

Rest Beach – Wilma inflicted severe erosion, flooding, and overwash, and substantially destroyed the entire park’s recreational infrastructure (Photo 57). Two beach access walkways were destroyed along with a picnic shelter. Approximately 175 feet of concrete sidewalks were also destroyed. East of Rest Beach, 35 feet of concrete block wall was destroyed.

Clarence Higgs Monroe County Beach – The White Street Pier sustained minor damage, losing some of its rails to the storm surge and waves. A county pavilion known as the Yoga by the Sea platform was separated by the storm surge, which floated it northeastward and set it down on the northwest corner of Rest Beach (Photo 58). At the west end of Higgs Beach, a concrete public fishing pier was substantially damaged and lost all its wood deck.

Along the southeastern shoreline of the city, various damages were incurred by the storm surge and waves. Between Rest Beach and Truman Annex, six piers were substantially damaged or destroyed. East of Dog Beach and Vernon Street, a commercial nonhabitable major structure was destroyed. A historic single-family dwelling was also flooded and damaged. West of South Beach, another historic dwelling sustained flood damage and a recreation building sustained ground floor major structural damage landward of 30 feet of concrete seawall that was destroyed. East of Southmost Point, another concrete seawall was damaged, and to the north, 150 feet of ornamental concrete block wall was destroyed. Truman Annex sustained additional revetment damage. A pier near Mallory Square adjacent to the Key West Ship Channel was also destroyed.



Photo 57. Damage to Rest Beach infrastructure.



Photo 58. Wilma's storm surge carried the Yoga by the Sea platform from Higgs Beach east to Rest Beach.

Fort Zachary Taylor Historic State Park

The park's coastal and shore protection structures withstood their most significant storm surge and wave effects since they were constructed. Of the four detached breakwaters, the second breakwater from the west sustained major damage (level three); however, the structure appears to still provide substantial wave energy dissipation. Along the west shoreline, the first 150 feet of revetment landward of the terminal groin sustained level two damage that can be repaired by adding additional rocks to raise the crest up to the design elevation. Elsewhere along the revetment was approximately 50 feet of level one damage, where any rocks displaced by the waves can likely be replaced by a front-end loader.

Sunset Key (formerly Tank Island)

Approximately 2,000 feet of rock revetment was substantially damaged (level three to four) along the southern and southwestern portion of the island. Docks were also damaged.

Fort Jefferson, Dry Tortugas

The national park facilities sustained major damages due to the winds and storm waves of Wilma. Park office and living quarters sustained interior water damage; however, there was no major structural failure of the fort. The docking facilities were destroyed and several boats were damaged. Seawall damages were also sustained, and many shrubs and trees were lost.

Flamingo and Everglades National Park

The community and national park facilities sustained major damages due to the winds and storm surge of Hurricane Wilma. Several mobile homes were destroyed and many others sustained major damage. Many single-family dwellings throughout the community sustained major damages due to flooding and winds. Within the park, most of the grade-level buildings were flooded by the storm surge and most buildings sustained major roofing damage. Major structural damage was sustained by many of the grade-level buildings, and understructure damage was sustained by many of the elevated, pile-supported structures. Most of the marina and dock facilities were destroyed or sustained major damage. Throughout the area, trees were uprooted, plants and shrubs were damaged, and wildlife were stressed (Photo 59).



Photo 59. Damaged ecosystem, Everglades National Park (credit: National Park Service).

Dade County

The Dade County coast includes 20.8 miles of barrier beaches extending southward from Broward County to Cape Florida at the south tip of Key Biscayne (Figure 13). South of Key Biscayne, the central Dade County coast is a generally open water stretch fronting Biscayne Bay for eight miles between Cape Florida and the Ragged Keys. One small island, Soldier Key, is located in this open water stretch of coast, located roughly five miles south of Cape Florida. The southern 15 miles of the Dade County coast are the northern Florida Keys islands of the Ragged Keys (1.7 miles of five small islands), Sands Key (1.7 miles), Elliot Key (8 miles), Old Rhodes Key (2.6 miles), and Swan Key (0.7 mile). There are four coastal barrier inlets in northern Dade County, including from north to south, Bakers Haulover Inlet, Government Cut, Norris Cut, and Bear Cut. The four major tidal passes in south Dade County are Sands Cut, Caesar Creek, Old Rhodes Channel, and Broad Creek. Dade County includes the following barrier beach communities and major parks: Golden Beach, Sunny Isles, Haulover Beach Park, Bal Harbour, Surfside, Miami Beach, Fisher Island, Virginia Key Beach Park, Crandon Park, Village of Key Biscayne, Bill Baggs Cape Florida State Park, and Biscayne National Monument.



Figure 13. Dade County location map.

Prior to the 2005 hurricane season, most of Dade County's barrier island coast north of Cape Florida was designated critically eroded. There are designated three critically eroded areas (17 miles), two noncritically eroded areas (1.4 miles), and one noncritically eroded inlet shoreline area (0.3 mile). The northern 5.1 miles of Dade County (R1-R26.7) has critical erosion threatening development along Golden Beach and Sunny Isles and recreational interests at Haulover Beach Park. This segment of coast has a federal and state cost-shared beach restoration project along Sunny Isles and Haulover Beach Park.

Between Bakers Haulover Inlet and Government Cut (R27-R74.4) are 9.4 miles of critical erosion, which threatened development and recreational interests along Bal Harbour, Surfside, and Miami Beach. This reach is also a federal and state cost-shared beach restoration project.

The northern end of Virginia Key along the south shoreline of Norris Cut (0.3 mile) has noncritical inlet shoreline erosion. The southern 0.8-mile of beach on Virginia Key (R84-R88) is also noncritically eroded. The northern end of Key Biscayne (R89-R92) has 0.6 mile of noncritical erosion, and the southern half of Key Biscayne (R101-R113) has 2.5 miles of critical erosion. The critically eroded area threatens development in the Village of Key Biscayne and recreational interests at Bill Baggs Cape Florida State Park. This shoreline segment is another federal and state cost-shared beach restoration project.

Storm Effects and Erosion Conditions

The center of the eye of Hurricane Wilma passed approximately 70 miles north of Dade County on a west to east track. This track placed Dade County within the maximum wind field whereby the majority of the county experienced hurricane force winds. The direction of Wilma's sustained wind in Dade County was primarily from the southwest to west. Due to the predominantly offshore wind, the storm tide along the county's beaches fronting on the Straits of Florida was minimal. Some wave set-up along the west shorelines of the barrier islands did occur. The storm tide at Cape Florida was observed to be about five to six feet. Generally, only minor beach erosion (condition I) was sustained from the Broward-Dade County line south to Government Cut, as well as, along Virginia Key. To the south, along most of Key Biscayne, minor beach erosion (condition I) prevailed; however, at Bill Baggs Cape Florida State Park (R108-R113) erosion conditions transitioned from minor beach erosion (condition I) between R108 and R111.5 to minor beach and dune erosion (condition II) between R111.5 and the terminal groin at the cape near R114. Along this segment, a debris line comprised of old trash and marine invertebrates was deposited (Photo 60).



Photo 60. Minor beach erosion at Bill Baggs Cape Florida State Park (R112).

Storm Damage

The majority of the structural damage that occurred in Dade County was caused by hurricane force winds out of the west and southwest. Widespread light to moderate wind damage was sustained throughout the county. In downtown Miami, numerous high-rise office buildings were severely impacted by hurricane force winds. The Miami Metromover was closed due to falling debris from a neighboring high rise building. Power outages occurred county-wide for three weeks due to damaged power lines and utility poles. Power losses to service station fuel pumps caused a major but temporary impact on recovery operations. Wind damage to trees and shrubs (native and ornamental) was extensive throughout the county. Ficus trees and Australian Pines sustained the majority of the tree damage, while palms appeared to sustain minimal damage.

Throughout the Biscayne Bay area there was significant marine damage. Many boats were transported by the storm surge onto bulkheads, docks, and overpasses. Some vessels were freed from their moorings and deposited hundreds of feet from where they were originally docked. The Port of Miami sustained damage to roughly 2,000 feet of bulkheads, and a cruise terminal lost a section of its roof. The Sunny Isles Marina dry storage facility collapsed, damaging close to 300 vessels. Numerous docks and pilings throughout the county were severely damaged by the battering of vessels that were moored to them.

On the barrier islands, there was minor to moderate wind damage to ocean front high-rise condominiums, low-rise motels, commercial buildings, and single-family dwellings (Photo 61). The typical wind damages were broken windows, damaged hurricane shutters, and minor roofing losses. No major structural damage was observed seaward of the Broward County Coastal Construction Control Line or within the Coastal Building Zone. The majority of the damage near the coast occurred north of Bakers Haulover Inlet.



Photo 61. Broken windows, Golden Nugget Motel, Sunny Isles Beach.

At Cape Florida, a concrete seawall and rock revetment sustained destruction requiring reconstruction. A 72-foot section of the wall was observed to have rotated seaward, and a 12-foot section of the wall lost its concrete cap (Photo 62).



Photo 62. Concrete cap damage, Cape Florida State Park.

Broward County

Broward County is located on the southeast coast of Florida between Dade County to the south and Palm Beach County to the north (Figure 14). The county has approximately 24 miles of Atlantic Ocean fronting beaches. Barrier dune elevations average about +15 feet and beach-dune sediments are comprised of carbonate and silica sands and shell fragments. The net direction of longshore transport along Broward County's beaches is to the south. There are two coastal inlets in Broward County: Hillsboro Inlet and Port Everglades Entrance. Broward County includes the following beach communities and major parks: Deerfield Beach, Hillsboro Beach, Pompano Beach, Sea Ranch Lakes, Lauderdale-by-the-Sea, Fort Lauderdale, John U. Lloyd Beach State Park, Dania, Hollywood, and Hallandale.



Figure 14. Broward County location map.

Prior to the 2005 hurricane season, 21.3 miles of the Broward County coastline was designated as critically eroded with three critical erosion areas specifically identified. The south end of Deerfield Beach and the entire City of Hillsboro Beach along northern Broward County is a 3.2-mile long critically eroded area (R6-R23). Private development is threatened throughout this area. Some armoring exists in Hillsboro Beach and a boulder mound and groin project exists in Deerfield Beach. A beach restoration project

extends from R6 in Deerfield Beach to R12 in Hillsboro Beach. South of Hillsboro Inlet and extending for 10 miles along Pompano Beach, Sea Ranch Lakes, Lauderdale-by-the-Sea, and Ft. Lauderdale is a continuous critically eroded area (R25-R77) that threatens development and recreational interests, including State Road A1A. A beach restoration project has been constructed at Pompano Beach and inlet sand transfer is ongoing at Hillsboro Inlet. Numerous bulkheads and retaining walls also exist along this segment of coast. Beach restoration is being conducted throughout this area. Along the southern 8.1 miles of Broward County south of Port Everglades Entrance is a critically eroded area (R86-R128) that threatens recreational interests at John U. Lloyd Beach State Park and development and recreational interests along the communities of Dania, Hollywood, and Hallandale. Beach restoration projects are ongoing at J.U. Lloyd Beach State Park and at Hollywood and Hallandale.

Storm Effects and Erosion Conditions

As the eye wall of Hurricane Wilma passed over Broward County, hurricane force winds were sustained for five hours with the wind direction varying from south-southwest to west. Given the offshore directed winds while Wilma exited, there was no significant storm surge along the coast of Broward County. Prior to Wilma's arrival, onshore winds caused mostly minor beach erosion (condition I) along Broward County's beaches. Isolated minor to moderate beach and dune erosion (condition II and III) was observed at a few locations. Specific beach conditions throughout Broward County are discussed as follows.

Deerfield Beach and Hillsboro Beach (R1-R23.8)

Northern Deerfield Beach (R1-R4.3) sustained minor beach erosion (condition I) and southern Deerfield Beach (R4.3-R6) generally sustained minor beach and dune erosion (condition II). Vertical beach losses were observed to range between two to three feet. At the south end of the Deerfield Beach groin field (R6-R6.8) and along northern Hillsboro Beach (R6.8-R11.6), moderate beach and dune erosion (condition III) was sustained (Photo 63). Vertical beach losses were observed to range between three to six feet. Southern Hillsboro Beach (R11.6-R22) sustained minor beach erosion (condition I). North of Hillsboro Inlet (R22-R24), accretion of the beach was observed.



Photo 63. Moderate erosion at Deerfield Beach (R6.8).

Pompano Beach, Sea Ranch Lakes, Lauderdale-by-the-Sea, Fort Lauderdale (R25-R84.7)

The beaches between Hillsboro Inlet (R25) and Port Everglades Entrance (R84.7) generally sustained minor beach erosion (condition I). Minor beach and dune erosion (condition II) was sustained immediately south of Hillsboro Inlet and accretion was observed immediately north of Port Everglades Entrance. Wind blown sand was observed to cover dune vegetation in many areas.

John U. Lloyd State Park, Dania, Hollywood and Hallandale (R86-R128)

South of Port Everglades Entrance, conditions within John U. Lloyd State Park (R86-R98) varied between minor beach erosion (condition I) and minor beach and dune erosion (condition II) (Photo 64). Also within the park, small segments of moderate beach and dune erosion (condition III) were sustained near R90 and R96. To the south, Dania, Hollywood, and Hallandale generally sustained minor beach erosion (condition I); however, small segments of beach accretion were observed.



Photo 64. Moderate beach erosion at John U Lloyd State Park (R88).

Storm Damage

Hurricane Wilma inflicted the worst storm damage in Broward County since Hurricane King in 1950. Widespread minor to major wind damages to residential and commercial buildings were sustained throughout Broward County, which was impacted by category one and two hurricane intensity winds between 80 to 100 mph for approximately five hours. The building construction regulatory offices of Broward County cited 5,111 dwellings as uninhabitable due to wind related damages, including 2,800 condominiums and apartments, 1,441 mobile homes, 42 single-family dwellings, and 170 commercial buildings. The majority of damage was to roofing, siding, or cladding, with subsequent interior damages due to rain and winds. Worst damaged areas included downtown Ft. Lauderdale and the nearby City of Plantation, where 93 buildings were reported to have sustained major damage. In Hollywood, three single-family dwellings were severely damaged and 16 mobile homes were destroyed. Many homes and businesses east of the

Atlantic Intracoastal Waterway sustained major roof damage (Photo 65). Many boats, docks, and bulkheads were damaged. Dry storage marinas sustained major damage (Photo 66).



Photo 65. Major roofing damage. Fort Lauderdale.



Photo 66. Destroyed dry storage marina (Marina One, Deerfield Beach).

Damages to coastal construction seaward of the established Broward County Coastal Construction Control Line are discussed as follows.

Deerfield Beach and Hillsboro Beach (R1-R23.8)

Along the ocean front of Deerfield Beach, 15 major structures sustained major roofing damage, including seven multifamily dwellings (condominiums) and six single-family dwellings. One unit of a condominium was also severely damaged by a storm-related propane gas explosion. Further inland in Deerfield Beach, numerous retirement communities of manufactured homes sustained major damages. In Hillsboro Beach, only one multifamily dwelling sustained complete roof failure, but many others sustained major damage to roof sheathing/cladding (Photo 67).



Photo 67. Damaged multifamily dwellings, Hillsboro Beach (R16.7)

Pompano Beach, Sea Ranch Lakes, Lauderdale-by-the-Sea, Fort Lauderdale (R25-R84.7)

Along the coastal communities between Hillsboro Inlet (R25) and Port Everglades Entrance (R84.7), widespread wind damage to roofing and siding was sustained. High-rise condominiums along the ocean front sustained significant interior losses due to damaged sliding glass doors, windows, and siding. The Pompano Beach Fishing Pier, previously damaged by the waves of Hurricane Frances in 2004, sustained additional wind damage. A construction crane in Fort Lauderdale Beach experienced high fatigue stresses that weaken the structure's support brackets. Commercial buildings along State Road A1A within the Coastal Building Zone sustained major roofing damage (Photo 68). In Lauderdale-by-the-Sea, a beach motel (R49.3) sustained major roof damage (Photo

69). Portions of State Road A1A along Pompano Beach and Fort Lauderdale were covered with sand overwash deposits, but were otherwise undamaged.



Photo 68. Major roofing damage to commercial building, Ft. Lauderdale (R55.6).



Photo 69. Roof destroyed at beach side hotel, Lauderdale-by-the-Sea (R49.3).

J. U. Lloyd State Park, Dania, Hollywood and Hallandale (R86-R128)

At John U. Lloyd State Park, the park manager's living quarters were damaged. Along the ocean front of Dania, Hollywood, and Hallandale, many multifamily dwellings (condominiums and hotels) sustained minor to major roofing damage. Most of the high-rise hotels and condominiums seaward of the Broward County Coastal Construction Control Line sustained cladding and window damage on their south and west sides. In Hollywood, a condominium (R119.8) sustained major roof damage (Photo 70). In Hallandale a construction crane was toppled and strewn along A1A.



Photo 70. Major roofing damage, Hollywood (R119.8).

Palm Beach through Nassau Counties

The center of the eye of Hurricane Wilma crossed Palm Beach County and exited the coast near Lake Worth Inlet (Figure 15). The counter-clockwise circulating wind field around Wilma’s eye as it entered the Atlantic Ocean caused offshore winds along southern Palm Beach County, Broward County, and Dade County. Along northern Palm Beach County and the remainder of the Florida east coast the winds were directed onshore or towards the coast. Storm tides were generally not significant along Florida’s east coast during Wilma’s passage. Waves rapidly grew over the Atlantic as the winds of Wilma intensified. NOAA buoys measured maximum significant wave heights of 19.7 feet, 20 nautical miles off Cape Canaveral, and 33.5 feet, 120 nautical miles off Cape Canaveral (see Figure 4, page 6).

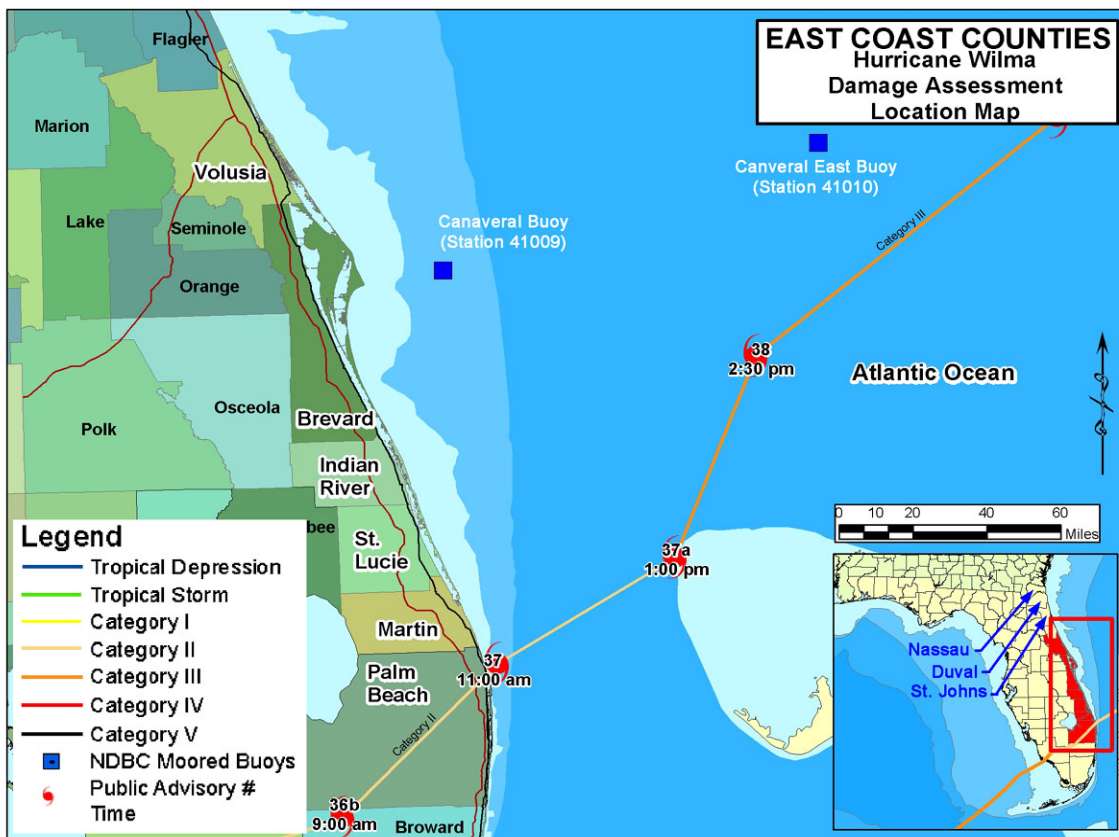


Figure 15. Florida east coast counties location map.

Storm Effects and Erosion Conditions

The storm waves generated by Hurricane Wilma inflicted varying beach erosion conditions along the east coast of Florida as shown in Table 1, page 10.

Palm Beach County

In Palm Beach County, little to no erosion was observed south of Lake Worth Inlet. There was accretion in many areas. North of Lake Worth Inlet along Singer Island (R60-R65) moderate beach and dune erosion (condition III) was sustained. This erosion aggravated an already critical erosion problem in an area severely eroded by Hurricanes Frances and Jeanne in 2004. Another localized segment of beach south of Jupiter Inlet (R14-R15.5) also sustained moderate beach and dune erosion (condition III). Between the north county line and Jupiter Inlet, and from south of Jupiter Inlet to the southern portion of J.D. MacArthur State Park (R16-R58), minor beach erosion (condition I) prevailed.

Martin County

With a few exceptions, most of Martin County sustained minor beach erosion (condition I). Along MacArthur Boulevard, south of the beach restoration project on Hutchinson Island, and immediately south of an emergent rock headland at R27, moderate beach and dune erosion (condition III) was sustained. The beach segment immediately south of the rock headland at the House of Refuge between R30 and R31 sustained minor to moderate beach and dune erosion (condition II-III). Along southern Hutchinson Island through Sailfish Point (R31-R40), conditions varied between minor beach erosion (condition I) and minor beach and dune erosion (condition II). North of St. Lucie Inlet (R40-R42.5), accretion prevailed. South of St. Lucie Inlet, minor beach erosion (condition I) prevailed along most of Jupiter Island (R44-R93 and R96-R127). In the Town of Jupiter Island between R93 and R96, minor beach and dune erosion (condition II) was observed.

St. Lucie County

Most of St. Lucie County (R1-R80 and R84-R99) sustained minor beach erosion (condition I). At the Florida Power and Light (FP&L) nuclear power plant on Hutchinson Island, the discharge canal (R81) and intake canal (R83) were left vulnerable to further erosion after the impact of Hurricanes Frances and Jeanne in 2004. A substantial post-storm recovery dune was subsequently constructed; however, moderate beach and dune erosion (condition III) was sustained along this segment of beach (R80-R84) during Wilma. Along the developed and critically eroded southern St. Lucie County (R99-R115), erosion conditions varied between minor to moderate beach and dune erosion (condition II-III).

Indian River County

Gray and Gorham (2005) reported that Hurricane Wilma's passage to the south of Indian River County brought maximum sustained winds of 80 mph and peak gusts of 90 mph in the county. Wave conditions and erosion were typical of an extratropical storm (northeaster). Beach erosion was substantially less severe than the erosion that occurred from Hurricanes Frances and Jeanne in 2004 or Hurricanes Floyd and Irene in 1999.

Most of the county sustained minor beach and dune erosion (condition II). No overwash occurred within the county, and the most significant dune recession was observed adjacent to vertical seawalls. The most severe erosion conditions were observed in the Town of Indian River Shores between R46 and R55, where moderate beach and dune erosion (condition III) was sustained (Photos 71 and 72). The critically eroded south county beaches between R101 and R107 sustained minor beach and dune erosion (condition II) (Photo 73).



Photo 71. Erosion of dune restoration project, R47.4, Indian River County.



Photo 72. Moderate beach and dune erosion, Indian River County (R51).



Photo 73. Erosion of dune restoration project, south Vero Beach (R102.5).

Brevard County

Throughout Brevard County, minor beach erosion (condition I) was sustained. One exception was observed in the critically eroded south county area near R158.5. In early September 2005, when Hurricane Ophelia passed 70 miles offshore of Brevard County, there was significant erosion at this location where dune restoration had been conducted following the 2004 storms (Photo 74). Additional moderate beach and dune erosion (condition III) from Hurricane Wilma's offshore passage, has now undermined a swimming pool and threatened a neighboring single-family dwelling (Photo 75).



Photo 74. Erosion of dune restoration project by Hurricane Ophelia, Brevard County (R158.5).



Photo 75. Pool undermined and dwelling threatened by Wilma, Brevard County (R158.5).

Volusia County

The beaches and dunes of Volusia County were severely eroded in 2004 by the impacts of Hurricanes Charley, Frances, and Jeanne, and a December northeaster. In early September 2005, Hurricane Ophelia passed offshore and caused additional beach erosion throughout the county. Hurricane Wilma's offshore passage inflicted additional erosion to these vulnerable beaches. Along most of northern Volusia County (R1-R115) only minor beach erosion (condition I) was sustained. South of the Port Orange Causeway along the south end of Daytona Beach Shores, Wilbur by the Sea, and the Town of Ponce Inlet (R115-R145), minor to moderate beach and dune erosion (condition II-III) was sustained. The dune erosion escarpment varied from two to six feet in this area (Photo 76). The area immediately north of Ponce de Leon Inlet (R145-R148) sustained only minor beach erosion (condition I).



Photo 76. Dune erosion escarpment, Town of Ponce Inlet (R139).

South of Ponce de Leon Inlet (R148-R158.5), minor beach and dune erosion (condition II) was sustained. However, along the northern three miles of New Smyrna Beach (R160-R176), moderate to major beach and dune erosion (condition III-IV) was sustained (Photos 78 and 81). The erosion threatens several single-family dwellings along North Atlantic Avenue between R161 and R162 (Photo 77). New Smyrna Beach was particularly vulnerable to additional erosion prior to Hurricane Wilma. The dunes along many properties were severely eroded similar to the conditions observed at the Holiday Inn (R168) (Photos 79 and 80). Along the southern two miles of New Smyrna Beach (R176-R188), minor beach and dune erosion (condition II) was sustained. To the south along Bethune Beach (R188-R207), accretion of the beach prevailed.