ANNEX G
CEPP PACR INVASIVE AND NUISANCE SPECIES MANAGEMENT PLAN

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ANNEX G CEPP PACR INVASIVE AND NUISANCE SPECIES MANAGEMENT PLAN

In accordance with the Comprehensive Everglades Restoration Plan (CERP) Guidance Memorandum 062.00 (CGM62), Invasive Species, the CEPP Post Authorization Change Report (PACR) will incorporate invasive and nuisance species assessments and management of those species into pertinent planning documents and phases of the project consistent with CEPP. Therefore, the CEPP PIR Invasive and Nuisance Species Management Plan (INSMP) contains detailed documentation consistent with CGM62 and this CEPP PACR INSMP should be considered supplemental. The CEPP PIR INSMP details all CEPP features; the CEPP PACR proposes to construct an A-2 Reservoir, A-2 stormwater treatment area (STA), and conveyance modifications instead of the A-2 flow equalization basin (FEB) authorized in CEPP. This INSMP provides supplemental information specific to the A-2 Reservoir, A-2 STA, and conveyance modifications. The INSMP is a living document and will be updated throughout the Design, Construction and Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) phases.

The Project Partnership Agreement (PPA) and the Construction Phasing, Transfer, and Warranty (CPTW) Plan are developed and agreed to prior to construction. The documents outline the responsibilities of the federal and non-federal sponsor during the construction phase, the operational testing and monitoring period, and the OMRR&R phase, and will include the cost estimates associated with the INSMP. The CEPP PIR INSMP and this CEPP PACR supplemental INSMP must be included with the CPTW Plan.

The INSMP for the authorized CEPP plan was developed with the input and guidance of multiple agencies and subject matter experts and was presented in the CEPP PIR as Annex G. Text, technical guidance, and cost estimates for the CEPP INSMP were provided by:

- South Florida Water Management District – David Black, LeRoy Rodgers
- U.S. Army Corps of Engineers – Angie Huebner, Jon Morton, Jessica Spencer, Sue Wilcox
- U.S. Fish and Wildlife Service – John Galvez, Art Roybal
- Everglades National Park – Jeff Kline, Jonathan Taylor
- Florida Fish and Wildlife Conservation Commission – Jenny Ketterlin Eckles, Kelly Gestring
- University of Florida – Frank Mazzotti

The CEPP PACR supplemental INSMP has been modified and included herein to focus on the invasive and nuisance species aspects of the proposed modifications to the authorized CEPP plan contained in the Tentatively Selected Plan (TSP) presented in the CEPP PACR; a change of the A-2 FEB to an A-2 Reservoir, A-2 STA, and conveyance modifications.

G.1 INTRODUCTION

Components of the CEPP PACR are highly interdependent features that would be implemented in a comprehensive and integrated manner and are the main portion of CERP, similar to CEPP. The CEPP PACR encompasses the A-2 Reservoir, A-2 STA, and conveyance modifications.

Nationally, more than 50,000 species of introduced plants, animals, and microbes cause more than $120 billion in economic damages and control costs each year (Pimentel et al. 2005). Not all introduced species become invasive species. According to the Office of Technology Assessment, Harmful Non-indigenous

Species in the United States report, approximately 10 to 15% of introduced species will become established and 10% of the established species may become invasive.

Executive Order (E.O.) 13112, entitled *Invasive Species*, signed 03 February 1999, states an "invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Alien species means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem. Invasive species are broadly defined and can be a plant, animal, fungus, plant disease, livestock disease or other organism. The terms 'alien' and exotic also refer to non-native species. A native species is defined as a species that historically occurred or currently occurs in a particular ecosystem and is not the result of an introduction.

Invasive non-native species decrease biodiversity, displace native plant and animal communities, reduce wildlife habitat and forage opportunities, alter the rates of soil erosion and accretion, alter fire regimes, upset predator/prey relationships, alter hydrology, degrade environmental quality and spread diseases to native plants, animals and other organisms. Furthermore, invasive species are the second largest threat to biodiversity following only habitat destruction (Wilcove et al. 1998); invasive species are second in destructive nature only to human development. In the United States, invasive species directly contributed to the decline of 49% of the threatened and endangered species (Wilcove et al. 1998). In addition to environmental impacts, invasive species impact human health, reduce agricultural production and property values, degrade aesthetic quality, decrease recreational opportunities and threaten the integrity of human infrastructure such as waterways/navigation channels, locks, levees, dams and water control structures.

Florida is particularly vulnerable to the introduction, invasion and naturalization of non-native species. This is due to several factors including a subtropical climate, dense human population centers, major ports of entry and the pet, aquarium and ornamental plant industries. Major disturbance to the landscape has also increased Florida's vulnerability to invasive species. Alteration of the landscape for urban development, flood control and agricultural uses has exacerbated non-native plant and animal invasions. Florida is listed as one of the states with the largest number of invasive species. This list also includes Hawaii, California, and Louisiana. Stein, Kutner, & Adams (2000) estimated that over 32,000 exotic species (25,000 plants and 7,000 animals) have been introduced into Florida. There are approximately 4,000-5,000 native species of plants and animals in Florida. The number of non-native species that have been introduced is eight times the total number of native species in the entire state.

The Atlas of Florida Vascular Plants (Wunderlin and Hansen 2008) documented 4,289 plant species in Florida. Of the 4,289 plant species, 1,419 were considered non-native and were naturalized (freely reproducing) populations. The Florida Exotic Pest Plant Council (FLEPPC) identifies 80 of the 1,419 species of non-native plants as Category I species in the 2017 Invasive Plant List. Searches through existing data and resources indicate 159 non-native plant species have been documented to occur within the CEPP PACR TSP project area are consistent with species in the CEPP PIR (USACE 2014). Other non-native species are probably present; however, documented citations could not be located. Of the 159 species of plants documented to occur within the project area, there are 77 FLEPPC Category I species, 41 FLEPPC Category II species and 28 Florida Noxious Weed species.

Significant scientific evidence and research document invasive non-native plants are degrading and damaging south Florida natural ecosystems (Doren and Ferriter 2002). Many species are causing significant ecological impacts by crowding out and displacing native plants, altering soil types and soil/water chemistry, altering ecosystem functions such as carbon sequestration, nutrient cycling and fire regimes and reducing gene pools and genetic diversity. Non-native invasive animal distribution, extent and impacts are not well understood; however, implications of invasive animals are apparent in south Florida. It has been documented there are 14 non-native species that are causing direct impacts to threatened and endangered species and rare habitats. It has also been documented that 19 species within Florida are among the world's worst weeds (Holm et al. 1977). It is estimated that Federal, State, and county agencies in Florida spend between $94 million and $127 million each year in an effort to manage invasive non-native plants (GAO 2000).

Invasive species are a major threat to the success of CERP. "The intent of CERP is to restore, preserve and protect the south Florida ecosystem while providing for other water-related needs of the region. CERP focuses on hydrologic restoration to improve degraded natural habitat in the south Florida ecosystem. Hydrologic restoration alone cannot ensure habitat restoration" (USACE and SFWMD 2010). In order to restore the Everglades and ensure south Florida's natural ecosystems are preserved and remain intact, invasive species must be comprehensively addressed (South Florida Ecosystem Task Force 2015). The lack of management will allow invasive non-native species to flourish and to continue to out-compete native species.

G.2 STATUS OF PRIORITY SPECIES AND THEIR IMPACTS

G.2.1 Plants

The CEPP PIR provides a full list of non-native plant species that have been documented to occur within the CEPP PACR TSP project area (the A-2 parcel and A-2 Expansion area) (USACE 2014). Searches through existing data and resources indicate 159 non-native plant species have been documented; other non-native species are probably present but documented citations could not be located. Of the 159 species of plants documented to occur within the project area, there are 77 FLEPPC Category I species, 41 FLEPPC Category II species, and 28 Florida Noxious Weed species.

Table G-1 lists the priority species that infest portions of the project area (A-2 parcel and A-2 Expansion area). These plant species are currently a concern and have the potential to impact project benefits. In addition there are seven species of non-native invasive plants that have the potential to create structural or operational threats (**Table G-1**). **Table G-1** is specific to the A-2 Reservoir, A-2 STA, and CEPP PACR conveyance modifications and is intended to supplement information presented in the CEPP PIR INSMP. An extensive list of priority species in the CEPP project area associated with all the authorized CEPP features is available as Table G-2 in the CEPP PIR INSMP.

Table G-1. Priority Species / Areas for Early Detection and Rapid Response

Species	Natural Area Threat	Structural / Operational Threat
Plants		
Australian pine (*Casuarina spp*.)	X	X
Brazilian pepper (*Schinus terebinthifolius*)	X	X
floating heart (*Nymphoides cristata*)	X	X
para grass (*Urochloa mutica*)	X	X
roundleaf toothcup (*Rotala rotundifolia*)	X	X
torpedograss (*Panicum repens*)	X	X
tropical American watergrass (*Luziola subintegra*)	X	X
West Indian marsh grass (*Hymenachne amplexicaulis*)	X	
Wright's nut-rush (*Scleria lacustris*)	X	
Invertebrates		
island apple snail (*Pomacea insularum*)	X	
Amphibians		
Cuban treefrog (*Osteopilus septentrionalis*)	X	
Reptiles		
Argentine black and white tegu (*Tupinambis merianae*)	X	
Burmese python (*Python molurus bivittatus*)	X	
green iguana (*Iguana iguana*)		X
Nile monitor (*Varanus niloticus*)	X	
Fish		
asian swamp eel (*Monopterus albus*)	X	
brown hoplo (*Hoplosternum littorale*)	X	
bullseye snakehead (*Channa marulius*)	X	
sailfin catfish (*Pterygoplichthys disjunctivus*)	X	X
Mammals		
feral hog (*Sus scrofa*)	X	X

G.2.2 Other Species

Ten other non-native invertebrate, amphibian, reptile, fish and mammal species are probably present in the A-2 parcel and A-2 Expansion area (**Table G-1**); however, documented citations of these species could not be located. Information regarding species presence and distribution is largely incomplete for most taxonomic groups of animals. As previously stated, **Table G-1** is intended to supplement information presented in the CEPP PIR INSMP.

G.3 INTRODUCTION TO MANAGEMENT

G.3.1 Prevention

Prevention is the first line of defense and the most efficient and cost-effective approach to reduce the threat of invasive non-native species. Successful prevention will reduce the rate of introduction and establishment and thereby reduce the impacts of invasive species. One essential element to prevention is identifying the high-risk pathways that facilitate introductions and implementing actions to impede those introductions. Other critical elements include using effective management tools to reduce unintentional introductions and using risk assessment for both intentional and accidental introductions of non-native species. Baseline data and monitoring systems are required in order to evaluate the success of preventative measures, consistent with the CEPP PIR INSMP.

G.3.2 Monitoring

Natural resource managers need spatial data on invasive species populations to develop management strategies for established populations, direct rapid response efforts for new introductions, and evaluate the success of control efforts (Myers et al. 2000, Dewey and Andersen 2004, Barnett et al. 2007). Several approaches may be taken to document the spatial distribution and population trends of invasive species. Each method has strengths and weaknesses and should be utilized according to specific management objectives. Monitoring is the collection and analysis of population measurements in order to determine changes in population status and progress towards meeting a management objective (Elzinga et al. 1998). This type of monitoring is usually intended to detect relatively small changes in populations over time and often utilize small scale plots and/or transects. Invasive species surveys and inventories may be preferred when the objective is to detect populations and describe their spatial distributions over large landscapes, especially when early detection of new populations is desired (see EDRR discussion below).

Optimally invasive plant mapping methods have high positional accuracy, high species detection accuracy (particularly for low-density infestations), rapid turnaround time, relatively low cost, and the ability to quantify the degree of infestation (USDA 2012). Ground-based surveys can provide high positional accuracy and species detection, but can be time consuming and logistically unrealistic for large landscapes (Rew et al. 2005). Stratified subsampling approaches to ground surveys can mitigate some of these limitations but probabilistic mapping may be ineffective for early detection needs of land managers (Barnett et al. 2007) and may not provide sufficient fine scale information over large areas.

Developments in remote sensing technology have greatly improved opportunities for rapidly obtaining spatially-precise data on invasive plant populations, particularly for large areas (Lass et al. 2005). However, the ability to detect target species using remote sensing is still limited to conditions where the species has a unique spectral signature or is a dominant canopy species and is often ineffective at detecting target species at low densities (Shafii et al. 2003). This inability to detect target species at low densities is a significant limitation for land managers focused on containment of expanding populations and detection of new invasions. Visual surveys from aircraft have been effectively used to map invasive plant distributions in the Everglades since 2008 (Rodgers, Pernas, & Hill 2014). While visual aerial surveys may provide cost-effective information on landscape distributions of targeted plants, it has limited value for long-term change detection or fine scale assessments of abundance. This method may also lack

sufficient detection precision for small plant species or species that occupy understories. Use of UAVs may also provide relatively inexpensive invasive plant monitoring data and video documentation provides a permanent record of conditions. However, detection accuracy may be less than that of visual surveys, especially at low densities or new species introductions.

G.3.3 Early Detection and Rapid Response

Once a species becomes widespread, the cost to control it will more than likely require significant and sustained funding. Early detection and rapid response (EDRR) may be a cost-effective strategy to locate, contain, and eradicate invasive species early in the invasion process in order to minimize ecological and economic impacts of non-indigenous species (Rejmanek and Pitcairn 2002).

The three components of EDRR are *Early Detection*, *Rapid Assessment*, and *Rapid Response*. Early detection is defined as a comprehensive and integrated system of active or passive surveys to locate, identify and report new invasive species as quickly as possible in order to implement procedures when it is feasible and less costly. Rapid Assessment includes the actions necessary to determine the appropriate response. This assessment identifies the current and potential range of the infestation, an analysis of the risks associated with the invasion, and timing and overall strategy for the appropriate actions. Rapid response is defined as a systematic approach to control, contain or eradicate these species while the infestation is still contained in a particular area. Based on the results of the rapid assessment, a rapid response may be implemented to address new introductions or isolated infestations of a previously established species invading a new site (i.e., containment strategy).

Another critical element to rapid response is having the infrastructure in place to quickly implement management actions while new invasions can still be eradicated or contained. Effectively implementing EDRR will require coordination and collaboration among federal, tribal, state, local governments, nongovernment organizations (NGOs) and the private sector (National Invasive Species Council 2012).

G.3.4 Control and Management

Integrated Pest Management (IPM) is an effective approach to manage invasive species. IPM is the coordinated use of the most appropriate strategy to prevent or reduce unacceptable levels of invasive species and their damage by utilizing the most economical means, and with the least possible hazard to people, property and the environment. Physical, mechanical, chemical and biological control methods are utilized in IPM. Physical control, sometimes referred to as cultural control, is the physical manipulation of an invasive species or their habitat. A number of techniques are used for physical control. These include manual removal, installing barriers and environmental alterations such as water level manipulation, prescribed fire and light attenuation.

Mechanical control refers to the use of machinery designed to cut, shear, shred, uproot, grind, transport and remove invasive species. Equipment used to complete mechanical control may include but is not limited to heavy equipment such as an excavator or front-end loader (with a root rake, grinding heads or other attachments), cutter boats, dredges and mechanical harvesters (Haller 2009).

Chemical control is the use of a specially formulated pesticide to control an invasive species. The United States Environmental Protection Agency defines a pesticide as “a substance or mixture of substances intended for the prevention, destruction, repulsion, or mitigation of any pest”. The term pesticide

encompasses a broad range of substances including herbicides, insecticides, fungicides etc. Pesticides are applied through ground and aerial applications.

Biological control, also known as bio-control, is the planned use of one organism to suppress the growth of another. Biological control is primarily the search for and purposeful introduction of species-specific organisms that selectively attack a single target species. Organisms such as insects, animals or pathogens that cause plant diseases are used as biological controls.

Objectives of management can include complete eradication within a given area, population suppression, limiting spread and reducing effects of invasive species. Once an invasive species becomes widely established complete eradication is usually not feasible. The most effective action for managing widely spread invasive species is often preventing the spread and reducing the impacts by implementing control measures. This concept is known as maintenance control. Maintenance control is defined as controlling an invasive species in order to maintain the population at the lowest feasible level.

G.3.5 Risk and Uncertainties Related to Invasive Species

As with most land management activities, there are a number of risks and uncertainties associated with invasive species management. The use of an adaptive management approach will help develop and prioritize invasive species control strategies. As restoration proceeds, invasive species may establish and/or spread as a direct result or independently of restoration activities. In the context of the CEPP PACR and the long-term management of the natural resources within the project area, risks include but are not limited to:

- Introduction of new invasive species which are difficult or impossible to control.
- Restoration activities which unintentionally facilitate the spread of invasive species via contaminated earth moving equipment.
- Undetected spread of invasive species into new areas, making containment of populations more costly and less likely to succeed.
- Uncontrolled invasive species which create disturbances or alter ecosystems such that desired restoration outcomes are not achieved.
- Failure to secure necessary funding to control invasive species.
- Undesirable impacts on non-target species and ecosystem functions resulting from invasive species control efforts.
- Not taking action to manage a species due to inaccurate assessments of the species impact on restoration activities.

The major uncertainty is that in most cases we do not have necessary information for detailed, specific pre-project evaluations of the need for management activities to control invasive species. With the exception of a few well-established and well-studied species (e.g., melaleuca), there is an information deficit on the status, potential impact, and effective control techniques for priority species. This is particularly true for non-indigenous animals. Current knowledge on invasion mechanisms suggests that some restoration activities may facilitate the spread of certain priority species in the Everglades, consistent with what is described in the CEPP PIR INSMP.

Given the high degree of uncertainty, the most effective and lowest cost management option is early detection and rapid removal of invasive species during and post project. Central to this strategy is the implementation of a rigorous monitoring program, consistent with the CEPP PIR INSMP.

Several specific uncertainties have been identified in the initial analysis of the selected plan. They are listed here to provide a starting point for developing monitoring, control and Best Management Practice strategies for the construction and operations phases of the restoration.

- Will Rotala and other aquatic weeds expand into the ENP with expanded conveyance capacity and flow distribution?
- Will increased flow result in increased nutrient loading thereby increasing spread of invasive and/or nuisance plants (e.g., torpedograss, cattail)?
- Will there be secured and available funding for management and control of invasive species? Will other priorities outcompete for funds?
- How will the introduction of new invasive species affect ecosystem restoration efforts?
- How will the lack of biological information for new introduced species affect invasive species management?

G.4 EXISTING MANAGEMENT PROGRAMS

G.4.1 South Florida Water Management District

The SFWMD manages invasive exotic aquatic and terrestrial plants in canals and on levees of the C&SF Project, WCAs 2 and 3, STAs, and interim project lands and on public conservation lands. Most of the vegetation management is outsourced through the Vegetation Management Division and includes herbicide application contractors, mechanical removal contractors, and use of biological controls such as plant specific insects and herbivorous fish. The Melaleuca Control Program is a major focus for the SFWMD, but other priority plant species are controlled within the CEPP PACR project area as funding resources allow.

G.4.2 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) manages floating vegetation on Lake Okeechobee, the Okeechobee Waterway and associated tributaries. The USACE also conducts treatments of priority species on the Herbert Hoover Dike. In addition to the operations and maintenance program on Lake Okeechobee, the USACE conducts treatments of vegetation during the construction phase of CERP and Modified Water Deliveries to ENP projects in south Florida. Vegetation treated includes FLEPPC Category I and II species, as well as native nuisance species.

G.4.3 Everglades National Park

The ENP Exotic Plant Management Team is actively engaged in treatment of numerous priority invasive plant species, primarily melaleuca, Old World climbing fern, and Australian pine. In recent years, ENP has focused invasive plant control efforts in the northeastern sections of the park and in the extreme southwestern sections where Old World climbing fern aggressively invades marsh communities. Brazilian pepper is also managed as part of the Hole-in-the-Donut restoration program.

G.4.4 U.S. Fish and Wildlife Service

Invasive plant management in the Loxahatchee National Wildlife Refuge (LNWR) is carried out by the U.S. Fish and Wildlife Service (USFWS) under a 50-year license agreement with SFWMD. The USFWS invasive plant management strategy addresses control of all invasive, non-indigenous species but the primary focus is on melaleuca, Brazilian pepper, Australian pine, and Old World climbing fern. Brazilian pepper and Australian pine are currently managed at low levels (maintenance control) and melaleuca is nearing low levels in most sections of the refuge. Old World climbing fern remains a significant management challenge given its aggressive invasion in tree islands and limited control options.

G.4.5 U.S. Department of Agriculture / University of Florida

The SFWMD, USACE, National Park Service (NPS), USFWS, Florida Fish and Wildlife Conservation Commission (FWC), and other agencies provide financial support to the U.S. Department of Agriculture – Agricultural Research Service (USDA-ARS) and the University of Florida (UF) for the development of invasive plant biological controls. Efforts to identify safe and effective biological controls have led to important advancements in the integrative management of several invaders, including melaleuca, Old World climbing fern, water hyacinth, and alligator weed. The *CERP Melaleuca Eradication and Other Exotic Plants – Implement Biological Controls Project* is dedicated to the implementation of biological control agents once overseas surveys and quarantine testing has developed agents deemed safe for release in Florida. The project included the construction of a mass rearing annex to the existing USDA-ARS biological control facility in Davie, Florida, in support of implementing the mass rearing, field release, establishment, and field monitoring of approved biological control agents for melaleuca and other invasive nonindigenous species.

G.4.6 Florida Fish and Wildlife Conservation Commission

The FWC's Invasive Plant Management Section is the designated lead entity in Florida responsible for coordinating and funding the statewide control of invasive aquatic and upland plants in public waterways and on public conservation land. In addition to funding the SFWMD melaleuca control program, FWC annually awards funding for individual invasive plant management projects in the Everglades region.

Allocation of control funding is determined by an interagency regional working group. FWC land managers also implement control programs for other invasive plant species in wildlife management areas (WMA), including Holey Land, Rotenberger, Everglades, and Southern Glades WMAs.

G.4.7 Invasive Animals

Efforts to develop control tools and management strategies for several priority invasive animal species are underway. These include the Burmese python and other giant constrictors, the Nile monitor, and the Argentine black and white tegu. Each of these species is approached differently depending on the current status of the population and feasibility of containment or eradication. Management strategies for well-established species, such as the Burmese python, recognize the low probability of eradication and instead focus control efforts aimed at reducing the impact of the species on natural resources over the long term. Species with limited distributions (e.g., Nile monitor) are addressed using containment strategies with the goal of preventing further spread across the landscape. Those species with very localized populations (e.g.,

northern African python) may be the focus of eradication strategies given the higher likelihood of successful expiration from Florida.

Control tools are limited for free-ranging reptiles, and the application of developed methods is often impracticable in sensitive environments where impacts to non-target species are unacceptable. For example, the use of toxins has proven to be a successful control tool for the brown tree snake in Guam where there are no native snake species, but this approach would lead to unacceptable mortality to native reptiles in the Everglades. Available tools for removing large constrictor snakes and lizards currently include visual searches, use of Judas snakes (released animals with location transmitters), and detection dogs. Potential tools include the use of traps, introduced diseases and parasites, and pheromone attractants, but these have not been fully explored to date. The District, FWC, NPS, and other partner agencies have implemented programs using the most effective available tools while continuing to fund research to development of other control methodologies. For example, agencies developed hunting programs to allow qualified volunteers to search for and capture giant constrictors on federal and state managed lands throughout the Everglades. This approach was greatly expanded in 2017, when the District and FWC incentivized these programs by paying hunters for searching and removal activities. The incentivized hunting programs are considered the most effective means available to reduce populations within core population areas. The District and other agencies also continue to fund science-based monitoring and tool development research to inform management efforts and refine control methods. Programs such as the Everglades Invasive Reptile and Amphibian Monitoring Project provide important information on the status and trends of established species, improve control efficiencies, and provide an early detection, rapid response capacity for new invaders.

G.5 EXISTING MONITORING PROGRAMS

Since 2008, the SFWMD and NPS, along with other partner agencies, have utilized DASM for a region-wide mapping program over 728,000 ha in the Everglades. DASM is a method for mapping plant infestations “on-the-fly” using GPS-linked computers and trained biologists. Visual surveys allow an observer to learn to recognize targeted species, sometimes at low densities, under a range of environmental and phenological conditions. Visual aerial surveys also may provide data more rapidly than other methods, which is important when rapid responses to newly established threats are expected. The primary objective of the DASM inventory program is to determine the distributions of four priority invasive plant species on managed conservation lands in the region. These are Australian pine, Brazilian pepper, melaleuca, and Old World climbing fern. A secondary objective of the program is to detect new plant species invasions in remote areas to facilitate rapid response efforts. These data are currently collected on a two-year cycle.

There are no system-wide ground based monitoring programs for invasive plants in the Everglades region. Individual agencies may collect spatial information on infestations, but these efforts are not part of a formalized, systematic monitoring network. Interagency working groups (e.g., Everglades Cooperative Invasive Species Management Area [ECISMA]) regularly meet to exchange information on new or potential invasive plants. As these species are detected, ad hoc efforts to conduct rapid assessment (monitoring and risk assessment) and containment are pursued. However, a lack of dedicated funding for rapid response limits the effectiveness of these initiatives.

In 2010, the UF, FWC, and SFWMD began collaboration on the Everglades Invasive Reptile, Amphibian, and Mammal Monitoring Program (EIRAMMP). The purpose of the project is to develop a monitoring program for priority invasive reptiles and amphibians and their impacts to south Florida. Specifically, the program seeks to (1) determine the status and spread of existing populations and the occurrence of new populations of invasive reptiles and amphibians, (2) provide additional EDRR capability for removal of invasive reptiles and amphibians, and (3) evaluate the status and trends of populations in native reptiles, amphibians, and mammals. The monitoring program involves visual searches for targeted invasive species on fixed routes along levees and roads within Arthur R. Marshall LNWR, WCAs 2 and 3, Big Cypress National Preserve, and ENP. Visual searches and call surveys, in addition to trapping, are conducted to monitor invasive reptile and amphibian species. Thirteen routes have been established.

G.6 MANAGEMENT STRATEGY AND PLAN

The management strategy and plan for non-native invasive and native nuisance species for proposed modifications to the CEPP PACR would be the same as presented in the CEPP PIR (Section 6.1.5 and Annex G). Generally, the strategy for managing invasive species would be to utilize an Integrated Pest Management approach. Objectives of management would include complete eradication, population suppression, limiting spread and reducing effects of invasive species. Eradication would be the objective for new established species that are localized. The objective for widespread invasive species will be to implement control measures to suppress and prevent the spread of identified priority invasive species, consistent with the CEPP PIR INSMP.

The strategy for managing invasive species remains consistent with the CEPP PIR INSMP. This CEPP PACR INSMP should be considered supplemental to work previously completed. EDRR should be implemented during every phase for the life of the project. A combination of biological, physical, and mechanical control methods will be utilized to manage invasive species. Monitoring of invasive species populations will be conducted through DASM, Unmanned Aircraft System (UAS) surveys, and EIRAMMP and will occur from the pre-construction phase through OMRR&R, consistent with the CEPP PIR INSMP (USACE 2014).

Specific control during the construction and OMRR&R for each authorized feature is described in the CEPP PIR INSMP. As a supplement to the CEPP PIR INSMP, this CEPP PACR INSMP describes the controls at the A-2 parcel and A-2 Expansion area; many or which are similar to those proposed for the federally authorized A-2 FEB.

Thorough surveys would be conducted during the construction phase of the CEPP PACR TSP, to identify and treat high priority species on the A-2 parcel and A-2 Expansion area, which could proliferate after construction phase and impact operations. Depending on design, it may or may not be necessary to treat Brazilian pepper or other priority species along the agricultural ditches. If the ditches are filled with existing spoil, Brazilian pepper and other species would be removed by the scraping of material to fill the ditches. If the spoil is not used to fill the ditches then treatment or removal of Brazilian pepper other species should be completed. Management options include aerial herbicide application and mechanical removal via heavy equipment. Levees and dams should be maintained throughout the construction phase to prevent invasion of plant species such as cogon grass.

With respect to future OMRR&R of the CEPP modifications proposed in the CEPP PACR, vegetation will be difficult to manage due to high nutrient loading from surface water inflows. Similar conditions are

experienced in the existing STAs, and maintenance control of many invasive plant species have proven difficult and not cost-effective. In addition, most of these species have not spread downstream of the STAs into the WCA. Vegetation management within the areas impacted by the proposed modifications addressed in this CEPP PACR would focus on maintaining storage reservoir and STA functionality. Vegetation would be controlled to ensure adequate surface water conveyance and minimal impact to infrastructure (e.g., levee instability, floating tussocks). However, any invasive species capable of establishing in the storage reservoir or STA and spreading to natural areas would be a priority for control.

Chemical treatments of floating and submersed vegetation would be performed upstream and downstream of water control structures. Occasional mechanical removal of tussocks or uprooted submersed species may be required in order to maintain operations and the function of the storage reservoir and STA. In STAs, it is recommended to utilize best management practices such as strategic management of vegetation in strips immediately in front of water control structures to prevent floating vegetation and mats from blocking the structures. This has been demonstrated to be an effective management practice in STAs and reduces the cost of operations and maintenance. Levee vegetation would be maintained throughout the OMRR&R phase, with an emphasis on minimizing the spread of invasive plants capable of spreading to natural areas (e.g., cogongrass).

G.7 EDUCATION/OUTREACH

Recreational opportunities will be created at the A-2 Reservoir. Recreation areas such as boat ramps can serve as vectors and pathways for aquatic and terrestrial invasive species. For example, invasive species can be transferred from one area to another by boats/trailers. Many recreational users are unaware of their role in the spread of unwanted species. Hence, educating the public on preventing the spread of invasive species can be a cost-effective component of the overall management strategy. Consistent with the education and outreach proposed in the CEPP PIR INSMP, recreation access points can be used to display educational information on invasive species identification, prevention/control measures, and awareness of the invasive species programs in the area, and how individuals can contribute to invasive species prevention. Educational kiosks are recommended and should include information on:

- Specific priority invasive species in the area
- Impacts and costs of invasive species on conservation, human health, and recreation
- Preventative measures, such as removing vegetation from boats/trailers before leaving the boat ramp
- Ways to report invasive species observations
- Programs that citizens can get involved with and learn more about invasive species
- Laws against the release of non-native wildlife

G.8 COSTS

Costs for invasive and nuisance species management over the life of the proposed modifications to the authorized CEPP plan in the CEPP PACR are expected to be essentially the same.

G.9 REFERENCES

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