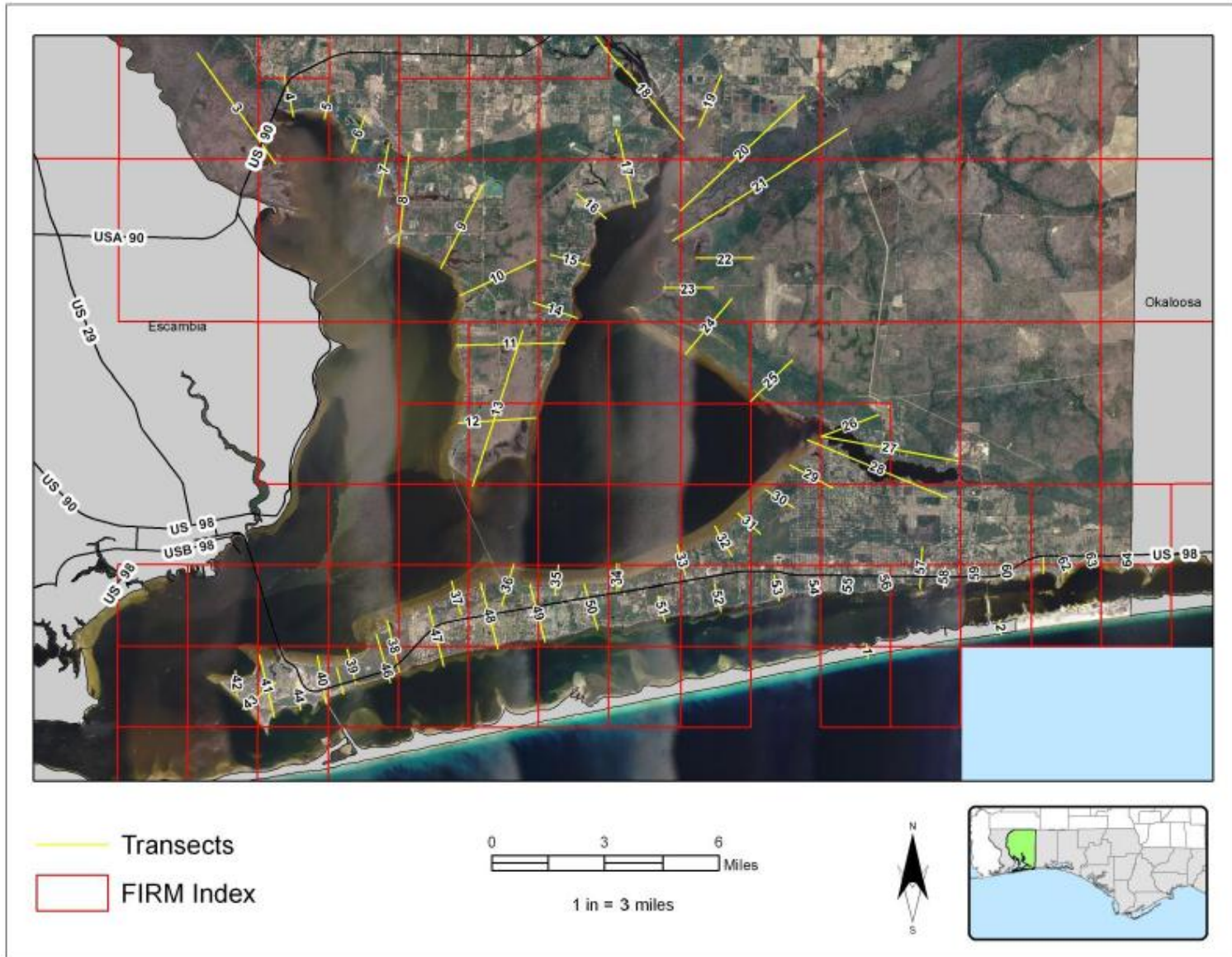
Storm Surge (SLOSH) for the Coastal Restudy Counties



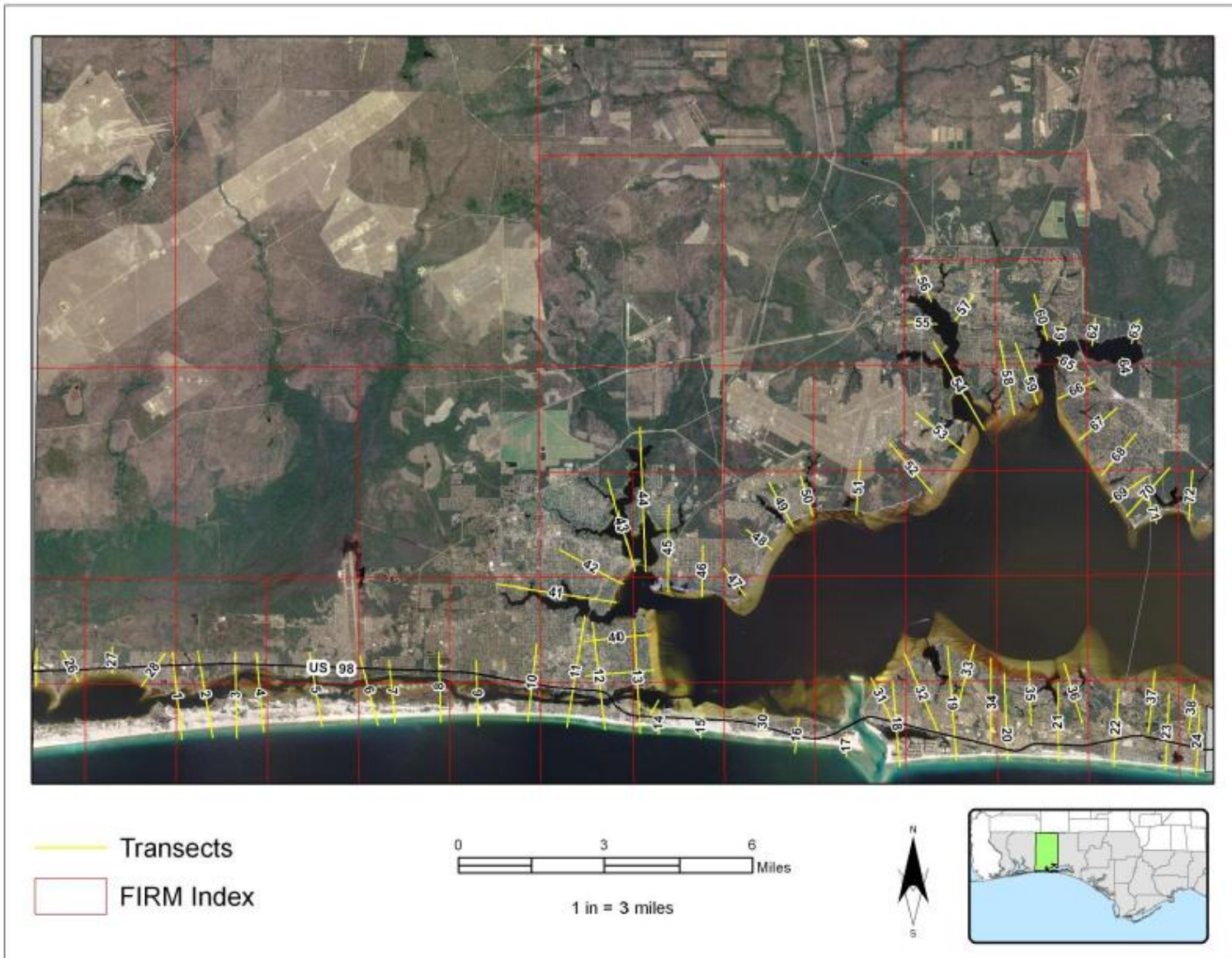
Attachment F – Coastal Study Area Draft Paneling Scheme & Transects Layout – Escambia County



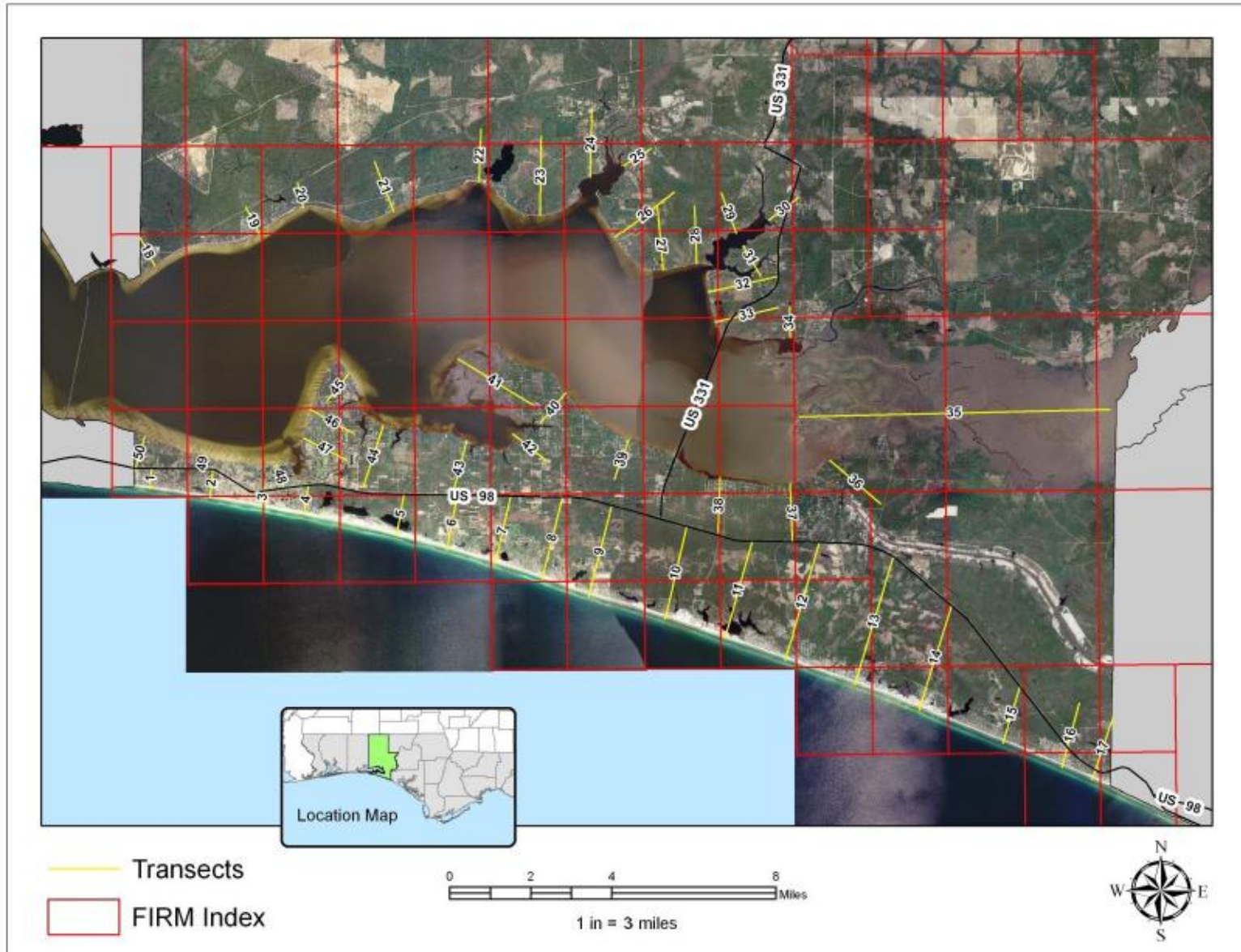
Attachment F – Coastal Study Area Draft Paneling Scheme & Transects Layout – Santa Rosa County



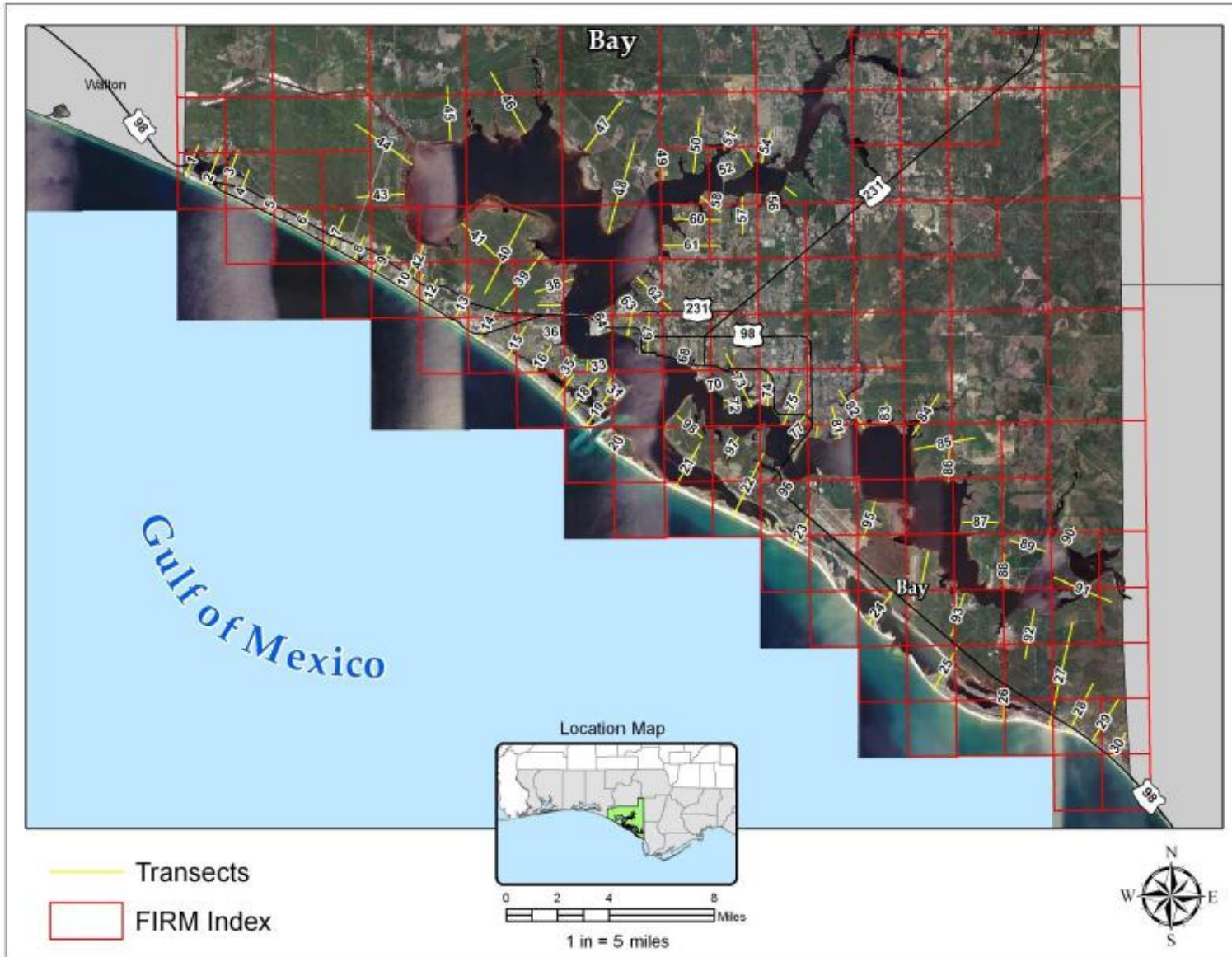
Attachment F – Coastal Study Area Draft Paneling Scheme & Transects Layout – Okaloosa County



Attachment F – Coastal Study Area Draft Paneling Scheme & Transects Layout – Walton County



Attachment F – Coastal Study Area Draft Paneling Scheme & Transects Layout – Bay County



**Attachment F – Coastal Study Area Draft Paneling Scheme & Transects Layout –
Gulf County**

