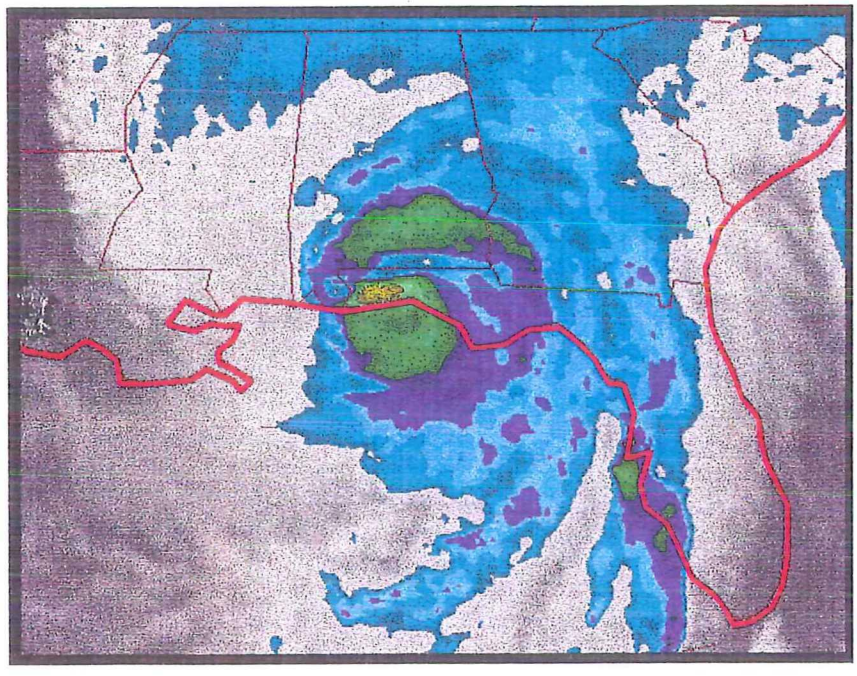
# *HURRICANE OPAL*

***Executive Summary***

*of a Report on*

# STRUCTURAL DAMAGE AND BEACH AND DUNE EROSION ALONG THE PANHANDLE COAST OF FLORIDA



**DECEMBER 1995**

**BUREAU OF BEACHES AND COASTAL SYSTEMS**
**DIVISION OF ENVIRONMENTAL RESOURCE PERMITTING**
**DEPARTMENT OF ENVIRONMENTAL PROTECTION**

## FOREWORD

**This executive summary was prepared by Mark E. Leadon, P.E., Section Administrator of the Research, Analysis, and Policy Section, of the DEP Bureau of Beaches and Coastal Systems (the Bureau), and is considered to be a preliminary report based on data being collected for a larger, more detailed post-Opal report being prepared by the Bureau. A number of staff of the Bureau contributed information including photography, survey data collection, erosion and structural damage analysis, and graphic illustrations which assisted in the preparation of this report.**

**APPROVED BY**

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# I. INTRODUCTION

More structures were damaged or destroyed due to wave and erosion impact by Hurricane Opal than by all other coastal storms which have occurred in Florida since 1975 combined. This report provides a brief summary of coastal damage from Hurricane Opal on the Panhandle coast of Florida including structural damage and beach/dune erosion.

Hurricane Opal was the 15th storm to occur during the 1995 storm season which has been the most active since 1933. On October 4, 1995, at approximately 6:00 p.m. (CDT), Hurricane Opal made landfall at Pensacola Beach along the Florida Panhandle coast. The hurricane was accompanied by sustained winds of 150 miles per hour (mph) which were reduced to 115 mph at the time of landfall. Storm surge, estimated at 12-15 feet above sea level with accompanying destructive breaking waves, ravaged beachfront areas including highly-developed areas such as Pensacola Beach, Navarre Beach, Ft. Walton Beach, Destin, Seagrove Beach, Panama City Beach, and Mexico Beach.

Hurricane Opal was the most destructive hurricane to impact the sandy beach coastal areas of Florida in many years. Damage extended across the entire Panhandle region of Florida from Escambia County through Franklin County, as well as, to lower Gulf Coast counties. The 120 mile stretch of coast from Escambia through Bay counties was particularly hard hit. Severe damage also occurred on St. Joseph Peninsula in Gulf County, as well as, to portions of eastern St. George Island and on Dog Island in Franklin County. Erosion impacts were also felt on beaches in Pinellas, Manatee, and Sarasota counties. Opal's damage resulting from coastal flooding and erosion exceeded that of Hurricane Andrew, Hurricane Eloise, and other severe storms of recent years.

Beaches and dunes are critical to the economic welfare of the Panhandle region. They provide storm protection to upland development and recreational resources for tourists. The U.S. Army Corps of Engineers has estimated that a beach restoration project planned for Bay County prior to Hurricane Opal could have prevented 70% of the damages resulting from Hurricane Opal had it been completed prior to the storm occurrence.

Structural damage resulting from Opal's high storm surge and accompanying waves and erosion was extensive, particularly along the seawardmost line of construction. An extensive number of structures were damaged or destroyed particularly within a zone extending landward over the first two to three hundred feet from the beach. This zone generally corresponds to the area seaward of the State's coastal construction control line (CCCL). The CCCL is intended to define the zone impacted by the wave and water forces associated with a coastal storm occurring once in one hundred years.

Most structural damage occurred to habitable structures which were constructed prior to establishment of the control lines and, therefore, were not subject to the more stringent construction standards needed to survive in a high hazard coastal zone. Habitable structures permitted pursuant to the CCCL standards survived throughout

**the Panhandle counties while many neighboring non-permitted structures were severely damaged or destroyed.**

**Extensive beach and dune erosion occurred throughout the Panhandle. The western Panhandle as well as lower lying areas in the eastern Panhandle experienced significant areas of overwash. Generally, the beach and dune were both lowered and recessed. The lowering of beach and, particularly, dune elevations were responsible for many of the structural damages, however, many habitable structures were damaged by direct wave attack, as a result of first floor elevations which were too low. In overwash areas, extensive quantities of sand were transported landward by the surge destroying roads and flooding other structures.**

**Storm effects along the lower Gulf coast, including Pinellas, Manatee, and Sarasota counties, were less severe and were generally confined to beach erosion. Large portions of these counties were fortunate to have the added protection afforded by beach restoration projects. The restored areas sustained less storm damage than areas in need of restoration which had not been restored.**

**This summary is a preliminary report. A more detailed report will be provided once final survey data is collected. The Bureau, in conjunction with the University of Florida's Coastal and Oceanographic Engineering Department, is also currently developing a post-Opal recovery plan for the Panhandle beaches. The recovery plan will identify critical erosion areas, recommended remedial measures, and estimated costs for the recovery efforts.**

## II. STRUCTURAL DAMAGE SUMMARY

**The table below provides a summary of structural damage which occurred in the Panhandle as a result of Hurricane Opal. Damages include severe damage (ie, greater than 50% of the structure destroyed) as well as total destruction and were primarily caused by wave impacts and erosion. Significant wind damage was also observed. As stated in the introduction, more structures were damaged or destroyed due to wave and erosion impact in this storm than in all other coastal storms which have occurred in Florida over the past 20 years combined.**

**SUMMARY OF DAMAGES TO COASTAL STRUCTURES**
**HURRICANE OPAL, OCTOBER 4, 1995**
**(Structures with 50% of structure destroyed)**

| County | Single Family Dwelling (SFD) | MultiFamily Dwelling(MFD) | | Other Major Non-Habitable Structures | Armoring (feet) |
|---|---|---|---|---|---|
| | | Bldgs. | Units | | |
| Franklin | 9 | 0 | 0 | 1 | 0 |
| Gulf | 19 | 3 | 14 | 4 | 475 |
| Bay | 156 | 172 | 1,042 | 58 | 11,730 |
| Walton | 69 | 20 | 75 | 4 | 1,475 |
| Okaloosa | 36 | 72 | 409 | 54 | 3,450 |
| Santa Rosa | 48 | 32 | 169 | 8 | 115 |
| Escambia | 201 | 15 | 74 | 10 | 190 |
| Total | 538 | 314 | 1,783 | 139 | 17,435 |

**Bay County sustained the most overall damage due to the high density of development and large number of structures which were constructed to inadequate design standards. The Bay County CCCL had not been reestablished prior to Hurricane Opal as it had been for the other Panhandle counties. The positive effects of the CCCL on reducing storm damage through improved construction design and siting were clearly observed following Opal.**

The table below demonstrates the positive influence of the CCCL program as related to Opal.

STRUCTURAL DAMAGE OF
MAJOR HABITABLE STRUCTURES (MHS)
SEAWARD OF CCCL ALONG PANHANDLE

| County | Number of MHS Structures | | Number of MHS Structures Damaged | |
|---|---|---|---|---|
| | Existing | Permitted | Non-Permitted | Permitted |
| Franklin | 377 | 181 | 9 | 0 |
| Gulf | 316 | 80 | 22 | 0 |
| Bay[2] | 600 | 45 | 326 | 1[1] |
| Walton | 443 | 196 | 69 | 1[1] |
| Okaloosa | 134 | 24 | 74 | 0 |
| Escambia / Santa Rosa | 316 | 50 | 268 | 0 |
| Total | 1942 | 576 | 768 | 2 |

Note 1 The two permitted habitable structures which were damaged by Hurricane Opal were permitted under early, less-stringent permit standards. The damage to the single-family dwelling in Bay County, constructed in 1981, occurred to the portion of the structure located landward of the CCCL which was not built to permit standards. A statutory change in 1982 has since required all portions of permitted structures to conform to permit design standards. The damaged single-family dwelling in Walton County was permitted in 1981, seaward of the old coastal construction setback line, prior to the CCCL reestablishment in 1982 with more stringent permit design standards.

Note 2 The numbers of structures for Bay County are based on the current interim location of the CCCL.

The performance of the permitted structures exposed to the same conditions as the non-permitted clearly shows the positive affect of the CCCL in reducing damages from major storms such as Hurricane Opal.

The post-storm photographs on the following pages are representative of the types of damages experienced by structures from Opal.

## POST-HURRICANE OPAL STRUCTURAL DAMAGE

**Escambia County - Pensacola Beach**

**Escambia County - Pensacola Beach**

## POST-HURRICANE OPAL STRUCTURAL DAMAGE

**Walton County - Dune Allen**

**Bay County - Panama City Beach**

## POST-HURRICANE OPAL STRUCTURAL DAMAGE

**Gulf County - St. Joseph Peninsula**

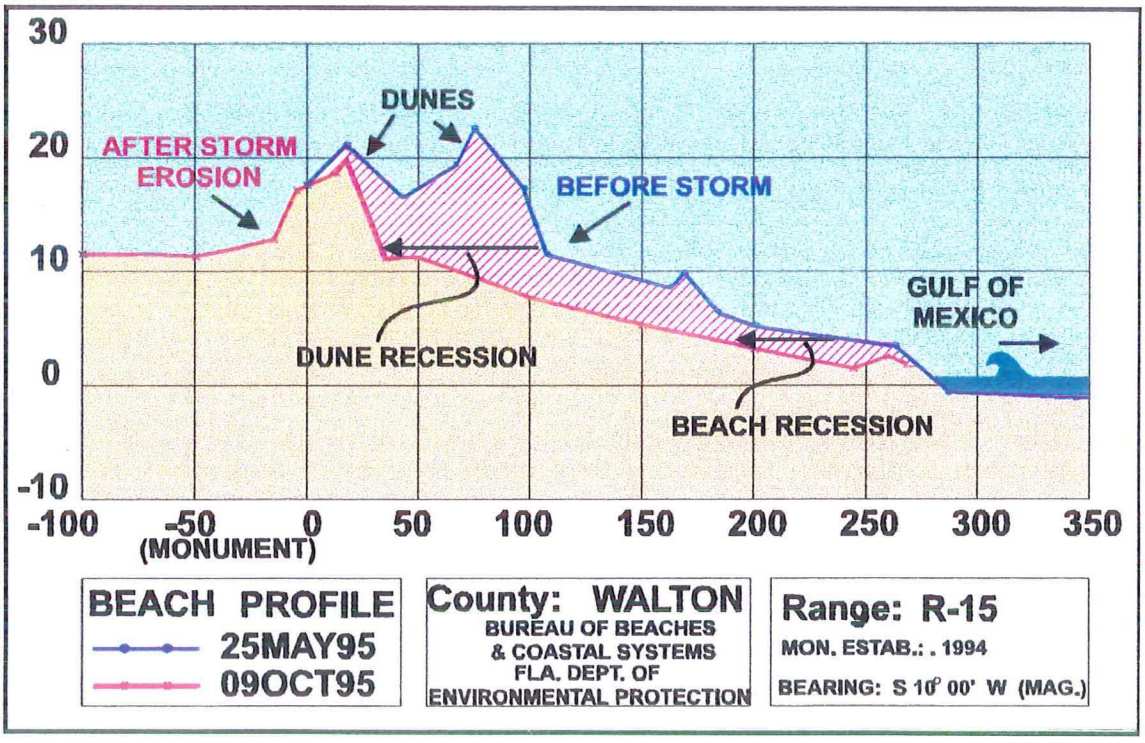
**Franklin County - Dog Island**

## III. BEACH AND DUNE EROSION

Hurricane Opal's substantial storm surge and breaking waves severely eroded the beach and dune system throughout the Panhandle Coast. Beach erosion resulted in a significantly lower beach and a shoreline which retreated landward. Areas of high, continuous dunes experienced substantial recession while in areas with lower dune topography experienced dune overtopping in which sand material was transported inland as overwash (see photos on the next page).

The Bureau of Beaches and Coastal Systems maintains an extensive series of beach and offshore profile survey control monuments located on 1000 foot intervals across each of the coastal counties in the state with sandy shorelines. A post-Opal profile survey of the Panhandle counties was performed by the Bureau. All beach profiles in Bay and Walton counties as well as most profiles in Okaloosa County and a number of stations in Escambia and Santa Rosa counties were surveyed. In all counties, some permanent survey monuments were destroyed by Opal and had to be re-set before post-storm profiles could be surveyed.

Recent profile data had been collected in Bay County in March and April of 1995 and in Walton County in May of 1995 providing good pre-storm data with which to compare the post-Opal profiles. Some post-Hurricane Erin profile data from August 1995 was also available for Okaloosa, Escambia and Santa Rosa counties. An illustration of a typical dune erosion profile from Opal depicting both beach and dune recession is shown below.



To Right: View of critically eroded dune in Walton County following impact of Hurricane Opal.

Below: View of extensive overwash in Okaloosa County just east of Ft. Walton Beach (looking to west); typical of overwash throughout the west Panhandle counties following Hurricane Opal.

A summary of average and maximum beach and dune recession values and volumetric erosion determined from these surveys is listed in the table below.

*BEACH AND DUNE EROSION SUMMARY*

| COUNTY | RECESSION (County Avg.,Max. in ft.) Beach (2ft. Contour) Avg. | Max. | Dune (10ft. Contour) Avg. | Max. | EROSION VOLUME (above MSL) Avg.Per Foot | Total |
|---|---|---|---|---|---|---|
| BAY | - 31 | - 153 | - 38 | - 120 | - 13 cy/ft | - 2.9 mcy |
| WALTON | - 35 | - 76 | - 44 | - 155 | - 27 cy/ft | - 3.6 mcy |
| OKALOOSA | - 40 | - 208 | - 52 | - 170 | - 18 cy/ft | - 1.3 mcy |
| SANTA ROSA | ----- | ----- | not available at this time | | | |
| ESCAMBIA | ----- | ----- | not available at this time | | | |

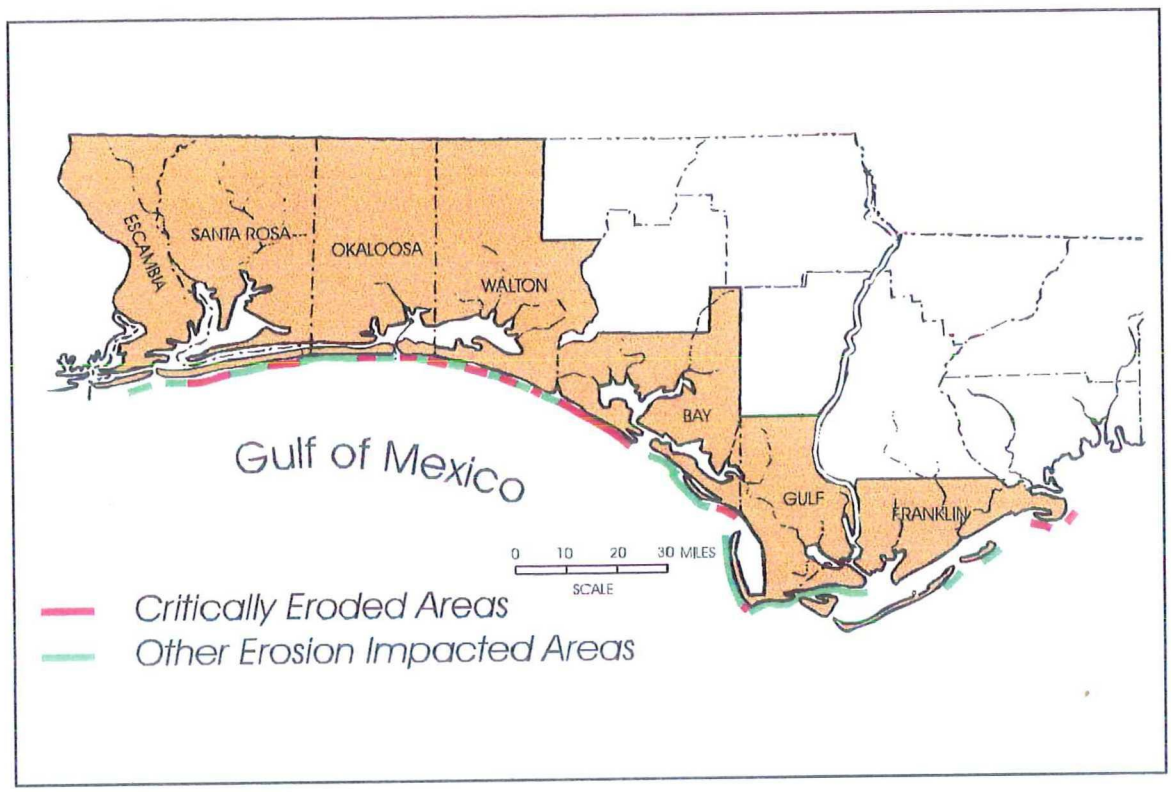
These recession values include county averages and maximum observed values of representative beach and dune contours, respectively. The 2 foot contour (elevation above mean sea level) was chosen to represent beach recession and the 10 foot contour was chosen to represent dune recession. Volumetric erosion is given both as eroded volume (in cubic yards above mean sea level) per foot of beach, measured in an alongshore direction, and estimated total erosion volume (in million cubic yards above mean sea level) for the entire county. A portion of this eroded sand is expected to return to the beach area through natural recovery processes following the storm. Full beach recovery in many areas will require assistance through restoration projects. Some dune areas will require a significant time period, possibly decades or longer, to recover naturally and may not recover to pre-storm levels without enhancement or restoration.

Beach and dune recession and erosion volume values for Santa Rosa and Escambia counties similar to those for Bay, Walton and Okaloosa counties given above, were not available at the time this report was being prepared because the survey data was incomplete. Also, comparable beach recession computations will not be obtainable for these two counties because of the significant beach recovery which occurred prior to surveying those areas. Many parts of these western Panhandle counties experienced substantial overwash in which dunes were flattened and sand was transported landward and deposited, up to 3-4 feet deep, across the landward portion of the barrier islands and into bay and inland waters. In some areas, particularly in the overwash areas, the

shoreline may be expected to be permanently changed with little prospect for natural recovery to pre-storm conditions.

Significant beach and dune erosion including dune overtopping and overwash also occurred on the mainland and on parts of the barrier islands in Gulf and Franklin counties. Because of delays with surveying these areas, profiles from these two counties were not available at the time of this report preparation.

The Bureau is evaluating areas which were critically eroded in the Panhandle counties of Escambia through Bay. Such critically eroded areas are considered to be in need of restoration or other remedial actions. The map below gives a preliminary estimate of the critically eroded areas as well as other erosion impacted areas. A listing of the specific critically eroded areas is given in the table on the following page.




A preliminary cost estimate to perform remedial post-Opal recovery measures for the critical erosion areas depicted above is $104 million. Many areas are expected to recover to some degree naturally, and the final cost may be less. A more refined cost estimate for remedial measures will be provided in the post-Opal recovery plan currently under development by the Bureau.

**Specific critically eroded area locations in the Panhandle region, based on a preliminary assessment following Hurricane Opal, and the shoreline lengths of these areas are listed below.**

## CRITICALLY ERODED AREAS IN FLORIDA PANHANDLE

| County | Location | Shoreline Length (miles) |
|---|---|---|
| Escambia | Pensacola Beach | 5.9 |
| Santa Rosa | Navarre Beach | 3.6 |
| Okaloosa | Ft. Walton Beach | 3.0 |
| Okaloosa | Destin | 2.9 |
| Okaloosa | Eastern Okaloosa County | 2.1 |
| Walton | Western Walton County | 5.2 |
| Walton | Beach Highlands/Dune Allen | 2.9 |
| Walton | Blue Mt. Beach | 1.0 |
| Walton | Seagrove Beach | 3.1 |
| Walton | Camp Creek Lk. to E. Walton Co. | 1.7 |
| Bay | Panama City | 18.5 |
| Bay | Mexico Beach | 2.8 |
| Gulf | Stump Hole | 0.3 |
| Franklin | Alligator Point | 4.0 |
| | TOTAL | 57.0 |

## IV. POST-STORM RESPONSE ACTIVITIES AND ISSUES

**The aftermath of Opal presented a number of difficulties for property owners and local, state, and federal agencies. Post-storm response efforts will continue for a period that is expected to extend well into the future. In addition to the immediate cleanup efforts, the recovery process will include extensive rebuilding of the damaged structures and infrastructure, as well as, the beach and dune restoration work.**

**Three major post-storm issues are:**

**<u>Sand and debris removal</u> - The structural damage from Opal's storm surge, breaking waves, and wind coupled with beach and dune erosion and overwash produced a widespread and potentially dangerous situation in terms of debris distribution and burial. Excessive debris along roadways created immediate access problems after the storm, but was also carried both in offshore and overland directions by storm surge and wave forces. A photo below depicts storm debris in the aftermath cleanup period.**

**Storm Debris in Bay County Following Hurricane Opal**

**It should be noted that the bulk of the debris was generated from the damage or destruction of non-conforming unpermitted structures.**

Large quantities of sand from coastal sand dunes were carried overland, much of it debris-laden. In some areas, the overwash sand has been picked up and taken back to beach areas and placed in mound formations. In other areas it may be permanently lost from the active beach dune system. Sand-sifting equipment must be employed to remove debris from these accumulations. However, hazardous debris may still be buried on the beach and, even more problematical, in nearshore, submerged regions. There has been little organized effort to retrieve much of this debris. The debris removal effort could be complex, costly, and result in long term public safety concerns and liability.

Beach scraping - Topographic losses from beach and dune erosion left many structures without soil support beneath their foundation and loss of a storm-protective dune buffer seaward of them. In order to facilitate and accelerate the beach and dune recovery process, a proliferation of beach scraping activity was undertaken by private citizens and local governments in certain areas. Beach scraping consists of excavating sand material from the lower beach berm area just upland of the mean low water line and placing it in upper beach areas or at the base of the dune system. Natural processes tend to replace the excavated sand thus accelerating the recovery process. A depiction of beach scraping being conducted following Opal is shown in the photo below.

Beach Scraping Activity Following Hurricane Opal

Guidelines were established by the Bureau to control the extent and methods of scraping and reduce potential for adverse impacts. Beach scraping activities that

**transpired in the weeks following the storm included excavation which significantly exceeded these guidelines endangering the beach and upland areas such that general authorizations for scraping were halted and only carefully controlled activities permitted by the Department. An analysis of the effects of the beach scraping on the post-storm recovery processes will be included in the post-Opal recovery study currently being conducted by the Bureau.**

**<u>Rebuilding</u> - The extent of rebuilding facing the Panhandle counties is clear from a review of the structural damage inventory. The rebuilding process will continue for years. It is evident from review of the structural damage inventory that the damaged habitable structures were built prior to the more stringent construction standards required by the State of Florida's CCCL program or, in the case of Bay County, were built upland of the original coastal construction setback line.**

**The Bureau's post-storm response efforts included providing guidance and consultation regarding rebuilding, as well as, establishment of three temporary field offices in the Panhandle to assist in the permitting process. A new, interim CCCL was adopted for Bay County to ensure that rebuilt construction is in conformance with the more stringent construction standards imposed by the CCCL program.**

**In order to assist in facilitating post-storm recovery, a special post-Opal permit with general design parameters (ie, first-floor elevations) was developed for rebuilding certain structures, such as single-family dwellings.**

## V. SUMMARY

**In terms of both coastal erosion and structural damage Hurricane Opal may prove to have been the most destructive storm ever to impact the coastal zone of Florida. Structural damage, as well as, beach and dune erosion occurred throughout all of the Panhandle from Escambia to Franklin counties. Damage extended to a lesser degree into lower Gulf Coast counties including Pinellas through Sarasota. Although significant wind damage was observed, the most extensive damage in the coastal zone seaward of the State of Florida CCCL lines was the result of the storm surge and accompanying wave heights and erosion.**

**The structural damage which occurred was primarily the result of structures not being designed and constructed to withstand the impacts of the hurricane. The structural damage to non-conforming structures generated large volumes of debris. Structural damage assessments performed by the Bureau clearly demonstrate the effectiveness of the CCCL program in drastically reducing damages sustained by a major hurricane event.**

**Post-Opal response presented a number of problems including retrieval of sand which was transported by overwash processes, much of it containing construction debris, as well as, the potential of hazardous debris being buried in beach and nearshore areas. Beach scraping and the rebuilding process will continue for months following the storm. Restoration and remedial assistance will be needed to ensure a full and rapid recovery of the beaches and dunes in the Panhandle, particularly in view of the economic importance of those beaches.**

**The Bureau of Beaches and Coastal Systems is currently developing a plan for restoration and recovery of eroded shoreline areas within the Opal-impacted Panhandle region. In addition to the recovery plan, a longer-term study of the impacts of Opal and post-storm recovery processes will be conducted.**