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South Florida Natural Resources Center
Everglades National Park

RESOURCE
EVALUATION
REPORT

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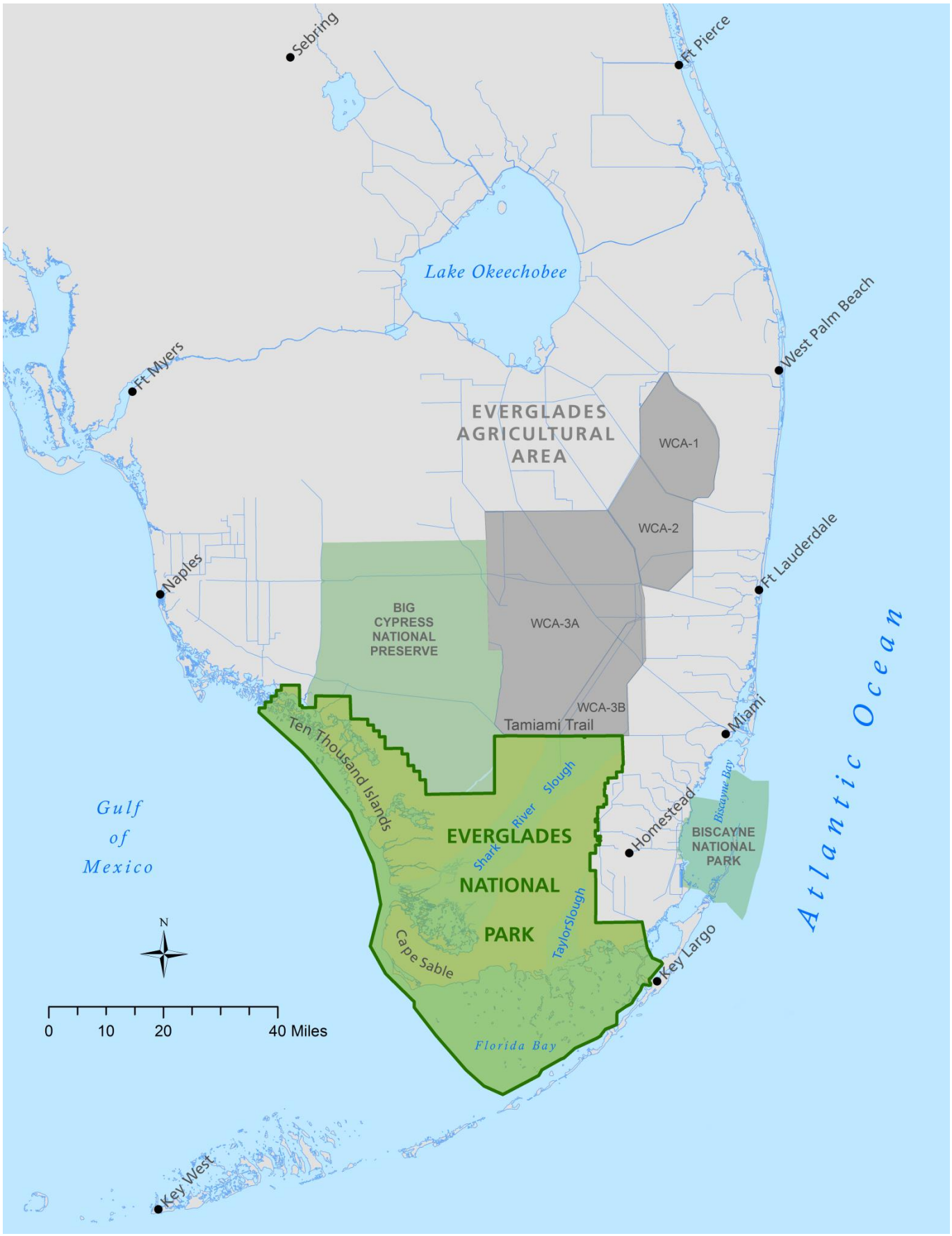
2015:1

Everglades National Park 2015 State of Conservation

Report to the World Heritage Committee, UNESCO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BIG
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PRESERVE
WCA-3A
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Atlantic Ocean
Ten Thousand Islands
Shark River Slough
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Everglades National Park 2015 State of Conservation

Report to the World Heritage Committee, UNESCO

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LIST OF ABBREVIATIONS

BMP	Best Management Practices
C&SF	Central and Southern Florida Project
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
CPUE	Catch per Unit Effort
COP	Combined Operational Plan
CSOP	Combined Structural & Operational Plan
DASM	Digital Aerial Sketch Mapping
Decomp	Decompartmentalization and Sheetflow Enhancement Project
DOI	Department of the Interior
EAA	Everglades Agricultural Area
ENP	Everglades National Park
EPA	U.S. Environmental Protection Agency
ERTP	Everglades Restoration Transition Plan
FEB	Flow Equalization Basin
GMP	General Management Plan
IUCN	International Union for the Conservation of Nature
MWD	Modified Water Deliveries
NESRS	Northeast Shark River Slough
NGVD	National Geodetic Vertical Datum of 1929
NPS	National Park Service
NRC	National Research Council
POR	Period of record
ppb	Parts per billion
SAV	Submerged Aquatic Vegetation
SFWMD	South Florida Water Management District
STA	Stormwater Treatment Area
TP	Total phosphorus
TTNS	Tamiami Trail Next Steps
UNESCO	United Nations Educational, Scientific and Cultural Organization

USACOE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WCA	Water Conservation Area
WSS	Western Shark Slough
WY	Water Year

BACKGROUND

Report Purpose

Everglades National Park (ENP) was established in 1947 with a mission unique within the National Park Service (NPS). In contrast to parks in the western United States featuring dramatic landscapes, this park was to protect the abundant and diverse biological resources of a vast wetland ecosystem. Achieving this mission has proven challenging in light of human modifications to the south Florida hydrology and landscape. Current local and regional restoration efforts now serve as important corrective measures to help move the park closer to the Desired State of Conservation.

Reporting requirements of the World Heritage Committee have recently changed from an annual reporting cycle to a biennial cycle. This 2015 report is the first biennial report to be submitted by NPS. As with previous NPS reports, this report provides information on the status of ENP indicators of site integrity and on the progress of Everglades Restoration projects and other corrective measures. The information presented is intended to assist decision-making regarding the status of ENP as a World Heritage site and to gauge the overall response of the ENP ecosystem to factors such as changes to water management, climatic change, invasive exotic species, and implementation of Everglades Restoration projects.

Goals of Everglades National Park Biennial Report to the World Heritage Committee

- Describe the Desired State of Conservation of the park as developed by the World Heritage Committee and the NPS and establish the status and trends of important indicators of ecosystem integrity.
- Describe the current status of the corrective measures that ENP is undertaking to bring park habitats toward the Desired State of Conservation. The majority of these corrective measures, especially those affecting the water management system, are under the direct control of the U.S. Army Corps of Engineers (USACE) and the State of Florida. ENP's role is in the review of these projects such that they support to the maximum extent possible the park vision of the Desired State of Conservation.
- Synthesize the information on the status of integrity indicators as well as the status of corrective measures, providing an assessment of progress as well as further actions required to move ENP toward the Desired State of Conservation.

Everglades National Park and its Conservation Designations

ENP contains the largest subtropical wilderness reserve (6,000 km^2, see map of park and region inside front cover) on the North American continent. Located at the southern tip of the Florida peninsula, the park supports a high level of biological diversity due to its interface of temperate and subtropical climates and aquatic environments ranging from fresh to brackish to marine water.

Although the areal extent of the historic Greater Everglades ecosystem has been reduced by about 50% due to agricultural and urban development and related hydrologic changes over the last 100 years, the park protects vital remnants of all of the original, pre-drainage Everglades habitats including forested uplands, a diverse mosaic of freshwater wetlands, and coastal wetlands and mangrove forests that transition into the open water marine ecosystems of the Gulf of Mexico and Florida Bay. It is in large part due to the value of this collection of component habitats that the park has received conservation designations at the state, federal, and international levels.

Threats to Everglades National Park

ENP is located at the southernmost end of the highly modified Everglades wetland ecosystem. The flow of water in this once natural ecosystem is now controlled and managed by the canals, levees, and pumps of the Central and Southern Florida (C&SF) water control project, resulting in unnatural discharges to fragile estuaries and limited flow southward through the system (Fig. 1). Managed reservoirs, or Water Conservation Areas (WCAs), located upstream of the park, confine freshwater for flood control purposes and urban and agricultural water supply needs. These changes outside the park have had tremendous implications within ENP: the northeastern sector of the park (called Northeast Shark River Slough, or NESRS) is unnaturally dry; western Shark Slough (WSS) is too wet; and the estuaries of Florida Bay are starved for freshwater and suffer from high salinity levels.

Conservation Designations Awarded to Everglades National Park

State

- Outstanding Florida Water, 1978
- Outstanding National Resource Water, 1989

Federal

- Everglades National Park, 1947
- Marjory Stoneman Douglas Wilderness, 1978

International

- International Biosphere Reserve, 1976
- World Heritage Site, 1979
- Ramsar Wetland of International Importance, 1987
- Cartagena Convention Designation, 2012

The altered wetland function has profoundly affected both habitats and the wildlife that depend on them. In recognition, at the request of the U.S. Government, ENP was inscribed on the list of World Heritage Sites in Danger in 1993. Four major threats, which had been repeatedly identified as sources of impact to ENP since its inception, were highlighted at the time of the time of the listing.

Primary Threats to Everglades National Park

Threat 1. Alterations of the hydrologic regime have resulted in changes in the volume, distribution, and timing of water flows to the park.

Threat 2. Adjacent urban and agricultural growth has resulted in flood protection improvements that alter the park's wetlands and in the invasion of exotic species from urban and agricultural environments.

Threat 3. Increased nutrient pollution has resulted from runoff from upstream agricultural areas, causing alterations in native flora and fauna in the park's freshwater ecosystems.

Threat 4. Impacts to the protection and management of Florida Bay have resulted from reduced freshwater inflows and increased nutrient loadings.

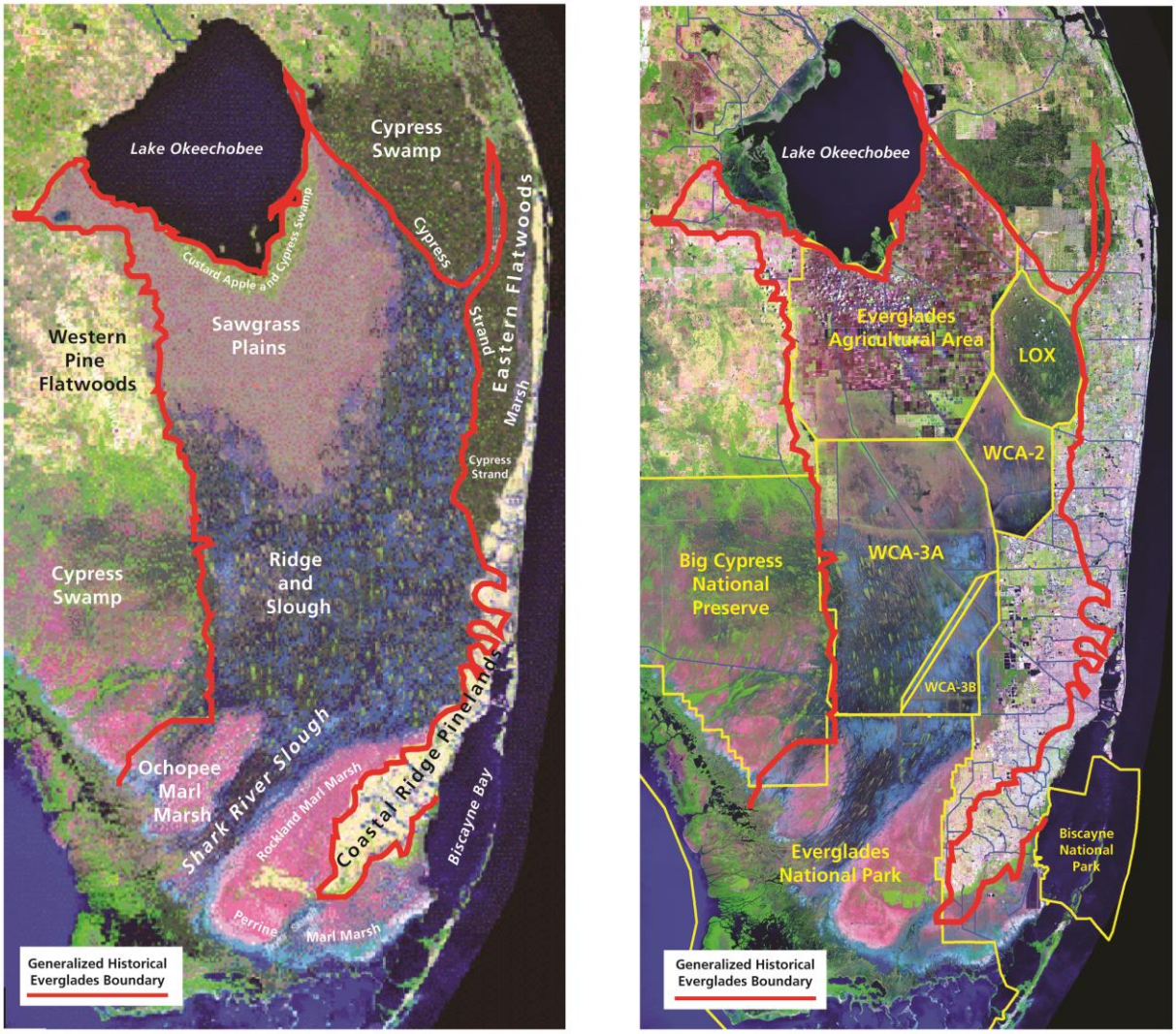


Figure 1. Comparison of the historic south Florida landscape (left) with the highly compartmentalized landscape of today (right). The current landscape illustrates the extent to which characteristics of the historic landscape have been lost to agriculture and urban development. The barriers to sheetflow created by the construction of the levees and canals of the Central and Southern Florida Project resulted in the loss of natural marsh connectivity. (Map adapted from McVoy et al. 2011.)

Everglades National Park: A World Heritage Site in Danger

ENP has been on the list of World Heritage Sites in Danger since 1993, with the exception of a brief period in 2007–2010. Specific recommendations were made by the World Heritage Committee, at the time of the 2010 relisting, to enhance existing corrective measures. In 2012, for the purpose of securing the long-term restoration and preservation of the Everglades ecosystem, ENP developed a narrative statement of the Desired State of Conservation and selected a suite of "integrity indicators." The integrity indicators represent the most important aspects of the ecosystem that are expected to benefit from the implementation of the corrective measures and allow us to measure progress toward the Desired State of Conservation. These integrity indicators and their status were presented in the 2012 State of Conservation Report to the World Heritage Committee.

In the 2013 State of Conservation report, we developed a "stoplight" evaluation system that provides information on the current status and the trend of each indicator and can be used to evaluate progress toward removal of ENP from the list of World Heritage Sites in Danger (Mitchell and Johnson 2013a). The technical basis for the indicators was published in a companion technical report (Mitchell and Johnson 2013b). In the present 2015 State of Conservation report, the current status of each indicator is reported and compared to that of 2013.

World Heritage Committee

2010 Recommendations

- The Committee encouraged the United States to complete a congressionally directed feasibility study of additional bridging and road-raising along the eastern Tamiami Trail to allow unconstrained water flows beneath the highway, and to secure long-term ecosystem function. The World Heritage Committee considered the implementation of this project as critical to ensuring the restoration and preservation of the Outstanding Universal Value of the property.

- The Committee's 2010 recommendations urged the United States to plan for additional upstream corrective measures beyond those established in 2006, and to reinstate the planned Florida Bay/Florida Keys Feasibility Study.

- The Committee requested that future United States reports include not only progress on the corrective measures (i.e., the restoration projects themselves) but also progress toward the Desired State of Conservation (i.e., hydrologic and ecological measures of the health of ENP).

DEFINING THE DESIRED STATE OF CONSERVATION

The Desired State of Conservation (for eventual removal from the list of World Heritage In Danger) represents the goal of restoration and preservation efforts and is based on the characteristics of the physical factors, primary landscapes, and fish and wildlife in the Everglades ecosystem and the Outstanding Universal Values that led to the inscription of the park on the World Heritage list (Fig. 2). A detailed description of each important component was provided in the 2013 State of Conservation report. Here, the summary statement of the Desired State of Conservation for each component is reiterated.

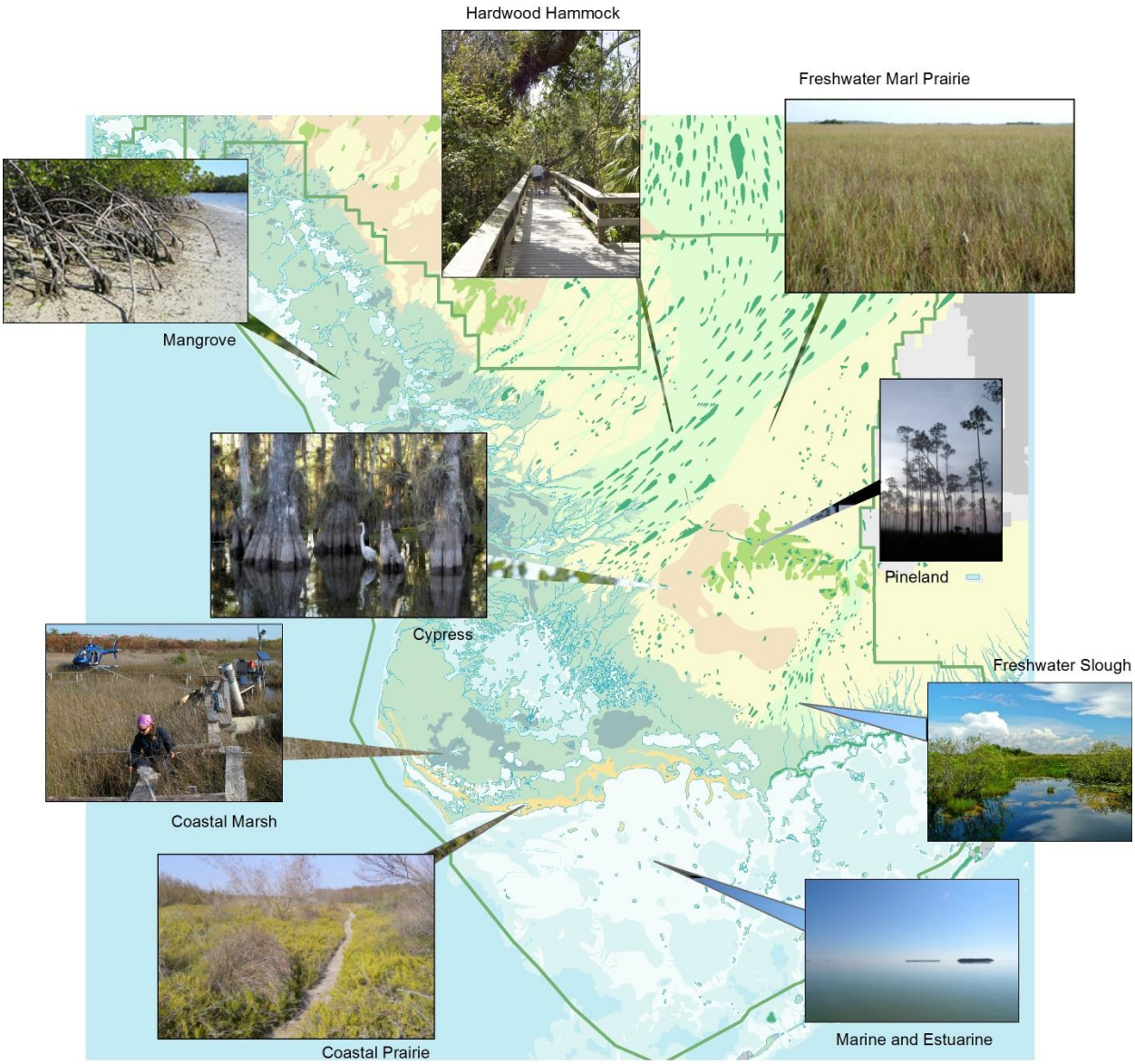


Figure 2. Everglades National Park was declared a World Heritage Site in 1979 by the UNESCO World Heritage Committee. The park was recognized as an area of Outstanding Universal Value due to the unique geological processes of the limestone substrate, the juxtaposition of temperate and subtropical species and habitats, the complexity and integrity of biological processes in the park, the large number of bird and reptile species, and the threatened and endangered species that reside within the ecosystem.

The Physical Environment

Hydrology

The Desired State of Conservation for hydrology in ENP is broadly defined as a system in which more-natural water depths, distributions, and sheetflow patterns have been reestablished in the park. The majority of the water should flow through the historic flow-way of NESRS, the slough should dry out only very infrequently, and operation of the water management system should allow for natural seasonal patterns of the rise and fall of water levels, in concert with rainfall.

Water Quality

The Desired State of Conservation for Water Quality in ENP is to have very low nutrient levels in the water entering the park (less than 10 ppb or less than 10 µg L^{-1}), and to maintain the current status of large areas of the park interior that routinely are around the phosphorus detection limit of 2 ppb.

The Freshwater Environment: Ridge, Slough, and Marl Prairies

Ridge, Slough, and Tree Island Landscapes with Associated Fish and Wildlife

The Desired State of Conservation for the ridge, slough, and tree islands landscape is broadly defined as a system that approaches as much as possible the pre-drainage landscape patterns, vegetation, and fish and wildlife communities. A restored ridge and slough system will have re-established microtopography, with water depths and multi-year hydroperiods that can support aquatic vegetation such as white water lily (*Nymphaea ordorata*). These habitats will produce high biomass and high densities of native fish and macroinvertebrates as water recedes gradually during the dry season, providing a prey base for large numbers of American alligators (*Alligator mississippiensis*) and a diverse and abundant wading bird community.

Marl Prairie, Hardwood Hammock, and Pineland Landscapes with Associated Fish and Wildlife

The Desired State of Conservation for the park's marl prairie, hardwood hammock, and pineland landscapes is broadly defined as a system in which pre-drainage water patterns are restored as much as possible, leading to longer hydroperiods, annual deposition of marl soil, and the re-establishment of a healthy mosaic of native wet prairie grass species interspersed with diverse hardwood hammocks. Severe and multi-year drying down of this habitat will be less frequent than at present. Alligator nesting will be frequent along the transition between the marl prairies and the slough, and wading birds will have more abundant prey and adequate water levels to promote seasonal foraging in these areas. The western marl prairies will become less flooded, and the population of Cape Sable seaside sparrows (*Ammodramus mirabilis*) will increase. The pinelands will retain their current diverse suite of rare and endemic plant species and will serve as habitat for wildlife such as the Florida panther (*Puma concolor coryi*), Florida wild turkey (*Meleagris gallopavo osceloa*), and cavity-nesting birds.

The Coastal and Estuarine Environment: Florida Bay

Coastal Marshes, Prairies, Mangroves, and Florida Bay Landscapes with Associated Fish and Wildlife

The Desired State of Conservation for the coastal wetlands, mangroves, and Florida Bay is defined as a system in which 1) more natural freshwater flows have been restored and in which the input of nutrients and contaminants has been reduced; 2) algal blooms occur less frequently than at present, and clear, clean water in the bay supports healthy seagrass beds, including an increased presence of widgeon grass (*Ruppia*) and shoal grass (*Halodule*); 3) hardbottom communities such as sponges and corals are restored; 4) reduced salinities in the bay provide the conditions for a productive estuarine nursery, supporting region-wide populations of pink shrimp (*Farfantepenaeus duorarum*) and sport fish as well as improved conditions for the American crocodile (*Crocodylus acutus*); and 5) salinity conditions, combined with more natural water recession rates, in the mangrove transition zone support wading bird nesting colonies in the area.

Invasive Exotic Species in Everglades National Park Habitats

A general statement of the Desired State of Conservation is that park habitats will reflect as much as possible the natural species composition of the biological communities they represent, and the impact of exotic species on native biota will be nearly imperceptible. The extent and number of exotic invasions into ENP habitats is great; therefore, we do not expect to ever eliminate entirely all exotic species from the park. In this sense, the Desired State of Conservation is similar to that for hydrologic restoration of park habitats: we accept that we will not achieve full return to an historical Everglades biota. The extent to which we can approach the Desired State of Conservation depends on many factors, one of which is the taxa of the exotic species. At this time, four taxonomic groups are the focus of work in ENP: plants, freshwater fish, herpetofauna (reptiles and amphibians), and marine fish. Advances toward the Desired State of Conservation are also dependent on the science to develop appropriate detection and control techniques and on the resources (staff and funding) available to successfully apply early detection/rapid response and control methods. Education and outreach, and examination of potential legislative and policy changes that reduce the risk of introduction of invasive exotic species, are also key to achieving the Desired State of Conservation.

INTEGRITY INDICATORS: DESCRIPTION AND STATUS AS OF 2015

Everglades restoration is based on the premise that restoring more natural hydrologic conditions throughout the system will serve to improve ecological conditions, beginning with primary productivity and moving up through the trophic system to plants, fish, wading birds, and crocodilians. Our set of ecological indicators reflects this model and so begins with an assessment of hydrologic and chemical parameters. The altered hydrology also makes worse the problems associated with invasive exotic species, which continue to be important determinants of overall ecosystem health.

The 2015 Integrity Indicators that we expect to be improved by implementation of the corrective measures are listed in Table 1. Two new indicators, Fire Regime and Roseate Spoonbills, have been added to those included in the 2013 State of Conservation report. As in the previous report, a summary “stoplight” table is provided for each indicator. For each indicator criterion assessed, the Desired State of Conservation is stated and both the stoplight status of the criterion in the 2013 report and its current status, reflecting additional information obtained in 2013 and 2014, are presented. A rationale for the current status follows in the last column of the table. An explanation of the stoplight indicator colors and arrows is given in Table 2.

Table 1. Integrity indicators for freshwater and estuarine ecosystems of Everglades National Park.

Physical Environment Indicators
Water volume and distribution
Water pattern and water levels (timing and spatial distribution of surface water depths--hydro-pattern)
Water quality (total phosphorus and periphyton)
Freshwater Environment: Ridge, Slough, and Marl Prairies Indicators
Freshwater fish and aquatic invertebrates
American alligator
Everglades wading birds
Fire Regime
Coastal and Estuarine Environment: Florida Bay Indicators
Salinity patterns in Florida Bay
Algal blooms in Florida Bay
Seagrasses in Florida Bay
Estuarine fish (sport fish) and invertebrates
American crocodile
Roseate spoonbill
Exotic Invasive Species in Everglades National Park Habitats Indicators
Invasive exotic plants
Invasive exotic fish and wildlife (freshwater and marine)

Table 2. Stoplight indicator key.

Status		Trend		Confidence	
	Significant Concern		Condition Is Improving		High
	Caution		Condition is Unchanging		Medium
	Good Condition		Condition is Deterioration		Low

The Physical Environment

Water Volume and Distribution and Water Pattern and Water Levels

Three metrics provide a way to track progress toward the Desired State of Conservation for hydrology. The percentage of water that flows across the Tamiami Trail on the eastern and western sections of ENP is monitored and compared. On an annual basis, the majority (about 55%) of this water should flow across the eastern section of the trail, in the main historical flow-way of NESRS. For water volume, a target range is established, in thousands of acre-feet, for the water coming across Tamiami Trail. Third, water depths in NESRS need to increase and need to vary naturally with rainfall. Water depths are reported as water "stage," or the level of water in NESRS as compared to sea level. Corrective measures that improve sheetflow, water depth, and hydroperiod, and reduce seepage losses out of the park, will move toward the Desired State of Conservation for these hydrologic indicators.

Water Volume and Distribution				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Magnitude and direction of sheetflow	On an average annual basis, 55% of flows should come through NESRS and 45% through WSS.			A large disparity continues to exist in the distribution of flows between WSS and NESRS. Over the long term, 77% of the total Shark River Slough flow distribution was delivered to WSS and 23% to NESRS. In 2011, 78%, or almost double the WSS target volume, was delivered to WSS and only 22% was delivered to NESRS.
Average annual water volume into NESRS	On average, a total annual volume of water should be delivered to NESRS of 550 thousand acre-feet (acre-ft) with a range of 200 to 900 thousand acre-ft during years of below- and above-average rainfall, respectively.			Over the period from 1980 to 2013 (34 years), the target was met only one time, in 1986 during a dry year. During average and wet years, flow to NESRS was generally less than half the target.

Water Pattern and Water Levels				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Water pattern and water levels (timing and spatial distribution of surface-water depth hydropattern)	The target is to achieve annual average water levels (stage) in NESRS of approximately 8.0 feet (ft) National Geodetic Vertical Datum of 1929 (NGVD) during years of average annual rainfall. During years of below- and above-average annual rainfall, the average water level in NESRS should be 7.5 and 8.8 ft. respectively.			NESRS water levels are consistently significantly lower than targets. While in no year has the average water level in NESRS even reached the lower range of the target (7.5 ft NGVD), the trend over time is neither increasing or decreasing enough to be significant.

Water Quality (Total Phosphorus and Periphyton)

In the pre-drainage Everglades, concentrations of total phosphorus (TP) in surface water were generally less than 10 µg L^{-1}. TP concentrations are measured at inflow points and internal marsh sampling sites in both Shark River Slough and Taylor Slough, and the concentrations are used to track progress in reducing nutrient levels entering the park. The goal is to be in compliance with all State of Florida and federal water quality standards for TP (including the long-term limit in the Water Quality Settlement between the United States and the State of Florida), and to reduce the spatial distribution of nutrient-impacted areas.

Periphyton is an algal and diatom community in ENP that contributes to a large portion of net primary productivity. Periphyton responds quickly to changes in environmental conditions at both small and large spatial scales, and thus can be an early ecological indicator of impacts from management activities. In the Everglades ecosystem, even small increases in surface water phosphorus concentrations can decrease periphyton biomass and shift the periphyton community structure, ultimately impacting higher trophic levels. For water years (October – September) 2013 and 2014, only two of three metrics associated with periphyton are assessed: periphyton biomass and tissue phosphorus content (Gaiser 2009). Changes in periphyton are reported separately for the two main sloughs in the park, Shark River Slough and Taylor Slough, because these two areas are affected by different corrective measures. Corrective measures that improve hydrologic conditions and nutrient levels in the park should produce positive change in ENP periphyton communities in both Shark River Slough and Taylor Slough.

Water Quality: Total Phosphorus and Periphyton				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
TOTAL PHOSPHORUS				
Shark River Slough inflow phosphorus concentration	Inflow phosphorus concentrations to Shark River Slough below the target.			Inflow phosphorus concentration was below the long-term limit and the target during WY2013, but above the limit in WY2014.
Shark River Slough interior marsh phosphorus concentration	Interior marsh phosphorus concentrations in Shark River Slough below the target.			Interior marsh phosphorus concentration is below the target and a downward trend is apparent.
Taylor Slough and Coastal Basins inflow phosphorus concentration	Inflow phosphorus concentrations to Taylor Slough and Coastal Basins below the target.			Inflow phosphorus concentration declined below the long-term limit and phosphorus target this year.
Taylor Slough and Coastal Basins interior marsh phosphorus concentration	Interior marsh phosphorus concentrations in Taylor Slough and Coastal Basins below the target.			Interior marsh phosphorus concentration is below the target and concentrations have declined since October 1992.
PERIPHYTON				
Shark River Slough periphyton tissue phosphorus content	25% or less of Shark River Slough stations are coded yellow or red.			More than 25% of monitored stations in Shark River Slough were coded yellow or red for periphyton tissue phosphorus content, exceeding the desired state.

Water Quality: Total Phosphorus and Periphyton				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Shark River Slough periphyton biomass	25% or less of Shark River Slough stations are coded yellow or red.			More than 25% of monitored stations in Shark River Slough were coded yellow or red for periphyton biomass, exceeding the desired state.
Shark River Slough periphyton composition	25% or less of Shark River Slough stations are coded yellow or red.		Not Monitored	The condition was not assessed this year, but in 2012 more than 25% of monitored stations in Shark River Slough were coded yellow or red for periphyton composition and this pattern is expected to continue for the next few years, exceeding the desired state.
Taylor Slough periphyton tissue phosphorus content	25% or less of Taylor Slough stations are coded yellow or red.			More than 25% of monitored stations in Taylor Slough were coded yellow or red for periphyton tissue phosphorus content, and reductions in hydroperiods, water depth, or increased nutrient loading may lead to declines in the indicator.
Taylor Slough periphyton biomass	25% or less of Taylor Slough stations are coded yellow or red.			More than 25% of monitored stations in Taylor Slough were coded yellow or red for periphyton biomass.

Water Quality: Total Phosphorus and Periphyton				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Taylor Slough periphyton composition	25% or less of Taylor Slough stations are coded yellow or red.		Not Monitored	The condition was not assessed this year, but in 2012 more than 25% of monitored stations in Taylor Slough were coded yellow or red for periphyton composition and this condition is expected to continue over the next few years, exceeding desired state.

The Freshwater Environment: Ridge, Slough, and Marl Prairies

Freshwater Fish and Aquatic Invertebrates

Fish and aquatic invertebrate assemblages play an important role in Everglades food webs and can be used as an indicator of ecosystem health. Factors that influence the fish and aquatic invertebrate populations cascade up the food web and influence species such as alligators and wading birds. The Desired State of Conservation is to maximize densities of small-sized freshwater fishes and aquatic invertebrates in a manner consistent with contemporary knowledge of the pre-drainage Everglades ecosystem. The near-term goal is a measurable positive trend in fish abundance that can be verified by monitoring field conditions and using models developed to predict population densities of freshwater fish and invertebrates relative to target hydrologic conditions (Trexler et al. 2003, Trexler and Goss 2009, Brandt et al. 2012). As with the periphyton indicator, freshwater fish metrics are reported for Shark Slough and Taylor Slough separately. The overall metric for freshwater fish and large aquatic invertebrates in each slough is based upon an average of independent assessments performed on each individual site. Condition assessments at individual sites in Shark River Slough were split between two opposing results. Fish abundance fell within expected model targets at half of the sites and fewer fish were observed than expected at the other half of the sites. Overall, the condition is considered a moderate concern with medium certainty in Shark River Slough because of the split between sites meeting and sites failing to meet target. Although this is an improvement from the 2013 condition assessment, this result was consistent for the past 2 years, which suggests a stable trend in Shark River Slough. In contrast, fewer fish were present than expected and drought tolerant species were more abundant than expected in Taylor Slough. Overall, this warranted significant concern and a declining trend from previous years in Taylor Slough. These results are summarized from those presented in Brandt et al. (2014). Corrective measures associated with increasing the duration of low nutrient surface water flooding (in both the ridge and slough and marl prairie communities) are hypothesized to contribute to increased freshwater faunal assemblages and promote a more natural species composition.

Fish and Wildlife: Freshwater Fauna				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Shark River Slough overall	Abundance is maximized in a manner that reflects pre-drainage conditions.			Marginally fewer fish were present than expected based on rainfall conditions, but drought-tolerant species were not overly abundant. This is an improvement in condition from the 2013 report, and the trend is stable from the previous year.
Taylor Slough overall	Abundance is maximized in a manner that reflects pre-drainage conditions.			Fewer fish were present than expected based on rainfall conditions and drought-tolerant species were abundant. Represents a decline in condition from previous years.

American Alligator

The American alligator is a keystone species that functions as an ecosystem engineer, directly or indirectly influencing nearly all aquatic life in the Everglades (Beard 1938, Craighead 1968, Mazzotti and Brandt 1994, Simmons and Ogden 1998). Alligators are important indicators of Everglades ecosystem health because they are responsive to hydrologic change; these characteristics make them ideal candidates for inclusion in long-term studies that track restoration progress. Alligators were abundant throughout the pre-drainage Everglades, but the highest densities were in the marl prairies and along the freshwater fringe of the mangrove communities within ENP. Alligators are much less common in these areas today because of reduced and highly variable water depths and hydroperiods in the marl prairies, and reduced freshwater flows and elevated salinities in the southern coastal marshes. Several metrics are monitored that together provide a picture of the status of alligators in ENP: nesting effort and nesting success, nest density and distribution, and population demographics including size class and relative density of alligators in the park. American alligator nesting responds readily to changing hydrologic conditions resulting from both environmental conditions and anthropogenic water management changes. Consequently, annual assessments of nesting success and effort may fluctuate substantially from year to year, and these metrics are best evaluated over long periods. Similarly, established alligators may shift home ranges and new recruits select alternative home ranges in response to changing habitat suitability.

Considering these dynamic factors, evaluations of population size and nesting are best achieved when considering alligator density and numbers across large areas of diverse habitat.

American Alligator				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Positive trend in nesting effort	Increasing trend in nesting effort throughout all freshwater marshes, particularly peripheral marshes historically believed to support the majority of nesting effort. The target is nesting effort consistent with a restored Everglades ecosystem.			Nesting effort has increased significantly since 1985; recent trends show more stability during poor to moderate conditions and record numbers during favorable conditions. 2012–2013 effort was consistent with a recent stable trend when taking into account normal variability related to different environmental conditions among years.
Positive trend in nest success	Increasing trend in nest success and reduced failure due to flooding of egg cavity. The target is nest success levels consistent with a restored Everglades ecosystem.			Nest success continues to be highly erratic due both to extreme natural and managed seasonal hydrologic fluctuation.

American Alligator				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Positive trend in nest density/distribution	Increasing trend in density of nests across hydrologic basins, particularly within shorter hydroperiod peripheral marshes. The target is nest density and distribution consistent with a restored Everglades ecosystem.			Nest density and distribution throughout freshwater hydrologic basins of ENP have demonstrated an increasing trend in recent years. 2012–2013 effort was consistent with recent stable trend when taking into account normal variability related to different environmental conditions among years.
Positive trend in alligator abundance	Increasing trend in abundance for all size classes of alligators within freshwater wetlands. The target is an abundance of alligators consistent with a restored Everglades ecosystem.			Results of spotlight surveys indicate reduced abundance estimates in all size classes within ENP. Recent surveys indicate continued relatively low abundance. Surveys in limited areas may not represent system-wide conditions. We are exploring new methods to expand this effort to provide more comprehensive assessment.

Everglades Wading Birds

The great abundance and diversity of wading birds—the herons, egrets, ibises, and storks—is a defining characteristic of the Everglades, and a significant reason for the creation of ENP. Since wading birds are relatively easy to monitor across the landscape and much is known about their habitat requirements and historical nesting patterns, they are excellent indicators of environmental conditions in the Everglades. Wading birds breeding in the Everglades require easily available and abundant aquatic prey, which are

dependent on a variety of environmental factors including the quantity, distribution, and timing of water flows.

In the pre-drainage Everglades, the largest and most persistent nesting colonies were at the marsh/mangrove ecotone in the southern portions of ENP. Large "super colonies" would form in response to peaks in prey-base availability, following years with high wet-season water levels and very stable dry-season recession rates. In the post-drainage Everglades, wading birds have seen a 70–90% reduction in abundance, and the major nesting areas have shifted northward into the impounded central Everglades (Water Conservation Areas). A number of key species, most notably the endangered wood stork, have also experienced a shift in the timing of reproduction, initiating nesting later into the dry season because water levels in the impounded central Everglades tend to recede more slowly. Under these conditions, fledglings emerge near the end of the dry season, and in years when wet season rainfall begins early, water levels rapidly rise, dispersing the prey base, and causing the nests to fail.

Everglades Wading Birds				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Total number of pairs of nesting birds in south Florida	Maintain or increase current total numbers of nesting birds in ENP mainland colonies to a level consistent with a restored Everglades ecosystem.			Absolute size of breeding populations of ibises, storks, and long-legged wading birds declined sharply from the 1930s to the 1970s. Since the mid-1980s, nesting numbers in ENP are trending up. Numbers fluctuate greatly from year to year.
Month of wood stork nest initiation	Month of wood stork nest initiation should be November or December.			Nest success continues to be highly erratic due both to extreme natural and managed seasonal hydrologic fluctuation. Trend is improving slightly, but storks continue to fail because of late nest initiation.

Everglades Wading Birds				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Proportion of nests located in ENP headwaters	At least 70% of all wading bird nests should be located in the headwaters ecotone of the mangrove estuary of Florida Bay and the Gulf of Mexico (ENP).			Recent trends are positive, especially for storks, but distant from the 70% target.
Mean interval between exceptional white ibis (*Eudocimus albus*) nesting years	Mean interval between exceptional white Ibis nesting years (≥13,000 nesting pairs) should be 1–2 years.			The trend is positive and consistent in recent years. This interval now consistently exceeds the target for restoration and has shown dramatic improvement in the last decade.
Ratio of wood stork and white ibis nests to great egret nests	Ratio of the combination of wood stork and white ibis nests to great egret nests should be 30:1, which is characteristic of the community composition of pre-drainage conditions.			Current ratio (3:1) is well below the 30:1 ratio that is considered to be representative of healthy nesting conditions. Ratio appears to have stabilized and has not moved much in the last 10 years (range ~1.5:1 to 4:1).

Fire Regime

Wildland fire is an important process in shaping the Everglades ecosystem. An appropriate fire regime on the landscape is necessary to maintain resilient communities that are likely to withstand severe organic substrate-consuming fires, decrease exotic plant species populations, prevent volatilization of organic soil, and provide a mosaic of habitats and unburned refugia for native plants and wildlife.

The desired state of conservation is that fire and fire effects on the landscape will, as much as possible, resemble a more natural/historic fire regime than currently exists. Fire-adapted habitats will experience predominantly low- to mixed-severity surface fires. Post-fire vegetation response will promote a mosaic of diverse natural habitats, while fire sensitive communities are protected from unwanted fire impacts.

Characteristics related to a restored Everglades ecosystem have been identified for the desired fire regime within the ridge and slough landscape. These include fires on the landscape that are predominantly low- or mixed-severity surface fires, mosaic patterns of burned and unburned landscapes, and fires that promote post-fire vegetation recovery.

Fire management actions influence post-fire vegetation recovery and mosaic burn patterns. With prescribed fire treatments, timing, environmental conditions, and ignition techniques influence fire behavior and subsequent fire effects. In wildfire situations, management actions may also influence fire effects. In the ridge and slough landscape, the interplay of fire and hydrology will determine the success in achieving the desired state of conservation for the fire regime and associated fire effects.

The fire regime indicator is currently in development. Future State of Conservation reports will include a stop-light indicator assessment of relevant fire regime criteria.

The Coastal and Estuarine Environment: Florida Bay

Salinity Patterns in Florida Bay

Salinity is a driving parameter controlling the major ecological processes in estuarine ecosystems, including the distribution of aquatic plants and animals, overall biological productivity, and nutrient cycling. In the pre-drainage ecosystem, freshwater inflows were more persistent, and stable estuarine, low-salinity conditions existed over large areas along the park's coastline along the Gulf of Mexico and throughout much of Florida Bay. In the post-drainage Everglades, water flows are diverted away from the park, causing the southern coastal ecosystems to receive less freshwater and become more marine. Three metrics are used to track the progress of salinities in Florida Bay toward the desired pre-drainage, low-salinity conditions. These are 1) the amount of time during the year that salinities are in the desired range; 2) a measure of the difference between observed salinities and the desired low-salinity conditions; and 3) a measure of the frequency of extreme high-salinity events. The goal is to have each of these measures reflect pre-drainage, low-salinity conditions. In the most recent 2 years, Florida Bay salinity performance metrics have been variable across stations but within the range of values observed over the period of record. While a slight improvement in mean salinity and extreme high-salinity event performance was observed in the upper eastern basins, a decrease in performance was observed at more central coastal stations. The bay-wide average conditions are poor with no indication of a sustained trend toward or away from the target conditions.

Salinity Patterns in Florida Bay				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Amount of time during the year that salinity is in the desired range	Salinity is within the interquartile range of the desired pre-drainage conditions 50% of the time.			Salinity conditions overlap with desired conditions only during 2 months at the end of the dry season. Conditions are variable but exhibit no year-to-year trend.

Salinity Patterns in Florida Bay				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Difference between observed mean salinities and desired mean salinities	The mean salinity is within the variability of the mean salinity of desired pre-drainage conditions.			The mean salinity is above desired mean salinity throughout the year. The degree of difference over the period of record (POR) is variable but largely driven by precipitation and shows no year-to-year trend.
Occurrence of extreme high-salinity events	Salinity does not exceed the 90th percentile defined by the desired conditions more frequently than 10% of the time.			Salinity exceeds the 90th percentile of the desired conditions much more frequently than desired and shows no year-to-year trend.

Algal Blooms in Florida Bay

Florida Bay has a history of highly variable water quality conditions, with algal bloom episodes that can last from weeks to even years. Blooms sustained for more than several months can be damaging to seagrass habitat and fauna, especially sponges. The last period of extended blooms was during 2005–2007. Conditions subsequently improved. In order to better understand causes of bloom variability and responses to Everglades restoration, the park has deployed and tested new automated sensors that provide prolonged high-frequency measurements ("continuous monitoring"). Field methodologies and data analyses have shown annual fluctuations especially in the North/Central region of the bay, possibly due to freshwater inputs from the Everglades. Additional monitoring using the current method will improve the ability to discriminate between "normal" variability due to climatic variability and other environmental factors and damaging conditions.

Algal Blooms in Florida Bay: Chlorophyll *a* Concentration				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Central Florida Bay (Whipray Basin) chlorophyll *a* concentration	Average monthly concentrations below 1 ppb.			Levels were below threshold levels through 2014, with annual average below 1 ppb. Elevated levels (as high as 23 ppb) have been recorded in previous years.
Northern Florida Bay (Garfield Bight and Terrapin Bay) chlorophyll *a* concentration	Average monthly concentrations below 1 ppb.			Levels in 2013–2014 were much lower and had only one month of elevated readings (22 ppb) in Garfield bay. Elevated levels recorded in 2012 included extremely high levels (12 to 21 ppb) for 5 months in Terrapin Bay. Improvement in recent years likely represents variability in a stable condition.
Western Florida Bay (Buoy Key) chlorophyll *a* concentration	Average monthly concentrations below 1 ppb.			Levels were below threshold levels through 2014, and only slightly above desired levels.
Southern Florida Bay (Peterson Key) chlorophyll *a* concentration	Average monthly concentrations below 0.5 ppb.			Levels were below threshold levels through 2014 and only slightly above desired levels.

Seagrasses in Florida Bay

The seagrass indicators are created from a set of metrics including spatial extent, abundance, species dominance, and presence of target species, which are monitored throughout Florida Bay. The Abundance Index combines all four metrics and reflects the status and health of the seagrass community as a whole, emphasizing abundance and spatial extent of seagrasses in Florida Bay. For the Abundance Index metric, the Desired State of Conservation is a long-term positive trend in community composition (abundance and extent) of submerged aquatic vegetation (SAV) in the Florida Bay ecosystem. The Target Species Index is a measurement of the frequency of occurrence of the desirable non-dominant SAV species that are expected to increase with increased freshwater flow to Florida bay *(Halodule, Ruppia)*, resulting in improved habitat quality (Madden et al. 2009). For the Target Species Index, the desired State of Conservation is a long-term positive trend toward restoration conditions in the distribution of *Halodule* and *Ruppia* in the Florida Bay ecosystem. Indicator targets vary spatially and are zone-specific due to the complexities of the bay bottom and associated factors. For 2013–2014, results are based largely on findings from the South Florida Water Management District as reported in Brandt et al. (2014).

Seagrasses in Florida Bay				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
NORTHEASTERN ZONE				
Seagrass abundance	Abundance of seagrass consistent with a restored Everglades ecosystem.			Aggregate abundance Index has now remained favorable for 5 years, indicating recovery from the 2005–2008 algal bloom. Environmental conditions in the region (primarily salinity) suggest potential for unfavorable conditions to develop.
Target species diversity	Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem.			Species diversity index improved since 2012 and stabilized in the favorable range in 2013 and 2014, though environmental conditions show potential for reduction in diversity.

Seagrasses in Florida Bay				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
TRANSITION ZONE				
Seagrass abundance	Abundance of seagrass consistent with a restored Everglades ecosystem.			Aggregate Abundance Index was fair for 2013 and 2014, and has not shown improvement since density levels fell in 2006.
Target species diversity	Seagrass species diversity and niche diversity consistent with a restored Everglades ecosystem.			Species diversity improved from 2013 to 2014 with expansion of *Ruppia*, and is approaching favorable conditions, though may not be stable.
CENTRAL ZONE				
Seagrass abundance	Abundance of seagrass consistent with a restored Everglades ecosystem.			Aggregate Abundance Index continued to be fair for 2013–2014, since improving from poor in 2008.
Target species diversity	Species diversity and niche diversity consistent with a restored Everglades ecosystem.			Reflects the increasing presence of target species of *Halodule* and *Ruppia*.
SOUTHERN ZONE				
Seagrass abundance	Abundance of seagrass consistent with a restored Everglades ecosystem.			The seagrass abundance continues to be poor in the region.

Seagrasses in Florida Bay				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Target species diversity	Species diversity and niche diversity consistent with a restored Everglades ecosystem.			Fair after improving in 2009 from several years in the poor range. *Thalassia* continues to dominate.
WESTERN ZONE				
Seagrass abundance	Abundance of seagrass consistent with a restored Everglades ecosystem.			Reductions in abundance in 2013 and 2014 were recorded in the western zone.
Target species diversity	Species diversity niche diversity consistent with a restored Everglades ecosystem.			Reflects good scores because the target species component increased.

Estuarine Fish (Sport Fish) and Invertebrates

The abundance and availability of the four native sport fish species chosen indicate the condition of nearshore marine and estuarine communities because each of these species relies on this region for its entire life cycle. Sport fish are monitored using a metric called "catch per unit effort" or CPUE, which tracks the catch success of fishermen who are targeting the particular species in the bay. The Desired State of Conservation for the sport fish species is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions. Unlike some other indicators in this suite, the Desired State of Conservation for sport fish may be met before full freshwater restoration is achieved, because it is currently based on the standard of sustaining conditions experienced over the last two decades. With additional analysis, we may be able to more fully develop this indicator and its associated State of Conservation with respect to restoration of freshwater flows. Pink shrimp density is sampled in the spring and the fall and has been shown to closely track upstream water management changes. The desired condition for pink shrimp is to have densities at or above those recorded during the pre-restoration baseline at the majority of sites in Florida Bay and along the southwestern coast of ENP. An analysis of pink shrimp was completed for the 2013 Condition and Trend, but not for 2015 due to unavailability of these data.

Estuarine Fish (sport fish) and Invertebrates				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Trend in snook (*Centropomus undecimalis*) catch-per-unit effort (CPUE)	The target is the CPUE levels during 2007–2009, or at least a stable CPUE trend, indicating sustainable recreational use and environmental conditions.			Snook populations declined in response to a cold-spell kill in 2010. The CPUE has indicated a return to a stable condition approaching recovery.
Trend in red drum (*Sciaenops ocellata*) CPUE	The target is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions.			Red drum CPUE has been relatively stable for the period of record (POR) and has increased in recent years (2010–2013).
Trend in spotted seatrout (*Cynoscion nebulosus*) CPUE	The target is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions.			Spotted seatrout CPUE has been relatively stable for the POR, with indications of a slightly increasing trend from 2005–2011.
Trend in gray snapper (*Lutjanus griseus*) CPUE	The target is a stable to increasing trend in CPUE, indicating sustainable recreational use and environmental conditions.			Gray snapper CPUE has been relatively stable for the POR, with indications of an increase in CPUE since 2006.

Estuarine Fish (sport fish) and Invertebrates				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Pink shrimp (*Farfantepenaeus duorarum)* density	The target is densities at or above those recorded during the pre-restoration baseline at the majority of sites in Florida Bay and along the southwestern coast of ENP. Note: restoration projects are not yet complete.		No data available since 2012.	In the 2013 Condition and Trend, pink shrimp density was generally below baseline levels and showed a declining trend at most sites compared to the pre-restoration baseline.

American Crocodile

The American crocodile (*Crocodylus acutus*) functions as an ecosystem indicator in the coastal areas of the Everglades because its lifecycle is responsive to patterns of freshwater flow to the estuaries and resultant nearshore salinity patterns. American crocodiles were federally listed as "endangered" by the U.S. Fish and Wildlife Service (USFWS) in 1975, largely due to extensive habitat degradation (including nesting sites) and over-hunting. Crocodile recovery has been a story of cautious success in south Florida. While still in need of continuing protection, there are more crocodiles in more places today than there have been for at least the prior 35 years, thus leading to USFWS reclassification to "threatened" in 2007.

The most important metrics believed to directly relate crocodiles to hydrologic restoration include nest distribution/nesting effort, and differential growth and survival from hatching to late juvenile stages. Crocodiles nest in the late dry season primarily in elevated, sandy areas along ENP mangrove shorelines and also islands of northeast (NE) Florida Bay. Hatchlings have to migrate inland from their nesting sites to nursery areas because they cannot tolerate high salinity for extended periods. Habitat degradation and water management practices have reduced freshwater inflows to the coast of south Florida. Effects of unnatural freshwater flows include: longer hatchling migration to suitable nursery habitat, reduced use of nest sites further from mainland freshwater sources, and impacts to growth, survival, and dispersal of juvenile crocodiles.

Periodic sampling of these metrics in crocodiles has been underway in ENP and surrounding areas since 1978. Three metrics are reported: relative density, distribution, and abundance of American crocodiles, reproductive effort (nesting effort, nest success, and nest distribution), and hatchling and juvenile growth and survival. This entire suite of characteristics is used to infer trends in total population.

Nesting effort has increased throughout ENP and has been most pronounced in the Flamingo/Cape Sable region. Nesting continues to increase in NE Florida Bay but at a much slower rate. Hatchling growth rates (which increase odds of survival) have also significantly improved in the Flamingo/Cape Sable regions but not in NE Florida Bay. These positive crocodile responses are coincident with ongoing efforts to plug canals and reduce unnatural saltwater intrusion in the Cape Sable/Flamingo region. Similar responses are predicted within the NE Florida Bay region as upstream hydrologic restoration projects are completed and more natural freshwater flows restored.

American Crocodile				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Trend in total population	Population is nearing pre-drainage estimates consistent with a restored Everglades ecosystem. Occupation throughout historic range.			Total population is inferred from the other metrics monitored. From 2011–2013, relative density, distribution, and abundance increased in some areas and, decreased in others. Nesting has increased throughout ENP.
Trend in reproduction	Increasing trend present in nesting effort, distribution, and success in ENP, including historical nesting sites in northeastern Florida Bay. Increasing trend present in growth and survival of juvenile crocodiles, consistent with a restored Everglades ecosystem.			Reproductive effort within ENP has exhibited an increasing trend and is the best indicator of continued species recovery. Nesting effort peaked in 2008, declined in 2009–10, and has slowly rebounded from 2011to present.
Trend in hatchling-juvenile growth and survival	Reduced salinity regimes occur, encouraging rapid hatchling growth rates (approaching mass ≥200 g 3–4 months post-hatching) and allowing juveniles to more rapidly reach total length ≥75 cm.			Survival is directly linked to increased hatchling-juvenile growth rates, which increase with lower salinities. Hatchlings within ENP consistently exhibit lower growth rates than adjacent nursery sites.

Roseate Spoonbill

The roseate spoonbill (*Platalea ajaja*) was almost extirpated in Florida during the early decades of the 20th century. By 1935, the only known nesting colony in the state consisted of about 15 pairs on Bottle Key in Florida Bay (Allen 1942). Spoonbill abundance steadily increased from the time ENP was established in 1948 until the early 1980s, at which time 1,258 nests were estimated. Following 1984, the expansion of canal systems and changes in water management practices began to impact spoonbills nesting in Florida Bay by diminishing, redirecting, and disrupting the timing of freshwater inflows and

thus negatively affecting the availability of prey on spoonbill foraging grounds. After 1984, numbers steadily declined to a low of 87 nests in the 2010–2011 nesting season. The state of Florida reclassified the status of the roseate spoonbill from a “Species of Special Concern” to "Threatened" because of the bird's small population and restricted range (Florida Fish and Wildlife Conservation Commission 2011). However, it is important to note that statewide, spoonbill numbers and nesting locations are on the rise, with statewide nests currently estimated to be about 1,250–1,500. Because spoonbills are nesting in areas outside the park, it is a clear indication that the Florida Bay birds are being affected by manmade changes to their foraging wetlands in the Everglades. Reestablishment of healthy spoonbill breeding populations in Florida Bay is required if ENP is to be removed from the list of World Heritage Sites in Danger.

This indicator assessment is largely based on data collected by Audubon of Florida, as summarized in Brandt et al. (2014). Roseate spoonbills are well adapted to the variable environmental conditions of south Florida; consequently, they respond readily to rainfall patterns as well as anthropogenic hydrologic management actions. These behavioral responses can sometimes result in substantial variation in indicator values among years. Consequently, trends in condition are best evaluated over long periods, with an expectation of some variation around the trend among years.

Roseate Spoonbill				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Total number of pairs of nesting roseate spoonbills in Florida Bay	Increase and maintain the number spoonbill nests in Florida Bay to those consistent with peak (pre–1984) numbers.			Breeding populations of roseate spoonbills in Florida Bay have decreased sharply since the 1980s and remain below the minimum target.
Presence of roseate spoonbills in historical nesting sites in northeast Florida Bay (NEFB)	Increase the number spoonbill nests at historical colony sites in NEFB.			Past trends were above the target (1988–1991); however, numbers declined during 2002–2013. A historical colony has since become active again with positive influence on nest numbers for NEFB.

Roseate Spoonbill				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Presence of roseate spoonbills in historical nesting sites in northwest Florida Bay (NWFB)	Increase the number of spoonbills nests at historical colony sites in NWFB.			Past trends were above the target (1991) and slowly declined (2002–2009). The downward trend through 2014 has brought the indicator below the target.
Roseate spoonbill chick production in NEFB	Increase the number of chicks fledged per nest attempt at historical colony sites in NEFB.			Past trends were above the target (1991–1992) but declined sharply (1994–2001), rose again to near target, and declined in 2013. However, the overall trend is still positive.
Roseate spoonbill chick production in NWFB	Increase the number of chicks fledged per nest attempt at historical colony sites in NWFB.			Many seasons were at or above target but nest success has recently fallen below the target. Delay in restoration of foraging grounds and predation by crows are having a negative impact on NWFB colonies.

Exotic Invasive Species

The corrective measures established for ecosystem restoration include numerous modifications to the water management system to improve hydrologic parameters and to lower the input of nutrients to the ecosystem. Some of these hydrologic corrective measures, such as the re-connection of previously separated water bodies by removal of levees or construction of pump stations, may actually increase the potential for the invasion of exotic species into the park (Kline et al. 2013). This issue has been recognized by the agencies implementing Everglades Restoration: however, solutions are complex and require a high degree of innovation.

Everglades National Park is working to maintain and expand existing successful exotics control and maintenance programs, primarily for plants. Control programs are not established for invasive exotic fish (freshwater or marine) or wildlife (particularly herpetofauna); therefore, the park is working to keep track of existing and new invasions, and is investing in research, early detection and rapid response where possible, and on education, outreach, and working with policymakers. The park has not yet established formal corrective measures with the World Heritage Committee with respect to exotic species. This report builds on the 2012 World Heritage report in the development of indicator metrics and statements of desired conditions.

Invasive Exotic Plants

Approximately 1,000 plant species currently are recorded in ENP and of these, approximately 250 are non-native (exotic) plants. Of these approximately 250 exotic plant species, four are of the highest management priority in ENP: melaleuca (*Melaleuca quinquenervia*), Australian pine (*Casuarina equisetifolia*), Old World climbing fern (*Lygodium microphyllum*), and Brazilian pepper (*Schinus terebinthifolius*). The percent cover of these invasive exotic plant species is measured during bi-annual (every 2 years) overflights throughout ENP, through a technique called Digital Aerial Sketch Mapping (DASM).

The desired state of these exotic plants and their management in ENP is species-dependent. Their current status reflects funding available for control, current treatment technologies, and the biology, distribution and accessibility of the particular exotic plant species. For melaleuca and Australian pine, the Desired State of Conservation is defined as less than 1% cover per km^2 in the areas now or historically containing these species, and prevention of the expansion of these species to new areas. The Desired State of Conservation for Old World climbing fern and Brazilian pepper is set as less than 5% cover per km^2 in areas currently containing these species, and prevention of the expansion of these species to new areas. The Desired State of Conservation of the remaining exotic plant species is defined as less than 1% cover per species per km^2 in areas currently containing these species, and prevention of the expansion of these species to new areas. The Desired State of Conservation would also include monitoring and control of newly detected species.

Invasive Exotic Plants				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Percent cover of melaleuca *(Melaleuca quinquenervia)*	Less than 1% cover per km^2 present in currently infested areas and area of infestation is not expanding.			Most park invasive plant management effort is directed at this species. Chemical and bio-control agents are effective. Number of infested acres has decreased during the past 10 years.

Invasive Exotic Plants				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Percent cover of Australian pine (*Casuarina equisetifolia*)	Less than 1% cover per km^2 present in currently infested areas and area of infestation is not expanding.			*Casuarina* is second in terms of the amount of effort dedicated to management. Chemical control is effective, but access to some remote infestations is difficult. No effective bio-control exists. Number of infested acres is decreasing.
Percent cover of Old World climbing fern (*Lygodium microphyllum*)	Less than 5% cover per km^2 present in currently infested areas and area of infestation is not expanding.			Management activity is limited by remoteness but is effective on dense infestations. Development of an effective bio-control is possible. Change in condition & trend due to 2013 DASM survey information showing expanded areas of *Lygodium* coverage and other reports of *Lygodium* being detected in areas it was previously not detected in.
Percent cover of Brazilian pepper (*Schinus terebinthifolius*)	Less than 5% cover per km^2 present in currently infested areas and area of infestation is not expanding.			Management of this species is limited to specific areas of high priority. No effective control currently exists for use in remote areas. No effective bio-control exists. Overall, the area of infestation is increasing.

Invasive Exotic Plants				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Percent cover of additional collective exotic plant species	Less than 1% cover per km^2 present in currently infested areas and area of infestation is not expanding.			Management efforts for these species are currently limited to areas of high concern such as those with high visitor use or areas with threatened and endangered species that may be impacted by the presence of exotic plants. Chemical controls and effective bio-controls differ by species. The overall area affected by the combination of these plants is increasing.

Invasive Exotic Fish and Wildlife

Invasive exotic fish and wildlife continue to present significant challenges in ENP. Because new introductions dilute available management resources, preventing the arrival and establishment of additional species remains the preferred course of action for ENP. Unfortunately, there is little reasonable optimism that favorable regulatory action—for which the National Park Service bears no significant authority—will be advanced in the near future. Thus, park efforts focus on addressing new threats as they emerge, and conducting long-term management of well-established species.

No new introductions of exotic freshwater fishes have been observed in ENP since 2010, suggesting that the rate of introduction for these species may be slowing from the rate observed between 2000 and 2009. During a study of fish assemblages in the border canals during 2010–2013, only one exotic species not already known to have been present in ENP was collected—grass carp (*Ctenopharyngodon idella*), a species stocked by the South Florida Water Management District for aquatic vegetation control. ENP may be virtually saturated with the exotic fish species presently established in the canals bordering the park. However, other exotic fishes persisting in more distant urban canals could potentially spread to ENP. Furthermore, several new exotic fishes recently collected in Florida could establish populations that pose a risk of spreading into ENP.

The relative abundance of exotic freshwater fishes remained below threshold levels at the long-term monitoring sites in Shark River and Taylor sloughs; however, the relative abundance and spatial distribution has increased over the entire freshwater area of ENP. Exotic fishes have exceeded the 2% threshold at a few of the long-term monitoring sites in Shark River and Taylor sloughs, but on average remained <2%. However the relative abundance and spatial distribution of exotic fish reached study highs of 44% and 84%, respectively, in the October 2013 park-wide project. The non-native African Jewelfish

(*Hemichromis letourneuxi*) is becoming the largest component of fish catch in this study. High catches and relative abundance of African jewelfish in shorter hydroperiod marshes and an increase in relative abundance in slough habitats may be driving this trend.

Best available evidence suggests all previously documented exotic invasive reptile and amphibian species continue to persist across their formerly known range in and around ENP. Limited monitoring and survey efforts during 2012 –2013 also suggest range expansion for select species, including the Burmese python (*Python molurus bivittatus*) and the Argentine tegu (*Tupinambis merianae*). New species of nonnative herpetofauna have been discovered in south Florida in recent years (*Furcifer pardalis*, *Leiolepis rubritaeniata)*, as have new satellite populations of previously established species (*Chamaeleo calyptratus*). The latter—in particular—presents a potential threat for incursion into ENP.

Though some suppression and containment efforts continue, there is little evidence these actions are providing demonstrable control. Burmese pythons were captured in substantial numbers in 2013 and 2014 (B. Falk, U.S. Geological Survey, personal communication, January 21, 2015), during which two specimens set new size records for the state of Florida. Argentine tegus continue to be captured in increasing numbers and have been documented to take a wide variety of native prey—including eggs from the nests of American alligators. And though credible sightings of Northern African pythons (*Python sebae*) have been scant over recent years, optimism is somewhat marred by the relative lack of organized monitoring effort undertaken during the 2013–2014 survey seasons.

Presently, the Indo-Pacific lionfish (*Pterois volitans*) is the only invasive marine species of note in and around ENP. Partner agencies have documented the occurrence of lionfish in large numbers along the Intracoastal Waterway immediately outside the park boundary. In 2010, lionfish were first reported in ENP, and sightings from park staff and visitors have been increasing in subsequent years. The park initiated a lionfish monitoring program in 2013, and to date a total of 27 lionfish have been found in Florida Bay.

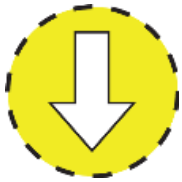
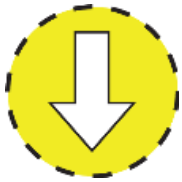
Though the majority of lionfish captured thus far in ENP have been associated with hardbottom environments, the species is known to occupy a wide range of habitats including coral reef, seagrass, mangrove, estuary, and man-made structures. Coupled with their ability to tolerate a wide range of salinities, lionfish can potentially invade any habitat within Florida Bay. Because seagrass beds and mangrove areas are known to be important nursery areas for juvenile fish and invertebrates, the potential impact of lionfish in ENP is a serious concern.

Given the limited time since introduction, no trend in lionfish population or occurrence can be established at present. However, the potential for lionfish recruitment into Florida Bay appears high. Thus, we expect the number of lionfish sightings will continue to increase over time.

Enhanced information sharing and planning across non-governmental organizations and local, state, federal, and tribal governments provides some optimism. Collaboration across organizations has resulted in a more effective sharing of information and resources, and intensive early detection and rapid response efforts. Nonetheless, it is not yet clear that interagency efforts have influenced the overall status and trends of invasive exotic fish and wildlife in south Florida.

Invasive Exotic Fish and Wildlife (Freshwater and Marine)				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
A. FRESHWATER FISH				
Rate of new introductions of exotic fish	Rate of new introductions of exotic fishes is decreasing over time.			No new introductions of exotic freshwater fish have occurred in ENP since 2010, suggesting the rate of introductions may be decreasing from that observed in the previous decade.
Relative abundance of exotic fishes in Shark River Slough	Freshwater fish assemblage is dominated by native species and contains less than a 2% relative abundance of exotic individuals.			Exotic species are present and relative abundance is increasing, but on average, relative abundance continues to be less than 2% threshold at monitored sites.
Relative abundance of exotic fishes in Taylor Slough	Freshwater fish assemblage is dominated by native species and contains less than a 2% relative abundance of exotic individuals.			Exotic species are present and relative abundance is increasing, but on average, relative abundance continues to be less than 2% threshold at monitored sites.
Relative abundance of exotic fishes in ENP-wide annual sample	Freshwater fish assemblage is dominated by native species and contains less than a 2% relative abundance of exotic individuals.			The relative abundance and spatial occurrence of exotic fish reached study highs.

Invasive Exotic Fish and Wildlife (Freshwater and Marine)				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
B. HERPETOFAUNA				
Rate of new herpetofaunal introductions in and around ENP	Minimize and eliminate new invasive herpetofaunal introductions to ENP.			Several new species have been reported in south Florida in recent years, as well as new satellite populations of previously established species. There is presently little prospect for comprehensive preventative regulation.
Containment and control of established populations: Burmese python	Burmese python population in the park is contained and decreasing.			Available evidence suggests Burmese pythons occupy an increasingly larger range over which they are having a significant impact. There remains little optimism for widespread control.
Response efforts to known invasives adjacent to ENP: Northern African python	Known invasives adjacent to ENP are eliminated prior to establishment in the park.			Credible observations of Northern African pythons have been scant in recent years. However, a lack of significant effort over the 2013–2014 survey seasons provides little evidence upon which to assess the current status of this population.

Invasive Exotic Fish and Wildlife (Freshwater and Marine)				
Criteria	**Desired State of Conservation**	**Condition & Trend Assessed for the 2013 Report**	**Condition & Trend Assessed for the 2015 Report**	**Rationale**
Response to recent introductions to the park: Argentine tegu	Recent introductions to the park are effectively addressed and populations of incipient invasives are eliminated.			Several tegus invaded ENP from neighboring populations, and many have been captured just outside park boundaries. Funding constraints threaten the continuity of trapping and monitoring efforts.
C. MARINE SPECIES				
Lionfish density	Minimize the number of lionfish in Florida Bay			Lionfish density in mangroves and on seagrass beds often exceeds density on reefs (Barbour 2010, Claydon 2010).
Biomass of prey species	Minimize the impact from lionfish on post-settlement native fish and invertebrate populations			Lionfish will have a large impact on prey species
Distribution of lionfish	Minimize the spatial distribution of lionfish			Lionfish are able to invade any habitat type within Florida Bay

THE ROLE OF THE CORRECTIVE MEASURES

In response to the four major threats to the integrity of ENP ecosystems, the United States and the State of Florida have, since the 1993 listing of the park on the list of Sites in Danger, made substantial investments into region-wide Everglades Restoration initiatives. By the mid- to late-1990s, the Federal government began construction on two major water engineering projects, the Modified Water Deliveries (MWD) and C–111 South Dade projects, which were designed to improve water deliveries to and reduce groundwater seepage losses from ENP. At the same time, as a result of a federal water quality Consent Decree, the State of Florida began work on the Everglades Construction Project and Long-Term Plan, constructing a series of man-made wetlands (stormwater treatment areas [STAs]) and implementing Best Management Practices (BMPs) to reduce nutrients entering the Everglades ecosystem from the agricultural areas south of Lake Okeechobee (National Research Council 2008, 2010, and 2012). An additional large-scale restoration program, called the Comprehensive Everglades Restoration Plan (CERP), is a joint Federal/State of Florida effort that was conceptually designed during the mid- to-late 1990s. CERP was approved and authorized by Congress in 2000 for further planning and implementation (www.evergladesplan.org).

These four large projects, regional in scope and multi-decadal in implementation, together are intended to make structural and operational changes to the water management system that should restore significant ecological function, ecosystem resilience, and fish and wildlife abundance to ENP, as well as to other parts of the south Florida ecosystem. On-the-ground implementation of features (such as removal of levees, filling of canals, or addition of flow-ways), and changes to water operations (such as water control plans that allow more water to reach the park) are expected to bring about positive change in hydrologic and ecological indicators of ecosystem integrity. In 2006, the United States proposed and the World Heritage Committee accepted these projects as *benchmarks* toward recovery of ENP. Individual elements of these large projects were identified as *corrective measures* that, when implemented as originally conceived and described, are expected to bring about specific, measurable, and positive changes to integrity indicators, including both hydrologic and ecological metrics, within the park.

Corrective Measures as of 2015: Continued Constraints but Tangible Progress

The landscape of south Florida is one of the largest, most highly engineered, and closely operated water management systems in the world. It was designed specifically, and is currently operated specifically, to provide flood protection and water supply to the urban and agricultural areas of Miami, Fort Lauderdale, and West Palm Beach. All of the above-mentioned large-scale projects assure that legal levels of flood protection, as well as water availability for people, will not be diminished as a result of implementation of restoration project features. In the very important case of NESRS in the park, flood-protection features must be finished prior to implementation of restoration features that bring water back to areas that have been too dry for decades.

These constraints are integral to the work on restoration of the natural system and can change rapidly as urban development moves closer to the natural system and as the face of agriculture in south Florida changes in response to economic factors. Although the overall purpose and vision of the large-scale restoration projects remains the same, this backdrop of shifting constraints (encompassing legal and economic issues as well as land use) provokes changes in the scope and timing of implementation of restoration corrective measures. Reductions in scope of one large-scale project may mean that another project takes up the slack, albeit at a slower pace and with modified features. The major concepts—restoring flow through removal of barriers, reducing nutrient inputs into the natural system, stopping the loss of water from the natural system (seepage control)—remain the same, while the official title and agency “home” of the project and/or its components and the associated engineering solutions are highly mutable through time.

The 2015 status of the corrective measures that track progress on engineered restoration features is provided in Table 3. The table includes the original benchmarks and corrective measures that were identified in 2006, the status of those measures in 2013, and the status as we move into 2015. By examining a particular corrective measure through time, the effects of shifting constraints as well as the changing nature of planned solutions is evident. Also included in the table is the "Park Need," which describes in conceptual terms what is needed for restoration: protection of the built system (flood protection), delivery of water in consonance with rainfall patterns, nutrient reduction, removal of barriers to flow, and increase in water levels in the park. The Park Need provides an anchor for the corrective measure that allows tracking of the logical, ecosystem-based origin of a particular action through time and as the action (i.e., corrective measure) travels through various projects.

A number of changes to the corrective measures occurred in 2013 and 2014, in both the implementation and the planning arenas.

Implementation of Corrective Measures

- Corrective Measure 1B (rainfall-driven water deliveries): The park continues to operate under the water control plan called the Everglades Restoration Transition Plan. Incremental field testing to slightly increase water flows to NESRS is expected to begin in April 2015. The final operational plan for the Modified Water Deliveries Project is not expected to be complete until 2019, and in its final form will fall well short of delivering the desired water targets to ENP.
- Corrective Measure 1C (removal of barriers to flow): Construction of the Tamiami Trail 1-mile bridge and associated road-raising is complete, and water is flowing under the bridge.
- Corrective Measure 1C (removal of barriers to flow): The Decompartmentalization physical model along the L–67 levees and canals is complete. Testing outside ENP for the ecological effects of additional water volume and sheetflow began in late 2013 and will continue through 2015.
- Corrective Measure 2C (seepage control): Construction of the 2-mile-long rock-mining shallow seepage barrier pilot project just south of Tamiami Trail was completed in the spring of 2012. The shallow seepage barrier is intended not only to keep ENP seepage from affecting adjacent agriculture and urban locations, but to keep the water in the park for hydrologic restoration. The barrier needs to be shallow, to allow deeper water supply flows to Miami Dade to travel under it; thus, the total reduction in loss of water from ENP from this project is expected to be small.
- Corrective Measure 4B (water to Florida Bay): Phase 1 (Western Project) of the C–111 Spreader Canal project was completed in spring of 2012 and began operating in July 2012. In 2015, the South Florida Water Management District will report on an evaluation of the first 3 years of operation of this project. The schedule for additional phases of the project, to reach the full project scope as originally designed in the CERP, is dependent on Congressional authorization and as such, timing is uncertain.

Planning Changes to Corrective Measures

- Corrective Measure 1A (land acquisition): The NPS is moving forward with acquisition of the remaining six parcels of land in the East Everglades Acquisition Area. Real estate interests that allow water to flow on these lands are expected to be acquired by the NPS by 2018; cures to protect infrastructure from increased water levels are not expected to be complete until 2021.
- Corrective Measure 1B (rainfall-driven water deliveries): The Central Everglades Planning Project (CEPP) has been finalized and a Record of Decision was signed by the USACE in December 2014. The CEPP is an evolution of the Comprehensive Everglades Restoration Plan.

Construction is not expected to begin before 2022. New targets and operational approaches from CEPP may encourage the redistribution of water into NESRS before that date.

- Corrective Measure 1C (removal of barriers to flow): The next, more detailed phase of planning/design for the Tamiami Trail Next Steps (TTNS) project is underway as of October 2012. Final design and permits for Phase 1 of this project (2.6 miles of a total of 5.5 additional miles of bridging, and associated road-raising) are nearly complete, a contract is expected to be in place by December of 2015, and construction is expected to be complete by 2019.
- Corrective Measure 1C (removal of barriers to flow): Decompartmentalization and Sheetflow Enhancement features have been incorporated into the approved Final Environmental Impact Statement for the CEPP project. However, at the time of this writing, the timeline for these features is delayed, with the first phase (L–29 levee removal) expected to occur by 2031, and the upstream features expected to occur beyond 2040.
- Corrective Measure 2C (seepage control): Construction of the C–111 northern detention area, critical to the functioning of the MWD project, is delayed and currently expected to be complete by the end of 2017.
- Corrective Measure 3 (water quality): The first phase of water quality treatment efforts (1992–2009) were not resulting in desired decreases in TP concentrations; therefore, the State of Florida agreed to a second phase. Construction on this second phase is proceeding as planned. The Flow Equalization Basin (FEB) that will most directly affect the park will be constructed by 2016 and functioning at full compliance by 2021. These water quality treatment features will allow for changes to the distribution of the existing water that currently reaches the northern border of ENP, but will not allow for increasing the overall volume of water deliveries to the northern border of ENP. A third phase of water quality treatment will be constructed under CEPP, which calls for an additional FEB to assist in the treatment of the additional flows to the park anticipated under this new restoration project.

Table 3. Everglades National Park – History and Status of Corrective Measures 2015.

Corrective Measure (Established 2006)	Status of Corrective Measure 2013	Status of Corrective Measure 2015
Threats 1 and 2: Alterations to the Natural Hydrologic Regime, and Adjacent Urban and Agricultural Growth.		
Park Need: Public ownership of lands in the East Everglades is a prerequisite to re-establishing water flows in Northeast Shark River Slough.		
1A: Complete East Everglades Expansion Area land acquisition (approximately 44,000 hectares (ha)).	1A: Land acquisition is 99% complete though six of the largest parcels remain in private ownership, totaling 300 ha. Funds for acquisition remain in the NPS budget. An NPS decision on the pathway for acquisition of five of the six parcels is expected in 2013. NPS is preparing an Environmental Impact Statement for acquisition of the sixth and largest parcel (a utility corridor of approximately 134 ha). Estimated completion date is spring 2014.	1A: Land acquisition is 99% complete, though six of the parcels remain in private ownership, totaling 300 ha. Real estate funding is available in the NPS budget. Limited water flow improvements in Northeast Shark River Slough will begin in April 2015, but full implementation requires both the acquisition of all private property and construction of flood protection cures for any remaining developed sites in the East Everglades. The NPS is currently acquiring real estate interests on two radio tower sites and three commercial airboat operations through a combination of fee simple acquisition and flowage easements (expected completion is in 2018). Planning for the flood protection cures is underway, but completion of design & construction is expected to extend into 2021, pending additional appropriations. The NPS has completed a draft Environmental Impact Statement for acquisition of the sixth and largest parcel (a utility corridor of approximately 134 ha). The Final EIS is expected in late 2015, and a proposed land exchange will likely occur in 2016.
Park Need: The inhabited area adjacent to the park, called the 8.5 Square Mile Area, must be protected from flooding in order to allow water flows into NESRS.		
1B: Complete flood mitigation features in the 8.5 Square Mile Area.	1B: Construction of the flood mitigation features for the 8.5 Square Mile Area was completed in 2009. Monitoring data indicated that additional work was needed to achieve flood protection goals. A "connector canal" modification was designed in 2012 and construction will be completed in 2013. Completion of this project will remove one of the main barriers to increasing water levels in the L–29 canal.	1B: The construction of the "connector canal" modification has been delayed but is estimated to be complete in May 2015. This will remove one of the main barriers to increasing water levels in NESRS. Note that this project is also linked to Corrective Measure 4A: Full implementation of the 8.5 Square Mile Area flood mitigation system depends on completion of the C-111 North Detention Area, which receives stormwater runoff from the 8.5 SMA system. Note that this project is also linked to Corrective Measure 2C: protection of the 8.5 Square Mile Area not only provides flood mitigation to residents, but also provides one of the numerous elements of seepage control along the eastern border of the park.

Table 3. Everglades National Park – History and Status of Corrective Measures 2015. Continued.

Corrective Measure (Established 2006)	Status of Corrective Measure 2013	Status of Corrective Measure 2015
Park Need: A water control plan defining water operations that will improve rainfall-based water deliveries and promote increased sheetflow to ENP, while maintaining flood control and water supply requirements is necessary.		
1B: Complete the Water Control Plan (CSOP) for the Modified Water Deliveries (MWD) and C–111 South Dade Projects. This Corrective Measure is the same as Corrective Measure 2B.	1B: Everglades Restoration Transition Plan operations have been implemented. A water operations field test is being designed and agreed upon between the U.S. Government and the State of Florida that should address water quality concerns associated with increases in flow to NESRS. This field test is expected in early 2013 and will last for 2 years. The CSOP and the COP plans have been eliminated from the MWD project, and future water control plans will be developed at the conclusion of the field test. Changes to water operations are likely to move forward very slowly and in small increments. Substantial change will occur only when raising and bridging the Tamiami Trail is complete as envisioned in the Central Everglades Planning Project (CEPP—a new element of the CERP) and the Tamiami Trail Next Steps (TTNS) project. Timeline for completion of these projects is >10 years from now.	1B: Everglades Restoration Transition Plan (ERTP) went into effect in late 2012 and is sending more water southward from Water Conservation Area 3A into ENP and the South Dade Conveyance System. The new Combined Operational Plan will built on the ERTP and further modify the water management regime in Water Conservation Area 3A, ENP, and the South Dade Conveyance System. The planned incremental field testing to reintroduce larger flows into NESRS is expected to start in April 2015. The first phase involves a minor relaxation of a marsh operational constraint and turning on the S-356 seepage control pump station, but does not include raising water levels in the upstream L-29 canal. This first increment will last up to 2 years. The second incremental test would begin to raise L-29 canal stages, after all of the East Everglades real estate acquisitions are in place and the 8.5 SMA flood mitigation features are fully operational (corrective measures 1A and 1B above) . The Combined Operational Plan and its associated Environmental Impact Statement is a significant interagency planning process, and will include extensive hydrological and ecological modeling and assessments that will incorporate the results of the incremental field testing. Initial model development will begin in 2015, but the final EIS is not expected to be complete until 2019. When fully implemented, the Modified Water Deliveries project would fall well short of achieving the 550Kaf/year average annual water volume target for the Northeast Shark River Slough basin of ENP. The shortfall in achieving the water volume and flow distribution targets would be most limiting in wetter years. The analyses in the Combined Operational Plan will be useful to inform our future actions, but our assessment remains the same as in 2013: the limited changes to water management operations associated with the MWD and C-111 projects are likely to move restoration forward slowly and in small increments. The substantial flow improvements required to fully achieve the desired state of conservation will occur only when the CEPP and TTNS projects are complete (>20 years from now.) Therefore, our strategy is to push for maximizing ENP benefits via the MWD and C-111 projects, while remaining fully engaged in the longer-term restoration initiatives.

Table 3. Everglades National Park – History and Status of Corrective Measures 2015. Continued.

Corrective Measure (Established 2006)	Status of Corrective Measure 2013	Status of Corrective Measure 2015
Park Need: Removal of barriers to water flow within Water Conservation Area 3 (WCA 3) upstream of the park is needed to enhance sheetflow and marsh connectivity into NESRS.		
1C: Construct water conveyance structures on the L–67A, L–67C, and L–29 canals and levees. In 2006, both the MWD project, and the CERP WCA 3 Decompartmentalization and Sheetflow Enhancement Project (Decomp) included projects to degrade levees and fill canals within WCA 3, north of the park.	1C: The Decomp physical model along the L–67 levees and canals is under construction. Construction components are expected to be complete in early 2013, and data will be collected during 2013 and 2014. The test is scheduled to conclude in 2014. Phase 1 of the Decomp project is incorporated into the CEPP, which is also examining changes to the L–67 levees and canals. The scope of alternatives ranges from small to large modifications to the L–67 structures. Schedule for completion of conceptual planning for CEPP is the end of 2013. The CEPP project then moves forward to Congress for authorization and funding. Timeline for completion of this project is >10 years from now. The CEPP plan to move water from WCA 3 to NESRS is needed in the same timeframe as required by the TTNS project.	1C: The Decomp physical model construction features along the L–67 A and C levees and canals have been completed. The second year of field testing is underway, and the findings will inform us on the best approaches to removing the upstream sheetflow impediments. The Final EIS and Record of Decision for the CEPP was completed in late 2014, and is now awaiting Congressional authorization. This project includes removal of portions of the L-67C and L-29 levees, and additional water conveyance structures in the L-67A levee.
Park Need: Removal of barriers to water flow along the Tamiami Trail is needed to enhance sheetflow and marsh connectivity into NESRS. Both bridges and modifications to the roadway are needed in order to raise water levels in the park while avoiding water damage to the road itself.		
1C: Tamiami Trail bridging and roadway modifications.	1C: The 2008 Tamiami Trail 1-mile bridge and limited road-raising project will provide modest flow increases into NESRS and is now scheduled for completion in spring of 2014. An NPS project to design and construct 2.6 miles of additional bridging is underway as of October 2012. Planning and final design should be complete by June 2014 and, depending on the availability of funding, a design and build contract should be awarded by the end of 2014, with construction completed by 2018. Raising the remainder of the Tamiami Trail roadway is still required in order to restore more-natural water levels to NESRS without compromising the roadway. The funding and timing of this work is unknown at this time.	1C: The 2008 Tamiami Trail 1-mile bridge and limited road-raising project is complete and providing modest flow improvements in NESRS. The TTNS phase 1 project with approx. 2.6 miles of additional bridging is underway and will be jointly funded by the Department of the Interior and the Florida Department of Transportation. The preliminary design and permitting process nearly complete, and the advertisement process is planned for March 2015. Award of a contract is expected in December 2015, and we expect construction to be complete by late 2019. The combination of the CEPP and TTNS phase 1 projects would remove a 2+ mile section of the L-29 Levee and the adjacent Tamiami Trail roadway, reconnecting the marshes in WCA-3B and NESRS. The timeline for CEPP removal of the L-29 Levee is 2031, and upstream conveyance features needed to route new water to this flow way is after 2040. Raising the remainder of the Tamiami Trail roadway is still required to fully implement the CEPP, and restore more natural water levels to NESRS without compromising the roadway. The funding and time line of this work is unknown at this time.

Table 3. Everglades National Park – History and Status of Corrective Measures 2015. Continued.

Corrective Measure (Established 2006)	Status of Corrective Measure 2013	Status of Corrective Measure 2015
Park Need: Water in NESRS and Taylor Slough needs to be retained inside the park via seepage management features. This water should flow down the historic sloughs, increasing water depths and hydroperiods in the park. Currently, lowered water levels in urban and agricultural areas east of the park draw large amounts of water out of the park via seepage.		
2A: Complete C–111 land exchange between the South Florida Water Management District (SFWMD) and NPS. This is required to construct the C–111 detention areas.	2A: The land exchange is complete and no additional real estate is required for completion of the C–111 detention area projects.	2A: The land exchange is complete and no additional real estate is required for completion of the C–111 detention area projects.
2B: See 1B.		
2C: Complete the construction of C–111 detention-area features from the 8.5 Square Mile Area south to the area known as the Frog Pond. These features include northern and southern components. The detention areas reduce seepage losses along the portions of the eastern ENP boundary. An existing pump station (S–356), constructed by the MWD project, is available for use to help retain water in NESRS. CERP included an ENP Seepage Management project that would add additional S–356 pump stations as well as a subsurface seepage barrier by 2015.	2C: Operation of the C–111 southern detention-area components and their effects on park ecology are being assessed. Construction of the C–111 northern detention area is still delayed, scheduled for completion in 2017. The water operations field test described in 1B should address water quality concerns associated with increases in flow to NESRS. This test is expected in early 2013 and will last for 2 years. Construction of the rock-mining shallow seepage barrier pilot (2 miles) was completed in spring of 2012. The feature is being monitored for effectiveness, and depending on results, may lead to an additional 3–5 miles of shallow seepage barrier in the near future. Additional seepage management to restore water levels in NESRS while maintaining flood protection is envisioned in the CEPP and would follow the schedule of design and implementation for that project.	2C: An assessment of the operation of the C–111 south detention area components and their effects on park hydrology and ecology was published in a dedicated volume in the journal *Wetlands* in July 2013. The operation of the S-332B/C/D pump stations and their associated detention areas has demonstrated that they can reduce the over-drainage of the adjacent ENP marshes, and begin to restore more natural wetland habitats and aquatic communities in these areas. The S-356 pump station is expected to begin returning seepage water to ENP in mid 2015, as part of the first incremental field test. This incremental field test described in 1B should also allow us to better understand water quality concerns associated with S-356 pumping and increases in flow to NESRS. An expansion of the S-356 pump station that would double its pumping capacity is included in the CEPP, and the construction is scheduled to be complete in 2026. A 2-mile shallow seepage barrier was successfully installed by the rockmining industry, as mitigation for increased seepage losses from the Everglades. An additional 3-mile shallow seepage barrier project is still in the planning phase. The total reduction in seepage from these barriers will be small, because we must allow deeper groundwater flows to the east to maintain public water supply and beneficial flows to Biscayne Bay. Construction of the C–111 northern detention area (Contract 8) has been delayed, and is now expected to be complete in 2017. This detention area will receive runoff from the 8.5 SMA features to the north, and create a nearly continuous seepage management system connecting NESRS and Taylor Slough.

Table 3. Everglades National Park – History and Status of Corrective Measures 2015. Continued.

Corrective Measure (Established 2006)	Status of Corrective Measure 2013	Status of Corrective Measure 2015
Threat 3: Increased Nutrient Pollution from Upstream Agricultural Areas.		
Park Need: Water entering the park must be low in nutrients, with concentrations of phosphorus in surface water <10 parts per billion (ppb), as established by the State of Florida. Total phosphorus (TP) concentrations above this level lead to imbalances in flora and fauna. Water needs to be cleaned upstream of the park, via improvement of agricultural practices and the implementation of stormwater treatment areas (STAs). Reduction of nutrient loading will contribute to healthier freshwater Everglades wetlands, as well as a healthier estuary in Florida Bay.		
3A: Implement upstream water quality source controls or Best Management Practices (BMPs) and construct man-made wetlands or STAs to achieve the long-term TP limits for water flowing into Shark River Slough and the Taylor Slough/Coastal Basins. In 2008, a Federal Court found that delay in achieving the State of Florida Phosphorus Threshold Rule (<0.01 mg per liter for the Everglades) was a violation of the Clean Water Act. The court directed the U.S. Environmental Protection Agency (EPA) to develop a plan for compliance for runoff from the Everglades Agricultural Area (EAA).	In June 2012, the State of Florida and the EPA reached a consensus on additional remedies needed for improving water quality in America's Everglades. They also agreed on a Water-Quality-Based Effluent Limit for STA discharges, to be enforced by permits that, if achieved, will ensure that park waters meet the 10 ppb target. The SFWMD will complete six projects that will create more than 2,630 ha of new STAs and 110,000 acre-ft of additional water storage through construction of Flow Equalization Basins (FEBs). These FEBs are upstream water storage features intended to provide a more steady flow of water to the STAs downstream, helping to maintain desired water levels and flows needed to achieve optimal water quality treatment performance. It is possible that the FEBs also will have some TP removal ability within their footprints. The component of these remedies that affects park water quality most directly—an FEB—is scheduled to be constructed by 2016. All of the proposed remedies are scheduled to be completed by 2025. In order for CEPP to be implemented, an additional FEB (A-2) upstream of the park is needed to ensure that additional future inflows to the park meet the water quality targets.	Construction on the State's Restoration Strategies water quality components is proceeding as planned. The FEB that will most directly affect the park will be constructed by 2016, operational by 2018, and is expected to be in full compliance by 2021. All of the proposed Restoration Strategies remedies are scheduled to be completed by 2025. In order for CEPP to redirect water flows from Lake Okeechobee back to the Everglades, an additional FEB (A-2) is needed. The new storage reservoir will be located within the Everglades Agricultural Area, upstream of ENP. This new reservoir will retain wet season inflows, then release this water to the adjacent STAs, to ensure that the additional flows from Lake Okeechobee (new source) to the park meet the water quality targets.

Table 3. Everglades National Park – History and Status of Corrective Measures 2015. Continued.

Corrective Measure (Established 2006)	Status of Corrective Measure 2013	Status of Corrective Measure 2015
Threat 4: Impacts to the Protection and Management of Florida Bay (Reduced Freshwater Inflows and Increased Nutrient Loadings).		
Park Need: Increasing natural freshwater flows from NESRS and Taylor Slough into the downstream estuaries will contribute to healthier and more diverse seagrass communities and increase fish and invertebrate productivity in Florida Bay.		
4A: Complete construction of the C–111 Detention Area features from the 8.5 Square Mile Area to the Frog Pond and implement CSOP operations. Implementing rainfall-driven pumping operations based on marsh water levels as envisioned in CSOP will reduce the likelihood of pumping nutrient enriched groundwater into ENP marshes.	4A: The C–111 North Detention area is still not complete; it is scheduled for completion in 2017. The CSOP and the COP plans have been eliminated from the MWD project, and future water control plans will be developed at the conclusion of the water operations field test described in 1B. Changes to water operations are likely to move forward very slowly and in small increments, with substantial change occurring only when raising and bridging the Tamiami Trail is complete as envisioned in the CEPP and TTNS projects (more than a decade). Rainfall-based pumping operations will be encouraged in the water control plan for ENP.	4A: The C–111 North Detention area has not been constructed and is delayed, pending future Army Corps appropriations, and is planned for completion in 2017. Water deliveries to NESRS and TS will be improved via the incremental field tests and implementation of the Combined Operational Plan for the MWD and C-111 South Dade projects, associated with Corrective Measure 1B. The COP modeling and environmental assessments will inform us as to the potential benefits these projects will have on freshwater flows to Florida Bay. Based on our prior analyses, substantial improvements in freshwater flows to Florida Bay required to fully achieve the desired state of conservation will occur only when the CEPP and TTNS projects are complete (>20 years from now.) Therefore, our strategy is to push for maximizing ENP benefits via the MWD and C-111 projects, while remaining fully engaged in the longer-term restoration initiatives.
4B: Complete the C–111 Spreader Canal and revised water management operations to include rainfall-driven operations.	4B: Phase 1 Western Project of the C–111 Spreader Canal project was completed in spring of 2012 and began operating in June 2012. The effects of this project on adjacent park wetlands and on Florida Bay are being monitored and will be evaluated after 3 years of monitoring (2015). Initial signals are positive. Rainfall-driven operational controls have not yet been implemented but will be incorporated into future water control plans. The remaining phases of the C–111 Spreader Canal project are not currently scheduled.	4B: The SFWMD will be producing a report in 2015 to evaluate the first three years of operation of the C111SC Western Project Phase I. The remaining phases of the C–111 Spreader Canal project are not currently scheduled.

A SYNTHESIS OF THE STATUS OF CORRECTIVE MEASURES AND INDICATORS OF INTEGRITY

Distinct progress has been made in the last two decades on a number of hydrologic and water quality corrective measures needed to address the threats to ENP and restore the desired State of Conservation. As part of the C–111 South Dade & C–111 Spreader Canal Western projects, a series of detention areas designed to maintain flood protection for agricultural lands to the east of the park border while retaining water inside the park were constructed from about 1995 to the present. These projects were intended to restore historic hydrologic conditions in the Taylor Slough, Rocky Glades, and eastern Panhandle areas of ENP, to protect the natural values of ENP, and to help restore freshwater flows to Florida Bay. A number of flood mitigation features (8.5 Square Mile Area levee system and pump station) and seepage management features (S–356 pump station) have been constructed via the MWD project in the same time period. A levee (L–67 extension) inside the park has been partially removed. Since 1992, the State of Florida implemented more than 18,200 ha of treatment wetlands, and these features, along with the implementation of BMPs within the agricultural sector, have assisted in reducing phosphorus loadings to the Everglades by more than 70%.

More recently, the first steps toward removal of barriers to water flow, the Decompartmentalization Physical Model and the Tamiami Trail 1-mile bridge MWD project, have been completed at the time of this report. Additional bridging associated with the Tamiami Trail Next Steps project is expected to start within a year, and to be complete by 2019. Although we are still far from the desired state of conservation with respect to water deliveries, small incremental changes are expected to take place as a result of the initial MWD bridging and road raising completion, and the start-up of incremental field tests scheduled to take place in 2015. The shallow seepage barrier and completed elements of the C–111 South Dade and C–111 Spreader Canal projects are helping to retain needed water inside ENP; however, additional shallow seepage barriers as well as the C–111 North Detention Area remain to be completed in order to effectively reduce seepage from the park along its eastern border. Construction of needed water quality features is progressing under the State of Florida's Restoration Strategies project, and we expect to see continued improvement in water quality reaching ENP in the next decade. The CEPP was finalized by the USACE, and now must go before Congress for authorization and subsequent requests for appropriations. Land acquisition by the NPS is progressing, with an acquisition strategy in place and a timeline for completion of all real estate interests by 2019, and needed flood protection cures by 2021.

These are significant advances. As each of the above restoration elements is completed over the next 6 to 8 years, the park moves one step closer to being able to deliver more clean water to Shark River Slough. However, until the water flow into the park actually increases, and more flow is redirected into NESRS, the ecological indicators of integrity will continue to be at risk. The physical changes (hydrology and water quality) need to come first, and the ecological benefits are expected to follow.

The status of the indicators of ecological integrity at this time continues to be a good reflection of the status of the corrective measures. For example, although the Tamiami Trail 1–mile bridge is complete, 2013–2014 field measurements still reflected that the vast majority of water coming across the northern border of ENP is through the western sector, and not the desired eastern sector of the Trail. Water levels in NESRS are still below the target. A new indicator, describing fire regime in ENP, is under development.

Total phosphorus (TP) entering Shark River Slough has decreased (i.e., a positive result) since the mid-1980s, and this is largely due to the implementation of upstream BMPs and the construction of treatment wetlands since the mid-1990s. The latest data indicate that this trend is continuing. There is still a need for concern and additional water quality features are still needed if water volume is to be increased to the park. Periphyton communities in the park, especially those observed in NESRS, showed elevated

tissue phosphorus (see page 12), indicating a need for concern regarding water quality. Because some elements of periphyton monitoring have been discontinued since 2012 (due to decreased funding in all agencies), there is increased uncertainty in the status of this indicator.

Freshwater fish and macroinvertebrates, especially in NESRS, are far from the Desired State of Conservation, with numbers still lower than expected and drought-tolerant species making up a large proportion of the small fish community. During the last 2 years, Shark River Slough freshwater fish conditions have remained below the target but have not declined, but Taylor Slough data indicate a worsening condition. Measures of the health of the American alligator population during 2013 and 2014 indicate that improvement is still needed in habitat conditions. Although nesting effort has increased since 1985 (i.e., more nests are being built), the success rate of nests continues to be erratic due to extreme hydrologic variation (both naturally induced and managed), and alligator abundance in the park has recently decreased. Measures of the status of wading birds in the last 2 years continue the previous trends and provide a mixed picture. Abundance counts in the park show an increasing trend in the last several decades, and conditions appear to be good for species such as the white ibis. However, wood storks are still initiating nesting too late in the season, resulting in erratic nest success due to natural and managed hydrologic variation, and the proportion of wood stork and white ibis nests is still far from the desired condition.

The status of integrity indicators for the coastal zone and Florida Bay also indicate that corrective measures must continue to be implemented in order to reach the Desired State of Conservation. Mean salinities in Florida Bay are still higher than those that support desired estuarine conditions, and no discernible trend toward desired conditions was found over the last 12 years. Measures of the potential for algal blooms show a slight improvement: sampling for this indicator is limited but hopefully can be increased in future. Measures of seagrass abundance and diversity indicate that some recovery has occurred since the die-offs in the mid-1980s and that trends have continued to improve in the northeast zone in 2013 and 2014. However, the abundance and diversity of seagrasses over most of Florida Bay are still at less-than-desired conditions. Sport fish abundance, as measured by fishermen's catch, is good and has remained relatively stable for the last several years, and the snook population, which suffered due to an extended cold spell in the winter of 2010, appears to be recovering. Data collection on juvenile pink shrimp ceased in 2012: these animals are very sensitive to estuarine salinities, and until data collected ceased, were showing poor conditions with a negative trend. The American crocodile trends are similar to those in the 2013 SOC report: this species is increasing in total population and reproductive effort is improving, while the measure most closely related to upstream hydrologic conditions—hatchling growth and survival—is still lower in ENP than in nursery sites adjacent to the park. An indicator for roseate spoonbills was added to our list in 2015: in the last 2 years these birds have continued a declining trend that began in the mid-1980s.

Measures of invasive exotic species continue to indicate severe problems. ENP programs to control and reduce the presence of invasive exotic plant species are limited to only two of the four problem species due to funding limitations, and trends in Brazilian pepper and Old World Climbing Fern appear to be worsening. For exotic freshwater fish, no new species have invaded the park since 2010, a striking change from the previous decade. However, those species in the park continue to spread and to become more abundant: no measures of control are known that can eliminate exotic fish but are protective of native species. Measures of herpetofaunal invasion continue to be uniformly negative, with Argentine tegus encroaching along the park border during 2013 and 2014. The Burmese python invasion continues to grow as we learn more about the devastating effect of these apex predators on Everglades mammals and other native fauna. The first invasion of a top marine predator, the lionfish, was recorded in ENP during the last 6 years: this species is now seen frequently on reefs adjacent to the park and continues to be collected in Florida Bay. The park still has no new programs to deal with this emerging issue of exotic fish and wildlife (either freshwater or marine); however, a working group of the South Florida Ecosystem

Restoration Task Force completed an Exotic Invasive Species Action Framework in 2014, and is pursuing the means to address the problem.

Status as of 2015: Suitability of Timeframe for the Implementation of Corrective Measures

A great part of the challenge in implementing these corrective measures is in making sure that objectives for restoration originating two decades ago are not lost in the extended planning, authorization, and funding process. When the park was placed on the list of World Heritage Sites in Danger in 1993, the MWD and C–111 South Dade flow restoration projects and the Everglades Construction Project water quality improvements were just being designed and authorized. Two decades later, the MWD and C–111 South Dade project construction components are currently scheduled to be completed by about 2017. Similarly, the Everglades Construction Project features were fully operational by 2012, including a substantial expansion of the treatment area footprint. However, the completion of these structural features does not by itself guarantee the delivery of additional clean freshwater to the historical flow-way of ENP.

For example, the Army Corps 1992 design document for the Modified Water Deliveries project focused on restoring the timing, location, and volumes of water flows to ENP. The objective of restoring the timing of water flows to be in consonance with meteorological conditions will need to be addressed through improvements to the rainfall-driven water delivery plan for Shark River Slough (or part of the revised Water Control Plan to be completed by 2019). The objective of restoring flow through WCA 3B and into Northeast Shark Slough as a functioning component of the Everglades hydrologic system was not implemented as envisioned due to funding constraints. This flow connection through WCA 3B has been incorporated into the CEPP, a project whose implementation is several decades into the future. Similarly, the flow volume targets for the MWD project were lowered with the modifications to the Tamiami Trail component, and now the flow volume increases needed to achieve the target would be linked to the CEPP implementation.

If restoration project components are implemented according to the current plans as of 2015, we should expect to receive small but positive changes to the distribution and quantity of water in NESRS within the next 6 to 8 years. The timeline for the next increment of bridging (TTNS Phase 1) has been accelerated compared to what we reported in the SOC 2013 report. The timeline for implementation of water quality features is proceeding as planned, with completion of an element important to ENP also occurring within the next 6 years. Incremental operational changes during this time period should help to provoke measureable positive changes in the ecological indicators. The timeline for substantial water operations changes, however, is delayed, as the CEPP is still decades from completion. At the time of this writing, with our knowledge of the expected physical and water quality changes over the next 6 to 8 years, the expected changes in the coming decade will not be commensurate with the original corrective measures established in 2006. Those changes will await the construction of the CEPP, Tamiami Trail Next Steps, and Restoration Strategies projects and will likely not occur for several decades.

To address the question of suitability of these current timelines for hydrologic restoration, the assessment of indicator status and trend presented here is pertinent, as is the most recent report from the National Research Council (NRC) of the National Academies (National Research Council 2012). The Council stated that “substantial *near-term* [emphasis in original] progress to address both water quality and hydrology in the central Everglades is needed to prevent further declines.” Therefore, what we might expect from the small incremental changes currently planned for the next decade is the potential slowing of negative trends or potential stabilizing of some indicators.

ADDITIONAL INFORMATION REQUESTED BY THE WORLD HERITAGE COMMITTEE

The ENP General Management Plan in 2015

It is noteworthy that the corrective measures originally identified by the World Heritage Committee and NPS in 2006 are almost exclusively associated with ecosystem restoration projects implemented *outside* of park boundaries and have overarching effects on the hydrology and water quality of ENP. During the ENP General Management Plan (GMP) development process, managers deliberately chose not to address ecosystem restoration issues in detail and instead focused primarily on management of lands and resources *inside* park boundaries. Nonetheless, these two efforts necessarily connect in several places: primarily in the statements of desired conditions in the GMP (these are broader than and consistent with the Desired State of Conservation statements in the current report), but also in broad statements within the GMP that commit NPS to continued work with stakeholders and to strengthening of partnerships for management of ENP as a critical component of the south Florida ecosystem.

The intent of the GMP is to manage park lands, visitor services, and visitor activities in such a way that the desired conditions for ENP resources and visitor experiences are attained and maintained. A suite of management alternatives is presented in the plan for consideration. At the time of this writing, the ENP Draft GMP has undergone an extensive, multi-year process of public review and comment. The Final GMP was expected to be complete by this time; however, it was delayed for about a year, and is expected to be complete in 2015.

The GMP focused on several major planning issues and concerns that were identified early in the process, including management of the lands encompassing NESRS (called the East Everglades Addition), wilderness assessment and management, visitor use (boating, visitor facilities, and user capacity), park stewardship, and climate change. The GMP includes several important statements that connect internal park management with the elements of external threat that are described in this report and that are being addressed through the evolution of the corrective measures originally established in 2006. Several of these statements follow:

> Marine, estuarine, freshwater, and terrestrial habitats are managed from an ecosystem perspective, considering both internal and external factors affecting visitor use, environmental quality, and resource stewardship.
>
> … NPS managers adapt management strategies to changing ecological and social conditions and are partners in regional land planning and management….The resources and processes of the national park retain a significant degree of ecological integrity. Management decisions about natural resources are based on scholarly and scientific information and on the national park's significant resources….Human impacts on resources are monitored and harmful effects are minimized, mitigated, or eliminated.
>
> Hydrologic conditions within Everglades National Park and the south Florida ecosystem are characteristic of the natural ecosystem prior to European American intervention, including water quality, quantity, distribution, and timing. Water levels and timing of water deliveries reflect quantities resulting from natural rainfall and are distributed according to pre-engineered drainage patterns. Water is free of introduced agricultural nutrients and urban-related pollutants.
>
> ….natural processes…enhance and maintain native plant communities. Communities [are] representative of an ecologically functioning subtropical wetland system. Natural wildlife populations and systems are understood and perpetuated…. Naturally functioning and healthy fisheries are maintained as an important component of the

> ecology of Florida Bay and other waters in the park. …populations of invasive nonnative fish and wildlife species [are managed] wherever such species threaten park resources or public health and when control is prudent and feasible.

Based on the expected GMP approval in 2015, the establishment of the ENP Advisory Committee and actions to educate park users could begin to take place by 2016. The process to determine pole and troll zones has already begun with the implementation of a pilot project in 2011. The pilot project is being evaluated in 2015, and those results together with the participation of the Advisory Committee will help to identify the strategy for establishing and managing additional pole and troll zones. Therefore, a number of constructive actions under the GMP are likely to be implemented prior to complete implementation of the corrective measures.

Significant Recent Issues: Invasive Exotic Species and Climate Change

Two major conservation issues that were not contemplated at the time the 2006 corrective measures were established are invasive exotic species and climate change. ENP is engaging in actions to address these threats to site integrity, and is coordinating closely with the South Florida Ecosystem Restoration Task Force effort, although immediate actions and funding are needed to address the invasive species that we currently know about.

Regarding climate change, the ENP General Management Plan speaks to this issue in a broad way and provides guidance for park management in several aspects. First, the GMP states that the vulnerability of the Everglades area to sea-level rise is moderate to high, based on the U.S. Geological Survey Coastal Vulnerability Index. With this in mind, the GMP outlines several strategies for the park to use in addressing the anticipated effect of climate change on park resources. Research to identify natural resources at risk from climate change, formation of partnerships with other management entities to maintain regional habitat connectivity, restoration of key ecosystem features to increase ecosystem resilience, and minimization of the impacts of other stressors on park resources are all important aspects of the overall ENP strategy to address climate change and sea-level rise impacts to park natural resources. ENP has recently added several studies to our suite of climate change projects to assess the potential impact of sea-level rise on the ecotone between the marine and freshwater landscapes. ENP also continues to work to reduce the impact of man-made features near the coast: currently the park is completing an Environmental Assessment to examine the potential for a second phase project that would plug and repair canals on Cape Sable, in the farthest southwestern coast of the park. The park is poised to undertake comprehensive climate-change planning as soon as the GMP is approved. Wayside exhibits are being developed to illustrate the risk sea-level rise poses to park resources and to open a conversation with visitors regarding climate change.

SUMMARY

The corrective actions currently in progress—particularly the work to raise and bridge the Tamiami Trail, the work to provide seepage control along the eastern border of ENP, the work to improve water quality, and small incremental changes to water operations—are intended to provide the conditions for improvement to the indicators of ecological integrity in ENP. These actions are expected to be complete in the next 6 to 8 years, and along with the additional protections to be implemented after approval of the GMP in 2015—establishment of an Advisory Body, additional wilderness designation, management/zoning of visitor activity (especially in Florida Bay), and outreach—should provide the physical and water quality conditions to potentially slow down long-term negative trends in Everglades ecological indicators. Additional critical steps, such as the decompartmentalization features of the CEPP, and the ability to bring substantial quantities of additional clean water south to ENP, are still many years

in the future. During the next 6–8 years, ENP intends to continue to focus its efforts on completion of the TTNS Phase 1, seepage control, and water operations, and will continue to encourage the State of Florida to progress on water quality features. These changes should allow for some improvement in ENP outstanding universal values, with additional improvements expected in future decades.

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