April 22, 2019

Dr. Ann Hodgson
U.S. Army Corps of Engineers Jacksonville District
P.O. Box 4970
Jacksonville, FL 32232-0019
LakeOComments@usace.army.mil
Ricki.L.Mitchell@usace.army.mil

Re: LOSOM scoping comments

On behalf of the Center for Biological Diversity, Calusa Waterkeeper, Sierra Club, Bullsugar, and Save the Manatee Club, I submit the following scoping comments on the U.S. Army Corps' (Corps) Lake Okeechobee System Operating Manual (LOSOM).

As an initial matter, we continue to believe **the Corps' process can be improved by (1) broadening the scope of the Corps' review to allow implementation of elements of LOSOM prior to the completion of infrastructure projects; and (2) compressing the review timeline from three years and nine months to eighteen months.**

The comments detail concerns with ongoing Lake Okeechobee operations and planned infrastructure projects that may impact operations, including **significant impacts to the human environment and federally endangered and threatened species**.

Finally, the comments provide several **alternatives to current operations that do not require additional infrastructure projects or authorization** that may be implemented immediately to help address the above-referenced concerns.

Sincerely,

Jaclyn Lopez, Florida Director
Center for Biological Diversity
jlopez@biologicaldiversity.org
727-490-9190

I. Background

The Greater Everglades Ecosystem stretches from Orange to Monroe County, and comprises a network of freshwater ponds, sloughs, prairies, and forested uplands. Historically, water flowed from Shingle Creek just south of present-day Orlando, through the Kissimmee River, into Lake Okeechobee and south where it reached Florida Bay.

More than a century ago, the Everglades was drained for development, agricultural production, and subsequently, for flood control. Congress then approved the Flood Control Act of 1948 which authorized the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project). The purpose of the C&SF Project was to provide flood control; water supply for municipal, industrial, and agricultural uses; prevention of saltwater intrusion; water supply for Everglades National Park; recreation; and protection of fish and wildlife resources.[1] To accomplish these objectives, the Corps constructed a network of levees, water storage areas, pumps and canal improvements in south Florida.[2] These modifications have fundamentally altered the nature of the ecosystem, and today, the Everglades is half the size it was a hundred years ago.[3]

Moreover, much of what remains of the historic Everglades is heavily polluted by phosphorous, nitrogen, and mercury as a result of urban and agricultural development.[4] Most of this pollution is from "nonpoint sources" which arise "from many dispersed activities over large areas" and "not traceable to any single discrete source."[5] These diffuse sources of pollution (like farms and roadways) are sources from which runoff drains into a watershed.[6]

The Corps now finds itself in the unenviable position of having to manage water through a human-made system in an ever-changing environment. Too much water enters Lake Okeechobee too quickly, and too few outlets exist to relieve pressure from aging infrastructure. Several high precipitation seasons have resulted in the Corps discharging dangerous amounts of polluted Lake Okeechobee water to the Caloosahatchee and St. Lucie ecosystems, causing and/or sustaining harmful algal blooms.

---

[1] 68 Fed. Reg. 64200, *Programmatic Regulations for the Comprehensive Everglades Restoration Plan*, (Nov. 12, 2003).
[2] *Id.*
[3] Florida Department of Environmental Protection, Brief History of the Everglades, *at* http://www.dep.state.fl.us/evergladesforever/about/default.htm.
[4] National Research Council, National Academy of Sciences, Preface to Progress Towards Restoring the Everglades: The Fourth Biennial Review (2012), *available at* http://www.nap.edu/catalog/13422/progress-toward-restoring-the-everglades-the-fourth-biennial-review-2012.
[5] *Nw. Envtl. Def. Ctr. v. Brown*, 640 F.3d 1063, 1070 (9th Cir. 2011).
[6] *American Farm Bureau Federation v. United States Envtl. Protection Agency*, 792 F. 3d 281, 289 (3d Cir. 2015).

A. History of Lake Okeechobee Management

Historically, water traveling through the system would take 6-8 months to travel from the northern part of the system to Lake Okeechobee, but due to the channelization of the system and upstream agriculture, water now arrives at the lake in one month.[7] This coupled with the diking of the south side of the lake which cuts off natural flow to the Everglades, causes lake levels to rise rapidly, and for the Corps to release large volumes of water to the northern estuaries – the St. Lucie and Caloosahatchee – to lower the risk of damage to the Hebert Hoover Dike. (HHD). Nearly 70% of the rainfall enters the system during just five months of the year, and each year is highly variable with annual rainfall varying as much as 82% between wet and dry years.[8] El Nino years,[9] competing water users, and aging plumbing further strain the system.[10]

In 2000, Congress approved the Comprehensive Everglades Restoration Plan (CERP), a $10.5 billion, 35-year-plus project to restore central and south Florida water resources. As part of the Corps' management and restoration of the Everglades, it is responsible for establishing a regulation schedule for managing the water levels in Lake Okeechobee.[11]

The Corps has managed the lake under several different regulatory regimes throughout the years, including the "Run 22" schedule in 1988, the "Run 25" schedule in 1992, and the Water Supply and Environment (WSE) schedule in 2000.[12] During the 2004 and 2005 hurricane seasons, the lake sustained high water levels which caused the Corps to release high volumes of water to the estuaries to reduce risk of damage to the dike. This in turn led to poor ecological conditions in the lake and the St. Lucie and Caloosahatchee estuaries.[13] In 2005, the Corps revisited the WSE schedule in-part to address concerns regarding the frequency of high volume freshwater releases from Lake Okeechobee to the rivers.[14]

In 2007, the Corps created the Lake Okeechobee Regulation Schedule (LORS) to replace the WSE to address periods of high precipitation events, to preserve the integrity of the dike, to

[7] Florida Oceanographic Society. 2013. Water Flows & Current Issues. Presentation to Florida Governor Rick Scott.
[8] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute.
[9] FWS 2007, citing 1981-82 drought, followed by the "Mother of All El Ninos" in 1982-1983, to moderately severe drought in 1990, and severe drought in 2001 and 2007, and hurricanes in 2004 and 2005.
[10] South Florida Water Management District, Report of Expert Review Panel Technical Evaluation of Herbert Hoover Dike Lake Okeechobee, Florida, 2016 (SFWMD 2016).
[11] Corps 2008 at 1.
[12] FWS 2007 at 6.
[13] *Id*. at 47.
[14] U.S. Army Corps of Engineers, Final Environmental Impact Statement on the Lake Okeechobee Regulation Schedule (Corps 2008a) at ii; National Marine Fisheries Service, NMFS Concurrence Letter on Lake Okeechobee Regulation Schedule (2007) at 1, 2 (NMFS 2007).

protect ecological resources of the lake's littoral zone, and to reduce high discharges to the estuaries. The regulation schedule is a compilation of operating criteria, guidelines, rule curves and specifications for the storage and release of water from Lake Okeechobee to the St. Lucie Canal (C-44) and the Caloosahatchee Canal (C-43) and River, and is an ongoing agency action.[15] The Corps originally intended to use LORS only until the dike repairs had been completed, or certain CERP projects had been completed, and in any event, only until 2010.[16]

The Corps selected LORS in part because federal agencies assumed that it would not negatively affect "any downstream ecosystems more than they already experience."[17] The Corps intended LORS to be active for three years, until around 2010 when the Corps would then incorporate structural improvements along with benefits from initial components of the Comprehensive Everglades Restoration Plan into LORS.[18]

In creating LORS, the Corps determined that flows between 450 cfs and 2,800 cfs are necessary to sustain an ecologically appropriate range of salinity conditions in the Caloosahatchee estuary, and that flows greater than 2,800 cfs are too high for the estuary.[19] The Corps determined that if inflows to the inner estuary exceeded 2,000 cfs, salinity in the mid estuary would cause significant stress and a high probability of oyster mortality, and therefore, concluded that when possible, the lake release to tide would be limited to a pulse release not to exceed 2,800 cfs measures at S-79, and 2,000 cfs measured at the inner estuary.

The Corps' National Environmental Policy Act (NEPA) analysis only briefly mentioned algae, noting that "a small percentage of algae produce toxins, and are termed HAB [harmful algae blooms]," but that even non-toxic algae can have harmful effects on marine ecosystems when masses of algae die and decompose, depleting oxygen in the water.[20] The analysis stated that cyanobacteria (also known as blue-green algae) and dinoflagellates (also known as red tide) "have traditionally received the dubious distinction of constituting nuisance bloom populations

---

[15] Corps 2008; *See Central and Southern Florida Project for Flood Control and Other Purposes, System Operating Manual,* Vol. I.

[16] FWS 2007 at 1. The Corps intended that LORS be in effect until the earlier of (1) implementation of a new lake schedule as a component of the system-wide operating plan for CERP Band 1 projects and Florida's Acceler8 projects; or (2) completion of HHD seepage berm construction or equivalent dike repairs for reaches 1, 2, and 3, upon information and belief, the Corps intended LORS to be interim and only last until 2010.

[17] *Id*. at 11, 64; The ROD states that a key feature of LORS is that "it allows long-term, low-volume releases to the Caloosahatchee and St. Lucie estuaries" which are "intended to manage lake levels while reducing the potential for future prolonged high-volume releases." Corps 2008 at 2.

[18] FWS 2007 at 1. The Corps intended that LORS be in effect until the earlier of (1) implementation of a new lake schedule as a component of the system-wide operating plan for CERP Band 1 projects and Florida's Acceler8 projects; or (2) completion of HHD seepage berm construction or equivalent dike repairs for reaches 1, 2, and 3, upon information and belief, the Corps intended LORS to be interim and only last until 2010.

[19] Corps 2008.

[20] Corps 2008a at 111.

or HAB,"[21] and acknowledged that "[p]opulation increased [sic] and other anthropogenic factors have led to significant nutrient enrichment of Florida coastal waters over the past several decades," yet the Corps then summarily concludes that "[i]t is unlikely that discharges from Lake Okeechobee are a prerequisite for HAB formation,"[22] and offered no further information or analysis on algae or its effects on the human environment.

When the Corps implemented LORS, it wrongly assumed that it would not negatively affect "any downstream ecosystems more than they already experience."[23] The Corps assumed that "future events similar to those experienced over the period of record (1965-2000) will be effectively managed by the 2008 LORS."[24] When the Corps consulted with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) to analyze the effects of LORS on Florida's most imperiled species, the federal agencies understood that LORS would in effect for only three years, or until around 2010 when the Corps would then incorporate HHD's structural improvements along with benefits from initial components of the CERP into LORS.[25] Neither of those triggers has come to pass: HHD repairs remain ongoing, and few CERP projects have been completed.

LORS, as it relates to the quantity and timing of the water delivered from the lake to the Caloosahatchee and St. Lucie rivers, causes significant adverse impacts to the rivers and their estuaries by introducing and then depriving freshwater into the systems in a manner that is inconsistent with the rivers' natural salinity regime and that causes significant harm due to the algae and nutrients that are allowed to accumulate in the Lake. This in turn, has adversely affected the human environment and Florida's most imperiled species, like the Florida manatee, smalltooth sawfish, Johnson's seagrass, sea turtles, and coral and degraded their designated critical habitat.

B. Harmful Algal Blooms in the Greater Everglades

Lake Okeechobee and the rivers that drain it to the Gulf of Mexico and Atlantic Ocean – the Caloosahatchee and St. Lucie rivers, respectively – are human-altered systems that help sustain

---

21 *Id*.
22 *Id*. at 112.
23 U.S. Fish and Wildlife Service 2007 Biological Opinion on the Lake Okeechobee Regulation Schedule (FWS 2007) at 11, 64; The Corps' Record of Decision states that a key feature of LORS is that "it allows long-term, low-volume releases to the Caloosahatchee and St. Lucie estuaries" which are "intended to manage lake levels while reducing the potential for future prolonged high-volume releases." U.S. Army Corps of Engineers Record of Decision for the Lake Okeechobee Regulation Schedule (Corps 2008) at 2.
24 2008 WCP.
25 FWS 2007 at 1. The Corps intended that LORS be in effect until the earlier of (1) implementation of a new lake schedule as a component of the system-wide operating plan for CERP Band 1 projects and Florida's Acceler8 projects; or (2) completion of HHD seepage berm construction or equivalent dike repairs for reaches 1, 2, and 3, upon information and belief, the Corps intended LORS to be interim and only last until 2010; 2008 WCP.

the greater Everglades region. Lake Okeechobee is often referred to as the "liquid heart" of the Everglades, encompassing 730 square miles. The lake itself is home to alligators, snail kites, bald eagles, crested caracara, Florida manatees, and grasshopper sparrows.

Over the past several decades, the lake has been heavily polluted by nutrients, particularly phosphorous and nitrogen, from nonpoint source runoff. After years of delay, and following a suit by environmental and conservation organizations to compel action,[26] the state of Florida adopted a Total Maximum Daily Load (TMDL) in 2001 for Lake Okeechobee limiting phosphorous to 140 metric tons a year and set a target date of 2015 to meet the phosphorous TMDL.[27] To implement and achieve the TMDL, the Lake Okeechobee Protection Act directed the Florida Department of Environmental Protection to create a "Lake Okeechobee Protection Plan" (LOPP). The LOPP set a target date of 2015 to meet the phosphorous TMDL.[28]

When 2015 came and went, the state was far from meeting the TMDL. The Florida Legislature amended the law in 2016 calling for the achievement of the TMDL 20 years after the adoption of a basin management action plan (BMAP),[29] which was finalized in 2014. Consequently, this nonpoint source pollution is managed in the BMAP through non-regulatory controls (i.e. "best management practices").[30] If achieving the TMDL within 20 years is "not practicable" additional five-year milestones can be established.[31]

The lake has been besieged by nutrient pollution for decades and there are few signs that things are improving. A 2014 environmental report prepared by the South Florida Water Management District (SFWMD) revealed that the five-year phosphorous load was 451 metric tons, which is 311 metric tons or 322% of the water quality goal.[32] The majority of these nutrients entered the watershed from agricultural and urban sources. An estimated 4,256 metric tons of new phosphorous are added each year.[33] There have been no significant reductions in phosphorous

---

[26] *See Florida Wildlife Federation v. Browner*, 4:98-CV-2560-WS (N.D. Fla. July 2, 1999).
[27] §373.4595, Fla. Stat. (2000), Florida Department of Environmental Protection. 2001. Total Maximum Daily Load for Total Phosphorous Lake Okeechobee, Florida.
[28] § 373.4595, Fla. Stat (2000).
[29] *See id* (2018).
[30] *See* Florida Department of Environmental Protection. 2014. Final Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Total Phosphorous by the Florida Department of Environmental Protection in Lake Okeechobee, *available at* https://floridadep.gov/sites/default/files/LakeOkeechobeeBMAP.pdf. Voluntary measures, such as BMPs, have been the hallmark of nonpoint source pollution management since 1972 even though there continues to be little empirical evidence on the relative effectiveness of such schemes. *See* Oliver A. Houck, *Cooperative Federalism, Nutrients, and the Clean Water Act: Three Cases Revisited*, 44 Envtl. L. Rep. 10426 (2014).
[31] *See* § 373.4595(3)(b), Fla. Stat (2018).
[32] SFWMD South Florida Environmental Report 2014. Pg. 8-3, 8-34, 8-35 at http://apps.sfwmd.gov/sfwmd/SFER/2014_SFER/v1/chapters/v1_ch8.pdf.
[33] The HDR Team. 2010. Nutrient budget analysis for the Lake Okeechobee watershed: final comprehensive report. SFWMD, West Palm Beach.

loading in many of the Okeechobee sub-watersheds.[34] As such, "more aggressive nutrient control measures still need to be implemented in all the surrounding basins that discharge to the lake in order to reach the lake's TMDL goal of 140 mt of phosphorous per year."[35]

Since 1974, annual total phosphorous loads to Lake Okeechobee have exceeded 500 metric tons nearly 50% of the time.[36] Averaged over the 41-year period of record, the annual phosphorous load is approximately 3.6 times the annualized TMDL.[37] Thus, annual average phosphorous loads will have to be reduced by more than 350 metric tons per year to meet the current TMDL for the Lake.[38] Current efforts to achieve the Lake Okeechobee TMDL "have proven inadequate" and "none of the current BMAPs for the Lake Okeechobee, St. Lucie or Caloosahatchee watersheds will achieve their respective TMDLs within the next 5 years."[39] Additional controls, such as flow equalization basins, storage treatment areas, and "aggressive BMPs" that include in-situ immobilization of legacy phosphorous by chemical amendments, will be needed to meet TMDL targets."[40] New field-verified agricultural and urban BMPs that protect water quality, advance in situ treatment technologies, and the strategic placement of additional FEB-STAs in priority basins will be essentials to achieve State and Federal water quality standards.[41] Beyond these approaches, the substantial amount of legacy phosphorus in the Northern Everglades watersheds "will necessitate new and more aggressive strategies to combat the mobility of phosphorous."[42]

The shallow lake along with the nutrient runoff from north of the lake provide the ideal conditions for the algal blooms.[43] In 2016, January rainfall raised the lake level nearly two feet. It then took constant releases until mid-April for the lake to return to the pre-rainfall level going into rainy season. In 2017, Hurricane Irma caused the lake to rise over three and a half feet, putting the lake at the highest levels since the Corps started operating under LORS.[44] The heavy rain that came with Hurricane Irma and above-average rainfall in spring 2018 set the stage for another large-scale summer algal bloom in Lake Okeechobee in 2018, which prompted the Corps to initiate large-scale discharges out of the S-77 canal (Caloosahatchee) and S-380 canal (St.

---

[34] SFWMD South Florida Environmental Report 2011, Pg. 10-49 at http://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_sfer/portlet_prevreport/2011_sfer/v1/chapters/v1_ch10.pdf.
[35] *Id*. at 10-48.
[36] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 63.
[37] *Id*. at 63-64.
[38] *Id*. at 64.
[39] *Id*. at 84.
[40] *Id*.
[41] *Id*. at 7.
[42] *Id*. at 131.
[43] Havens, K. 2013. Deep Problems in Shallow Lakes: Why Controlling Phosphorus Inputs May Not Restore Water Quality. IFAS Extension. University of Florida; Havens, K, et al. 2016. Natural Climate Variability Can Influence Cyanobacteria Blooms in Florida Lakes and Reservoirs. IFAS Extension. University of Florida.
[44] Corps letter to Mast July 5, 2018, at 1.

Lucie) on June 2, 2018. This water was rich in nutrients and algae and diluted the normally saline water, creating conditions for the growth and survival of intense cyanobacteria blooms in the estuaries. This happened in 2005 and 2016 as well.[45] The dominant algae discharged was the cyanobacteria *Microcystis aeruginosa.*

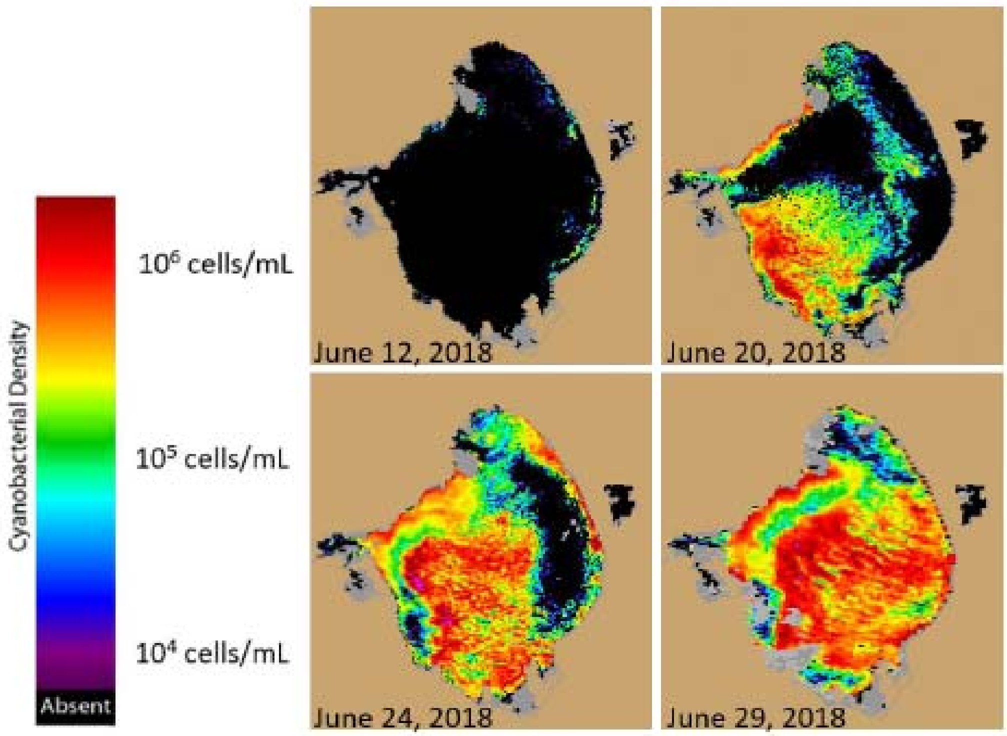


Image source: NOAA, derived from Copernicus Sentinel-3 data from EUMETSAT

It is well-established that the release of large amounts of water from the lake contribute nutrients downstream and lead to the formation of toxic algae blooms in the northern estuaries.[46] The damaging discharges from Lake Okeechobee in 2016 and again in 2018 had a significant impact on the ecology of the northern estuaries, harming the economy, including significant economic losses in commercial fishing, recreation tourism, and the real estate sectors.[47] From July through September 2016, bloom conditions persisted with a peak in July of roughly 200 square miles. In 2017, phosphorous loading to the lake approached 2.3 million pounds, the highest ever recorded. While the total incidents of bloom detections were less than in 2013, the 2017 samples had the

[45] Philips, E. et al. 2012. Climatic Influences on Autochthonous and Allochthonous Phytoplankton Blooms in a Subtropical Estuary, St. Lucie Estuary, Florida, USA.
[46] NAS 2018; Exhibit 1.
[47] South Florida Water Management District. 2018. Central Everglades Planning Project Post Authorization Change Report: Feasibility Study and Draft Environmental Impact Statement. (SFWMD 2018b).

highest recorded concentration of microcystin collected in the past five years.[48] By July 2018, 90% of the surface of Lake Okeechobee was covered with a blue green algae bloom.

C. Low Flows to the Caloosahatchee

Conversely, in times of relevant drought, harm associated with impacts to the Caloosahatchee estuary from inadequate dry season flows, as defined by the Minimum Flows and Levels (MFL) rule (Rule 40E-8.221 F.A.C.) and associated statutory definition of harm (Florida Water Resources Act Section 373 F.S.), has been significant, largely stemming from the duration and severity of low flow impacts since LORS was implemented. There were four consecutive years of MFL exceedences (2007-2011).

D. Lake-Related Infrastructure Projects

There are a number of infrastructure projects that are associated with the Lake's management, including the dike repairs and CERP projects.

1. Herbert Hoover Dike Repairs

Dike repairs began in 1999 with Reaches 1-3 prioritized because the risk of loss of life.[49] Reach 1A was completed in 2005, but SFWMD expressed "considerable uncertainty regarding the effectiveness of the proposed repair measures."[50] In 2006, it was estimated that Reach 1 would be completed in March 2010, Reach 2 by 2013, and Reach 3 by 2012.[51] In 2007, the Corps launched an effort to rehabilitate the HHD, investing more than $500 million from 2007-2016.[52] The Corps' 2016 Dam Safety Modification Study proposed a revised rehabilitation plan for HHD. While the Corps has completed repairs to Reach 1, repairs to Reach 2 and 3 are now scheduled to be completed by 2020.[53]

The 2016 Herbert Hoover Dike Dam Safety Modification Study states that the goal of repairing the dike is to make the dike safe under the current LORS schedule; however, it also found that

[48] Zhang, J. et al. 2018. Chapter 8B: Lake Okeechobee Watershed Research and Water Quality Monitoring Results and Activities in 2018 South Florida Environmental Report – Volume I.
[49] SFWMD 2016.
[50] *Id*.
[51] *Id*.
[52] National Academies of Sciences, Engineering, and Medicine. 2016. Progress Toward Restoring the Everglades: The Sixth Biennial Review – 2016. Washington, DC: The National Academy Press (NAS 2016).
[53] Elsken, K. Storm damage sets back river restoration; repairs estimated at $11 million, Lake Okeechobee News (May 9, 2018); U.S. Army Corps of Engineers, Fact Sheet: South Florida Ecosystem Restoration. 2017.

even when repaired, the dike will not provide a final solution for managing lake levels.[54] The Corps had "not determined what, if anything, will be done with the Lake Okeechobee regulation schedule once rehabilitation of the Herbert Hoover Dike is complete," and has stated that "[a] process to revise LORS 2008 is not scheduled to begin until 2022."[55] The July 2018 Draft Integrated Delivery Schedule advanced this timeline to revise LORS with a scheduled start date of 2019 and completion date of 2023, one year after the scheduled Herbert Hoover Dike completion,[56] but this revision is not intended to address ongoing harm to the estuary from the current 2008 LORS. The Corps' July 2018 update to the Integrated Delivery Schedule (IDS) SFER Program Snapshot Through 2030 reports the "Lake Okeechobee Regulation Schedule Revision accelerated to FY19-22 (to sync with accelerated schedule of HHD) dependent upon FY19 funding."[57] The purpose of the review is to "provide an opportunity to evaluate the feasibility and the benefits and risks of allowing higher water levels in the lake once the Herbert Hoover Dike repairs are compete."[58]

2. Comprehensive Everglades Restoration Plan

Furthermore, estimated deadlines for completion for CERP projects have been extended again and again. Additionally, new information and changes in lake management and planned projects have "reduced the storage capacity envisioned originally in CERP by over one million acre feet compared to the 1999 plan, which could have serious ecological consequences in both the northern estuaries and the Everglades ecosystem."[59] Therefore, there is considerable uncertainty regarding future Lake Okeechobee regulation, available water storage beyond Lake Okeechobee, not to mention the impacts of a changing climate.[60]

II. The Corps' Proposed NEPA Process

Scoping is the first step in the Corps' NEPA process. It is the public's first opportunity to learn about the Corps' proposed action, to tell the Corps what impacts it should analyze, and to inform the Corps' alternatives to the proposed action; yet, we note that the Corps' preferred alternative, statement of need, and project purpose have not been published.[61] Therefore, the analysis

---

[54] U.S. Army Corps of Engineers, Herbert Hoover Dike Dam Safety Modification Study: Glades, Hendry, Martin, Okeechobee and Palm Beach Counties, Florida. 2016; South Florida Water Management District, Report of Expert Review Panel Technical Evaluation of Herbert Hoover Dike Lake Okeechobee, Florida, 2006.
[55] NAS 2016.
[56] National Academies of Sciences, Engineering, and Medicine. 2018. Progress Toward Restoring the Everglades: The Seventh Biennial Review – 2018. Washington, DC: The National Academy Press (NAS 2018).
[57] U.S. Army Corps of Engineers, Integrated Delivery Schedule (IDS) SFER Program Snapshot Through 2030. 2018.
[58] NAS 2018.
[59] NAS 2016.
[60] *Id*.
[61] Nor has LOSOM scoping been noticed in the Federal Register.

provided herein is based on the premise that the project purpose can be very broadly described as managing Lake Okeechobee. Alternatives provided below are based on this presumed project purpose and are not provided in contrast or relative to the Corps' preferred alternative.

It is our understanding that the action the Corps is reviewing is not LORS per se, but LORS with dike repairs and/or other infrastructure projects completed, meaning that whatever decision the Corps reaches in its NEPA process will not be implemented until, at a minimum, the HHD repairs are complete,[62] which are currently estimated to be completed by 2022. Repairs began in 1999 and there have been several promised and missed deadlines: including 2006, 2012, 2013,[63] and 2020 was recently bumped to 2022.[64] Therefore, there is little reason to believe that the repairs will be completed on time, this time.

Even if the HHD repairs are completed by 2022, waiting to implement a new LORS until then would mean the Corps would continue to operate under LORS, exposing the Caloosahatchee and St. Lucie estuaries to high volume discharges and harmful algal blooms for potentially four more years. Furthermore, significant concerns have been expressed regarding the effectiveness of the repairs,[65] and the Corps itself has found that even when repaired, the dike will not provide a final solution for managing lake levels.[66] For all these reasons, the Corps should adopt an expansive view of its authority to implement elements of LOSOM as early as possible, infrastructure projects notwithstanding.

A. The Corps has not Defined the Project Need

The Greater Everglades ecosystem has been completely altered by impounding Lake Okeechobee. As a result, efforts to restore the Everglades have had to work around the fact that the principle organ of the Greater Everglades, Lake Okeechobee, has been dammed. This impediment is significant, and has resulted in significant harm to lake ecology and the estuaries.

62 U.S. Army Corps of Engineers, *Integrated Delivery Schedule (IDS) SFER Program Snapshot Through 2030*, July 2018 Update, https://evergladesrestoration.gov/content/tf/minutes/2018_meetings/072518/10b_IDS_PLACEMAT%20July%202018%20TF%20meeting.pdf, stating "Lake Okeechobee Regulation Schedule Revision accelerated to FY19-22 (to sync with accelerated schedule of HHD)."
63 South Florida Water Management District, *Report of Expert Review Panel Technical Evaluation of Herbert Hoover Dike, Lake Okeechobee, Florida*, 2016, https://my.sfwmd.gov/portal/page/portal/common/newsr/hhd_report.pdf.
64 Elsken, K. Storm damage sets back river restoration; repairs estimated at $11 million, Lake Okeechobee News (May 9, 2018); U.S. Army Corps of Engineers, Fact Sheet: South Florida Ecosystem Restoration. 2017.
65 SFWMD 2016.
66 U.S. Army Corps of Engineers, *Herbert Hoover Dike Dam Safety Modification Study: Glades, Hendry, Martin, Okeechobee and Palm Beach Counties, Florida*. 2016; South Florida Water Management District, *Report of Expert Review Panel Technical Evaluation of Herbert Hoover Dike Lake Okeechobee, Florida*, 2006.

The Corps describes the scope of LOSOM as the creation of "a new system operating manual (SOM) for Lake Okeechobee."[67] The Corps has also stated that the *proposed action* here is "to reevaluate and define operations for the Lake Okeechobee regulation schedule that take into account additional infrastructure that will soon be operational."[68] That infrastructure includes the Herbert Hoover Dike rehabilitation, Kissimmee River Restoration Project, C-43 West Basin Storage Reservoir, and C-44 Reservoir and Storm Water Treatment Area.[69] The Corps' July 2018 update to the Integrated Delivery Schedule (IDS) SFER Program Snapshot Through 2030 reports the "Lake Okeechobee Regulation Schedule Revision accelerated to FY19-22 ([is] to sync with accelerated schedule of HHD) dependent upon FY19 funding."[70] As the proposed action is currently described, this likely means that the Corps will not implement whatever alternative it selects through the NEPA process until one or more of those infrastructure projects moves online.[71]

B. The Corps has the Authority to Implement LOSOM Immediately

The Corps has the authority and obligation to more broadly define the "proposed action" to include managing the Lake regardless of the status of the infrastructure projects to ensure the "proposed action" or selected alternative is implemented immediately. The Corps cites as its authority for LOSOM Section 1106 of the 2018 Water Resources Development Act (WRDA) which states that "The Secretary shall expedite completion of the Lake Okeechobee regulation schedule to coincide with completion of the Herbert Hoover Dike project, and may include all relevant aspects of the Comprehensive Everglades Restoration Plan described in section 601 of the Water Resources Development Act of 2000 (114 Stat. 2680)."[72] Yet, this is plainly a floor, a bare minimum of what the Corps must complete by 2022, not a ceiling of what the Corps is authorized to do pursuant to its existing and inherent responsibilities for managing Lake Okeechobee.

For example, under NEPA, the Corps is required to initiate and complete a supplemental evaluation of its ongoing management of the Lake immediately, infrastructure projects notwithstanding, given all that has happened over the last ten years. "Even if the agency prepared

---

[67] Corps 2022 Factsheet.
[68] https://www.saj.usace.army.mil/Media/News-Releases/Article/1742909/corps-invites-public-to-provide-input-on-new-lake-okeechobee-system-operating-m/.
[69] https://www.saj.usace.army.mil/Media/News-Releases/Article/1742909/corps-invites-public-to-provide-input-on-new-lake-okeechobee-system-operating-m/.
[70] U.S. Army Corps of Engineers, Integrated Delivery Schedule (IDS) SFER Program Snapshot Through 2030. 2018.
[71] The Corps cites as its authority for LOSOM, Section 1106 of the 2018 Water Resources Development Act (WRDA), which directs "The Secretary shall expedite completion of the Lake Okeechobee regulation schedule to coincide with completion of the Herbert Hoover Dike project." https://www.saj.usace.army.mil/Media/News-Releases/Article/1742909/corps-invites-public-to-provide-input-on-new-lake-okeechobee-system-operating-m/.
[72] Corps LORS 2022 Factsheet.

an EIS when the project was first initiated, it must prepare a supplemental EIS ('SEIS') if the agency intends to make 'substantial changes' to the action or if 'there are significant new circumstances,' and those changes or new circumstances would relate to the project's effects on the environment." *United States v. City of Detroit*, 329 F.3d 515, 529 (6th Cir. 2003) (citing 40 C.F.R. § 1502.9(c)(1)). Here, this means that because of the substantial changes to the action (that it has lasted well beyond 2010) and the significant new circumstances (the harmful algal blooms), the Corps is already duty-bound to reevaluate the effects of LORS, and implement any measures that result from that process.

In the context of examining whether new information gives rise to the need to prepare a supplemental EIS, an agency must take a "hard look at the proffered evidence." *Marsh v. Oregon Natural Res. Council*, 490 U.S. 360, 385 (1989). *Marsh* explained the court's "searching and careful" review in determining whether the agency took a hard look:

> [C]ourts should not automatically defer to the agency's express reliance on an interest in finality without carefully reviewing the record and satisfying themselves that the agency has made *a reasoned decision* based on its evaluation of the significance—or lack of significance—of the new information. A contrary approach would not simply render judicial review generally meaningless, but would be contrary to the demand that courts ensure that agency decisions are founded on a reasoned evaluation "of the relevant factors."

Marsh, 490 U.S. at 378. *See also Nat'l Audubon Soc'y v. Dep't of the Navy*, 422 F.3d 174, 187 (4th Cir. 2005) ("The hallmarks of a 'hard look' are thorough investigation into environmental impacts and forthright acknowledgment of potential environmental harms."). As these comments detail, those conditions are clearly met with LORS.

By all accounts LORS was to commence in 2008 and conclude, or at the very least, be revisited by the Corps in 2010.[73] The extension of LORS past the planned 2010 termination date constitutes a significant project modification that could have significant long-term implications to human environment. Since 2015, there have been two sustained summers (2016 and 2018) of blue-green algae and red tide which have harmed sea turtles, smalltooth sawfish, and elkhorn and staghorn coral. And prior to that there were four years for drought that harmed the Caloosahatchee attributable to LORS. Furthermore, there is mounting science suggesting that Lake Okeechobee discharges are feeding the HABs which are in turn impacting the human environment in ways not previously evaluated by Corps under NEPA.

---

[73] "The Lake Okeechobee Regulation Schedule Study (LORSS) is at the point of selection of an alternative, and that new schedule is expected to be in effect in the years 2007 through 2010." *See* Letter from U.S. Fish & Wildlife Service to Army Corps, May 16, 2006; "The final SEIS also explains that the recommended plan will be an interim schedule…" Corps 2018, *supra* note 1, at 6; "The schedule is planned to be active for three years (2007-2010)." FWS 2007 at 11.

The Corps currently proposes a 44-month-long NEPA process, presumably based on its narrow interpretation of its legal obligations. The Corps held eight public scoping meetings throughout south Florida February-March 2019. The Corps has stated it further intends to conduct workshops from October 2019-September 2021.[74] There is no legitimate reason the Corps must extend this NEPA process for an unprecedented 44 months. The Corps has the discretion to define the scope of the action it is analyzing under LOSOM.[75] It should exercise this discretion to broaden the scope of its action to not be dependent on the status of the HHD repairs and other infrastructure projects. Given the profound impact of these low flow periods, high discharges, and harmful algal blooms, the Corps must act expeditiously and undertake every possible measure to prevent further harm. The Corps must compress its proposed 44 month NEPA process to 18 months to implement solutions immediately.[76]

III. Current Lake Okeechobee Operations Have Many Significant Impacts

The Corps must consider the direct, indirect, and cumulative effects of LOSOM on the human environment.[77] *Direct effects* are those that result immediately and directly from the action.[78] *Indirect effects* occur as a result of the action, but are later in time, farther in distance, but are nonetheless reasonably foreseeable.[79] *Cumulative effects* are those past, present and reasonably foreseeable future actions that have an incremental impact.[80] *Human environment* means the natural and physical environment and the relationship of people with that environment (i.e. resources, ecosystems, and human communities).[81]

The Corps will need to consider the context and intensity of the impacts, both beneficial and adverse, including (1) effects on public health and safety; (2) unique characteristics of the area; (3) potential for controversy; (4) uncertainty about effect or unique risks; (5) potential for

---

[74] Corps LORS 2022 Factsheet.

75 Nothing in America's Water Infrastructure Act of 2018, Sec. 1106 Lake Okeechobee Regulation Schedule Review limits the Corps' authority to expedite and reopen 2008 LORS. This section states "The Secretary shall expedite completion of the Lake Okeechobee regulation schedule to coincide with the completion of the Herbert Hoover Dike project, and may consider all relevant aspects of the Comprehensive Everglades Restoration Plan," https://www.congress.gov/bill/115th-congress/senate-bill/3021/text#toc-H7B862DC3DA6542E79542A2A3B12693AA.

[76] When the Corps originally announced it NEPA plan, it called for three years and nine months of NEPA, including two years of public workshops – a process not required by NEPA. By comparison, the Council on Environmental Quality which promulgates regulations binding on all federal agencies implementing NEPA, recommends that for "even large complex" project, the agency take "only about 12 months for the completion of the entire EIS process." EIS refers to Environmental Impact Statement and is synonymous with NEPA. Council on Environmental Quality, *Memorandum to Agencies: Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, https://www.energy.gov/sites/prod/files/G-CEQ-40Questions.pdf.

[77] Effects" and "impacts" are used interchangeably under NEPA.

[78] 40 C.F.R. § 1508.8.

[79] 40 C.F.R. § 1508.8.

[80] 40 C.F.R. § 1508.7.

[81] 40 C.F.R. § 1508.14.

establishing precedent; (6) cumulative impacts; (7) potential adverse effects on things listed on the National Register of Historic Places and on the loss or destruction of significant scientific, cultural, or historical resources; (8) potential adverse effects on endangered or threatened species or their habitat, or on critical habitat; and (9) potential for violation of another law or requirement imposed for the protection of the environment.[82]

A. LORS Significantly Impacts Health and Human Safety

1. Cyanobacteria

Cyanobacteria, commonly known as blue-green algae, are photosynthetic bacteria that often occur naturally in Florida surface waters.[83] Cyanobacteria are prokaryotes in that they have no discrete membrane-bound nucleus or membrane-bound subcellular organelles.[84] They are genetically related to other bacteria in the eubacteria domain.[85]

Under the right environmental conditions of nutrient availability (e.g. nitrogen and phosphorus), temperature, light, pH, oxidative stressors, and other factors such as interactions with other biota, cyanobacteria can reproduce rapidly and form what are commonly referred to as cyanobacterial harmful algal blooms or HABs.[86] When the rate of cyanobacterial cell growth exceeds the loss rate for a population, floating cyanobacterial cells can form a visibly colored scum on the water surface.[87] This scum can contain more than 10,000 cells/mL.[88] Prevailing winds can concentrate the floating scum.[89]

Scientific consensus is that the magnitude, frequency, and duration of HABs appear to be increasing at a global scale, particularly in coastal and inland waters.[90] Large scale ecological disturbances associated with urbanization, agricultural activities, and the introduction of invasive species, combined with climate change, have likely increased the intensity, frequency, and geographic occurrence of HABs in the United States.[91]

---

[82] 40 C.F.R. § 1508.27.
[83] U.S. Environmental Protection Agency. 2016. Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microsystins and Cylindrospermopsin, Draft, p. 1. (EPA 2016).
[84] EPA 2016 at 15.
[85] *Id*.
[86] *Id*. at 3.
[87] *Id*. at 17.
[88] *Id*.at 17.
[89] *Id*.
[90] Brooks, B.W., J.M. Lazorchak, M. Howard, M.V. Johnson, S.L. Morton, D. Perkins, E.D. Reavie, G.I. Scott, S.A. Smith, and J.A. Steevens. 2015. Are harmful algal blooms becoming the greatest inland water quality threat to public health and aquatic ecosystems? Environ. Toxicol. Chem. 35: 6-13. *See also* Congressional Research Service, *Freshwater Harmful Algal Blooms: Causes, Challenges, and Policy Considerations* (Aug. 20, 2018).
[91] Preece, E.P., F.J. Hardy, B.C. Moore, and M. Bryan. 2017. A Review of microcystin detections in estuarine and marine waters: environmental implications and human health risk, Harmful Algae 61: 31-45.

Florida waters have been besieged by harmful algae blooms from the St. John's River to Florida Bay. In 2005, a *Microcystis* bloom in the Lower St. Johns River covered a 100-mile stretch from Jacksonville to Crescent City.[92] In 2009, a 14-mile long algal bloom, linked to surface water runoff of nutrients and pollutants, impacted Tampa Bay.[93] In 2010, algal blooms and fish kills once again hit the St. John's River.[94]

Cyanobacteria, particularly *Microcystis*, have been found in Lake Okeechobee and the northern estuaries. *Microcystis aeruginosa* has been correlated with nitrogen and phosphorous, and toxic strains may have higher nitrogen and phosphorous requirements.[95] Exposure of *Microcystis aeruginosa* to saltwater may increase its toxicity.[96]

South Florida has experienced the most severe HABs. From 2005-2008 and again in 2013, widespread HABs killed marine life throughout Florida Bay.[97] In mid-June 2008, a toxic blue-green algae bloom occurred north of the Franklin Lock on the Caloosahatchee River and forced the temporary shut-down of the Olga Water Treatment Plant, which obtains its source water from the Caloosahatchee and provides drinking water for 30,000 people.[98] HABs caused widespread destruction to the St. Lucie and Caloosahatchee estuaries in 2005, 2008, 2013, 2016 and 2018.

Microsystins are the most common cyanotoxins found worldwide and have been reported in surface waters in most states.[99] Microsystins can be produced by several cyanobacteria genera including *Microcystis*, *Anabaena, Nostoc*, *Oscillatoria*, *Fischerella*, *Planktothrix*, and *Gloeotrichia*.[100] *Microcystis* sp. have been found in blooms occurring on all continents except Antarctica and often dominate phytoplankton assemblages in the summer.[101] Research shows that environmental factors such as nutrient load, increased water temperature, salinity, pH, light intensity, and reduced mixing, provide competitive advantages to *Microcystis* relative to other phytoplankton.[102] This cyanobacteria thrives in warmer temperatures, with optimal growth and

---

92 *See* Environmental Protection Agency, Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters, Proposed Rue, 77 Fed. Reg. 74924, 74935 (Dec. 18, 2012).
93 *Id*.
94 *Id*.
95 Cessa, M. (ed). 2014. Beaches: Erosion, Management Practices and Environmental Implications. Environmental Health-Physical, Chemical and Biological Factors.
96 Rosen, B.H. et al. 2018. Understanding the effect of salinity tolerance on cyanobacteria associated with a harmful algal bloom in Lake Okeechobee, Florida: U.S. Geological Survey Scientific Investigations Report 2018-5092, 32 p. https://doi.org/10.3133/sir20189082.
97 *See* Hubbard, K. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute. 2018. Harmful Algae Blooms and Implications for the Florida Keys, at https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/docs/20181016-habupdate.pdf.
98 Environmental Protection Agency, Water Quality Standards for the State of Florida's Lakes and Flowing Waters, Final Rule, 75 Federal Register 75762, 75769 (Dec. 6, 2010).
99 EPA 2016 at 25.
100 *Id*. at 1.
101 *Id*.
102 *Id*.

photosynthesis occurring above 25 degrees Celsius.[103] *Microcystis aeruginosa* has been correlated with nitrogen and phosphorus, and toxic strains may have higher nitrogen and phosphorus requirements.[104] Exposure of *Microcystis aeruginosa* to saltwater may increase its toxicity.[105]

One of the most common and studied forms of microcystins is microcystin-LR,[106] and is as potent as or more potent than other microcystins.[107] Microcystins are water-soluble and remain within the cyanobacterial cell until the cell breaks and they are released into the water.[108] These cyanotoxins have a half-life of 4-14 days in surface waters but may persist longer depending on conditions.[109] Microcystins can persist after a cyanobacterial bloom is no longer visible.[110] Microcystins have been observed to persist up to 6 months in dry scum.[111] Microcystin-LR is an extremely acute toxin according the World Health Organization,[112] which has published a provisional guideline value of 1 ug/L for microcystin-LR.[113]

Cylindrospermopsin can be produced by cyanobacteria species including *Cylindrospermopsis raciborskii*, *Aphanizomenon* species, *Anabaena* species, *Lyngbya wollei*, and *Rhaphidiopsis species*.[114] The highest concentrations tend to occur below the water surface.[115] The biodegradation of cylindrospermopsin is complex and can be influenced by toxin concentration, temperature, sunlight, and other factors.[116] Half-lives can vary from 11-15 days to 8 weeks.[117]

---

[103] *Id.*
[104] Cessa, M. (ed). 2014. Beaches: Erosion, Management Practices and Environmental Implications. Environmental Health-Physical, Chemical and Biological Factors.
[105] Rosen, B.H. et al. 2018. Understanding the effect of salinity tolerance on cyanobacteria associated with a harmful algal bloom in Lake Okeechobee, Florida: U.S. Geological Survey Scientific Investigations Report 2018-5092, 32 p. https://doi.org/10.3133/sir20189082.
[106] EPA 2016 at 1.
[107] *Id.* at 22.
[108] *Id.* at 1.
[109] *Id.*
[110] *Id.*
[111] EPA. 2015. Drinking Water Health Advisory for the Cyanobacterial Microcystin Toxins, EPA Doc. Number 820R15100, p. 14 June 15, 2015.
[112] World Health Organization, Cyanobacterial toxins: Microcystin-LR in Drinking water, background document for development of WHO guidelines for drinking-water quality, 7, 2003, at https://www.who.int/water_sanitation_health/water-quality/guidelines/chemicals/cyanobactoxins.pdf?ua=1.
[113] *Id.*
[114] EPA 2016 at 1.
[115] *Id.*
[116] *Id.*
[117] *Id.*

Cyanobacteria have been known to cause animal and human poisonings in waters throughout the world for more than 100 years.[118] Cyanotoxins have been implicated in human and animal illness and death in at least 43 states.[119]

a. Cyanotoxins have Significant Human Health Effects

Cyanotoxins, produced during HABs, can have several adverse human health effects. Exposure can occur through various recreational and non-recreational pathways. Exposure from recreational water sources can occur through incidental ingestion wile recreating, contact with the skin during activities like swimming, wading, and surfing, and inhalation as waterborne cyanotoxins are aerosolized.[120] Researchers at Florida Gulf Coast University found toxins can be inhaled and reach deep into the lungs[121] and recently documented airborne particles of cyanobacteria more than a mile inland from any retention ponds and three miles from the Caloosahatchee River.[122] Non-recreational exposure can occur through the consumption of cyanotoxin-contaminated drinking water and food (including fish) and during bathing or showering.[123] Several studies have demonstrated bioaccumulation of cyanotoxins and transfer through the food chain and there is a possibility that these toxins can reach humans through the consumption of fish.[124]

Exposures can result in gastrointestinal, dermatologic, respiratory, neurologic and other symptoms.[125] Some exposures have resulted in severe respiratory impairment (such as pneumonia and adult respiratory distress syndrome), as well as liver and kidney damage from ingesting contaminated drinking water.[126] Exposure to water polluted by cyanobacterial blooms

---

[118] World Health Organization, Cyanobacterial toxins: Microcystin-LR in Drinking water, background document for development of WHO guidelines for drinking-water quality, 9, 2003, at https://www.who.int/water_sanitation_health/water-quality/guidelines/chemicals/cyanobactoxins.pdf?ua=1.
[119] Graham, J.L., N.M. Dubrovsky, and S.M. Eberts. 2016. Cyanobacterial Harmful Algal Blooms and U.S. Geological Survey Science Capabilities: U.S. Geological Survey Open-File Report 2016-1174, 12 p., http://dx.doi.org/10.3133/ofr20161174.
[120] EPA 2016 at 29-30, 35.
[121] Williams, A.B. 2018. Algae toxins are airborne and can reach deep into human lungs, FGCU research shows, Fort Myers News Press, Nov. 29, 2018 at https://www.news-press.com/story/tech/science/environment/2018/11/27/blue-green-algae-toxins-can-penetrate-lungs-fgcu-research-shows/2120238002/.
[122] *Id*.
[123] EPA 2016 at 1.
[124] Zanchett, G. and E.C. Oliveira-Filho. 2013. Cyanobacteria and cyanotoxins: from impacts on aquatic ecosystems and human health to anticarcinogenic effects, Toxins 5(10): 1896-1917, doi: 10:3390/toxins5101896.
[125] EPA 2016 at 4.
[126] Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374.

and microcystins resulted in normocytic anemia, liver failure, and death at a hemodialysis center in Caruaru, Brazil.[127]

According to the EPA, data indicates that the primary target organ for microcystins is the liver.[128] Studies in laboratory animals document liver, kidney, and reproductive effects following short-term and sub-chronic oral exposures to microcystin-LR.[129]

Drinking water treatment involving filtration, flocculation, and disinfection may not always eliminate cyanobacteria and cyanotoxins and drinking water treatment processes may be ineffective when large quantities of cyanobacteria enter the source water intake.[130] In Florida, it appears the most frequently utilized management technique for drinking water treatment facilities (SWTPs) for neutralizing a bloom event is to chemically treat the area where the bloom dominates with copper sulfate.[131] This procedure, however, may kill beneficial bacteria that degrade some cyanotoxins and it lyses algal cell walls which in turn liberates toxins directly into the water column where bioavailability of the toxin is increased.[132] It does not appear that SWTPs analyze for the presence of cyanotoxins.[133] There also do not appear to be any studies testing the effectiveness of water treatment methods for BMAA removal.[134] Studies have linked many health problems, both acute and chronic, to exposure to low concentrations of microcystins present in water used for consumption.[135]

These cyanobacteria have been linked to poisoning and cancer.[136] According to one leading expert, "[c]yanotoxins are among the most potent toxins known, far more potent than industrial chemicals."[137] The International Agency for Research on Cancer classified microcystin-LR as possibly carcinogenic to humans.[138] This was based on substantial evidence supporting a

---

[127] Rastogi, R.P., D. Madamwar, and A. Incharoensakdi. 2015. Bloom dynamics of cyanobacteria and their toxins: environmental health impacts and mitigation strategies. Front. Microbiol. 17 https://doi.org/10.3389/fmicb.2015.01254.
[128] EPA 2016 at 35.
[129] *Id*. at 45.
[130] Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374.
[131] Williams, C.D., J. Burns, A. Chapman, M. Pawlowicz, and W. Carmichael. 2006. Assessment of Cyanotoxins in Florida's Surface Waters and Associated Drinking Water Resources, Final Report, 5, April 11, 2006.
[132] *Id*.
[133] *Id*. *See also* Holtcamp, W. 2012. The Emerging Science of BMAA. Environmental Health Perspectives. Vol. 120, No. 3.
[134] Holtcamp, W. 2012. The Emerging Science of BMAA. Environmental Health Perspectives. Vol. 120, No. 3.
[135] Zanchett, G. and E.C. Oliveira-Filho. 2013. Cyanobacteria and cyanotoxins: from impacts on aquatic ecosystems and human health to anticarcinogenic effects, Toxins 5(10): 1896-1917, doi: 10:3390/toxins5101896.
[136] A hepatoxin is a toxic chemical that damages the liver. Zanchett, G. and Oliveira-Filho, E.C. 2013. Cyanobacteria and Cyanotoxins: From Impacts on Aquatic Ecosystems and Human Health to Anticarcinogenic Effects. Toxins 2013, 5.
[137] Hudnell, K. 2009. Congressional Testimony.
[138] EPA. 2015. Drinking Water Health Advisory for the Cyanobacterial Microcystin Toxins, EPA Doc. Number 820R15100, p. 34 June 15, 2015.

plausible tumor promoter mechanism for these liver toxins.[139] According to one leading expert, "[c]yanotoxins are among the most potent toxins known, far more potent than industrial chemicals."[140] In a 12-year study, researchers at Ohio State University identified significant clusters of deaths attributable to non-alcoholic liver disease in coastal areas impacted by cyanobacterial blooms.[141] The only one in Florida occurred in St. Lucie, Indian River and Okeechobee counties, where based on data calculated by the CDC, included a death rate from non-alcoholic liver disease that was nearly twice as high as the national rate.[142] The study did not coincide with discharges that occurred in 2013 and 2016.[143]

The non-protein amino acid, beta-N-methylamino-L-alanine (BMAA), is a cyanobacteria-derived toxin that has been linked to neurodegenerative diseases like ALS (Amyotropihc Lateral Sclerosis) and Parkinsonism Dementia Complex (ALS/PDC).[144] ALS is a debilitating and fatal neuromuscular disease affecting 2 of every 100,000 people worldwide.[145] Approximately 30,000 and 500,000 people suffer from ALS and Parkinson Disease in the United States, respectively.[146] Alzheimer's disease inflicts another 5.4 million Americans.[147] Cases of these neurodegenerative diseases are on the rise.[148] Increased longevity alone may not account for all of this increase and heritability of these diseases is low (less than 10% of all cases).[149]

Extremely high rates of ALS were found in the Mariana Islands, particularly in Guam, in the 1940's and 1950's.[150] Researchers believed the cause to be environmental and later discovered

---

[139] *Id*.
[140] Hudnell, K. 2009. Congressional Testimony.
[141] Zhang, F, J. Lee, S. Liang, and C.K. Shum. 2015. Cyanobacteria blooms and non-alcoholic liver disease: evidence from a county level ecological study in the United States, Environmental Health, 14: 41; Treadway, T. 2017. Ohio State University study links toxic algae blooms, fatal liver disease, Naples Daily News, May 22, 2017, at https://www.naplesnews.com/story/news/local/indian-river-lagoon/health/2017/05/22/ohio-state-university-study-links-toxic-algae-blooms-fatal-liver-disease/100971180/.
[142] Treadway, T. 2017. Ohio State University study links toxic algae blooms, fatal liver disease, Naples Daily News, May 22, 2017, at https://www.naplesnews.com/story/news/local/indian-river-lagoon/health/2017/05/22/ohio-state-university-study-links-toxic-algae-blooms-fatal-liver-disease/100971180/.
[143] *Id*.
[144] Banack, S.A. et al. 2010. The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis Toxins 2010, 2, 2837-2850; doi: 10.3390/toxins2122837; Bienfang, P.K. et al. 2011. Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications. International Journal of Microbiology. Vol. 2011. Article ID 152815; doi:10.1155/2011/152815.
[145] *Id*.
[146] Holtcamp, W. 2012. The Emerging Science of BMAA. Environmental Health Perspectives. Vol. 120, No. 3.
[147] *Id*.
[148] Brand, L. et al. 2010. Cyanobacteria Blooms and the Occurrence of the neurotoxin beta-N-methylamino-L-alanine (BMAA) in South Florida Aquatic Food Webs. Harmful Algae. 2010 Sept. 1; 9(6): 620-635; doi:10.1016/j.hal.2010.05.002.
[149] *Id*.
[150] Banack, S.A. et al. 2010. The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis, Toxins 2010, 2, 2837-2850; doi: 10.3390/toxins2122837; Bienfang, P.K. et al. 2011. Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications. International Journal of Microbiology. Vol. 2011. Article ID 152815; doi:10.1155/2011/152815.

BMAA in flour made from cycad seeds.[151] In addition to consuming cycad flour, the Chamorro indigenous people also ate flying foxes (a type of fruit bat) and other animals that fed on cycad seeds.[152] It was later determined that BMAA can biomagnify up the food chain from the cycad seeds to the animals that consume these seeds and ultimately to people who consume these animals.[153] Studies by Cox et al. (2003), Banack and Cox (2003), Murch et al. (2004) and Banack et al. (2006) found a 10,000-fold biomagnification of free BMA and 50-fold biomagnification of total BMAA in the food chain in Guam from symbiotic cyanobacteria to cycads to fruit bats.[154] The Chamorro of Guam, who consumed the bats, pigs and squirrels had a 100-fold increase in ALS/PDC.[155] The Chamorro who died of these neurodegenerative diseases as well as Canadian patients with Alzheimer's disease had high concentrations of BMAA.[156] A 2016 study by Meneely et al., however, contradicted previous findings and did not find BMAA in the brains of patients with confirmed Alzheimer's disease.[157] Pablo et. al. (2009) documented high concentrations of BMAA in Americans who died of ALS but little to no BMA in the brains of Americans who died of other causes, suggesting that the situation in Guam is not unique and that BMAA can biomagnify in other food chains and enter the human diet.[158]

Brand et al. (2010) found BMAA bio-concentrated in crustaceans, mollusks, and some fish in South Florida.[159] High levels of BMAA have been found in fish in the Caloosahatchee River and

---

[151] *Id*.
[152] Banack, S.A. et al. 2010. The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis, Toxins 2010, 2, 2837-2850; doi: 10.3390/toxins2122837; Bienfang, P.K. et al. 2011. Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications. International Journal of Microbiology. Vol. 2011. Article ID 152815; doi:10.1155/2011/152815.
[153] *Id*.; Cox, P.A. and O.W. Sacks. 2002. Cycad neurotoxins, consumption of flying foxes, and ALS-PDC disease in Guam. Neurology. 2002 Mar. 26; 5896): 956-9; Holtcamp, W. 2012. The Emerging Science of BMAA. Environmental Health Perspectives. Vol. 120, No. 3.
[154] Brand, L. et al. 2010. Cyanobacteria Blooms and the Occurrence of the neurotoxin beta-N-methylamino-L-alanine (BMAA) in South Florida Aquatic Food Webs. Harmful Algae. 2010 Sept. 1; 9(6): 620-635; doi:10.1016/j.hal.2010.05.002 (Brand 2010)(citing Cox, P.A., S.A. Banack, and S.J. Murch. 2003. Biomagnification of cyanobacterial neurotoxins and neurodegenerative disease among the Chamorro people of Guam. Proc. Natl. Acad. Sci. USA 2003, 100:13380-13383; Banack, S.A. and P.A. Cox. 2003. Biomagnification of cycad neurotoxins in flying foxes. Neurol 2003, 61:387-389; Murch, S.J., P.A. Cox, and S.A. Banack. 2004. A mechanism for slow release of biomagnified cyanobacterial neurotoxins and neurodegenerative disease in Guam. Proc. Nat. Acad. Sci 2004, 101:12228-11131; Banack, S.A., S.J. Murch, and P.A. Cox. 2006. Neurotoxic flying foxes as dietary items for the Chamorro people, Marianas Islands. J Ethnopharm 2006, 106:97-104.
[155] Murch, S.J. et al. 2004. Occurrence of B-methylamino-L-alanine (BMAA) in ALS/PDC patients from Guam. Acta Neurol Scand. 2004; 110: 267-9.
[156] Pablo, J. et al. 2009. Cyanobacterial neurotoxin BMAA in ALS and Alzheimer's disease. Acta Neurol Scand. Published online 26 Feb, 2009; Murch, S.J. et al. 2004. Occurrence of B-methylamino-L-alanine (BMAA) in ALS/PDC patients from Guam. Acta Neurol Scand. 2004; 110: 267-9.
[157] Meneely, J.P. et al. 2016. B-methylamino-L-alanine (BMAA) is not found in the brains of patients with confirmed Alzheimer's disease. Sci Rep. 2016; 6: 36363.
[158] Brand, L. 2009. Human exposure to cyanobacteria and BMAA. Amyotrophic Lateral Sclerosis, 2009, (Supplement 2): 85-95 (Brand 2009) (citing Pablo, J. et al. 2009. Cyanobacterial neurotoxin BMAA in ALS and Alzheimer's disease. Acta Neurol Scand. Published online 26 Feb, 2009).
[159] Banack, S.A. et al. 2010. The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis, Toxins 2010, 2, 2837-2850; doi: 10.3390/toxins2122837; Brand, L. 2009. Human exposure to

Florida Bay.[160] Cox et al. (2005) recommended that BMAA concentrations be monitored in invertebrates, fish, and grazing animals used for human consumption that directly consume cyanobacteria or forage on plants or prey that may have accumulated cyanobacteria-produced BMAA.[161] Subsequent published articles by other researchers, including in the *Journal of the American Medical Association*, further support these recommendations.[162]

People near blue-green algae blooms have been found to have inhaled the toxins deep into their lungs.[163] There is concern that people exposed to waterborne BMAA may have an increased risk of neurodegenerative disease.[164] Researchers used GIS software to map ALS cases and lakes with a history of HABs in New Hampshire.[165] They found that people living within a half-mile of lakes contaminated with cyanobacteria had a 2.32-times greater risk of developing ALS than the rest of the population.[166] The researchers identified clusters of ALS cases in proximity to the HABs.[167] The latency period for disease development may be several decades.[168]

---

cyanobacteria and BMAA. Amyotrophic Lateral Sclerosis, 2009, (Supplement 2): 85-95; Brand, L. et al. 2010. Cyanobacteria Blooms and the Occurrence of the neurotoxin beta-N-methylamino-L-alanine (BMAA) in South Florida Aquatic Food Webs. Harmful Algae. 2010 Sept. 1; 9(6): 620-635; doi:10.1016/j.hal.2010.05.002.

[160] Brand, L. et al. 2010. Cyanobacteria Blooms and the Occurrence of the neurotoxin beta-N-methylamino-L-alanine (BMAA) in South Florida Aquatic Food Webs. Harmful Algae. 2010 Sept. 1; 9(6): 620-635; doi:10.1016/j.hal.2010.05.002.

[161] Bienfang, P.K. et al. 2011. Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications. International Journal of Microbiology. Vol. 2011. Article ID 152815; doi:10.1155/2011/152815; Cox, P.A., S.A. Banack, S.J. Murch et al. 2005. Diverse taxa of cyanobacteria produce B-N-methylamino-L-alanine, a neurotoxic amino acid, Proceedings of the National Academy of Sciences of the United States of America, vol. 102, no. 14, pp. 5074-5078, 2005.

[162] Bienfang, P.K. et al. 2011. Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications. International Journal of Microbiology. Vol. 2011. Article ID 152815; doi:10.1155/2011/152815 (citing Kuehn, B.M. 2005. Environmental neurotoxin may pose health threat, Journal of the American Medical Association, vol. 293, no. 20, pp. 2460-2462, 2005; Ince, P.G. and G.A. Codd. 2005. Return of the cycad hypothesis-does the amyotrophic lateral sclerosis/parkinsonism dementia complex (ALS/PDC) of Guam have new implications for global health? Neuropathology and Applied Neurobiology, vol. 31, no. 4, pp. 345-353, 2005; Esterhuizen, M. and T.G. Downing. 2008. B-N-methylamino-l-alanine (BMAA) in novel South African cyanobacterial isolates, Ecotoxicology and Environmental Safety, vol. 71, no. 2, pp. 309-313, 2008).

[163] Williams, A. 2018. Algae toxins are airborne and can reach deep into human lungs, FGCU research shows. Fort Myers News-Press. Nov. 27, 2018, at https://www.news-press.com/story/tech/science/environment/2018/11/27/blue-green-algae-toxins-can-penetrate-lungs-fgcu-research-shows/2120238002/.

[164] Metcalf, J. and G. Codd. 2009. Cyanobacteria, neurotoxins and water resources: Are there implications for human neurodegenerative disease? Amyotrophic Lateral Sclerosis, 2009; (Supplement 2): 74-78.

[165] Holtcamp, W. 2012. The Emerging Science of BMAA. Environmental Health Perspectives. Vol. 120, No. 3 (citing Caller, TA, et. al. 2009. A cluster of amyotrophic lateral sclerosis in New Hampshire: a possible role for toxic cyanobacterial blooms. Amyotroph Lateral Scler 10 (suppl 2): 101-108 (2009)).

[166] *Id*.

[167] Holtcamp, W. 2012. The Emerging Science of BMAA. Environmental Health Perspectives. Vol. 120, No. 3 (citing Caller, TA, et. al. 2009. A cluster of amyotrophic lateral sclerosis in New Hampshire: a possible role for toxic cyanobacterial blooms. Amyotroph Lateral Scler 10 (suppl 2): 101-108 (2009)).

[168] Banack, S.A. et al. 2010. The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis, Toxins 2010, 2, 2837-2850; doi: 10.3390/toxins2122837.

Cyanobacteria-produced BMAA has also been linked to motor neuron disease (MND). From 1986 to 2016 there has been a 250% increase in MND in Australia, where several lakes have experienced large HABs in recent years.[169] As Banack et al. (2010) concluded, "[s]ince human exposure to BMAA appears to be widespread, it "has the potential to be a major environmental factor capable of causing ALS and other neurogenerative diseases throughout the world."[170]

b. Cyanotoxins Kill and Injure Livestock and Pets

The toxic effects of a cyanobacteria bloom were first scientifically documented in an 1878 study by George Francis of mass livestock deaths in Lake Alexandria, Australia.[171] Livestock deaths have been reported on every inhabited continent and have included ruminants, hogs, horses, fowl, cultured fish and even honeybees.[172] Large numbers of livestock die every year in southern Africa from ingesting cyanotoxins.[173] Acute symptoms of poisoning in livestock include loss of appetite, weakness, staggering, or inflammation of the muzzle, ear, or udder.[174] Higher levels of cyanotoxins can lead to severe liver damage, the development of jaundice, and severe photosensitization.[175] Livestock may die minutes after drinking contaminated water.[176] Often poisoning from cyanobacterial blooms is not noticed until hours after ingestion of water or food, by which time it is too late.[177]

Pets can be exposed to higher concentrations of cyanotoxins than humans because they are known to consume cyanobacterial scum and drink contaminated water.[178] Dogs are particularly at risk because they may lick cyanobacterial cells from their fur after swimming in water impacted by an HAB.[179] Common signs of poisonings in pets include repeated vomiting, diarrhea, loss of appetite, abdominal swelling, stumbling, seizures, convulsions, disorientation, inactivity, or skin rashes and hives.[180] A number of dogs die each year from cyanotoxin

---

169 *See* The Project. 2019. MND Increase, Community Suffering (Feb. 10, 2019), at https://www.facebook.com/TheProjectTV/videos/359529861300197/.
170 Banack, S.A. et al. 2010. The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis, Toxins 2010, 2, 2837-2850; doi: 10.3390/toxins2122837.
171 Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374 (citing Francis, G. Poisonous Australian lake. Nature. 1878; 18:11-12. doi: 10.1038/08011d0).
172 Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374.
173 Masango, M.G., J.G. Myburgh, L. Labuschagne, D. Govender, R.G. Bengis, and D. Naicker. 2010. Assessment of *microcystis* bloom toxicity associated with wildlife mortality in the Kruger National Park, South Africa. Journal of Wildlife Diseases, 46(1): 95-102.
174 EPA 2016 at 76.
175 *Id*.
176 *Id*.
177 Brand, L. 2009. Human exposure to cyanobacteria and BMAA. Amyotrophic Lateral Sclerosis, 2009, (Supplement 2): 85-95.
178 EPA 2016 at 76.
179 *Id*.
180 *Id*.

poisoning.[181] Backer et. al. (2013) documented a significant increase in the reporting of canine mortalities since the 1970s.[182] In 2015, three dogs in New York state became ill after being exposed to recreational waters affected by HABs.[183] EPA believes the impacts on domestic and companion animals are likely under-recognized because many cases are misdiagnosed, few cases are biochemically confirmed, and even fewer are reported in scientific literature.[184]

In 2018, a necropsy determined that toxic blue-green algae in the St. Lucie River killed a standard poodle named Finn.[185] Two golden retrievers became seriously ill after they got into the North Fork of the St. Lucie River near the family home.[186] Pathology reports showed blue-green algae and microcystin in the blood, urine, and vomit.[187] At least three other dogs became sick after coming into contact with the river.[188]

2. Red Tide

Red tide has been called "one of the most common chemical stressors impacting South Florida coastal and marine ecosystems,"[189] and studies suggests that nutrients including phosphorous and nitrogen from discharges as well as biomass killed by cyanobacteria can energize or reawaken red tide.[190] Red tide is caused by the dinoflagellate *Karenia brevis* which produces brevetoxins

---

[181] Backer, L.C., J.H. Landsberg, M. Miller, K. Keel, T.K. Taylor. 2013. Canine cyanotoxin poisonings in the United States (1920s-2012): Review of suspected and confirmed cases from three data sources. Toxins 2013, 5, 1597-1628.
[182] *Id*. Reporting, attribution and detection biases, however, influenced the number of events that were confirmed being associated with cyanobacteria. *See* Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374.
[183] Mary Figgatt et al., Harmful Algal Bloom-Associated Illnesses in Humans and Dogs Identified Through a Pilot Surveillance System-New York, 2015. Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report, Nov. 3, 2017, available at www.cdc.gov/mmwr/volumes/66/wr/mm6643a5.htm.
[184] EPA 2016 at 75.
[185] Treadway, T. 2018. Toxic algae killed east coast dog after contact with St. Lucie River, owner says necropsy reveals, TC Palm (Sept. 17, 2018) at https://www.naplesnews.com/story/news/environment/2018/09/17/report-shows-dog-killed-toxic-blue-green-algae-st-lucie-river/1339559002/.
[186] *Id*.
[187] *Id*.
[188] *Id*.
[189] Pierce, R.H. 2008. Harmful algal toxins of the Florida red tide (Karenia brevis): natural chemical stressors in South Florida coastal ecosystems. Ecotoxicology. 2008 Oct. 17(7): 623-631. Doi:10.1007/s10646-008-0241-x.
[190] Olascoaga, M.J. 2010. Isolation on the West Florida Shelf with implications for red tides and pollutant dispersal in the Gulf of Mexico. Nonlinear Process Geophys. 2010 Jan. 1; 17(6): 685-696. Doi:10.5194/npg-17-685-2010; Olascoaga, M.J. et al. 2008. Tracing the Early Development of Harmful Algal Blooms on the West Florida Shelf with the Aid of Lagrangian Coherent Structure. J. Geophys. Res. 2008; 113(c12): c12014-doi: 10.1029/2007JC004533; Poulson-Ellestad, K. et al. 2014. Metabolics and proteomics reveal impacts of chemically mediated competition on marine plankton. PNAS. June 17, 2014. Vol. 11. No. 24. 9009-9014; Morey, J. et al. 2011. Transcriptomic response of the red tide dinoflagellate, Karenia brevis, to nitrogen and phosphorus depletion and addition. Genomics 2011, 12.346; Garrett, M. 2011. Harmful algal bloom species and phosphate-processing effluent: Field and laboratory studies. Marine Pollution Bulletin 62 (2011) 596-601; Heil, C.A. et al. 2014. Blooms of Karenia brevis (Davis) G. Hansen & O. Moestrup on the West Florida Shelf: Nutrient sources and potential management strategies based on a multi-year regional study. Harmful Algae 38 (2014) 127-43; Killberg-Thoreson,

which kill fish,[191] make filter-feeding fish extremely toxic to other animals, and cause respiratory and intestinal distress in humans.[192] Red tide has also been linked to land mammal and bird mortality,[193] and can bioaccumulate.[194] Exposed fish and seagrasses can accumulate high concentrations of brevetoxins and act as toxin vectors to dolphins and manatees.[195] People generally do not become aware of its presence until it reaches above 100,000 cells/l, which is when it leads to fish kills,[196] shellfish toxicity, and respiratory distress.[197]

There has been an increase in red tide in southwest Florida since 1954, in abundance and frequency.[198] Other red tide impacts include paralytic shellfish poisoning,[199] neurotoxic shellfish

---

L. et al. 2014. Nutrients released from decaying fish support microbial growth in the eastern Gulf of Mexico. Harmful Algae 38 (2014) 40-49; Mulholland, M.R. et al. 2014. Contribution of diazotrpohy to nitrogen inputs supporting Karenia brevis blooms in the Gulf of Mexico. Harmful Algae 38 (2014) 20-29; Redalje, D.G. et al. 2008. The growth dynamics of Karenia brevis within discrete blooms on the West Florida Shelf. Continental Shelf Research 28 (2008) 24-44; Munoz, C. 2018. Scientists: Lake Okeechobee runoff may enhance red tide. Daily Commercial. Oct. 11, 2018; Burkholder, J.M. and P.M. Gilbert. 2011. Grazing by Karenia brevis on Synechococcus enhances its growth rate and may help to sustain blooms. Aquatic Microbial Ecology 55:17-30. https://apprecautionaryprinciple.wordpress.com/2011/06/16/red-tide-blooms-influenced-by-rea-nitrogren-run-off-into-gulf-of-mexico-waters/.

[191] Rolton, A. et al. 2014. Effects of the red tide dinoflagellate, Karenia brevis, on early development of the eastern oyster Crassostrea virginica and northern quahog Mercenaria mercenaria. Aquatic Toxicology 155 (2014) 199-206; Rolton, A. et al. 2015. Susceptibility of gametes and embryos of the eastern oyster, Crassostrea virginica, to Karenia brevis and its toxins. Toxicon 99 (2015) 6-15; Rolton, A. et al. 2016. Effects of field and laboratory exposure to the toxic dinoflagellate Karenia brevis on the reproduction of the eastern oyster, Crassostrea virginia, and subsequent development of offspring. Harmful Algae 57 (20016) 13-26; Walsh, J.J. et al. 2009. Isotopic evidence for dead fish maintenance of Florida red tides, with implications for coastal fisheries over both source regions of the west Florida shelf and within downstream waters of the South Atlantic Bight. Progress in Oceanography 80 (2009) 51-73.

[192] Backer, L. et al. 2005. Occupational Exposure to Aerosolized Brevetoxins during Florida Red Tide Events: Effects on a Healthy Worker Population. Environmental Health Perspectives. Vol. 113. Iss. 5. May 2005; Bienfang, P.K. et al. 2011. Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications. International Journal of Microbiology Vol. 2011. Art. ID 152815; CDC. 2008. Illness Associated with Red Tide – Nassau County, Florida, 2007; Fleming, L. 2005. Initial Evaluation of the Effects of Aerosolized Florida Red Tide Toxins (Brevetoxins) in Persons with Asthma. Environmental Health Perspectives. Vol. 113. Iss. 5. May 2005; Naar, J. 2002. Brevetoxin Depuration in Shellfish via Production of Non-toxic Metabolites: Consequences for Seafood Safety and the Environmental Fate of Biotoxins. Harmful Algae 2002 (2002). 2004; 10: 488-490; Steensma, D. 2007. Exacerbation of Asthma by Florida "Red Tide" During an Ocean Sailing Trip. Mayo Clin Proc. Sept. 2007; 82(9): 1128-1130.

[193] Castle, K. et al. 2013. Coyote (Canis latrans) and domestic dog (Canis familiaris) mortality and morbidity due to a Karenia brevis red tide in the Gulf of Mexico. Journal of Wildlife Diseases, 49(4), 2013, pp. 955-64; Kreuder, C. 2012 Clinicopathologic features of suspected brevetoxicosis in double-crested cormorants (phalacrocorax auritus) along the Florida Gulf coast. Journal of Zoo and Wildlife Medicine, 33(1):8-15.

[194] Echevarria, M. 2012. Effects of Karenia brevis on clearance rates and bioaccumulation on brevetoxins in benthic suspension feeding invertebrates. Aquatic Toxicology 106-107 (2012) 85-94.

[195] Flewwelling, L. et al. 2005. Red tides and marine mammal mortalities.: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. Nature. 2005. June 9; 435(7043).

[196] Gravinese, P. et al. 2018. The effects of red tide (Karenia brevis) on reflex impairment and mortality of sublegal Florida stone crabs, Menippe mercenaria. Marine Environmental Research 137 (2018) 145-148.

[197] Bienfang 2011; Pierce, R. 2011. Compositional changes in neurotoxins and their oxidative derivatives from the dinoflagellate, Karenia brevis, in seawater and marine aerosol. Journal of Plankton Research. Vol. 30. No. 2.

[198] Brand, L and A. Compton. 2007. Long-term increase in Karenia brevis abundance along the Southwest Florida Coast. Harmful Algae. 2007. 6(2): 232-252. doi:10.1016/j/hal.2006.08.005.

[199] Watkins, S. 2008. Neurotoxic Shellfish Poisoning. Mar. Drugs 2008, 6, 431-455; DOI: 10.3390/md20080021.

poisoning, ciguatera fish poisoning, fish kills, loss of submerged vegetation, shellfish mortalities, and marine mammal mortalities.[200] Brevetoxins are large, lipid soluble molecules that bioaccumulate in fatty tissue and are not easily shed or excreted.[201] As a result, sublethal concentrations can have lethal consequences.[202] Because *k.brevis* is a particularly delicate dinoflagellate, turbulence can break apart the cells and aerosolize the brevetoxins which are then inhaled and can cause respiratory distress.[203]

Eerera et al. (2011) determined that by rapidly changing salinity to simulate the shift from oceanic to coastal conditions, brevetoxin was triggered, showing that brevetoxin production can increase dramatically in response to osmotic stress regardless of the initial source of the red tide.[204] Sources contributing to red tide include nutrients in runoff, iron-rich atmospheric dust, dead marine life, and nutrient rich groundwater.[205]

At concentrations of >100,000 cells/l, the 12 brevetoxins produced by red tide can and have killed marine animals, including fish, sea turtles, manatee, sea birds, and dolphins.[206] Brevetoxins from red tide have long been known to cause manatee mortality.[207] One study found markedly less shrimp and fish activity during red tide.[208] Meanwhile, almost nothing is known about the longterm chronic exposure.[209]

---

[200] Anderson, D. et al. 2008. Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States. Harmful Algae. 2008. Dec. 1; 8(1): 39-53. Doi:10.1016/j.hal.2008.08.017.
[201] Bienfang 2011.
[202] *Id*.
[203] *Id*.; Fleming, L. 2007. Aerosolized Red-Tide Toxins (Brevetoxins) and Asthma. Chest. 2007. Jan; 131(1): 187-194. Doi:10.1378/chest.06-1830; Kirkpatrick, B. et al. 2010. Inland Transport of Aerosolized Florida Red Tide Toxins. Harmful Algae. 2010. Feb. 1; 9(2): 186-189. Doi:10.1016/j.hal.2009.09.003; Kirkpatrick, B. et al. 2011. Aerosolized Red Tide Toxins (Brevetoxins) and Asthma: Continued health effects after 1 hour beach exposure. Harmful Algae 2011. Jan. 1: 10(2): 138-143. Doi:10.1016/j.hal.2010.08.005.
[204] Errera R. and L. Campbell. 2011. Osmotic stress triggers toxin production by the dinoflagellate Karenia brevis. PNAS. June 28,2011. Vol. 108. No. 26.
[205] Bienfang 2011; Walsh, J.J. et al. 2006. Red tides in the Gulf of Mexico: Where, when, and why? J. Geophys Res. 2006. Nov. 7; 111(C11003): 1-46. Doi:10.1029/2004JC002813.
[206] Bienfang 2011; Twiner, M. et al. 2012. Comparative Analysis of Three Brevetoxin-Associated Bottlenose Dolphin (*Tursiops truncatus*) Mortality Events in the Florida Panhandle Region (USA). PLoS ONE 7(8):e42974. Doi:10.1371/journal.pone.0042974; Twiner, M. et al. 2011. Concurrent Exposure of Bottlenose Dolphins (*Tursiops truncatus*) to Multiple Algal Toxins in Sarasota Bay, Florida, USA. PLoS ONE 6(3): e17394. Doi:10.1371/journal.pone.0017394.
[207] Kirkpatrick, B. et al. 2002. Florida Red Tides, Manatee Brevetoxicosis, and Lung Models Harmful Algae 2002 (2002). 2004; 10:491-493.
[208] Indeck, K.L. 2015. A severe red tide (Tampa Bay, 2005) cause an anomalous decrease in biological sound. R. Soc. Open sci. 2:150337.
[209] Erdner, D. et al. 2008. Centers for Oceans and Human Health: a unified approach to the challenge of harmful algal blooms. From Centers for Oceans and Human Health Investigators Meeting. Woods hole, MA. USA. 24-27. Apr. 2007.

HABs have also impacted coastal economies. Red tide increases the use of emergency medical services, local fisheries close, and local shops are affected.[210] One study found that red tide can cause $0.5-4 million in emergency room costs for treating respiratory illness associated with red tide.[211] Another calculated $300,000 impacts in lifeguard absenteeism in Sarasota County alone.[212] Anderson (2000) calculated red tide is responsible for more than $20 million tourism-related loses every year.[213]

The current, ongoing red tide bloom started in October 2017 and by November 2018, red tide and fish kills had reached the Florida panhandle in Okaloosa, Walton, Bay and Franklin counties and wrapped around the southern tip of Florida and up the Atlantic coast.[214] By October 2018, red tide closed beaches in Pinellas, Manatee, Sarasota, Lee, Collier, Escambia, Okaloosa, Brevard and Indian River counties.[215] Concentrations of more than 1 million *K.brevis* cells per liter were observed in Pinellas, Hillsborough, Manatee, and Sarasota counties by November 2018.[216] Governor Scott has declared a state of emergency, and by August 2018, thousands of tons marine life killed by the bloom had been removed, costing tax-payers millions of dollars.[217]

B. LORS Significantly Impacts the Environment

Red tide and blue-green algae blooms have individually, collectively, and synergistically killed tens of thousands of tons of marine wildlife, including ESA-listed species like sea turtles, Florida manatees,[218] smalltooth sawfish, and coral, and species protected under the Marine Mammal Protection Act, 16 U.S.C. §1361 *et. seq*., such as bottlenose dolphins. The National Oceanic Atmospheric Administration has collected data on unusual mortality events finding that 41 percent of marine mammal deaths 1991-2013 were due to HAB toxin exposure.219

---

[210] Backer, L. 2009. Impacts of Florida red tides on coastal communities. Harmful Algae 8 (2009) 618-622.
[211] Hoagland, P. et al. 2009. The Costs of Respiratory Illnesses Arising from Florida Gulf Coast Karenia brevis Blooms. Environmental Health Perspective. Vol. 117. Iss. 8; Fleming, L. et al. 2011. Review of Florida Red Tide and Human Health Effects. Harmful Algae. 2011. Jan. 1: 10(2): 224-233. Doi:10.1016/j.hal.2010.08.006; Anderson, D. 2008. Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States. Harmful Algae. 2008. Dec. 1: 8(1): 39-53. Doi: 10.101016/j.hal.2008.08.017.
[212] Fleming 2011; Nierenberg, K. et al. 2010. Florida Red Tide Perception: Residents versus Tourists. Harmful Algae. 2010 Sept. 1; 9(6): 600-606. Doi:10.1016/j.hal.2010.04.010.
[213] Anderson, D. and P. Hoagland. 2000. Estimated Annual Economic Impacts from Harmful Algal Blooms (HABs) in the United States. WHOI-2000-11. Sea Grant. Woods Hole.
[214] Keiek, B. Red tide update for Northwest Florida. Mynbc15.com (Nov. 1, 2018); Jones, C. 2018. Could toxic red tide move farther north to St. Johns County? The St. Augustine Record. Oct. 8, 2018.
[215] Murphy. 2018. Red tide is spreading in Florida. Hurricane Michael didn't stop it. CNN. Oct. 18, 2018.
[216] Ballogg, R. 2018. Red tide remains strong on Anna Maria Island. Bradenton Herald. Nov. 1, 2018.
[217] Murphy, P. 2018. Red tide just spread to Florida's Atlantic coast, choking some the most popular beaches. CNN. Oct. 5, 2018.
[218] The Florida manatee is also protected under the Marine Mammal Protection Act.
219 Schaefer, A. et al. 2019. Integrated observing systems: An approach to studying harmful algal blooms in south Florida. Journal of Operational Oceanography, DOI: 10.1080/1755876X.2019.160687; National Oceanic and Atmospheric Administration.
2013. Marine mammal unusual mortality events 1991–2013. www.nmfs.noaa.gov/pr/health/immume/.

BMAA concentrations of animals exposed to cyanobacteria have been observed in Florida, including moderate amounts in mollusks and high concentrations in fish in the Caloosahatchee River.[220] Bottlenose dolphins can eat similar diets to humans (fish and crustaceans), and those that have died in the Indian River Lagoon have similar concentrations of BMAA in their brains as humans that have died of neurodegenerative diseases.[221] In a recently published study, researchers at the University of Miami were the first to show detectable levels of BMAA in bottlenose dolphin brains that also displayed degenerative damage similar to Alzheimer's, Lou Gehrig's disease, and Parkinson's disease in humans.[222] The dolphins studied included seven that beached themselves in 2005 along the Atlantic, the Indian River Lagoon, the Banana River and Gulf of Mexico.[223] Impacted wildlife in Florida have been found to have similar concentrations of BMAA as in impacted wildlife in Guam.[224] Even coral in Florida are being overgrown by cyanobacteria and cyanobacterial diseases.[225]

In August 2018, the Florida Department of Environmental Protection collected water samples with toxic algae at the rate of 110 parts per billion, 10 times the level the World Health Organization has determined to be hazardous for humans in recreational waters.[226] Testing had detected even higher levels in July 2018 at 154.38 PPB and 33,000 PPB in 2016. Dozens of people have been hospitalized after being exposed to the toxic algae, which doctors describe as a "health hazard."[227]

A study sampling cyanobacteria in St. Lucie during the 2016 event detected concentrations of microcystins that greatly exceeded World Health Organization Guideline Values for drinking and recreational water, and also detected the neurotoxins anatoxin-a(S) and BMAA.[228] Additional research is underway at Florida Atlantic University after taking blood, urine, nose,

[220] Brand 2010.
[221] Brand 2009; Brand 2010.
[222] Staletovich, J. 2019. Dolphins poisoned by algae also showed signs of Alzheimer's-like brain disease, Miami Herald, (Mar. 20, 2019) at https://www.miamiherald.com/news/local/environment/article228126094.html; Davis D.A., Mondo K., Stern E., Annor A.K., Murch S.J., Coyne T.M., et al. 2019. Cyanobacterial neurotoxin BMAA and brain pathology in stranded dolphins. PLoS ONE 14(3):e0213346. https://doi.org/10.1371/journal.prone.0213346.
[223] Staletovich, J. 2019. Dolphins poisoned by algae also showed signs of Alzheimer's-like brain disease, Miami Herald, (Mar. 20, 2019) at https://www.miamiherald.com/news/local/environment/article228126094.html; Davis D.A., Mondo K., Stern E., Annor A.K., Murch S.J., Coyne T.M., et al. 2019. Cyanobacterial neurotoxin BMAA and brain pathology in stranded dolphins. PLoS ONE 14(3):e0213346. https://doi.org/10.1371/journal.prone.0213346.
[224] Brand 2009.
[225] Paul, V.J. et al. 2005. Benthic cyanobacterial bloom impacts the reefs of southern Florida (Broward County, USA), Coral Reefs. 2005; 24:693-7; Richardson, L.L. et al. 2003. Ecological physiology of the black band disease cyanobacterium Phormidium corallyticum. FEMS Microbiol Ecol. 2003; 43:287-98.
[226] Wright, P. 2018. Florida's Blue-Green Algae Bloom 10 Times Too Toxic to Touch, Testing Shows. Aug. 10, 2018. Weather.com (Wright 2018).
[227] *Id*.
[228] Metcalf, J.S. 2018. Public health responses to toxic cyanobacteria blooms: perspectives from the 2016 Florida event. Water Policy. Creative Commons.

and throat swab samples from people exposed to the 2018 bloom.[229] And yet another study has identified a correlation between cyanobacterial blooms and high levels of nonalcoholic liver disease in Florida counties where subsistence fishers eat 3 to 4 times more fish than the average U.S. citizen.[230]

Cyanobacteria are frequently dominant in waters without detectable red tide, suggesting that they may play an important role in providing fuel to initiate red tide blooms.[231] The cyanobacteria synechococcus is a potential prey source in nutrient poor environments for red tide.[232] Synechococcus has been detected in the Lake Okeechobee system.[233] Studies suggests that nutrients including phosphorous and nitrogen from discharges can energize or reawaken red tide.[234]

There have been numerous descriptions of mammal and bird mortalities associated with exposure to cyanobacteria.[235] HABs may have both direct and indirect impacts to fish and wildlife from the bottom of the food chain up.[236] Cyanotoxins can influence the structure of zooplankton communities and reduce the filtration capacity and survival of offspring.[237] Ingestion of microcystins can result in lethal poisoning.[238] Cyanotoxins can also inhibit the growth of underwater plants, and adversely affect aquatic invertebrates such as mollusks by reducing food intake, filtration, absorption and fecal loss, and the scope for growth.[239]

---

[229] Williams, A. 2018(a). Researchers in town testing residents for exposure to algae toxins. Fort Myers News-Press Oct. 15, 2018.
[230] Zhang, F., et al. 2015. Cyanobacteria blooms and non-alcoholic liver disease: evidence from a county level ecological study in the United States. Environmental Health, 1-11; ORCA. 2019. Abstract: Tracking Cyanobacteria in the Aquatic Food Web in Martin County.
[231] Jones, K. et al. 2010. Comparative analysis of bacterioplankton from Karenia brevis bloom and nonbloom water on the west Florida shelf (Gulf of Mexico, USA) using 16SrRNA gene clone libraries. FEMS Microbiol Ecol 73 (2010) 468-485 (Jones 2010).
[232] *Id*.; Gilbert, P. 2011. Grazing by Karenia brevis on Synechococcus enhances its growth rate and may help to sustain blooms.
[233] Rosen, B. et al. 2016. Cyanobacteria of the 2016 Lake Okeechobee and Okeechobee Waterway Harmful Algal Bloom.
[234] Olascoaga, M.J. 2010. Isolation on the West Florida Shelf with implications for red tides and pollutant dispersal in the Gulf of Mexico. Nonlinear Process Geophys. 2010 Jan. 1; 17(6): 685-696. Doi:10.5194/npg-17-685-2010; Olascoaga, M.J. et al. 2008. Tracing the Early Development of Harmful Algal Blooms on the West Florida Shelf with the Aid of Lagrangian Coherent Structure. J. Geophys. Res. 2008; 113(c12): c12014-doi: 10.1029/2007JC004533; Poulson-Ellestad, K. et al. 2014. Metabolics and proteomics reveal impacts of chemically mediated competition on marine plankton. PNAS. June 17, 2014. Vol. 11. No. 24. 9009-9014; Morey, J. et al. 2011. Transcriptomic response of the red tide dinoflagellate, Karenia brevis, to nitrogen and phosphorus depletion and addition. Genomics 2011, 12.346.
[235] EPA 2016 at 75.
[236] Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374.
[237] Zanchett, G. and E.C. Oliveira-Filho. 2013. Cyanobacteria and cyanotoxins: from impacts on aquatic ecosystems and human health to anticarcinogenic effects, Toxins 5(10): 1896-1917, doi: 10:3390/toxins5101896.
[238] *Id*.
[239] *Id*.

Fish can be exposed to microcystins while feeding or through the gills during breathing.[240] Fish in the early life stages are generally more sensitive.[241] HABs can result in damage to the liver, hearth, kidney, skin, gills, and the spleen.[242] Microcystins can induce disruption of the cytoskeletal network of the liver, leading to massive pool of blood, followed by sinusoid destruction and ultimately death as a result of hepatic hemorrhaging.[243] HABs can induce high pH and ammonia from the decomposition of cyanobacteria, causing damage to fish gills.[244] This gill damage may enhance microcystin uptake, leading to liver necrosis.[245] Indirect impacts may also include a decrease in dissolved oxygen and the proliferation of *Clostridium botulinum*, which in turn can poison birds.[246] Aquatic animals may die as a result of toxins from cells or a reduction in the amount of dissolved oxygen from the bloom decay process.[247]

In 2018, the Ocean Research and Conservation Association (ORCA) analyzed 54 fish caught in Martin County.[248] Researchers found that 27.8% of fillets and 69.8% of livers contained microcystin concentrations above established detection limits.[249] The average microcystin level in fillets was 7.4 ng/g with a range of 0.8-39 ng/g. and the average microcystin level of liver samples was 17.2 ng/g with a range of 0.6-149 ng/g.[250] ORCA researchers also interviewed 27 subsistence fishers and tested 22 fish from the Port Mayaca locks.[251] Based on these initial findings, subsistence fishers eat 3 to 4 times more fish than the average U.S. citizen and depend on fishing for up to seven meals per week.[252] Most fish caught at the locks had detectable microcystin in the fillets (63.6%) and livers (54.5%) with average levels of 3.1 ng/g and 13.6 ng/g, respectively.[253] ORCA's subsistence fishing study will be completed, with a paper submitted for publication, in the summer of 2019.[254]

The amount of cyanotoxins in Florida's waters is astonishing and the frequency, duration, and geographic scope of these HABs appear to be on the rise. From May 4 to August 4, 2016 the

---

[240] *Id*.
[241] *Id*.
[242] *Id*.
[243] Masango, M.G., J.G. Myburgh, L. Labuschagne, D. Govender, R.G. Bengis, and D. Naicker. 2010. Assessment of *microcystis* bloom toxicity associated with wildlife mortality in the Kruger National Park, South Africa. Journal of Wildlife Diseases, 46(1): 95-102.
[244] Zanchett, G. and Oliveira-Filho, E.C. 2013. Cyanobacteria and cyanotoxins: from impacts on aquatic ecosystems and human health to anticarcinogenic effects, Toxins 5(10): 1896-1917, doi: 10:3390/toxins5101896.
[245] *Id*.
[246] Hillborn, E.D. and V.R. Beasley. 2015. One health and cyanobacteria in freshwater systems: animal illnesses and deaths are sentinel events for human health risks, Toxins, 1374-1395, doi: 10.3390/toxins7041374.
[247] J. S. Metcalf, S.A. Banack, J.T. Powell, F.J.M. Tymm, S.J. Murch, L.E. Brand, and P.A. Cox. 2018. Public health responses to toxic cyanobacterial blooms: perspectives from the 2016 Florida event, Water Policy 20 (5): 919-932.
[248] ORCA. 2019. Tracking Cyanotoxins in the Aquatic Food Web in Martin County.
[249] *Id*.
[250] *Id*.
[251] *Id*.
[252] *Id*.
[253] *Id*.
[254] *Id*.

Department took approximately 200 water samples from the St. Lucie River and estuary, Caloosahatchee River and estuary, Lake Okeechobee, Indian River Lagoon, and other nearshore waters.[255] Microcystin concentrations ranged from below the detection limit to 414.3 micrograms per liter.[256] Among the species identified were *Microcystis aeruginosa*, *Scrippsiella trochoidea*, *Planktolyngbya limnetica*, *Dolichospermum circinalis*, and *Plectonema wollei*.[257] Once these toxic cells reached the St. Lucie estuary, *M. aeruginosa* continued to grow due to slow water movement and extended residence times.[258] The EPA noted that Lake Okeechobee is subject to agricultural runoff from adjacent cattle farms and sugar cane fields, which contributed to the formation of this "massive cyanobacterial bloom."[259]

In 2017, samples had the highest recorded concentration of microcystin collected in the past five years.[260] In August 2018, the Department collected water samples with toxic algae at the rate of 110 parts per billion, 10 times the level the World Health Organization has determined to be hazardous for humans in recreational waters.[261] Testing had detected even higher levels in July 2018 at 154.38 PPB and 33,000 PPB in 2016.[262]

Cyanotoxins can bioaccumulate in aquatic invertebrates and aquatic vertebrates and cyanotoxins may be transported through the food web.[263] Cyanotoxins can accumulate in zooplankton and aquatic invertebrates, thereby affecting fish that feed on plankton.[264] Piscivorous birds in turn consume cyanotoxins in the contaminated fish.[265] There has been increasing concern about HABs in wildlife refuges and other areas where animals, especially birds, congregate in large numbers.[266]

Meanwhile, from July 2018 - December 6, 2018, 126 bottlenose dolphins have stranded due to exposure to red tide.[267] Red tide is responsible for the deaths of countless marine animals including those listed below:

---

[255] EPA 2016 at 28.
[256] *Id*.
[257] *Id*.
[258] Preece, E.P., F.J. Hardy, B.C. Moore, and M. Bryan. 2017. A Review of microcystin detections in estuarine and marine waters: environmental implications and human health risk, Harmful Algae 61: 31-45.
[259] EPA 2016 at 28-29.
[260] Zhang, J. et al. 2018. Chapter 8B: Lake Okeechobee Watershed Research and Water Quality Monitoring Results and Activities in 2018 South Florida Environmental Report – Volume I.
[261] Wright, P. 2018. Florida's Blue-Green Algae Bloom 10 Times Too Toxic to Touch, Testing Shows. Aug. 10, 2018. Weather.com (Wright 2018).
[262] *Id*.
[263] Williams, C.D., J. Burns, A. Chapman, M. Pawlowicz, and W. Carmichael. 2006. Assessment of Cyanotoxins in Florida's Surface Waters and Associated Drinking Water Resources, Final Report, 29, April 11, 2006;
[264] Lopez-Rodas, E. Maneior, M.P. Lanzarot, N. Perdigones, and E. Costas. 2008. Mass wildlife mortality due to cyanobacteria in the Donana National Park, Spain, Veterinary Record 162: 317-318, doi:10.1136/vr.162.10.317.
[265] *Id*.
[266] *Id*.
[267] NOAA 2018.

Dead wildlife: Caloosahatchee, estuary, canals, back bays, Sanibel, Fort Myers beaches & Islands **Lee County has removed 2,200 tons of dead marine life. Sanibel = 425 tons** *Ongoing list not comprehensive* *Endangered/Threatened Species*		
American eels	Grunt sp.	Red snapper
American oystercatcher	Hardhead catfish	Remora
Anchovies	Horseshoe crabs	Reticulate moray
Angel fish	Jack fish sp.	Sand dollar
Anhinga	Kemps ridley sea turtle	Sanderling
Atlantic needlefish	Kingfish	Sand Trout
Atlantic spadefish	Lane snapper	Scaled sardine
Batfish	Laughing gull	Sheepshead
Black drum	Loggerhead sea turtle	Seahorses
Black tip shark	Lookdown fish	Shame- faced crab
Blenny	Mackerel	Snook
Blue crabs	Manatees	Snowy plover
Bottlenose dolphin	Mallard ducks	Starfish
Brown pelican	Mangrove snapper	Southern puffer
Bull shark	Mantis shrimp	Southern stargazer
Calico crab	Menhaden	Spanish mackerel
Catfish sp.	Minnows	Spotted eels
Cobia	Moray Eel	Spotted seatrout
Common tern	Muscovy duck	Sting rays sp
Coquina	Mullet sp.	Stone crab
Cowfish	Ornate diamondback terrapin	Striped burr fish
Crevalle jack	Osprey	Threadfin herring
Double crested cormorant	Pale spotted eels	Tarpon
Flounder	Parchment worms	Toadfish
Gafftopsail catfish	Permit	Tri-colored Heron
Goby	Pig fish	Tripletail
Goliath grouper	Pinfish	Whale shark
Green sea turtle	Florida Pompano	Whiting
Grey triggerfish	Red drum/ Redfish	Yellow snake eel
Grouper sp.	Red knot	[268]

1. Endangered Species Act-Listed Species are Significantly Impacted

The ESA, by way of its "language, history, and structure . . . indicates beyond doubt that Congress intended endangered species to be afforded the highest of priorities" for protection under the law.[269] The purpose of the Endangered Species Act is in part "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved [and] to provide a program for conservation of such endangered and threatened

[268] 2018. Sanibel Captiva Conservation Foundation Memo to Corps. Dec. 4, 2018.
[269] *Tennessee Valley Authority v. Hill*, 437 U.S. 153, 174 (1978).

species."[270] The secretaries of Interior and Commerce administer the ESA through FWS and NMFS respectively. FWS has jurisdiction over terrestrial species, non-marine aquatic species, and certain marine species while on land. NMFS has jurisdiction over marine species and most anadromous fish.

To fulfill the substantive purpose of the ESA, federal agencies are required to "insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the adverse modification of [the critical] habitat of such species."[271] An action will cause "jeopardy" if it "reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species."[272]

The first step in the Section 7 process is for the agency authorizing the project to determine if the proposed action "may affect" an endangered or threatened species.[273] If the agency determines the action will not affect a listed species, and FWS/NMFS concurs, no further action is required. If, on the other hand, the action agency has determined that the proposed action "may affect" a listed species or critical habitat, it may initiate "informal consultation" with FWS/NMFS.[274] If during this process it is revealed that the action is "likely to adversely affect" a listed species or critical habitat, formal consultation is required.[275]

The formal consultation process requires a written statement, known as a "biological opinion," setting forth the Secretary's opinion detailing how the agency action affects the species or its critical habitat.[276] After FWS/NMFS analyzes the direct, indirect and cumulative effects of the proposed action it makes a finding as to whether the action "is likely to jeopardize the continued existence of the species."[277] If it is determined that the action will jeopardize a species or adversely modify the species' critical habitat, the biological opinion must list any "reasonable and prudent alternatives" to the proposed action that would not result in jeopardy to the species.[278]

If FWS/NMFS concludes that the action or the RPAs will not cause jeopardy, but may result in the take of a listed species, FWS/NMFS must issue an incidental take statement (ITS) that

---

[270] 16 U.S.C. § 1531(b).
[271] *Id.* § 1536(a)(2).
[272] 50 C.F.R. § 402.02.
[273] *Id.* § 402.02.
[274] *Id.* § 402.13.
[275] *Id.* § 402.12(j).
[276] 16 U.S.C. § 1536(b)(3)(A); 50 C.F.R. § 402.02.
[277] 16 U.S.C. § 1536(b).
[278] *Id.* § 1536(b)(3)(A).

specifies "the impact, i.e., the amount or extent, of . . . incidental taking" that may occur.[279]

To "take" an endangered or threatened species means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" it, or "to attempt to engage in any such conduct."[280] "Harm" includes significant habitat modification or degradation that results in death or injury to listed species "by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering."[281] "Harass" is defined as intentional or negligent actions that create a likelihood of injury to listed species "to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering."[282] Congress intended the term "take" to be defined in the "broadest possible manner to include every conceivable way" a person could harm or kill fish or wildlife.[283]

An ITS must include "reasonable and prudent measures . . . necessary . . . to minimize such impact,[284] and must specify the permissible level of taking, "thus . . . serv[ing] as a check on the agency's original decision that the incidental take of listed species resulting from the proposed action will not [jeopardize the continued existence of the species]."[285] In addition, when the listed species to be taken are marine mammals, the take must first be authorized pursuant to the Marine Mammal Protection Act (MMPA) and the ITS must include any additional measures necessary to comply with the MMPA take authorization.[286]

Compliance with the biological opinion and its incidental take statement protects federal agencies, and others acting under the biological opinion, from enforcement action under Section 9's prohibition against take;[287] however, take not in compliance with a biological opinion or absent a valid take statement or take permit is in violation of Section 9 of the ESA.

Even after the procedural requirements of a consultation are complete, the ultimate duty to ensure that an activity is not likely to cause jeopardy to a listed species lies with the action agency. An action agency's reliance on an inadequate, incomplete, or flawed biological opinion cannot satisfy its duty to avoid the likelihood of jeopardy to listed species.[288]

---

[279] 50 C.F.R. § 402.14(h)(3).
[280] 16 U.S.C. § 1532(19).
[281] 50 C.F.R. § 17.3.
[282] *Id.*
[283] *See* S. Rep. No. 93-307, at 7 (1973), *as reprinted in* 1973 U.S.C.C.A.N. 2989, 2995.
[284] 16 U.S.C. § 1536(b)(4).
[285] *Id.*; *Center for Biological Diversity v. Salazar*, 695 F.3d 893, 911 (9th Cir. 2012).
[286] 50 C.F.R. § 402.14(h)(3).
[287] 16 U.S.C. §§ 1536(o)(2); 1538(a); 50 C.F.R. § 17.31(a).
[288] *See, e.g.*, *Florida Key Deer v. Paulison*, 522 F.3d 1133, 1145 (11th Cir. 2008) (action agency must independently ensure that its actions are not likely to cause jeopardy); *Pyramid Lake Tribe of Indians v. U.S. Dep't of Navy*, 898 F.2d 1410, 1415 (9th Cir. 1990) (same).

Moreover, although the Section 7 formal consultation process is complete upon the of a biological opinion, reinitiation of formal consultation is required and shall be requested by the Federal agency or by FWS/NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) If the amount or extent of taking specified in the incidental take statement is exceeded;
(2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
(3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or
(4) If a new species is listed or critical habitat designated that may be affected by the identified action.[289]

Furthermore, once the agencies reinitiate consultation, the action agency, here the Corps, shall not make any irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent measures which would not violate subsection (a)(2) of this section."[290] Congress enacted Section 7(d) "to ensure that the status quo would be maintained during the consultation process, to prevent agencies from sinking resources into a project in order to ensure its completion regardless of its impacts to endangered species".[291] Congress amended the ESA to include this provision to prevent agencies from steamrolling activities in order to secure completion of projects.[292]

Federal agencies have additional responsibilities under Section 7(a)(1) of the ESA, including a requirement that they "utilize their authorities in furtherance of the purposes of [the Act]" and to "carry[ ] out programs for the conservation of" listed species.[293] The ESA defines "conservation" to mean the use of "all methods and procedures" that are necessary to recover a listed species to the point where protections under the act are no longer necessary.[294] Thus, section 7(a)(1) requires each federal agency to ensure that its actions are consistent with the recovery of listed species.[295]

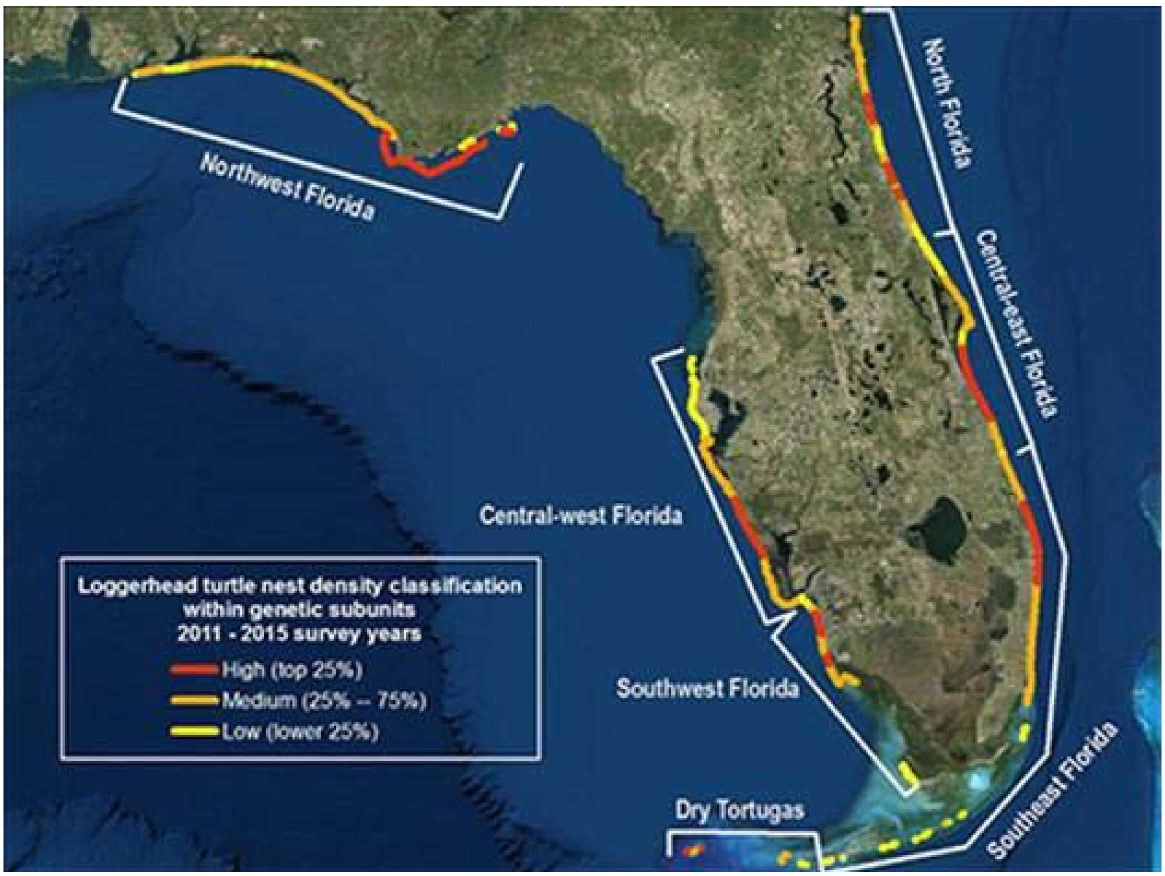
---

[289] 50 C.F.R. § 402.16.
[290] 16 U.S.C. § 1536(d).
[291] *Washington Toxics v. EPA*, 413 F.3d 1024, 1034-35 (9th Cir. 2005).
[292] *National Wilderness Institute v. Corps*, 2005 U.S. Dist. LEXIS 5159 (D.D.C. Mar. 23, 2005).
[293] 16 U.S.C. § 1536(a)(1).
[294] *Id.* at 1532(3).
[295] *See* 50 C.F.R. § 402.15(a) (explaining that it is each agency's continuing obligation to "determine whether and in what manner to proceed with the action in light of its section 7 obligations" to protect and recover listed species).

a. Sea turtles

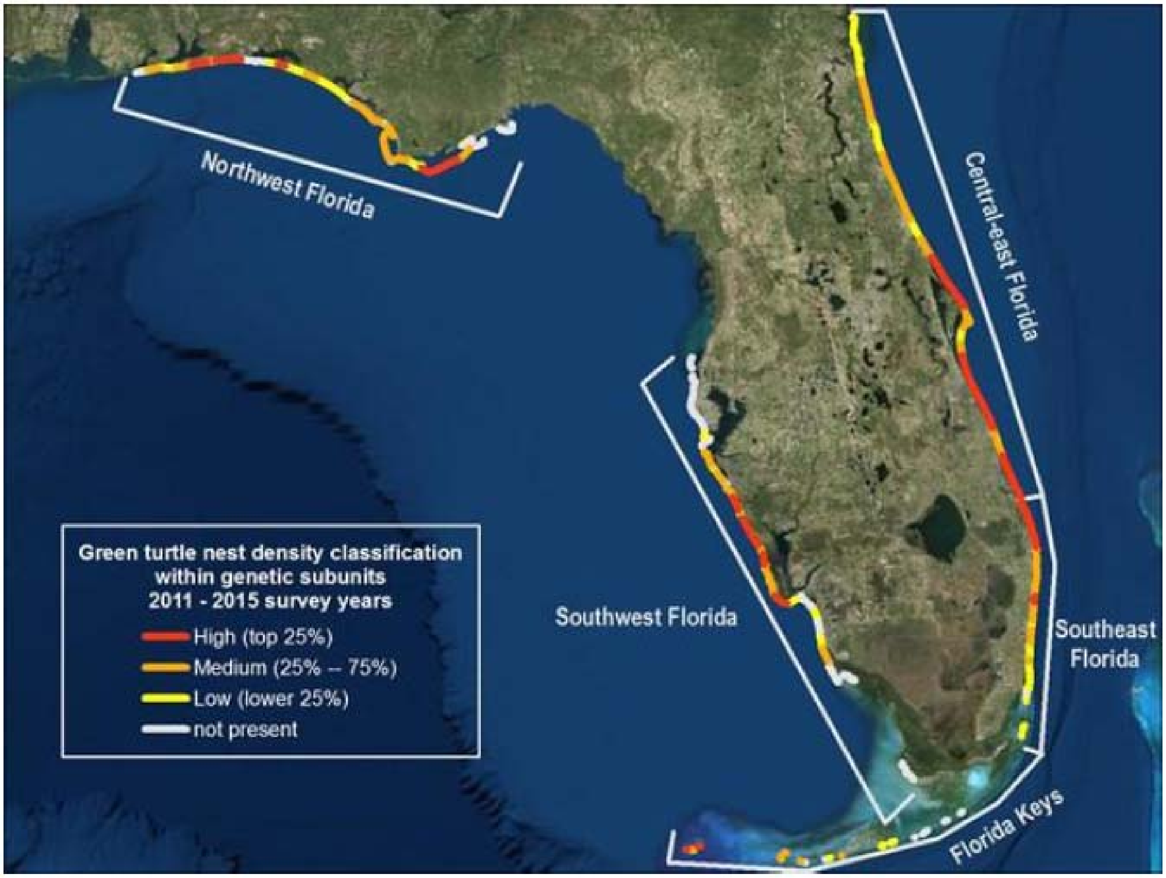
FWS and NMFS have designated the leatherback, Kemp's ridley, and hawksbill sea turtles as endangered under the ESA, and the Northwest Atlantic Ocean Distinct Population Segments of loggerhead and green sea turtles as threatened under the ESA.

The southeastern United States has the world's largest number of loggerhead nests, with 90% of nesting in Florida.[296] The majority of this nesting occurs in Brevard, Indian River, St. Lucie, Martin and Palm Beach counties. Loggerhead sea turtles consistently aggregate in Indian River Lagoon.[297]



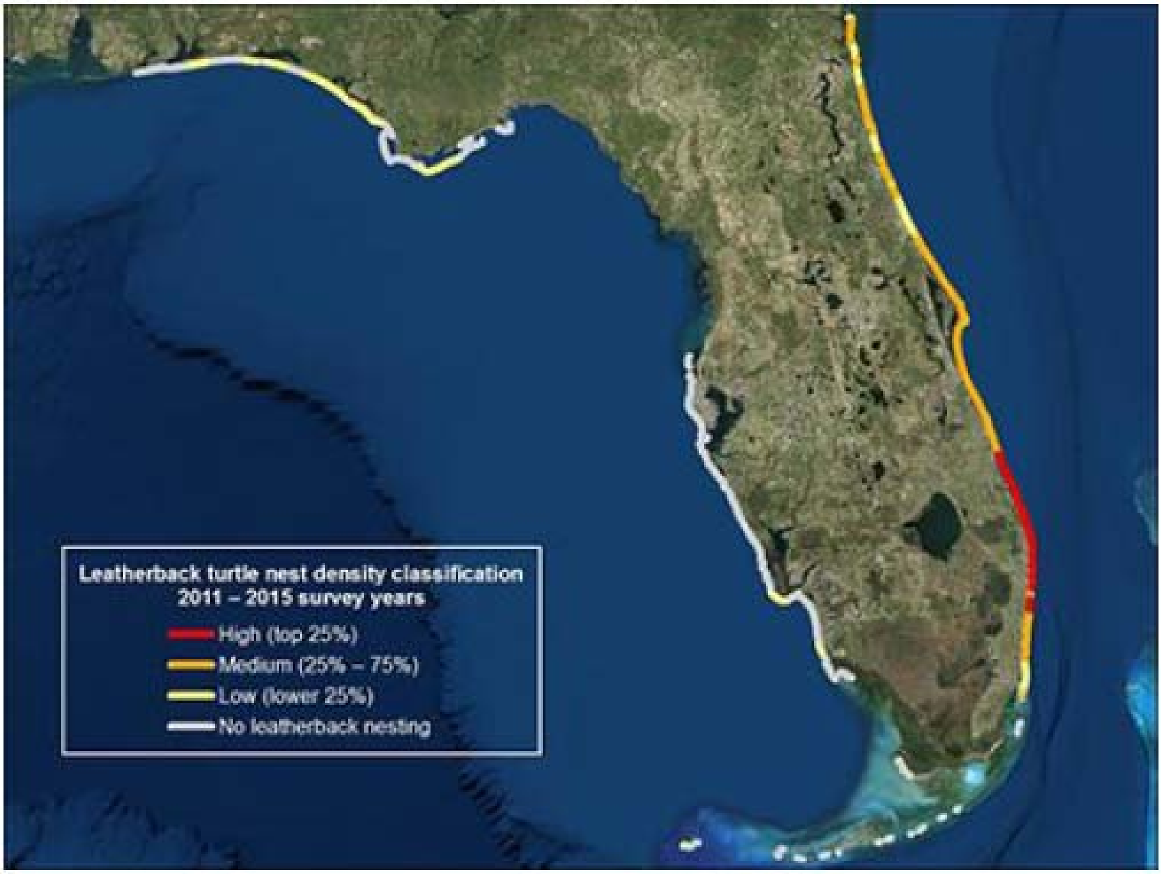
The second largest aggregation of green sea turtle nesting is in Florida.[298]

[296] Casale, P. and A.D. Tucker. 2017. Caretta caretta, Loggerhead Turtle. The IUCN Red List of Threatened Species; Ceriani, S.A. and A.B. Melyan. 2017. Caretta caretta (North West Atlantic subpopulation) loggerhead turtle. The IUCN Red List of Threatened Species.
[297] FWC. 2018. Loggerhead Nesting in Florida. (FWC 2018b).
[298] FWC. 2018. Green Turtle Nesting in Florida. (FWC 2018c).



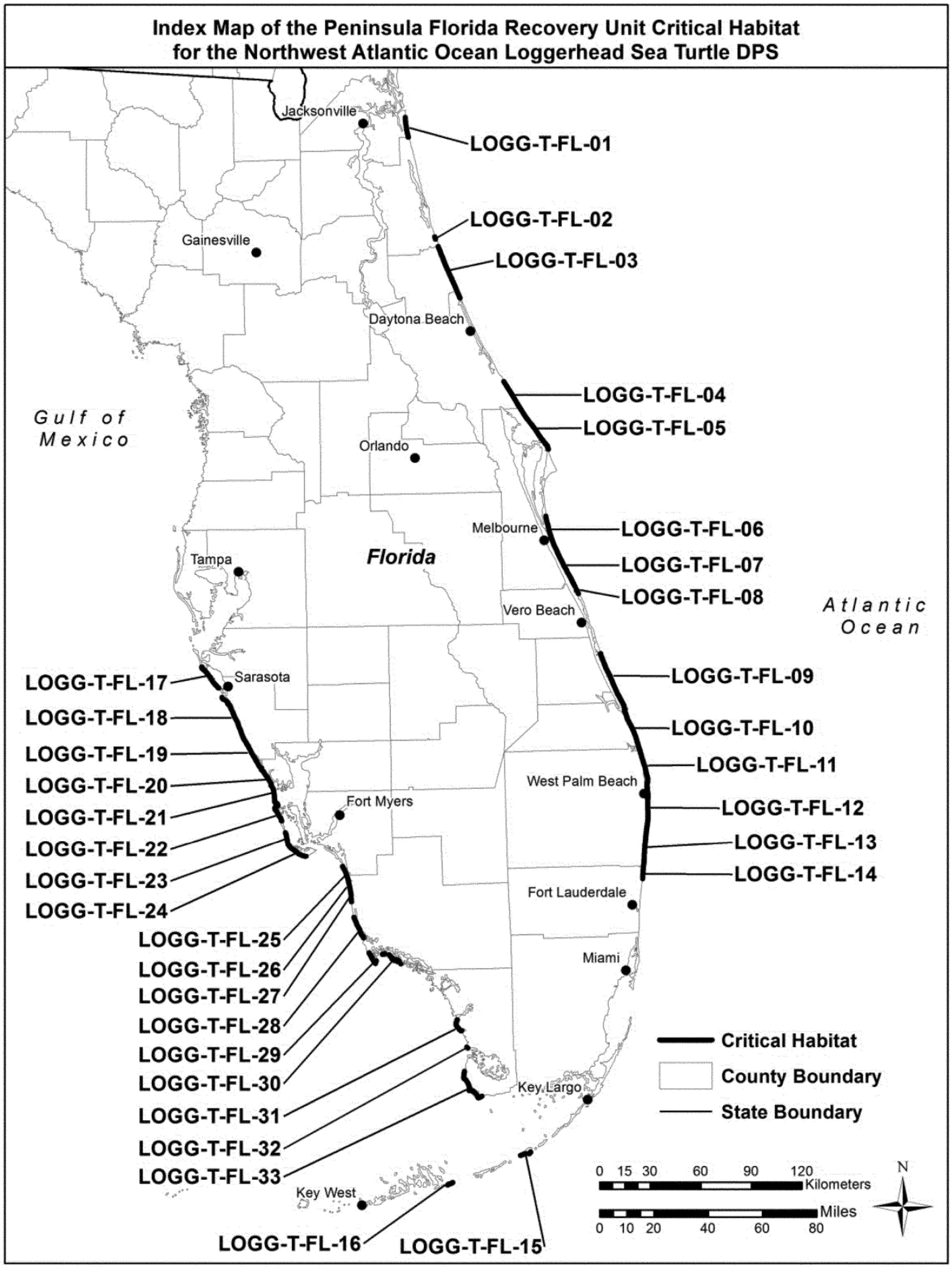
Florida is the only state in the continental U.S. where leatherback regularly nest.[299]

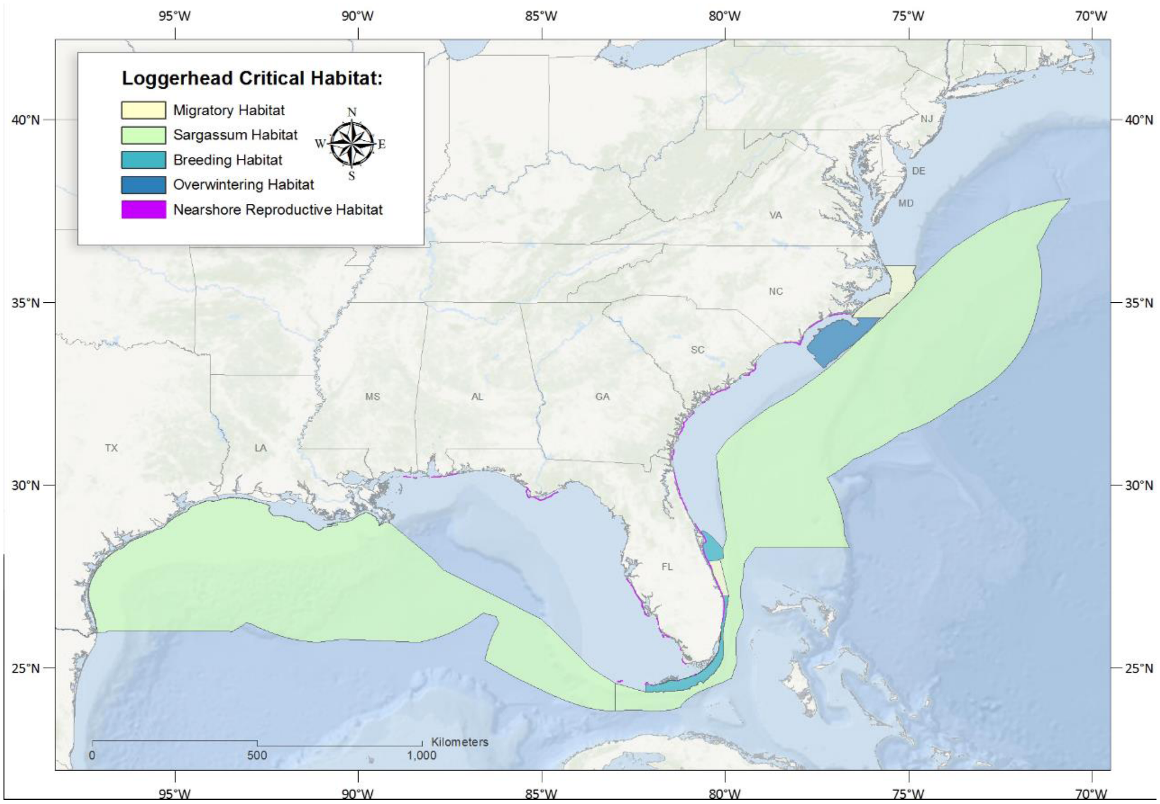
[299] FWC. 2018. Leatherback Nesting In Florida. (FWC 2018d).



On July 10, 2104, FWS and NMFS designated critical habitat for the Northwest Atlantic Ocean Distinct Population Segment of the loggerhead sea turtle (*Caretta caretta*).[300] The critical habitat designations include areas impacted by the LORS discharges, blue-green algae, and red tide.

[300] 79 Fed. Reg. 39756, *Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northwest Atlantic Ocean Distinct Population Segment of the Loggerhead Sea Turtle*, (July 10, 2014); 79 Fed. Reg. 39356, *Endangered and Threatened Species: Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS*, (July 10, 2014).


Index Map of the Peninsula Florida Recovery Unit Critical Habitat
for the Northwest Atlantic Ocean Loggerhead Sea Turtle DPS
Jacksonville
LOGG-T-FL-01
LOGG-T-FL-02
Gainesville
LOGG-T-FL-03
Daytona Beach
LOGG-T-FL-04
Gulf of
Mexico
LOGG-T-FL-05
Orlando
Melbourne
LOGG-T-FL-06
Tampa
Florida
LOGG-T-FL-07
LOGG-T-FL-08
Atlantic
Ocean
Vero Beach
LOGG-T-FL-09
LOGG-T-FL-17
Sarasota
LOGG-T-FL-18
LOGG-T-FL-10
LOGG-T-FL-19
LOGG-T-FL-11
LOGG-T-FL-20
West Palm Beach
Fort Myers
LOGG-T-FL-12
LOGG-T-FL-21
LOGG-T-FL-22
LOGG-T-FL-13
LOGG-T-FL-23
LOGG-T-FL-14
LOGG-T-FL-24
Fort Lauderdale
LOGG-T-FL-25
LOGG-T-FL-26
Miami
LOGG-T-FL-27
LOGG-T-FL-28
Critical Habitat
LOGG-T-FL-29
County Boundary
LOGG-T-FL-30
Key Largo
State Boundary
LOGG-T-FL-31
LOGG-T-FL-32
LOGG-T-FL-33
0 15 30 60 90 120
Kilometers
Key West
Miles
0 10 20 40 60 80
N
LOGG-T-FL-16
LOGG-T-FL-15



Red tide with concentrations of *karenia brevis* (at least 100,000 cells/l) is the concentration at which the Florida Fish and Wildlife Conservation Commission (FWC) believes sea turtle mortality due to brevetoxicosis typically begins to occur. It is believed that red tide exposure may pose significant implications for immune function in loggerhead sea turtles.[301] From Nov. 2017-Dec. 10, 2018 FWC documented 1,260 stranded sea turtles with 577 (250 loggerheads, 263 Kemp's ridleys, and 64 green sea turtles) to red tide, making it the largest number of stranded sea turtles attributed to red tide.[302]

[301] Walsh, C. 2009. Effects of brevetoxin exposure on the immune system of loggerhead sea turtles. Aquatic Toxicology 97 (2010) 293-303.
[302] Foley, A. Email. Sea Turtle Stranding and Red Tide. Dec. 10, 2018.

Sea turtle mortality attributable to red tide, by species

2018 Pinellas County - Collier County									
Dates	Loggerhead	Green turtle	Kemp's ridley	Hawksbill	Leatherback	Unidentified	Number found alive	Weekly total	5-year average
5/29 - 6/4	7	3	1	0	0	0	6	11	9
6/5 - 6/11	15	3	1	0	0	1	3	20	10
6/12 - 6/18	7	3	4	0	0	0	3	14	7
6/19 - 6/25	13	3	11	0	0	0	2	27	9
6/26 - 7/2	13	5	14	0	0	0	8	32	10
7/3 - 7/9	9	10	5	0	0	1	3	25	12
7/10 - 7/16	10	5	10	0	0	0	3	25	7
7/17 - 7/23	18	20	22	0	0	3	5	63	7
7/24 - 7/30	23	5	42	0	0	0	8	70	8
7/31 - 8/6	10	11	33	0	0	0	2	54	9
8/7 - 8/13	18	12	25	3	0	2	1	60	9
8/14 - 8/20	20	11	27	0	0	0	4	58	7
8/21 - 8/27	19	39	47	0	0	1	8	106	6
8/28 - 9/3	0	2	2	0	0	0	0	4	4
9/4 - 9/10	15	3	3	0	0	2	3	23	6
9/11 - 9/17	33	8	23	0	0	0	2	64	3
9/18 - 9/24	14	17	36	0	0	3	5	70	6
9/25 - 10/1	5	7	18	0	0	1	2	31	7
10/2 - 10/8	1	4	4	0	0	1	1	10	2
10/9 - 10/15	2	6	5	0	0	0	2	13	5
10/16 - 10/22	3	4	3	0	0	1	0	11	4
10/23 - 10/29	6	7	2	0	0	0	4	15	3
10/30 - 11/5	0	4	2	0	0	0	1	6	7
11/6 - 11/12	1	5	1	0	0	0	1	7	5
11/13 - 11/19	2	5	1	0	0	0	2	8	5
11/20 - 11/26	5	5	5	0	0	0	2	15	5
11/27 - 12/3	5	6	6	0	0	0	0	17	3
12/4-12/10	2	2	2	0	0	1	1	7	7
Total	276	215	355	3	0	17	82	866	182

Sea turtle mortality attributable to red tide, by county

Dates	Collier	Lee	Charlotte	Sarasota	Manatee	Hillsborough	Pinellas	Total
5/29 - 6/4	0	4	1	1	1	0	4	11
6/5 - 6/11	4	9	0	2	0	0	5	20
6/12 - 6/18	0	3	3	1	2	0	5	14
6/19 - 6/25	8	7	2	5	2	0	3	27
6/26 - 7/2	1	13	5	6	1	2	4	32
7/3 - 7/9	2	3	3	9	0	0	8	25
7/10 - 7/16	8	2	2	5	2	1	5	25
7/17 - 7/23	4	23	9	26	0	1	0	63
7/24 - 7/30	16	40	4	6	0	0	4	70
7/31 - 8/6	1	33	1	16	2	0	1	54
8/7 - 8/13	6	16	5	29	2	0	2	60
8/14 - 8/20	2	24	5	23	2	1	1	58
8/21 - 8/27	2	35	5	56	3	0	5	106
8/28 - 9/3	0	2	0	2	0	0	0	4
9/4 - 9/10	2	7	0	7	2	0	5	23
9/11 - 9/17	4	38	3	8	0	1	10	64
9/18 - 9/24	1	34	8	10	5	0	12	70
9/25 - 10/1	0	14	0	3	5	0	9	31
10/2 - 10/8	2	0	0	1	0	1	6	10
10/9 - 10/15	0	3	1	3	1	0	5	13
10/16 - 10/22	0	3	1	3	2	0	2	11
10/23 - 10/29	5	2	0	0	0	0	8	15
10/30 - 11/5	0	0	1	2	0	0	3	6
11/6 - 11/12	0	1	0	0	0	0	6	7
11/13 - 11/19	0	1	0	2	2	0	3	8
11/20 - 11/26	3	5	0	2	1	1	3	15
11/27 - 12/3	7	3	0	3	0	0	4	17
12/4-12/10	3	1	0	0	1	0	2	7
Total	91	326	59	231	36	8	125	866

FWC reports that it in Collier County, it documented 135 stranded sea turtles (72 loggerheads, 53 Kemp's ridleys, 7 green turtles, 1 hawksbill, and 2 sea turtles not identified to species) November 2017-December 2018. Most (N = 124) were found dead. The previous five-year average number of strandings for Collier County over that period was 36 (current number is 3.8 times greater than average). Red tide has been persistent in Collier County since March 2018 and FWC attributes 91 of the stranded sea turtles in Collier County (54 loggerheads, 36 Kemp's ridleys, and 1 green turtle) to the red tide.

In Lee County, FWC documented 404 stranded sea turtles (165 loggerheads, 165 Kemp's ridleys, 67 green turtles, and 7 sea turtles not identified to species) November 2017- December 2018. Most (N = 366) were found dead. The previous five-year average number of strandings for Lee County over that period was 101 (current number is 4.0 times greater than average). Red tide has been persistent in Lee County since November 2017 and FWC attributes 260 of the stranded sea turtles in Lee County (127 loggerheads, 114 Kemp's ridleys, and 19 green turtles) to the red tide.

In Charlotte County FWC documented 74 stranded sea turtles (24 loggerheads, 31 Kemp's ridleys, 18 green turtles, and 1 sea turtle not identified to species) November 2017- December

2018. Most (N = 68) were found dead. The previous five-year average number of strandings for Charlotte County over that period was 19 (current number is 3.9 times greater than average). Red tide was persistent in Charlotte County since December 2017 and FWC attributes 44 of the stranded sea turtles in Charlotte County (18 loggerheads, 21 Kemp's ridleys, and 5 green turtles) to the red tide.

In Sarasota County FWC has documented 263 stranded sea turtles (58 loggerheads, 89 Kemp's ridleys, 108 green turtles, 2 hawksbills, and 6 sea turtles not identified to species) November 2017- December 2018. Most (N = 248) were found dead. The previous five-year average number of strandings for Sarasota County over that period was 59 (current number is 4.5 times greater than average). Red tide was present in Sarasota County during November of 2017 and March 2018. It has been persistent in Sarasota County since June 2018 and FWC attributes 121 of the stranded sea turtles in Sarasota County (36 loggerheads, 59 Kemp's ridleys, and 26 green turtles) to the red tide.

In Manatee County, FWC has documented 66 stranded sea turtles (20 loggerheads, 14 Kemp's ridleys, 30 green turtles, and 2 sea turtles not identified to species) November 2017- December 2018. Most (N = 51) were found dead. The previous five-year average number of strandings for Manatee County over that period was 36 (current number is 1.9 times greater than average). Red tide has been persistent in Manatee County since August 2018 and FWC attributes 14 of the stranded sea turtles in Manatee County (5 loggerheads, 6 Kemp's ridleys, and 3 green turtles) to the red tide.

In Hillsborough County FWC has documented 18 stranded sea turtles (6 loggerheads, 4 Kemp's ridleys, 7 green turtles, and 1 sea turtle not identified to species) November 2017- December 2018. Most (N = 15) were found dead. The previous five-year average number of strandings for Hillsborough County over that period was 10 (current number is 1.7 times greater than average). Red tide has been present in Hillsborough County since August 21, 2018 and FWC attributes 2 of the stranded sea turtles in Hillsborough County (1 Kemp's ridley and 1 green turtle) to the red tide.

In Pinellas County FWC has documented 300 stranded sea turtles (50 loggerheads, 58 Kemp's ridleys, 186 green turtles, 3 hawksbills, and 3 sea turtles not identified to species) November 2017- November 2018. Most (N = 225) were found dead. The previous five-year average number of strandings for Pinellas County over that period was 241 (current number is 1.2 times greater than average). Red tide has been present in Pinellas County since August 21, 2018 and FWC attributes 45 of the stranded sea turtles in Pinellas County (10 loggerheads, 26 Kemp's ridleys, and 9 green turtles) to the red tide.

b. Florida manatee

FWS has designated the Florida manatee a threatened species under the ESA. Red tide can cause direct mortality of manatees, but can also cause sublethal impacts.[303] FWC reports that red tide has contributed to the deaths of 207 Florida manatees January-December 12, 2018.[304] The brevetoxin binds to manatees' brains, leading to edema and hemorrhaging,[305] and ultimately leads to their death.[306]

Water management for Lake Okeechobee creates negative impacts for the Caloosahatchee and St. Lucie estuaries, as well as Florida Bay. These impacts are caused by salinity changes and impacts to photosynthesis caused by algal blooms. Studies have documented dramatic changes to the Caloosahatchee River estuary, due in part to releases from Lake Okeechobee that have resulted from creating a connection between the two that did not naturally exist.[307] Among the changes are water pollution including altered salinity that kill seagrass.[308] Research at Florida Gulf Coast University found drastic salinity reductions at seagrass bed study sites in the Caloosahatchee estuary associated with periods of high freshwater discharges from Lake Okeechobee.[309]

The News Press reported on this issue, explaining that flows at the W.P.Franklin lock exceed 2,800 cfs, salinity declines to a level that harms seagrass. Flows of 10,000 cfs can occur as a result of water management response to high water levels in Lake Okeechobee. Researchers interviewed reported total elimination of seagrass in the upper estuary and decreased density of

---

[303] Walsh, C. 2015. Sublethal red tide exposure in free-ranging manatees (Trichechus manatus) affects the immune system through reduced lymphocyte proliferation responses, inflammation, and oxidative stress. Aquatic Toxicology 161 (2015) 73-84.

[304] Hagan, A. 2018. Red tide has contributed to the deaths of nearly 190 Florida manatees, FWC says. Abcactionnews.com. Oct. 29, 2018; FWC. 2018 Preliminary Red Tide Manatee Mortalities, Jan. 01-Nov. 9. Manatees Carcasses Collected Within the Known Red Tide Bloom Boundary.

[305] Bossart, G. et al. 1998. Brevetoxicosis in Manatees (*Trichechus manatus latirostris*) from the 1996 Epizootic: Gross, Histologic, and Immunohistochemical Features. Toxicologic Pathology.

[306] Landsberg, J.E. et at. 2009. *Karenia brevis* red tides, brevetoxins in the food web, and impacts on natural resources: Decadal advancements. Harmful Algae. Vol. 8, Iss. 4; Trainer, V. and D. Baden. 1999. High affinity binding of red tide neurotoxins to marine mammal brain. Aquatic Toxicology Vol. 46, Iss. 2. July 1999.

[307] Hopkinson, C. S., & Vallino, J. J. (1995). The relationships among man's activities in watersheds and estuaries: a model of runoff effects on patterns of estuarine community metabolism. Estuaries, 18, 598-621. https://link.springer.com/article/10.2307/1352380.

[308] Doering, P.H., R.H. Chamberlain, and D.E. Haunert. 2002. Using submerged aquatic vegetation to establish minimum and maximum freshwater inflows to the Caloosahatchee estuary, Florida. Estuaries 25:6, pp. 1343-1354. https://link.springer.com/article/10.1007/BF02692229; Barnes, T., D. Rumbold, M. Salvato. 2006. Caloosahatchee Estuary and Charlotte Harbor Conceptual Model. file:///G:/LOSOM%20Comments%20and%20Citations/Barnes%20et%20al% 202006.pdf.

[309] Behlmer, T.J. 2016. Indirect effects of freshwater discharges on seagrass beds in Southwest Florida: Mesograzers ad mediators of epiphyte growth? Masters Thesis, Florida Gulf Coast University. https://fgcu.digital.flvc.org/islandora/object/fgcu%3A28966/datastream/OBJ/view/Indirect_effects_of_freshwater_discharges_on_seagrass_beds_in_Southwest_Florida__Mesograzers_as_mediators_of_epiphyte_growth_.pdf.

turtle and manatee grass (species indicative of a more mature seagrass community) in response to 2013 discharges. These scientists expressed concern that successive years of high discharges and low salinity could encumber the ability of seagrasses to regenerate, leading to a more permanent disruption of the ecosystem.[310] In the St. Lucie estuary, 75% seagrass loss was documented in 2013.[311]

In announcing awards for seagrass and oyster restoration in the Caloosahatchee and St. Lucie estuaries in 2015, the Florida Department of Environmental Protection wrote:

> Harmful freshwater discharges have resulted in losses of oysters and seagrasses in both estuaries… The Caloosahatchee River was originally a shallow, meandering river, but over the past 120 years it has experienced extensive modifications in the interest of navigation, flood control and development. As a result, heavy rainfall brings large influxes of freshwater and polluted stormwater runoff from both the watershed and releases from Lake Okeechobee. These events degrade water quality and the health of oysters and seagrasses in the estuary.

The flow of freshwater in the upper estuary is also important, where freshwater Vallisneria grows and provides an important food source and habitat.[312]

As reported in Kelble (2006), "Historical water manipulation activities in south Florida have severely reduced the flow of freshwater into Florida Bay and changed the ecosystem from a predominantly estuarine condition, with a diverse seagrass community, to a more marine system, dominated almost exclusively by turtle grass. Managing water flows to reduce the severity and frequency of hypersalinity events in Florida Bay is one of the primary goals of the Comprehensive Everglades Restoration Plan."[313] Kelble et al. (2007) further explain how water management north of Florida Bay deprived it of freshwater and has led to detrimental changes, exacerbated by the fact that, "The shallow bathymetry of Florida Bay amplifies the effects of water management, resulting in highly variable temporal and spatial salinity distributions."[314]

---

[310] Lollar, K. 2015. Researchers monitor seagrass in Caloosahatchee. News Press. https://www.news-press.com/story/news/2015/09/29/seagrass-caloosahatchee-halodule-thalassia-syringodium/72678944/.
[311] Florida Oceanographic Society. 2014. Our Florida Reefs. http://ourfloridareefs.org/wp-content/uploads/2014/06/Martin_Our-Florida-Reefs-6-18-14_Perry-and-Encomio.pdf.
[312] Mazzotti, F. et al. Stressor response nodel for tape grass (*Vallisneria Americana*) CIR 1524 Wildlife Ecology and Conservation Department.
[313] Kelble, C. 2006. Salinity is an important variable in Florida Bay. Tropical Connections. https://www.aoml.noaa.gov/outreach/floridaseagrant/pdf_files/TropicalConnections_SalinityIsImportantVariableFloridaBay_Kelble.pdf.
[314] Kelble, C.R., E.M. Johns, W.K Nuttle, T.N. Lee, R.H. Smith, and P.B. Ortner. 2007. Salinity patterns in Florida Bay. Estuarine Coastal and Shelf Science. 71: 318-334.

The approved Southern Coastal System Performance Measure document for salinity in Florida Bay explains the Bay's restoration goals as follows: 1. Restore oligohaline to mesohaline salinity patterns in the nearshore environment; 2. Lower the average salinity in the bay; 3. Reduce the frequency, duration, magnitude, and spatial extent of hypersaline (>40 psu) conditions throughout the bay; and 4. Restore seasonal deliveries of freshwater more typical of the natural system, e.g., extension of water deliveries into the dry season.[315]

Cyanobacteria blooms occur regularly during summer months in some coastal Florida waterways, including the St. Lucie and Caloosahatchee Rivers. Newly published research detected the cyanobacterial neurotoxin β-methylamino-L-alanine (BMAA) in the brains of dolphin carcasses recovered from Florida. BMAA also bioaccumulates in the marine food web and crosses the blood-brain barrier to become integrated with proteins in the brain (neuroproteins). Seven bottlenose dolphin carcasses from Florida were examined, originating from the Atlantic Ocean, Gulf of Mexico, Banana River, and Indian River Lagoon. Seven common dolphin carcasses from Massachusetts were also studied. Post-mortem examination and testing found the dolphins with detectable levels of BMAA also exhibited indications of degenerative brain disease like Alzheimers Disease, Amyotrophic Lateral Sclerosis (ALS or Lou Gehrig's Disease), and Parkinsonism Dementia Complex of Guam in humans. Levels of BMAA found in the dolphins were considered high (20–748 µg/g). The seven dolphins from Florida had 3-fold higher concentrations of BMAA than the common dolphins from Massachusetts. Dolphins are a top marine predator, consuming prey carrying BMAA in their tissues. The authors also reported that "The mean concentration of BMAA in the stranded dolphin brains was 1.4-fold higher than in reference brains of patients with AD and ALS. In some dolphins, BMAA levels detected were up to 3.6-fold greater than found in those of AD and ALS reference brains."[316]

Causation has yet to be established, but concerns for the long-term effects of algal blooms on human health and the environment continue to grow. Concern also exists for synergistic neurotoxicity between BMAA and methylmercury, known to concentrate in fish and fish-eating marine mammals, linking to dementia.

Red tide in Florida is not limited to the Caloosahatchee and St. Lucie estuaries, but high levels of nutrients released from Lake Okeechobee during discharges can contribute to *Karenia brevis* blooms in these regions. As many as 80% of manatees killed by brevetoxicosis during a red tide bloom have originated from Lee County, where the Caloosahatchee estuary is located. Red tide produces a toxin that is neurotoxic to manatees, causing seizure-like symptoms. The toxin is released when the fragile dinoflagellate ruptures. Manatees may inhale red tide in an aerosol

---

[315] EvergladesRestoration.gov. 2012. Southern Coastal System Performance Measure Salinity in Florida Bay. http://141.232.10.32/pm/recover/recover_docs/perf_measures/062812_rec_pm_scs_ salinity_flbay.pdf.

[316] Davis DA, Mondo K, Stern E, Annor AK, Murch SJ, Coyne TM, et al. (2019) Cyanobacterial neurotoxin BMAA .and brain pathology in stranded dolphins. PLoS ONE 14(3): e0213346. https://doi.org/10.1371/journal.one.0213346.

form when they surface to breathe, or ingest the toxin via seagrass or tunicates that have absorbed the toxin. During seizures, manatees often become disoriented, cannot surface to breathe, and consequently drown. The long-term consequences to manatee survival of exposure to, and subsequent recovery from, red tide, are unknown.

Lee County Manatee Deaths from Red Tide[317]

Year	Lee Co Red Tide Mortality	Total Red Tide Mortality	Lee Co as % of Total Red Tide Mortality
1996	83	151	*55.0%*
1997	7	15	*46.7%*
1998	N/A	N/A	N/A
1999	7	12	*58.3%*
2000	2	15	*13.3%*
2001	4	16	*25.0%*
2002	15	37	*40.5%*
2003	51	100	*51.0%*
2004	1	4	*25.0%*
2005	37	93	*39.8%*
2006	19	64	*29.7%*
2007	41	52	*78.8%*
2008	0	3	*0.0%*
2009	8	10	*80.0%*
2010	N/A	N/A	N/A
2011	21	23	*91.3%*
2012	28	34	*82.4%*
2013	237	277	*85.6%*
2014	1	2	*50.0%*
2015	2	15	*13.3%*
2016	22	73	*30.1%*
2017	19	67	*28.4%*
2018	91	224	*40.6%*

c. Smalltooth sawfish

Smalltooth sawfish are a tropical marine and estuarine fish that was once commonly found in waters throughout Florida and other states in the Southeast. In 2003, NMFS listed the United

[317] https://myfwc.com/research/manatee/rescue-mortality-response/statistics/mortality/red-tide/.

States population as an endangered distinct population segment under the ESA due to habitat destruction and bycatch in various commercial fisheries.[318] Currently, sawfish can only be found with any regularity in South Florida between the Caloosahatchee River and the Keys. It has increasingly been observed in the St. Lucie area.319 It is believed that the population is at a level less than 5% of its size at the time of European settlement.[320]

While it is unclear what the precise impacts to smalltooth sawfish and their habitat are from the discharges, freshwater flows do influence the movement and distribution of smalltooth sawfish.[321] The fish have an affinity for salinities between 18 and 24 psu, and these salinity levels are impacted by LORS discharges.

When the Corps discharges water, "individuals may move to areas with their preferred salinity, but habitats within these areas may be less (or more) suitable than those previously occupied. Within the Caloosahatchee River, increases in salinity that led to [sawfish] occurring upriver of the study area may be most problematic as the river becomes quite narrow with few shallow habitats that species appears to use as a refuge from predation."[322] Flow regimes that result in sawfish being distributed in sub-optimal habitats may reduce the survival "and thus hinder the recovery of this population."[323]

The Simpfendorfor study further notes that water management practices that result in repeated large changes in flow over short periods of time will result in large amounts of movement between different habitats which will increase energy expenditure, and may expose individuals to greater risks of predation….Water management practices therefore need to be considered in relation to the recovery of the [sawfish] population."[324]

One of the three main objectives of the 2009 Smalltooth Sawfish Recovery Plan is to protect and/or restore sawfish habitats.[325] One of the criteria that must be met for both the down-listing and de-listing of the species states:

> Freshwater flow regimes (including timing, distribution, quality, and quantity)…are appropriate to ensure natural behavior (e.g., feeding, resting, and predator avoidance) by maintaining salinities within preferred physiological limits

---

[318] 68 Fed. Reg. 15674 (April 1, 2003).
319 Killer, E. Shark survey scientist finds two sawfish in eight days. TC Palm. Apr. 18, 2019.
[320] Smalltooth Sawfish Recovery Plan, National Marine Fisheries Service (Jan. 2009) at v.
[321] Simpfendorfer, C.A. 2011. Environmental Influences on the Spatial Ecology of Juvenile Smalltooth Sawfish (Pristis pectinate): Results from Acoustic Monitoring. PloS One 6(2).
[322] Simpfendorfer, et al. at 10.
[323] *Id*. at 11.
[324] *Id*. at 11.
[325] *See* Smalltooth Sawfish Recovery Plan at III-3.

of juvenile smalltooth sawfish.[326]

The Recovery Plan further calls for NMFS to "minimize the disruption of natural/historic freshwater flow regimes (including timing, quality, and quantity) and maintain or restore water quality to restore the long-term viability of the smalltooth sawfish"[327] and directs the smalltooth sawfish recovery team to "work with federal, state, and local agencies responsible for regulating and permitting freshwater flows and withdrawals and water quality to ensure that environmental conditions are maintained at levels suitable for sawfish survival and recovery."[328]

It is unclear what affect cyanobacteria may have on smalltooth sawfish, but given the recent science regarding impacts to sharks and dolphins and smalltooth's similar diet, there are likely impacts.

d. Coral

NMFS has designated boulder star coral (*Montastraea annularis*), elkhorn coral (*Acropora palmata*), and staghorn coral (*Acropora cervicornis*) threatened under the ESA. These coral were once the most abundant and important reef building corals of Florida and the greater Caribbean. They occur in United States waters off the coasts of Florida, Puerto Rico, the U.S. Virgin Islands and Navassa Island. Over just the last 30 years, these species have suffered an 80-98 percent decline throughout significant portions of their range, reducing coral cover and opening space on reefs at an unprecedented pace.

Dense thickets used to dominate Caribbean coral reefs in the 1970s. Now, colonies are small, isolated, and patchy. Because the populations are fragmented, the corals are unable to recruit new colonies because corals need to be in close proximity for reproduction. Habitat degradation and modification is a primary threat to these corals. Coral have suffered severe bleaching and mortalities due to increases in water temperature. The increasing acidity of seawater as a result of the oceans' uptake of carbon dioxide is also known to reduce the growth rate of corals and to impair the ability of elkhorn corals to populate a reef. These coral are also threatened by pollution and sedimentation, which further contributes to algae overgrowth of corals. Other threats include abrasion and breakage from contact with boats, anchors, and storms. Disease and predation also contributes to the decline of the corals.

---

[326] Recovery Plan at III-4, III-5. The criterion for delisting reads almost verbatim: "Freshwater flow regimes (including timing, distribution, quality, and quantity)…are appropriate to ensure natural behavior (e.g., feeding, breeding, and pupping) by maintaining salinities within preferred physiological limits of juvenile smalltooth sawfish."
[327] Smalltooth Sawfish Recovery Plan at III-4. *See also,* Recovery Plan at ix, IV-9, IV-22.
[328] *Id.* at IV-9.

Black band disease of coral is a cyanobacteria-obligate disease that leads to extensive reef deterioration.[329] Coastal pollution, cyanobacteria and BBD have impacted coral like the federally threatened boulder coral (*Montastraea annularis*).[330] Studies of coral impacted by BBD off the coast of Florida tested positive for cyanotoxin microcystin.[331]

e. Cape Sable seaside sparrow

Unfortunately, some have incorrectly blamed the Cape Sable Seaside Sparrow (CSSS) for harmful discharges to the estuaries. FWS has concluded that "[c]ompletion of Everglades restoration in the long-term is expected to benefit CSSS populations, primarily by shifting water flows to the east, but many projects have been delayed for years and the CSSS is in decline as water is sent to western side of SRS into CSSS-A habitat, rather than to the east, where it historically flowed."[332] Therefore, acquiring sufficient land in the EAA and completing CERP will allow water to be cleaned and moved south sufficient to stop harmful discharges and provide sufficient water to Florida Bay while protecting resources like the sparrow.

FWS has determined that the two most important metrics for maintaining and enhancing sparrow survival and recovery are the keeping the ground dry during nesting season and maintaining the marl prairie.[333] The sparrow needs at least 90 consecutive dry nesting days March 1-July 15 over at least 24,000 acres within and adjacent to subpopulation A and across at least 40 percent of each of the eastern subpopulations B-F.[334] The sparrow, and Everglades writ large, also requires an average annual discontinuous hydroperiod of between 90 and 210 days outside of nesting season to protect marl prairie habitat.[335] If there are consistently more than 210 days with surface water, the habitat will convert to sawgrass.[336] If it is consistently less than 90 days dry, woody

---

[329] Gantar, M. et al. 2011. Antibacterial Activity of Marine and Black Band Disease Cyanobacteria against Coral-Associated Bacteria. Marine Drugs. 2011, 9(10), 2089-2105; doi:10.3390/md9102089; Bourne, D. et al. 2009. Microbial disease and the coral holobiont. https://doi.org/10.1016/j.tim.2009.09.004; Muller, E.M. et al. 2010. Black-band disease dynamics: Prevalence, incidence, and acclimatization to light. Journal of Experimental Marine Biology and Ecology. Vol. 397, Iss. 1, 31 Jan. 2011, p. 52-57; Viehman, S. et al. 2007. Culture and identification of *Desulfovibrio* spp. from corals infected by black band disease on Dominican and Florida Keys reefs. Diseases of Aquatic Organisms. Vol. 69: 119-127; Gantar, M. et al. 2007. Cyanotoxins from Black Band Disease of Corals and from Other Coral Reef Environments. Microb Ecol. 2009 Nov. 58(4): 856-64, doi:10.1007/s00248-009-9540-x; Bourne, D. et al. 2009. Microbial disease and the coral holobiont. Trends in Microbiology Vol. 17 No. 12; Klaus, J. et al. 2007. Coral microbial communities, zooxanthellae and mucus along gradients of seawater depth and coastal pollution. Environmental Microbiology 9(5), 1291-1305.
[330] Klaus, J. et al. 2009. Coral microbial communities, zooxanthellae and mucus along gradients of seawater depth and coastal pollution. Environmental Microbiology https://doi.org/10.1111/j.1462-2920.2007.01249.x.
[331] Myers, J. et al. 2007. Molecular Detection and Ecological Significance of the Cyanobacterial Genera Geitlerinema and Leptolyngbya in Black Band Disease of Corals. Applied and Environmental Microbiology. Vol. 73, No. 16, Aug. 2006, p. 5173-82.
[332] FWS. 2016. ERTP BO.
[333] *Id*.
[334] *Id*.
[335] *Id*.
[336] *Id*.

vegetation will encroach and increase risk of fire.[337] These calcitic marl soils are characteristic of the short-hydroperiod freshwater and marl prairies of the southern Everglades, as does the herbaceous vegetation, including muhly grass, Florida little bluestem, black-topped sedge, and cordgrass.[338]

First, the S12-A and S12-B closures are not a significant factor in freshwater reaching Florida Bay or moving water out of Lake Okeechobee on an emergency, or otherwise, basis. Only two of the four S-12 structures are closed, and only during the dry season, to accommodate sparrow nesting. S12-A closes November through early July, and S12-B closes in January through early July. Both the S-12A and the S-12B structures are open and functional during the height of the wet season to allow flow to the south.

Especially during high water events (when water levels in the Park south of Tamiami Trail and the S-12s are higher), those western structures pass less water than S12-C and S12-D to the east; they are also less effective at moving water south than is an open S-333 gate, which allows water to move east along the L-29 canal and then flow south under the Tamiami Trail bridge. Reasons include the fact that the north-south gradient in the west is less steep than in the east and that the land is higher in WCA-3A north of those structures, so there may be less water to pass on the western side of the conservation area (compared to the eastern side).

Water released from the western-most Tamiami Trail structures (S-12A and S-12B) does not flow into central Florida Bay; water released from S12-A flows into Lost Man's Bay (Franklin Adams) further up the coast in the Ten Thousand islands. Getting more freshwater to the Central Florida Bay requires increasing the discharge of water into Northeast Shark River Slough, precisely what the CEPP and the decades-old ModWaters would do.

Second, the fact that WCA-3A receives stormwater runoff from EAA lands in addition to Lake Okeechobee water after it is treated in the Stormwater Treatment Areas (STAs) is a limiting factor in moving water from Lake Okeechobee south. In fact, the *first priority* in terms of moving water into STAs and south is agricultural runoff in the EAA. EAA wastewater is backpumped into STAs then conservation areas – first into WCA-1, then WCA-2A, then WCA-3A.[339] The current operating rules set out the process: if WCA-1 goes above schedule, then EAA wastewater goes to 2A; and if 2A then goes over its schedule, EAA wastewater is routed to 3A.

When Lake Okeechobee level threaten the dike's integrity, water can only be sent south if the EAA is dry *and* the WCAs are below their schedules. The Central & Southern Project operations also prioritize water deliveries to the EAA in the dry season and store water in WCA 3A

[337] *Id.*
[338] *Id.*
[339] 2008 WCP 7-5

throughout the year to "back up" urban water supply (east coast utilities generally first rely on groundwater from the Biscayne and Floridan aquifers as well as reverse osmosis as a primary water supply source). Restoration – in particular, opening up new pathways to allow water to flow in the historic Everglades flow-way and finding and purchasing land in locations that allow for more water to move more slowly through the historic Everglades – is the only path forward to managing the large quantities of water coming into and out of the EAA *and* moving that water south effectively.

When the Corps engaged in emergency releases in February 2016 of WCA-3A by opening S-12A gates, the effect on the WCA-3A was negligible but the impact to the sparrow sub-population A was significant and resulted in elimination of nesting habitat two weeks into sparrow season due to four inches of inundation.[340] Rapid drawdowns of WCA-3A may also harm the snail kite, making its nests more vulnerable to predation.[341]

Third, taxpayers have funded new pumps and levees around certain residential developments located in the historic Everglades flow-way. The 8.5 Square Mile Area, S-357 Pump Station Project – is now functioning (since mid-2014), and appears to be working as planned. The C-111 project is also largely complete – except for an expanded "North Detention Area" west of the C-111 canal, north of the existing, more southern, detention areas. The detention areas allow for more water to be retained within the Everglades flow-way, and stop seepage out of the Everglades east into the C-111 canal. They can also allow for pre-storm drawdowns to make room in the C-111 canal in advance of large storms to better facilitate floodwater drainage.

Current operation in the southern part of the C&SF system directs – contrary to CERP – too much water to the east by way of the S-197 structure into eastern Florida Bay, and not into central Florida Bay. The S-197 structure sends South-Dade water into Manatee Bay on the east side of US 1. Allowing flow out of that structure means too much freshwater going into Barnes Sound and Manatee Bay and harming those ecosystems. Improved modeling and data showing how and where flows make it into Florida Bay and perhaps whether US 1 prevents flow between eastern Florida Bay and the central part of the ecosystem are needed.

Finally, the CERP plan and planning process was developed over the course of the 1990s with extensive input from state and federal scientists and the public at large. It was approved by the federal Congress in December 2000 as the roadmap – and planning process – for restoring and protecting the ecosystems that stretch from north of Lake Okeechobee, out into the St. Lucie and Caloosahatchee estuaries, through the Water Conservation Areas, all the way to Florida and Biscayne bays, and into Everglades National Park and Big Cypress National Preserve.

---

340 FWS 2016 ERTP BO.
341 FWS 2016 ERTP BO.

When water managers at the state and federal level, with the support of environmental advocates, agreed in February 2015 to an emergency deviation to current water management operations, it was in large part to jump-start some long-stalled portions of CERP. After talking to area landowners and to the Department of Transportation, they relaxed the upper limit of the water level in the canal that runs alongside Tamiami Trail. This enabled more water to flow east and then south under the Tamiami Trail bridge, allowing some relief from the extreme high water levels in the Water Conservation Areas to the north.

f. Johnson's seagrass

Johnson's seagrass is also being impacted by LORS and must be evaluated.

2. National Wildlife Refuges are Significantly Impacted

The National Wildlife Refuge System is the only federal land that is managed chiefly for wildlife conservation.[342] The first national wildlife refuge was established in 1903, when President Theodore Roosevelt took executive action to protect plummeting wading bird populations on Florida's east coast from plume hunters who were supplying the fashion and costume industry. A series of similar proclamations and legislative actions soon followed including four executive orders that were issued in 1908 establishing Pine Island National Wildlife Refuge,[343] Matlacha Pass National Wildlife Refuge,[344] Island Bay National Wildlife Refuge,[345] and Caloosahatchee National Wildlife Refuge[346] as "preserves and breeding grounds for native birds."[347] Over the following decades, hundreds more were established by executive orders, secretarial orders, and legislative acts. Today, the Refuge System includes more than 560 national wildlife refuges spanning across 150 million acres.[348]

Five national wildlife refuges lie within the Caloosahatchee River and estuary, including J.N. "Ding" Darling National Wildlife Refuge, Pine Island National Wildlife Refuge, Matlacha Pass National Wildlife Refuge, Island Bay National Wildlife Refuge, and Caloosahatchee National Wildlife Refuge. These refuges comprise the Ding Darling Refuge Complex and total 8,000 acres of trust resources. FWS has acknowledged that the discharges from Lake Okeechobee are negatively impacting water quality at the refuges, contributing to "red tides, eutrophication, impaired water bodies, mercury contamination, and pesticides and polychlorinated biphenyls"[349]

---

[342] Michael J. Bean & Melanie J. Rowland, *The Evolution of National Wildlife Law* 283 (1997); Robert Fischman, *The National Wildlife Refuges: Coordinating a Conservation System Through Law* 32 (2003).
[343] Executive Order 939 (September 15, 1908).
[344] Executive Order 943 (September 26, 1908).
[345] Executive Order 958 (October 23, 1908).
[346] Executive Order 3299 (July 1, 1920).
[347] *See infra* notes 5-8.
[348] FWS, National Wildlife Refuge System-A Hundred Years in the Making, http://www.fws.gov/refuges/about/.
[349] Department of the Interior, J.N. Ding Darling National Wildlife Refuge, 2010 (DOI 2010).

in the Caloosahatchee ecosystem, and has described impacts from dry season lack of flows as allowing "saltwater from the Gulf of Mexico to migrate into brackish estuaries and up the Caloosahatchee River, thus raising salinities of San Carlos Bay and the waters of the refuges."[350]

The Refuge Act includes several provisions, which serve as conservation mandates. The Refuge Act in relevant part directs FWS to (1) manage these refuges to fulfill the mission of the NWR system; (2) provide for the conservation of fish, wildlife, and plants, and their habitats within the Refuge system; (3) ensure that the biological integrity, diversity, and environmental health of the system are maintained for the benefit of present and future generations of Americans; (4) ensure that the mission of the system and the purposes of each refuge are carried out and (5) assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the system and the purposes of each of these refuges.[351] The Corps in coordination with FWS must examine opportunities to protect these five national wildlife refuges from the destruction of fish and wildlife habitat caused by the discharge of polluted water from Lake Okeechobee.

C. Local Economies are Impacted

In 2018, with toxic blue-green algae flowing down the Caloosahatchee River from Lake Okeechobee and a persistent red tide in the Gulf of Mexico and along the coast, the importance of water quality to the economy has never been so apparent. Harmful algae blooms and poor water quality are negatively impacting human health, devastating wildlife, and harming the industries that depend on clean water.

Florida thrives on tourism; beautiful beaches, clear blue waters, world-class sports fisheries and wildlife refuges are the reason why people come from all around the globe to visit or live here. Tourists and residents engage in water-based recreational activities such as swimming, fishing, boating, kayaking, paddle boarding, bird watching and nature observation in and around the Caloosahatchee's river and estuarine area. Additionally, tens of thousands of jobs are supported by healthy waters in Florida's multibillion-dollar tourism, boating, real estate, recreational and commercial fishing industries.

1. Recreation

Tourists and residents engage in water-based recreational activities such as swimming, fishing, boating, kayaking, paddle boarding, bird watching and nature observation in and around the Caloosahatchee's river and estuarine area. These activities are strong contributors to the local economy. Recreational saltwater and freshwater fisheries in Florida have an $8.7 billion

[350] *Id.*
[351] *See* 16 U.S.C. §§ 668dd(2); 668dd(4).

economic impact;[352] and recreational boating expenditures contribute $10.3 billion to our economy.[353] According to the National Marine Fisheries Service, 5 million residents of the Atlantic Coast took part in marine recreational fishing in 2017, with 29% of the trips taking place on the east coast of Florida.[354] In the same timeframe, 2.6 million residents from the Gulf Coast states also engaged in marine recreational fishing with 74% of these trips to west Florida.[355] Other activities, such as wildlife viewing, have a $4.9 billion economic impact, and support 44,623 jobs in Florida.[356]

Due to HAB and water quality issues from the 2018 Lake Okeechobee discharges, Sanibel and Captiva Islands saw a $30 million gross revenue reduction for recreational businesses, including photographers, charter companies, fishing guides, contractors, rentals, marinas, attractions, and wedding planners.[357] The islands saw $8 million in lost revenue just from cancelled accommodations alone.[358]

2. Fisheries

Florida's fisheries and aquaculture sectors are of major economic, social, and cultural importance to the state, generating some $15 billion in economic activity, supporting over 150,000 jobs, and attracting more than 2.4 million visiting anglers to the 'fishing capital of the world'.[359] The marine industry in South Florida alone contributes $12 billion to our economy.[360]
Florida's commercial fisheries, without imports, generate $1 billion of sales, $262 million of income, and $400 million of value added.[361] In 2015, over 22 million pounds of wild harvested fish and shellfish including shrimp, blue and stone crab, grouper, mackerel, and mullet among others were harvested by commercial fishermen in the seven-coastal counties of Southwest Florida.[362] Furthermore, approximately 285 wholesalers and 750 retailers bought and sold seafood in this region, which contributed significantly to Florida's multi-billion dollar seafood industry.[363]

---

352 Southwick Associates. Sportfishing in America: An Economic Force for Conservation. Produced for the American Sportfishing Association 2013.
353 National Marine Manufacturers Association. Economic Significance of Recreational Boating in Florida. 2013.
354 National Marine Fisheries Service (2018) Fisheries of the United States, p. 36.
355 National Marine Fisheries Service (2018) Fisheries of the United States, p. 36.
356 The 2011 Economic Benefits of Wildlife Viewing in Florida. Prepared for Florida Fish and Wildlife Conservation Commission.
357 Sanibel Captiva Chamber of Commerce. Economic Impact Study. July- December 2018.
358 *Id*.
359 Lorenzen et al. Climate Change Impacts on Florida's Fisheries and Aquaculture Sectors and Options for Adaptation. 2017.
360 Thomas J. Murray & Associates, Inc. Economic Impact of the Recreational Marine Industry Broward, Miami-Dade, and Palm Beach Counties, Florida – 2018.
361 U.S. Department of Commerce. Fisheries Economics of the United States 2015 Economics and Sociocultural Status and Trends Series. 2017.
362 Commercial Fisheries Landings in Florida. Florida Fish and Wildlife Conservation Commission (FWC).
363 *Id*.

Improving water quality is a way to protect economically viable fisheries. According to the Mather Economics study that looked at the return on investment of restoring the Everglades, commercial fishing catch will increase by a total of $524 million (assuming a 20-year time to full recovery for the fishery) once the system has been fully restored.[364] LOSOM, in conjunction with other infrastructure and Everglades restoration projects, has the potential to help restore the estuaries, thereby, increasing the value of the commercial fisheries within.

In order for commercial fisheries to thrive, seagrasses, oysters, and other macroinvertebrates must remain healthy. Seagrass is a main source of food for juvenile fish and manatees. When the Caloosahatchee River salinity changes due to damaging high-volume or insufficient water flows, the seagrasses that thrive in the river (mainly shoal grass and tape grass) may die.[365] This thereby negatively impacts the aquatic species that live in this ecosystem. Juvenile fish die as a result of poor water quality, less habitat (i.e. loss of seagrasses) and lower oxygen levels in the water caused by pollution and nutrient-fueled algae outbreaks.[366] With fewer juvenile fish, that means fewer game fish and a decrease of the amount of viable fish within a commercial or recreational fishery.

Additionally, water conditions caused by severe discharges from the lake can cause mass oyster die offs.[367] Oysters are an important economic resource that also serve as habitat for many marine species and provide important filtration service for improving overall water quality.[368] When salinities are drastically changed by the lake discharges, mass oyster die-offs can occur.[369] Freshwater flows from Lake Okeechobee and the corresponding pollutant loading has a domino effect on oyster beds, and therefore, all the species that depend on oyster beds for habitat, food, protection, or water filtration. This has the potential to severely decrease the productivity of commercial fisheries, as well as many other benefits the river provides.

3. Tourism

Tourism is the backbone of the economy in Florida. In Florida, 1.2 million jobs are supported by tourism.[370] In 2018, 126.1 million visitors traveled to Florida; every 78 visitors is equivalent to

---

[364] Mather Economics. Measuring the Economic Benefits of America's Everglades Restoration. 2009.
[365] Chamberlain and Doering. Freshwater inflow to the Caloosahatchee Estuary and the resource-based method for evaluation. 1998.
[366] SFWMD. Salinity Preferences and Nursery Habitat Considerations for Blue Crab (Callinectes sapidus), Bull Shark (Carcharhinus leucas), and Smalltooth Sawfish (Pristis pectinata) in the Caloosahatchee Estuary. 2013.
[367] SFWMD. Document to Support a Water Reservation Rule for the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project. 2014.
[368] *Id*.
[369] Voletyet al. Easternoysters (Crassostrea virginica) as an indicator for restoration of Everglades ecosystems.2009.
[370] Employment data from the Florida Department of Economic Opportunity (as reported by Visit Florida)

one Florida job.[371] For Lee County alone, approximately 5 million visitors a year travel to the area and generate approximately $3 billion in economic impacts.[372]

The tourism-based economy has been greatly impacted by HAB and water quality issues tied to the management of Lake Okeechobee discharges. According to research produced in part by the University of Florida, over half of possible visitors to Florida are concerned enough by the spread of harmful algae blooms to delay or alter their travel plans.[373] In the Greater Fort Myers Beach and Sanibel and Captiva Islands' area, 61% of hotels reported cancellations or guests leaving early because of water problems in 2013.[374]

Property values have also been severely impacted, proving problematic for an area that thrives on part-time residents and "snow-birds". A study by the Florida Realtors' Association in 2015 looking at the changes in the water quality of the St. Lucie Estuary, Loxahatchee Estuary, and the portion of the Indian River Lagoon north of the St. Lucie Inlet and associated real estate prices found an estimated $488 million reduction in Martin County's aggregate property value between May 1, 2013 and September 1, 2013.[375] The same study found a $541 million estimated decrease in property values in Lee County attributed to water quality (2010-2013).[376]

The economic repercussions of poor water quality is devastating to the impacted areas' citizens and businesses, which suffer the consequences of decreased revenues from tolls, parking, gas tax, and bed tax, among others. The Sanibel Island and Captiva Island Chamber of Commerce and Fort Myers Beach Chamber of Commerce reported combined losses of $87 million between July-December 2018 due to poor water quality caused by the releases from Lake Okeechobee.[377] These economic losses are significant, and when coupled with the impact to wildlife and human health, must be considered in developing the new LOSOM.

D. Climate Change is a Significant Factor the Corps Must Consider

Climate change is likely contributing to the growth of HAB,[378] and "will severely affect our ability to control blooms, and in some cases could make it near impossible."[379] Favorable

---

[371] Visit Florida. Tourism Is Vital To Florida.
[372] Davidson-Peterson Associates. Lee County Annual Visitor Profile Summary Reports. 2018 Annual Visitor Profile and Occupancy Analysis.
[373] 2016 study by Black Hills State University and the University of Florida's Tourism Crisis Management Initiative.
[374] Sanibel & Captiva Islands Chamber of Commerce and Greater Fort Myers Beach Chamber of Commerce 2013 Survey.
[375] The Impact of Water Quality on Florida's Home Values – Florida Realtors. Final Report 2015.
[376] *Id*.
[377] Sanibel Captiva Chamber of Commerce. Economic Impact Study. July- December 2018.
[378] EPA. 2013. Impacts of Climate Change on the Occurrence of Harmful Algal Blooms (EPA 2013); Havens, K. 2015. Climate Change and the Occurrence of Harmful Microorganisms in Florida's Ocean and Coastal Waters. IFAS Extension; Havens, K. 2018. The Future of Harmful Algal Blooms in Florida Inland and Coastal Waters. IFAS Extension; Moss, B. et al. 2011. Allied attack: climate change and eutrophication. Inland Waters, 1:2, 101-105;

conditions for blooms include warm waters, changes in salinity, increases in atmospheric carbon dioxide concentrations, changes in rainfall patterns intensify coastal upwelling, sea level rise and high nutrient levels.[380] Climate change is warming ocean waters which may create a competitive advantage for harmful algae, including microcystis, by out competing other algae that is not as successful at warmer temperatures.[381] Warming surface waters increases the frequency, strength, and duration of stratification which favors both cyanobacteria and dinoflagellates.[382] Warmer temperatures reduce water viscosity, which may give cyanobacteria a competitive advantage over other algae.[383]

Climate change is also leading to an increase in extreme weather events. Extreme rainfall could increase nutrient loading from runoff.[384] Climate scientists believe that there is an Atlantic Multidecadal Oscillation, and that there are significant differences in Lake Okeechobee inflows between dry phases and wet phases. The dry phase, which lasted from about 1965 to 1994, has shifted to a wet phase, which means that nearly the entire period of record used by the Corps for evaluation of the LORS does not represent the wet phase we are now in. There is evidence that during the previous wet period from around 1930 to 1964 the inflows to the lake were about double as compared to the dry period of 1965 to 1994.[385] It is likely that climate-driven increases in inflows from human altered watersheds will increase the prevalence of HABs.[386]

Studies suggest that an increase in temperature may influence cyanobacterial dominance in phytoplankton communities.[387] Optimum temperatures for microcystin production range from 20 to 25 degrees Celsius.[388] These warmer temperatures appear to favor the growth of toxigenic strains of Microcystis.[389] Temperature may also indirectly increase cyanobacterial biomass through its effect on nutrient concentrations.[390]

Paerl, H. and J. Huisman. 2008. Blooms Like It How. Science. Vol. 320, 4 April 2008; Paerl, H. and J. Huisman. 2009. Climate change: a catalyst for global expansion of harmful cyanobacterial blooms. Environmental Microbiology Reports (2009) 1(1), 27-37.

[379] Havens, K. et al. 2015. Climate Change at a Crossroad for Control of Harmful Algal Blooms. Environmental Science & Technology 2015, 49, 12605-12606.

[380] EPA 2013.

[381] *Id*.

[382] *Id*.

[383] *Id*.

[384] EPA 2013.

[385] Enfield, D. et al. 2001. The Atlantic multidecadal oscillation and its relation to rainfall and river flows in the continental U.S. Geophysical Research Letters, Vol. 28, No. 10, Pages 077-2080, May 15, 2001.

[386] Wells, M. et al. 2015. Harmful algal blooms and climate change: Learning from the past and present to forecast the future. Harmful Algae. 2015 Nov. 1; 49: 68-93. Doi:10.1016/j.hal.2015.07.009.

[387] EPA 2016 at 18.

[388] *Id*.

[389] *Id*.

[390] *Id*.

Florida is experiencing rising temperatures, due in large part to the effects of climate change. Climate models project both continued warming in all seasons across the southeast United States and an increase in the rate of warming.[391] Climate change is also resulting in changed precipitation patterns, with an increase in the incidence and severity of both drought and major storm events in the southeast.[392] The percentage of the southeast region experiencing moderate to severe drought has already increased over the past three decades. Since the mid-1970s, the area of moderate to severe spring and summer drought has increased by 12 percent and 14 percent, respectively. Fall precipitation tended to increase in most of the southeast, but the extent of region-wide drought still increased by nine percent.[393] Studies have found that the frequency of high-severity hurricanes is also increasing in the Atlantic Ocean.[394]

Climate change is likely contributing to the growth of HAB,[395] and "will severely affect our ability to control blooms, and in some cases could make it near impossible."[396] Favorable conditions for blooms include warm waters, changes in salinity, increases in atmospheric carbon dioxide concentrations, changes in rainfall patterns intensify coastal upwelling, sea level rise and high nutrient levels.[397] Climate change is warming ocean waters, which may create a competitive advantage for harmful algae, including microcystis, by out competing other algae that is not as successful at warmer temperatures.[398] Warming surface waters increases the frequency, strength, and duration of stratification which favors both cyanobacteria and dinoflagellates.[399] Warmer temperatures reduce water viscosity, which may give cyanobacteria a competitive advantage over other algae.[400] Rising global temperatures and changing precipitation patterns may stimulate cyanobacterial blooms.[401] Warmer temperatures favor heat-adapted surface bloom forming

---

[391] Karl, T.R. et al. 2009. *Global Climate Change Impacts in the United States*. Global Change Research Program. New York: Cambridge University Press, pp. 111-113.
[392] *Id*.
[393] *Id*.
[394] Elsner et al. 2008. The increasing intensity of the strongest tropical cyclones. *Nature*, 455: 92:92-95; Bender, M.T. 2010. Modeled impact of anthropogenic warming on the frequency of intense Atlantic hurricanes. *Science*, 327: 454-458; Kishtawal, C.M. et al. 2012. Topical cyclone intensification trends during satellite ear (1986-2001). *Geophysical Research Letters*, Vol 39.
[395] EPA. 2013. Impacts of Climate Change on the Occurrence of Harmful Algal Blooms (EPA 2013); Havens, K. 2015. Climate Change and the Occurrence of Harmful Microorganisms in Florida's Ocean and Coastal Waters. IFAS Extension; Havens, K. 2018. The Future of Harmful Algal Blooms in Florida Inland and Coastal Waters. IFAS Extension; Moss, B. et al. 2011. Allied attack: climate change and eutrophication. Inland Waters, 1:2, 101-105; Paerl, H. and J. Huisman. 2008. Blooms Like It How. Science. Vol. 320, 4 April 2008; Paerl, H. and J. Huisman. 2009. Climate change: a catalyst for global expansion of harmful cyanobacterial blooms. Environmental Microbiology Reports (2009) 1(1), 27-37. See also Congressional Research Service, *Freshwater Harmful Algal Blooms: Causes, Challenges, and Policy Considerations* (Aug. 20, 2018).
[396] Havens, K. et al. 2015. Climate Change at a Crossroad for Control of Harmful Algal Blooms. Environmental Science & Technology 2015, 49, 12605-12606 (Havens 2015a).
[397] EPA 2013.
[398] *Id*.
[399] *Id*.
[400] *Id*.
[401] EPA 2016 at 19.

cyanobacteria.[402] Warmer surface waters, particularly where there is also reduced precipitation, are susceptible to high vertical stratification.[403] As temperatures rise due to climate change, stratification is expected to occur earlier in the spring and last longer into the fall.[404] The increase in water column stability associated with higher temperatures and climate change may favor the production of cyanobacteria and possibly the prevalence of cyanotoxins, including microcystins.[405]

Climate change is also leading to an increase in extreme weather events. Extreme rainfall could increase nutrient loading from runoff.[406] Climate scientists believe that there is an Atlantic Multidecadal Oscillation, and that there are significant differences in inflows to Lake Okeechobee between dry phases and wet phases. The dry phase, which lasted from about 1965 to 1994, has shifted to a wet phase. There is evidence that during the previous wet period from around 1930 to 1964 the inflows to the lake were about double as compared to the dry period of 1965 to 1994.[407] It is likely that climate-driven increases in inflows from human altered watersheds will increase the prevalence of HABs.[408] Nutrient pollution may also be further exacerbated by climate change as septic tanks and similar sources of waste are threatened by sea level rise, particularly in south Florida.[409]

1. Intensifying Storms

Climate change has contributed to an increase in North Atlantic hurricane activity since the 1970s.[410] The frequency of high-severity Atlantic hurricanes is increasing.[411] Anomalously warm ocean waters due to climate change have contributed to the formation and strength of destructive

[402] *Id*.
[403] *Id*.
[404] *Id*.
[405] *Id*.
[406] EPA 2013.
[407] Enfield, D. et al. 2001. The Atlantic multidecadal oscillation and its relation to rainfall and river flows in the continental U.S. Geophysical Research Letters, Vol. 28, No. 10, Pages 077-2080, May 15, 2001.
[408] Wells, M. et al. 2015. Harmful algal blooms and climate change: Learning from the past and present to forecast the future. Harmful Algae. 2015 Nov. 1; 49: 68-93. Doi:10.1016/j.hal.2015.07.009.
[409] As a result of sea level rise, by 2040, 64% of septic tanks in Miami-Dade County (more than 67,000) could have issues every year. Harris, A. 2019. Miami-Dade's septic tanks are failing due to sea rise, Jan. 12, 2019, at https://www.apnews.com/6076bb3a5cb348d88a471dab5a811b94.
[410] Elsner, James B. et al., The increasing intensity of the strongest tropical cyclones, 455 Nature 92 (2008); Saunders, Mark A. & Adam S. Lea, Large contribution of sea surface warming to recent increase in Atlantic hurricane activity, 451 Nature 557 (2008); U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 257; U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 74.
[411] Elsner, James B. et al., The increasing intensity of the strongest tropical cyclones, 455 Nature 92 (2008); Bender, M.A. et al, Modeled impact of anthropogenic warming on the frequency of intense Atlantic hurricanes, 327 Science 454 (2010); Kishtawal, C.M. et al., Tropical cyclone intensification trends during satellite era (1986–2010), 39 Geophysical Research Letters L10810 (2012).

storms like Hurricane Irma which devastated large parts of Florida with high-intensity winds, extreme rainfall, and high storm surge.[412] As the ocean and atmosphere warm, climate change is increasing the amount and intensity of rainfall of Atlantic hurricanes such as Hurricane Harvey with its record rainfall and massive flooding.[413] A recent study found that climate change is also contributing to rapid Atlantic hurricane intensification, in which hurricanes grow from a weaker storm to a Category 4 or 5 in a short period, causing a disproportionate amount of human and financial losses.[414]

The increasing intensity of Atlantic hurricanes is also resulting in more frequent and severe hurricane-generated surge events and wave heights.[415] Large storm surge events of Hurricane Katrina magnitude have doubled in response to warming during the 20th century,[416] and are projected to increase in frequency twofold to sevenfold for each 1°C in temperature rise.[417] One study projected that, under a lower emissions RCP 4.5 scenario, storm surge would increase by 25 to 47 percent along Florida's coasts due to the combined effects of sea level rise and growing hurricane intensity.[418] The increasing frequency of extreme precipitation events is also compounding coastal flooding risk when storm surge and heavy rainfall occur together.[419] As climate change continues unabated, Atlantic hurricane rainfall and intensity are projected to continue to increase, making hurricanes more and more destructive.[420]

2. Increasing frequency of heat waves and extreme precipitation events (Jacki)

---

412 Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 766-767.

413 Emanuel, Kerry, Assessing the present and future probability of Hurricane Harvey's rainfall 2017, 114 PNAS 12681 (2017); Risser, Mark D. and Michael F. Wehner, Attributable human-induced changes in the likelihood and magnitude of the observed extreme precipitation during Hurricane Harvey, 44 Geophysical Research Letters 12,457 (2017); van Oldenborgh, Geert J. et al., Attribution of extreme rainfall from Hurricane Harvey, 12 Environmental Research Letters 124009 (2017).; Trenberth, Kevin E. et al., Hurricane Harvey links to ocean heat content and climate change adaptation, 6 Earth's Future 730 (2018).

414 Bhatia, Kieran T. et al., Recent increases in tropical cyclone intensification rates, Nature Communications https://doi.org/10.1038/s41467-019-08471-z (2019).

415 Komar, Paul D. & Jonathan C. Allan, Increasing hurricane-generated wave heights along the U.S. east coast and their climate controls, 24 Journal of Coastal Research 479 (2008); Grinsted, Aslak et al., Homogeneous record of Atlantic hurricane surge threat since 1923, 109 PNAS 19601 (2012).

416 Grinsted, Aslak et al., Homogeneous record of Atlantic hurricane surge threat since 1923, 109 PNAS 19601 (2012).

417 Grinsted, Aslak et al., Projected hurricane surge threat from rising temperatures, 110 PNAS 5369 (2013).

418 Balaguru, Karthik et al., Future hurricane storm surge risk for the U.S. gulf and Florida coasts based on projections of thermodynamic potential intensity, 138 Climatic Change 99 (2016).

419 Wahl, T. et al., Increasing risk of compound flooding from storm surge and rainfall for major US cities, 5 Nature Climate Change 1093 (2015).

420 U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 74.

Extreme weather events are increasing in frequency in Florida and across the U.S., most notably heat waves and heavy precipitation events.[421] In south Florida, heat waves have increased significantly in frequency and duration since 1950.[422] In the contiguous United States, extreme temperatures are expected to increase even more than average temperatures, with more intense heat waves and 20 to 30 more days per year above 90°F by mid-century for most regions under a higher emissions scenario.[423] Heavy precipitation has become more frequent and intense in most regions of the U.S. including the Southeast since 1901,[424] as more water vapor is available to fuel extreme rain as the world warms.[425] Heavy precipitation events are projected to continue to increase in frequency and intensity across the United States including in the Southeast, with the number of extreme events rising by two to three times the historical average by the end of the century under a higher emissions scenario.[426]

3. Sea Level Rise

Global average sea level rose by seven to eight inches since 1900 as the oceans have warmed and land-based ice has melted.[427] Sea level rise is accelerating in pace with almost half of recorded sea level rise occurring since 1993.[428] The Fourth National Climate Assessment estimated that global sea level is very likely to rise by 1.0 to 4.3 feet by the end of the century relative to the year 2000, with sea level rise of 8.2 feet possible.[429] Sea level rise will be much more extreme without strong action to reduce greenhouse gas pollution. By the end of the century, global mean

---

[421] Coumou, Dim & Stefan Rahmstorf, A decade of weather extremes, 2 Nature Climate Change 491 (2012); Intergovernmental Panel on Climate Change, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, Special Report of the Intergovernmental Panel on Climate Change (2012); Herring, Stephanie C. et al., Explaining extreme events of 2016 from a climate perspective, 99 Bulletin of the American Meteorological Society S1 (2017); U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 18-20.

[422] Cloutier-Bisbee, Shealynn R. et al., Heat waves in Florida: climatology, trends, and related precipitation events, 58 Journal of Applied Meteorology and Climatology 447 (2019).

[423] U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 185, 199.

[424] U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 20, 212.

[425] U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 214.

[426] U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 207, 218-220.

[427] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 74.

[428] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 339; U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 74.

[429] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 74, 758; U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States, Fourth National Climate Assessment, Volume II (2018), https://nca2018.globalchange.gov/ at 74.

sea level is projected to increase by 0.8 to 2.6 feet under a lower emissions RCP 2.6 scenario, compared with 1.6 to 6 feet under a high emissions RCP 8.5 scenario.[430] The impacts of sea level rise will be long-lived: under all emissions scenarios, sea levels will continue to rise for many centuries.[431]

In south Florida, regional sea level rise in Miami-Dade County has significantly exceeded global average sea level rise.[432] Wdowinski et al. (2016) found that that the average rate of regional sea level rise off Virginia Key since 2006 is 9 ± 4 mm per year, which is much higher than the global average rate between 1993 and 2012 of 3.2 ± 0.4 mm per year based on satellite data and 2.8 ± 0.4 mm per year based on in-situ data.[433] This is consistent with research that has detected a rapid acceleration in the rate of sea level rise along the US Atlantic Coast since 2000.[434] Based on evidence of higher regional sea level rise in the Miami region, Wdowinski et al. (2016) concluded that planners "should rely on regional SLR rate projections and not only on the commonly used global SLR projections."

The Southeast Florida Regional Climate Change Compact ("Compact") Unified Sea Level Rise Projection for 2060 provides guidance on the sea level rise projections that planners should use for different time horizons, including short term (2030), medium term (2060) and long term (2100):

> (1) short term, by 2030, sea level is projected to rise 6 to 10 inches above 1992 mean sea level,
> (2) medium term, by 2060, sea level is projected to rise 14 to 34 inches above 1992 mean sea level,
> (3) long term, by 2100, sea level is projected to rise 31 to 81 inches above 1992 mean sea level.[435]

---

[430] U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 344.
[431] Melillo, Jerry M. et al. (eds.), Climate Change Impacts in the United States: The Third National Climate Assessment, U.S. Global Change Research Program (2014), https://www.globalchange.gov/browse/reports/climate-change-impacts-united-states-third-national-climate-assessment-0 at 45. Also U.S. Global Change Research Program, Climate Science Special Report: Fourth National Climate Assessment, Vol. I (2017), https://science2017.globalchange.gov/ at 345-346.
[432] Southeast Florida Regional Climate Change Compact Sea Level Rise Work Group (Compact), Unified Sea Level Rise Projection for Southeast Florida, A Document Prepared for the Southeast Florida Regional Climate Change Compact Steering Committee, 35 pp. (2015) ("Compact") at 9.
[433] Wdowinski, S. et al., Increasing flooding hazard in coastal communities due to rising sea level: Case study of Miami Beach, Florida, 126 Ocean & Coastal Management 1 (2016).
[434] Sallenger, A.H. et al., Hotspot of accelerated sea-level rise on the Atlantic coast of North America, 2 Nature Climate Change 884 (2012); Ezer, T. et al., Gulf Stream's induced sea level rise and variability along the U.S. mid-Atlantic coast, 118 Journal of Geophysical Research: Oceans 685 (2013); Compact 2015; Park, J. & W. Sweet, Accelerated sea level rise and Florida Current transport, 11 Ocean Science 607 (2015).
[435] Compact at 4.

The Compact recommends using the upper curve estimates from its Unified Sea Level Rise Projection for projects which are "not easily replaceable or removable, have a long design life (more than 50 years) or are critically interdependent with other infrastructure or services."[436]

4. Flooding from sea level rise, intensifying storms and storm surge, and increases in extreme precipitation events

South Florida, with its low elevation and dense population, is highly vulnerable to flooding due to climate change-driven increases in sea level, storm intensity and storm surge, and extreme precipitation. A nation-wide study estimated that approximately 3.7 million Americans live within three feet of high tide, putting them at extreme risk of flooding from sea level rise in the next few decades, with Florida residents ranking as particularly vulnerable.[437] Another study forecast that 4.2 million Americans would be at risk of flooding from three feet of sea level rise, while 13.1 million people would be at risk from six feet of sea level rise—including more than 6 million people in Florida alone—driving mass human migration and societal disruption.[438] An analysis of 136 of the world's largest coastal cities projected that global flood losses of US$6 billion per year in 2005 will grow to US$1 trillion or more per year by 2050 due to sea level rise and subsidence, if no adaptation actions are taken, with Miami suffering the highest current and projected economic losses in the U.S.[439]

High-tide flooding, also called "sunny day flooding," occurs when high tide conditions are exacerbated by sea level rise. Since the 1960s, sea level rise has increased the frequency of high tide flooding by a factor of 5 to 10 for several U.S. coastal communities, and flooding rates are accelerating in many Atlantic and Gulf Coast cities.[440] For much of the U.S. Atlantic coastline, a local sea level rise of 1.0 to 2.3 feet (0.3 to 0.7 m) would be sufficient to turn nuisance high tide events into major destructive floods.[441]

---

[436] Compact at 4 ("The upper curve of the Projection should be utilized for planning of high risk Projects to be constructed after 2060 or Projects which are not easily replaceable or removable, have a long design life (more than 50 years) or are critically interdependent with other infrastructure or services.").
[437] Strauss, Benjamin H. et al., Tidally adjusted estimates of topographic vulnerability to sea level rise and flooding for the contiguous United States, 7 Environmental Research Letters 014033 (2012).
[438] Hauer, Matthew E. et al., Millions projected to be at risk from sea-level rise in the continental United States, 6 Nature Climate Change 691 (2016); Hauer, Mathew E., Migration induced by sea-level rise could reshape the US population landscape, 7 Nature Climate Change 321 (2017).
[439] Hallegatte, Stephane et al., Future flood losses in major coastal cities, 3 Nature Climate Change 802 (2013).
[440] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,U.S. Global Change Research Program (2018), https://nca2018.globalchange.gov/, at 98-99.
[441] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,U.S. Global Change Research Program (2018), https://nca2018.globalchange.gov/, at 99.

In Miami-Dade County, the significant increase in high-tide flooding due to sea level rise has already resulted in severe property damage. According to a detailed flooding analysis for Miami Beach between 1998 and 2013, flooding frequency significantly increased after 2006, with a 33 percent increase in rain-induced flooding and a more than 400 percent increase in tide-induced flooding, jumping from 2 events during 1998-2005 to 8 to 16 events during 2006-2013.[442] Sweet et al. (2016) determined that the probability of a 0.57-m tidal flood within the Miami region has increased by >500% since 1994 from a 10.9-cm sea level rise (SLR)-related trend in monthly highest tides.[443] Studies project that high-tide flooding will become much more frequent and severe in the next few decades.[444] For example, an analysis by Dahl et al. (2017) projected that tidal flooding in Virginia Key off Miami will increase significantly in the near-term, from 5.1 flood events per year during 2001-2015 to 46 flood events per year by 2030 and 206 events per year by 2045.[445]

E. Water Quality is a Significant Factor the Corps Must Consider

Attainment of Water Quality Based Effluent Limitations (WQBEL) associated with CERP and CEPP water quality storage projects is a concern due to legacy nutrient concentrations in sediments and from biological and chemical processes of stored water (University of Florida 2015; SFWMD 2018b). Concern about WQBEL attainment with the C-43 has also been a consideration. The C-43 Test Cell Study indicated potential problems with harmful algal blooms. On average, blue-green algal species represented more than 90 percent of the organisms detected in each test cell.[446] In the case of C-43 the receiving water, the Caloosahatchee Estuary is impaired for nutrients and a TMDL was adopted in 2009 requiring additional emphasis that discharges from the reservoir for hydrological recovery does not cause or contribute to further impairment. Furthermore, the segment of the Caloosahatchee River the reservoir will discharge to is a Class I waterbody designated for potable water use due to the Olga Water Treatment plant which utilizes Caloosahatchee River as a source for treatment.

---

[442] Wdowinski, S. et al., Increasing flooding hazard in coastal communities due to rising sea level: Case study of Miami Beach, Florida, 126 Ocean & Coastal Management 1 (2016).
[443] Sweet, William V. et al., In tide's way: Southeast Florida's September 2015 sunny-day flood, [in "Explaining Extremes of 2015 from a Climate Perspective"], 97 Bulletin of the American Meteorological Society S20 (2016).
[444] U.S. Global Change Research Program, Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,U.S. Global Change Research Program (2018), https://nca2018.globalchange.gov/, 75; Moftakhari, H.R. et al., Increased nuisance flooding along the coasts of the United States due to sea level rise: Past and future, 42 Geophysical Research Letters 9846 (2015).
[445] Dahl, K.A. et al., Sea level rise drives increased tidal flooding frequency at tide gauges along the U.S. East and Gulf Coasts: Projections for 2030 and 2045, 12 PLoS ONE e0170949 (2017).
[446] Stanley Consultants 2007. C-43 West Storage Reservoir Test Cell Water Quality Summary, Prepared for Stanley Consultants, Inc., August 2007.

1. Increased Water Storage Alone Will Not Address Water Quality Concerns in the Estuaries

Federal and state ecosystem restoration plans (principally the Comprehensive Everglades Restoration Plan) call for increased water storage throughout the system as a primary strategy to restore the Everglades and reduce the discharges to the coastal estuaries.[447] This includes the construction of large reservoirs, including the EAA reservoir south of Lake Okeechobee.[448] As Graham et al. (2015) note, "the need to store substantial volumes of water both north and south of Lake Okeechobee is well recognized to both reduce high freshwater flows to the Caloosahatchee and St. Lucie estuaries and move water south of Lake Okeechobee to the Everglades Protection Area."[449] But as they explain:

> Increased storage capacity in and of itself is not sufficient, however, to reduce damage to the estuaries and the [Everglades Protection Area] which is due to both problems with the volume, timing and distribution of freshwater flows and high nutrient loads. *Even if all storage needs were achieved, water quality remains a significant problem for the St. Lucie and Caloosahatchee estuaries and a direct legal hurdle for moving water south of the lake into the [Everglades Protection Area].* Thus, a holistic and coordinated approach to providing both storage and treatment is needed to maintain water quality and protect these systems and the ecosystem services they provide.[450]

---

[447] *See* U.S. Army Corps of Engineers and South Florida Water Management District. 1999. Central and Southern Florida Project Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement.
[448] *See* § 373.4598, Fla. Stat. (codifying "Senate Bill 10" that directs the expedited design and constriction of a reservoir in the EAA to reduce discharges from Lake Okeechobee).
[449] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 60.
[450] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 60 (emphasis added). Further, sea level rise and the impacts of climate change could have profound implications for Everglades restoration in the years ahead. The National Academy of Sciences Committee on Independent Scientific Review of Everglades Restoration Progress remarked in 2016 that much more storage may be needed to compensate for saltwater intrusion and rising temperatures that result in greater evaporation of water supplies during periods of drought. National Academies of Sciences, Engineering, and Medicine. 2016. Progress Toward Restoring the Everglades: The Sixth Biennial Review-2016. Washington, DC: The National Academies Press. https://doi.org/10.17226/23672. *See also,* Reid, A. 2016. Everglades' water at risk from sea level rise, scientists say, Sun Sentinel, Dec. 15, 2016, at https://www.sun-sentinel.com/news/florida/fl-everglades-report-card-2016-20161215-story.html. The committee recently recommended that eighteen years into CERP, a mid-course assessment is needed to analyze projected CERP outcomes (including water storage in the EAA) in the context of future climate change and sea level-rise scenarios and other stressors. National Academies of Sciences, Engineering, and Medicine 2018. Progress Toward Restoring the Everglades: The Seventh Biennial Review-2018. Washington, D.C.: The National Academies Press. https://doi.org/10.17226/25198.

Given these limitations, rigorous measures will also need to be implemented to improve water quality and prevent cyanotoxins from threatening human health and the natural environment. Water quality protection is largely the responsibility of the State under the Clean Water Act (with federal EPA oversight) and decades of state government inaction,[451] followed by the development of grossly inadequate nonpoint source pollution controls (explained in greater detail below) have constrained (and will continue to constrain) any progress made through increased water storage and operational changes.

2. Current Approaches to Control Nutrient Pollution and Address Harmful Algae Blooms are Outdated, Ineffective, and Unresponsive

In promulgating regulations implementing state water quality standards, the Department of Environmental Protection highlighted the harm caused by nutrient pollution, finding "excessive nutrients (total nitrogen and total phosphorus) constitutes one of the most sever water quality problems facing the State."[452]

The State has promulgated both narrative and numeric standards for nutrients (Total Phosphorus and Total Nitrogen) for surface waters.[453] Many waterbodies and segments throughout the state, including Lake Okeechobee, the St. Lucie and Caloosahatchee estuaries, and the Indian River lagoon are "impaired" by pollutants, including nutrients.[454] To control these nutrients, the state relies in large part on TMDLs and Basin Management Action Plans (BMAPs). In 2001, the Department established a total phosphorus TMDL for Lake Okeechobee,[455] which was followed by a BMAP in 2014.[456] In 2009 the Department established a TMDL for total phosphorus (TP), total nitrogen (TN), and dissolved oxygen (DO) for the St. Lucie Basin,[457] and a TMDL for TN

---

[451] In 1998, environmental groups filed suit against the EPA for not compelling Florida to establish TMDLs for the state's water bodies, including Lake Okeechobee. The following year, the parties entered into a consent decree, which required EPA to establish TMDLs for more than 500 water bodies due to the state's failure. *See Florida Wildlife Federation v. Browner*, 4:98-CV-2560-WS (N.D. Fla. July 2, 1999). The consent decree established a priority schedule for TMDLs for waters throughout the state. The Florida legislature later enacted the Watershed Restoration Act, establishing Florida's TMDL program-some 26 years following the enactment of the Clean Water Act. *See* § 403.067, Fla. Stat.

[452] R. 62-302.300(13), F.A.C.

[453] *See* Rules 62-302.530, 62-302.531, and 62-302.532, F.A.C.

[454] *See* DEP, Comprehensive Verified List, at https://floridadep.gov/dear/watershed-assessment-section/documents/comprehensive-verified-list.

[455] *See* Florida Department of Environmental Protection, Total Maximum Daily Load for Total Phosphorus Lake Okeechobee, Florida, 9-10 (Aug. 2001), available at https://floridadep.gov/sites/default/files/Lake_O_TMDL_Final.pdf.

[456] *See* Florida Department of Environmental Protection. 2014. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Total Phosphorous by the Florida Department of Environmental Protection in Lake Okeechobee (Dec. 2014) at https://floridadep.gov/sites/default/files/LakeOkeechobeeBMAP.pdf.

[457] *See* Florida Department of Environmental Protection. 2008. TMDL Report, Nutrient and Dissolved Oxygen TMDL for the St. Lucie Basin, at https://floridadep.gov/sites/default/files/stlucie-basin-nutr_do-tmdl.pdf.

for the Caloosahatchee Estuary.[458] The Department finalized BMAPs for the St. Lucie and Caloosahatchee Basins in 2013 and 2012, respectively.[459]

These current plans do not provide an adequate framework for the state to effectively protect Lake Okeechobee, the coastal estuaries, and may other waters from excessive nutrient loads, much less from high levels of cyanotoxins and the formation of HABs. While the Lake Okeechobee TMDL for phosphorus recognizes the connection between phosphorus pollution and HABs as well as the harm caused by HABs,[460] the TMDL has failed to slow pollution and stop these HABs from forming over nearly the past two decades. In fact, the implementing BMAP (created in 2014) makes no mention of cyanobacteria, cyanotoxins, or algae blooms.[461] There are also no TMDLs for nitrogen or other nutrients in the Lake that may be further fueling HABs.[462]

After nearly two decades of failures, the State is not even close to meeting the 140 mt pollution standard for phosphorus in Lake Okeechobee and the BMAP lacks reasonable assurances that 140 metric tons will be achieved in the next 20 years, if at all. In fact, the BMAP does not even identify projects to reduce total phosphorus loads to the meet the TMDL, stopping several hundred tons per year short.

---

[458] *See* Florida Department of Environmental Protection. 2009. Final TMDL Report, Nutrient TMDL for the Caloosahatchee Estuary, at https://floridadep.gov/sites/default/files/tidal-caloosa-nutr-tmdl_0.pdf.

[459] *See* Florida Department of Environmental Protection. 2013. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients and Dissolved Oxygen by the Florida Department of Environmental Protection in the St. Lucie River and Estuary Basin (May 2013) at https://floridadep.gov/sites/default/files/stlucie-estuary-nutr-bmap.pdf; Florida Department of Environmental Protection. 2012. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients Adopted by the Florida Department of Environmental Protection in the Caloosahatchee Estuary Basin (Dec. 2012) at https://floridadep.gov/sites/default/files/caloosa-estuary-bmap-final-nov12.pdf.

[460] *See* Florida Department of Environmental Protection, Total Maximum Daily Load for Total Phosphorus Lake Okeechobee, Florida, 9-10 (Aug. 2001), available at https://floridadep.gov/sites/default/files/Lake_O_TMDL_Final.pdf. The TMDL sets a target 40 ppb concentration of phosphorous, which if achieved would significantly reduce the number of blooms from occurring. *See id*. at 30-33.

[461] *See* Florida Department of Environmental Protection. 2014. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Total Phosphorous by the Florida Department of Environmental Protection in Lake Okeechobee (Dec. 2014) at https://floridadep.gov/sites/default/files/LakeOkeechobeeBMAP.pdf.

[462] *See* Florida Department of Environmental Protection. 2014. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Total Phosphorous by the Florida Department of Environmental Protection in Lake Okeechobee (Dec. 2014) at https://floridadep.gov/sites/default/files/LakeOkeechobeeBMAP.pdf. Graham et al. (2015) contend that "all currently developed nutrient source control programs for the Lake Okeechobee watershed primarily focus on [phosphorus] reduction, but consideration should be given to nitrogen control as well because the ratios of these nutrients can yield variable effects on eutrophication of waterbodies and are particularly important in estuaries." Nitrogen loads to Lake Okeechobee measured between 2000-2014 ranged from 2,500 to 8,800 metric tons per year. Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 68.

The BMAP relies almost entirely on urban and agricultural BMPs and conservation programs to address nonpoint source pollution[463] despite a lack of data to quantify the effectiveness of these BMPs[464] and verifiable data that pollution reduction measures are being implemented as projected. The BMAP cites extensively to the use of BMPs in Appendix A to reduce phosphorus but Appendix A only contains lists of BMPs that entities "intend" to implement. There is no indication anywhere in the BMAP as to where, when, how, or why these BMPs are being implemented throughout the watershed.[465] In numerous instances where BMPs and other projects are considered for implementation, the costs, status, funding, and percentage of TP reductions are unknown.[466]

There is also no current modeling to identify sources of phosphorus and set appropriate loading estimates,[467] the land use data upon which the BMAP is based is a decade-old,[468] and there are no tracking and reporting requirements for urban nonpoint sources to confirm that pollution reduction requirements in the BMAP are being implemented.[469] The BMAP also relies on several unsupported assumptions. For example, the model's loading simulation assumes the implementation of common BMPs and general urban BMPs but it is unclear to what extent.[470] There is the "expectation" that MS4 permitted entities[471] are undertaking projects specified in the BMAP but there does not appear to be a reporting and tracking mechanism in place to verify

---

[463] *See* Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, p. 24.

[464] *See* Florida Department of Environmental Protection. 2014. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Total Phosphorous by the Florida Department of Environmental Protection in Lake Okeechobee, 13 (Dec. 2014) at https://floridadep.gov/sites/default/files/LakeOkeechobeeBMAP.pdf. It is estimated that the current BMP programs will remove approximately 32.8 metric tons of phosphorus per year but as Graham et al. (2014) explain, "these model predictions lack robust validation due to a dearth of data." Graham, W.D., et al. 2015, at 74. Under state law there is also a presumption of compliance with water quality standards so long as water quality monitoring is performed or a BMP is implemented, regardless of its actual effectiveness. *See* Douglas H. MacLaughlin, Will Basin Management Action Plans Restore Florida's Impaired Waters?, 89 Fla. B. J. 31 (Feb. 2015)(citing § 403.067(7)(c)3, Fla. Stat.).

[465] Lake Okeechobee BMAP at 37.

[466] *Id*. at 86.

[467] *Id*. at 23.

[468] *Id*. at 13; 42 (In the absence of outdated and at times incorrect land use data, DEP appears to rely on "local stakeholder knowledge and coordination" with FDACS to verify the category of agricultural activities and BMP implementation).

[469] *See* Lake Okeechobee BMAP at 27.

[470] *Id*. at 31.

[471] MS4s are stormwater systems that are not a combined sewer or part of a sewage treatment plant or publicly owned treatment works. These publicly owned systems collect or convey stormwater that discharge to waters of the United States. NPDES permits are required to prevent harmful pollutants from being washed or dumped into MS4s. Permit holders must develop stormwater management programs that describe stormwater control practices that will be implemented to minimize the discharge of pollutants. EPA, National Pollutant Discharge Elimination System (NPDES), Stormwater Discharges from Municipal Sources, at https://www.epa.gov/npdes/stormwater-discharges-municipal-sources.

compliance.[472] The BMAP further assumes that all agricultural lands are enrolled in the Florida of Department of Agricultural and Community Service's (FDACS) BMP program and these BMPs are being implemented,[473] despite the fact that a 2014 report by FDACS revealed that of the more than 4 million acres enrolled under the BMP program, the agency had only conducted 329 implementation site visits for 257,285 enrolled acres.[474]

The BMAP also lacks specific allocations to nonpoint source polluters[475], which arguably undermines the statutory mandate that these plans equitably allocate pollutant reductions between or *among* point and *nonpoint sources* to meet the TMDL.[476] In addition, the BMAP progress reports do not use readily available measured phosphorus loading data collected and reported by the South Florida Water Management District. Instead, they rely on computer simulations of best-case scenarios. This results in dramatic discrepancies between the BMAP loading estimate and the measured loads. For example, for the calendar year 2017, the annual BMAP report states that the loading was 812,623 pounds/yr.[477] while the measured 5-yr loading was 1,310,350 lbs/yr,[478] which is 60 percent greater than reported by the BMAP report. Despite the TMDL adopted by the state that specifically requires assessment of the TMDL be based on measured loads. In addition, the BMAP does not attempt to reconcile the significant discrepancies between their computer estimates of loading and the measured loading. Further, the BMAP ignores the phosphorus loading from over 800,000 acres (more than 20%) of the Lake Okeechobee Watershed.[479] The BMAP also fails to account for the vast tonnage of nutrients being imported into the watershed from Class AA biosolids.[480] The BMAP does not evaluate loading trends – but rather, adopts a "wait and see" approach that can only begin to make necessary corrections every 5-10 years – way too late to be effective.

---

[472] *See* Lake Okeechobee BMAP at 24.
[473] Lake Okeechobee BMAP at 42.
[474] Douglas H. MacLaughlin, *Will Basin Management Action Plans Restore Florida's Impaired Waters?*, 89 Fla. B. J. 31 (Feb. 2015) (citing Florida Department of Agriculture and Consumer Services, Office of Agriculture Water Policy, 2013-2014 Report on the Implementation of Agricultural Best Management Practices, iv, Figure 1).
[475] The 140 MT/year total phosphorous standard is allocated to the entire Lake Okeechobee watershed, which consists of 9 sub-watersheds. Currently, there are no sub-watershed expectations in the BMAP. *See also* Douglas H. MacLaughlin, *Will Basin Management Action Plans Restore Florida's Impaired Waters?*, 89 Fla. B. J. 31 (Feb. 2015)(explaining this statutory requirement).
[476] *See* § 403.067(6)(b), Fla. Stat.
[477] Florida Department of Environmental Protection. 2018. Florida Statewide Annual Report on Total Maximum Daily Loads, Basin Management Action Plans, Minimum Flows or Minimum Water Levels, and Recovery or Prevention Strategies, June 2018, Appendix A: Northern Everglades and Estuaries Protection Program (NEEP) BMAPs, at 18.
[478] The data analysis relied on spreadsheets constructed by the South Florida Water Management District using Microsoft Excel. Digital File: LakeO_WY2018_Flow_TP_TN.xlsx; Digital File: LakeO_montly_tp_tn_cfs_72to17 original from SFWMD.
[479] *See generally,* Lake Okeechobee BMAP.
[480] *Id.*

The adaptive management process further lacks procedures for corrective measures if BMPs are underperforming. The process appears to begin and end with meetings and discussions.[481] The BMAP identifies "potential" funding sources but the BMAP does not explain how, when, and where these funds will be obtained and applied towards reducing total phosphorus in the watershed.[482] The University of Florida Water Institute recently examined the Lake Okeechobee TMDL and BMAP in an independent technical review commissioned by the Florida Senate.[483] As Graham et al. (2015) report, since 1974, annual total phosphorus loads to Lake Okeechobee have exceeded 500 metric tons nearly 50% of the time.[484] Averaged over the 41-year period of record, the annual phosphorus load is approximately 3.6 times the annualized TMDL.[485] Thus, annual average phosphorus loads will have to be reduced by more than 350 metric tons per year to meet the current TMDL for the Lake.[486] The study found that the current efforts to achieve the Lake Okeechobee TMDL "have proven inadequate" and additional controls, such as flow equalization basins, storage treatment areas, and "aggressive BMPs" that include in-situ immobilization of legacy phosphorus by chemical amendments, will be needed to meet TMDL targets."[487] New field-verified agricultural and urban Best Management Practices (BMPs) that protect water quality, advance in situ treatment technologies, and the strategic placement of additional FEB-STAs in priority basins will be essentials to achieve State and Federal water quality standards.[488] Beyond these approaches, the substantial amount of legacy phosphorus in the Northern Everglades watersheds "will necessitate new and more aggressive strategies to combat the mobility of phosphorus."[489]

The BMAPs for the Caloosahatchee and St. Lucie rivers and estuaries suffer from many of the same defects. The vast majority of nutrient loading into the Caloosahatchee estuary comes from freshwater flows from Lake Okeechobee and the Caloosahatchee basin upstream of Control Structure S-79 (Franklin Lock and Dam). In fact, the Caloosahatchee BMAP "recognizes that approximately 85% of the total current loading of TN comes from sources upstream of S-79 and that reduction of loads from the watershed below S-79 alone will not result in the restoration of the Estuary," yet these sources are not addressed in this BMAP.[490] In other words, only 15% of

---

[481] *Id*. at 72.
[482] *Id*. at 139.
[483] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute.
[484] *Id*. at 63.
[485] *Id*. at 63-64.
[486] *Id*. at 64.
[487] *Id*.
[488] *Id*. at 7.
[489] *Id*. at 131.
[490] Florida Department of Environmental Protection. 2012. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients Adopted by the Florida Department of Environmental Protection in the Caloosahatchee Estuary Basin (Dec. 2012) at https://floridadep.gov/sites/default/files/caloosa-estuary-bmap-final-nov12.pdf.

the TN impacting the Caloosahatchee are the focus of the BMAP. The BMAP states that the other 85% will be addressed through "other efforts". Since the BMAP was finalized seven years ago, the Department has not clearly identified these "other efforts" (much less established any other TMDLs to address upstream TN sources) and the BMAP boundaries have not expanded upstream of the S-79.[491] As for the St. Lucie Estuary BMAP, the plan inexplicably excludes the significant nutrient load contained in the releases from lake Okeechobee.[492] The BMAP assumes Lake Okeechobee loads to the Caloosahatchee and the St. Lucie are addressed by the Lake Okeechobee BMAP and that the targets have been met.[493] As a result, the shortcomings of the Lake Okeechobee BMAP "have even more substantial consequences for the Caloosahatchee River and St. Lucie River estuaries."[494]

In short, transparency and accountability are sorely missing from the Lake Okeechobee, Caloosahatchee, and St. Lucie River TMDLs,[495] the state's reliance on existing BMPs will not achieve phosphorus and nitrogen loading targets,[496] and the TMDLs lack "reasonable

---

[491] *See* Florida Department of Environmental Protection. 2017. Five-Year Review of the Caloosahatchee Estuary Basin Management Action Plan (Dec. 2017), at http://publicfiles.dep.state.fl.us/DEAR/DEARweb/BMAP/Caloosahatchee%20Estuary%20Basin/Caloosahatchee%205-Year%20Review_v2.pdf.

[492] *See* Florida Department of Environmental Protection. 2013. Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients and Dissolved Oxygen by the Florida Department of Environmental Protection in the St. Lucie River and Estuary Basin.

[493] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 79, 84.

[494] *Id*. at 84.

[495] Comparatively, several mid-Atlantic states and the District of Columbia have developed a TMDL for the Chesapeake Bay that is built upon a framework of accountability and transparency, with multiple on-line resources and tools the public can use to track and evaluate its progress. EPA, Chesapeake Bay TMDL, at https://www.epa.gov/chesapeake-bay-tmdl. This "pollution diet" for the Bay establishes allocations among different kinds of sources, a timetable for action, and "reasonable assurances" that it will be implemented. *See generally* Envtl. Prot. Agency, Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorous, and Sediment, U.S. Envtl. Prot. Agency (2010). The Chesapeake Bay TMDL may provide the most promising steps towards recovery to date. *See, generally*, David K. Mears and Rebecca A. Blackmon, *The Evolution of the TMDLs: Lessons for Lake Champlain from Chesapeake Bay: Returning Both Waters to the "Land of Living,"* 17 Vt. J. Envtl. L. 564, 567 (Spring, 2016) Jamison E. Colburn, *Coercing Collaboration: The Chesapeake Bay Experience*, 40 Wm. & Mary Envtl. L. & Pol'y Rev. 677 (2016); Oliver Houck, *The Clean Water Act Returns (Again): Part I, TMDLs and the Chesapeake Bay*, 41 Envtl. L. Rep. 10208 (2011). Like the Chesapeake Bay TMDL, the Lake Champlain TMDL includes pollution allocations among the various sources, a timetable for achieving the required reductions in the pollutant load, and reliance upon phased implementation plans developed by the state of Vermont to address both point and nonpoint sources. Mears and Blackmon, at 585 (citing Phosphorus TMDLs for Vermont Segments of Lake Champlain, at chs. 6-8).

[496] *See* Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 64. State leaders have also questioned the effectiveness of BMPs to prevent nutrient pollution that leads to harmful algal blooms. In Ohio, Governor Kasich's administration recently stated that it cannot rely only on voluntary programs to stop algal blooms from harming Lake Erie. *See* Seewer, J. 2018. "Plan to fight Lake Erie's algae would force changes on farms," AP, March 23, 2018, at https://www.apnews.com/e9fe6f229ea5402b9ce4190bff9efdb9.

assurances" that the State is able to sufficiently reduce nutrient pollution.[497] A far more robust and comprehensive approach to reducing pollution is needed to stop the proliferation of HABs and achieve the goal of restoring these watersheds.[498] The state must establish specific allocations amongst nonpoint sources in sub-basins, require more rigorous BMPs, and develop phased implementation plans with enforceable "back-stops" if pollution goals are not achieved.[499] There has been no indication from DEP or the state legislature than any improvements to the way the state addresses nonpoint source pollution are on their way anytime soon.

3. The Inadequacy of Storage Options Coupled with State Regulatory Failures Pose a Continued Threat to Water Quality in the Lake and Estuaries

Unless aggressive measures are taken to reduce nonpoint source pollution and significantly increase the amount of storage north, south, east, and west of the lake, water quality problems will undoubtedly continue. The water in Lake Okeechobee is extremely polluted containing not only high amounts of nutrients but also other harmful constituents such as fecal coliform. In addition to fueling the proliferation of cyanotoxins, the discharges result in an unnatural salinity regime, which causes the formation of thick deposits of mud and silt that covers vast areas of the St. Lucie estuary preventing light penetration to aquatic vegetation. This leads to the loss of thousands of acres of seagrass beds and immensely important fish nurseries and oyster beds.[500] The lack of dry-season flows in the Caloosahatchee has resulted in multiple violations of the MFL resulting in hypersaline conditions and the loss of important submerged aquatic vegetation., Given these challenges and the Corps' stated intent to take a more holistic "system" based approach to managing Lake Okeechobee, the Corps should consider a range of reasonable alternatives to address water quality concerns. These alternatives could include conveying water to areas where it can be stored, treated and conveyed using natural wetlands and in a manner that mimics historical conditions.

---

[497] EPA guidance on TMDLs has long required "reasonable assurances that non-point source reduction will in fact be achieved." *See* EPA, Guidance for Water-Quality Based Decisions: The TMDL Process 7 (Apr. 1991).

[498] *See* Douglas H. MacLaughlin, *Will Basin Management Action Plans Restore Florida's Impaired Waters?*, 89 Fla. B. J. 31 (Feb. 2015) (discussing the short comings of the state's BMAPs). To further reduce pollutant loads, and more fairly and equitably address the responsibilities of those discharging into impaired water bodies, MacLaughlin recommends performing a comprehensive evaluation to make sure that all dischargers are fully complying with all applicable water quality programs, writing BMAPs as enforceable orders, identifying specifically what is to be done, setting specific deadlines, and noting the consequences for not complying with the BMAP, and more fully addressing agricultural discharges to impaired waters, since these are the leading sources of water quality impacts on lakes and rivers. *Id.*

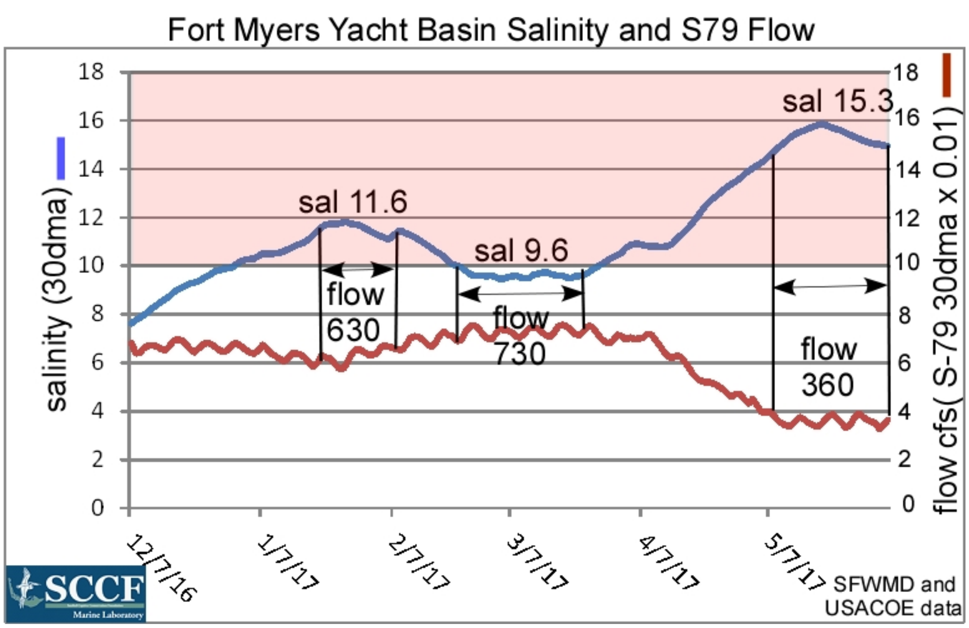
[499] *See* Envtl. Prot. Agency, Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorous, and Sediment, U.S. Envtl. Prot. Agency (2010), at https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-tmdl-document.

[500] See SFWMD, Lake Okeechobee Plan, Appendix A, Performance Measure Fact Sheets.

F. Caloosahatchee MFL is a Significant Factor the Corps Must Consider

MFLs are defined as the minimum flows or minimum water levels, adopted by the District Governing Board pursuant to Sections 373.042 and 373.0421, Florida Statutes, at which further withdrawals would be significantly harmful to the water resources or ecology of the area. A SFWMD Minimum Flow and level rule (F.A.C. Chapter 40E-8.221) was adopted for the Caloosahatchee Estuary in September, 2001. According to the 2001 MFL rule, an exceedance was defined as occurring when the 30-day average salinity concentration exceeds 10 parts per thousand at the Ft. Myers salinity station or when a single, daily average salinity exceeds a concentration of 20 parts per thousand at the Ft. Myers salinity station. Exceedance of either exceedance criteria for two consecutive years is a violation of the MFL and the definition of significant harm.

SFWMD revised the Caloosahatchee Estuary MFL in 2018 and adopted the revised rule in 2019. For the revised rule, A MFL exceedance occurs during a 365-day period when the 30-day moving average flow at S-79 is below 400 cfs and the 30-day moving average salinity exceeds 10 at the Ft. Myers salinity monitoring station (located at latitude 26° 38’ 57.84” N, longitude 81° 52’ 5.68” W). The revision of the flow rate from 300 to 400 cfs at S79 was considered controversial as flows measured by the Sanibel Captiva Conservation Foundation of 650 cfs at S-79 were not sufficient to keep the salinity at Fort Myers within the 10 psu maximum salinity.



However, the SFWMD modeled the C-43 reservoir performance and under the future condition, the without project scenario showed the minimum flow of 400 cfs was only met 78.5% of the time. Under the project (C-43 Reservoir) scenario the minimum flow target of 400 cfs was met 97.8% of the time.[501]

These performance data with respect to the revised MFL of 400 cfs at the Franklin Lock should not be thought of as a restoration target but rather the minimum flow needed to prevent significant harm. As cited earlier, 450,000 acre feet of storage is estimated to meet the estuary annual restoration target with only 170,000 acre feet planned.

The more recent SFWMD MFL model estimates on C-43 performance used the assumption that supplemental flows from Lake Okeechobee would not be available, whereas the earlier modeling done as part of the 2010 PIR estimated the needed estuary demand of 160,000 acre-feet at least 10 percent of the time to approximately 27,600 ac-ft 90 percent of the time, with a median value of approximately 106,000 ac-ft per year in addition to supplemental flows. This discrepancy in assumptions about C-43 performance could have underestimated estuary demand by the 2018 MFL modeling if supplemental flows were not available and may account for the discrepancy between the MFL modeled and observed flow-salinity relationship.

Despite a potentially improved regional system of federal and state projects aimed at restoring the greater Everglades ecosystem, less water will be available for maintaining the MFL for the Caloosahatchee Estuary "*Future land use changes along with CERP/CEPP projects reduce the amount of water being sent to the estuary.*"[502] This is a concern if a final LOSOM outcome reduces or eliminates supplemental flows to the Caloosahatchee Estuary, especially if C-43 Reservoir performance has been overestimated.

IV. The Corps Must Consider a Broad Range of Alternatives

The Corps states that in developing LOSOM, it "will not propose water quality improvement features, nor propose new infrastructure beyond evaluation of already authorized projects," but does not cite authority for why it would be limited in this way.[503]

It further describes the goals of LOSOM as to:[504]

(1) reduce undesirable releases to the Northern Estuaries and increase [the] number of times Caloosahatchee minimum flows and levels are met.
(2) Improve ecology of Lake Okeechobee.
(3) Increase water supply for the environment and existing legal users.

[501] SFWMD. 2018. Technical Document to Support Reevaluation of the Minimum Criteria of the Minimum Flow for the Caloosahatchee River Estuary, Final Report, January 30, 2018.
[502] *Id*.
[503] Corps 2022 Factsheet.
[504] *Id*.

(4) Ensure that all dam safety requirements are met.

Therefore, we offer the following alternatives, or elements of LOSOM for the Corps to consider in creating and implementing LOSOM.

A. Comprehensive Everglades Restoration Plan

1. C-43 Reservoir

The C-43 West Basin Reservoir (C-43) is a major component of CERP, which was approved by Congress as the Framework for Everglades Restoration funded through the Water Resources Development Act of 2000. The Corps is the Federal Sponsor and the SFWMD is the Non-Federal Sponsor. The Final Caloosahatchee River (C-43) West Basin Storage Reservoir Project Implementation Report (PIR) recommends 170,000 ac-ft of storage on approximately 10,700 ac with pump capacity of 1,500 cfs. Alternative 3B consists of two cells and associated features totaling approximately 10,700 acres providing a normal maximum storage capacity of approximately 170,000 ac-ft surrounded by a perimeter embankment and canals. The project will provide approximately 170,000 acre-feet (ac-ft) of above-ground storage volume in a two-cell reservoir with normal pool depths when the reservoir is full varying from 15 feet at the southeast corner to 25 feet at the northwest corner. To address changing conditions, concerns and issues which have arisen since the Restudy analysis of the Caloosahatchee River Watershed, it is recommend that project use an Incremental Adaptive Restoration approach of two PIRs, in which the first PIR, the Caloosahatchee River (C-43) West Basin Storage Reservoir will address the most immediate needs of the estuary, while ensuring that it is fully compatible and consistent with the CERP. The second PIR would be a more comprehensive study that could provide a complete solution to addressing the broader needs of the entire basin.[505]

While CERP is an important part of reducing HAB discharges to the estuaries and Everglades restoration, C-43 will not be sufficient to reduce discharges. The C-43 Reservoir will only capture some of the runoff discharging into the Caloosahatchee during high flow times, but will be 10 percent at most. Likewise, the Central Everglades Project will help establish a portion of the pathway needed to move more water south but will not be able to do so at the rate needed to stop the harmful discharges until the bottleneck in the EAA is addressed.[506] Furthermore, the

[505] Corps. 2010. C-43 PIR 2010. CENTRAL AND SOUTHERN FLORIDA PROJECT, COMPREHENSIVE EVERGLADES RESTORATION PLAN CALOOSAHATCHEE RIVER (C-43) WEST BASIN STORAGE RESERVOIR PROJECT, FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT, November 2010.

[506] University of Florida. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades: An Independent Technical Review by the University of Florida Water Institute. http://waterinstitute.ufl.edu/research/downloads/ontract95139/UF%20Water%20Institute%20Final%20Report%20March%202015.pdf.

water will need to meet the Water Quality Based Effluent Limitation to be moved into Everglades National Park and Florida Bay which will involve additional pollution controls.[507]

Currently, there is not enough storage capacity in the regional water management system to minimize or prevent the possible harmful effects of periodic high volume discharges of freshwater to the Caloosahatchee Estuary. Conversely, during dry periods, there is sometimes not enough freshwater available in the regional system to maintain desirable salinity levels in the estuary. The combined result of too much and too little freshwater flowing to the Caloosahatchee Estuary is a degraded estuarine ecological community, characterized by declines in the abundance and diversity of native finfish and shellfish populations and other marine and estuarine species, poor water quality, and reductions in the extent of submerged habitat suitable for sea grass and oysters (two primary indicators of healthy estuarine communities in south Florida) and other higher trophic level species, including threatened and endangered species (e.g., manatees, wood storks).[508]

C-43 addresses the need to restore the ecosystem function in the Caloosahatchee Estuary by reducing the number and severity of events where harmful amounts of freshwater from basin runoff and Lake Okeechobee releases are discharged into the estuary system. The project also helps to maintain a desirable minimum flow of fresh water to the estuary during dry periods. These two primary functions help to moderate unnatural changes in salinity which is extremely detrimental to estuarine communities.[509]

The environmental needs of the Caloosahatchee Estuary have been estimated at 400 MGD (450,000 ac-ft/yr) while average flows to the estuary are estimated to be approximately 580 MGD (650,000 ac-ft/yr. Flow to the estuary in excess of the needs can, therefore, be as high as 180 MGD (200,0000 ac-ft/yr) on average[510]

Since the estuarine system does not need additional fresh water during periods of excess flow, the analysis of water made available focused on the additional water delivered from the reservoir to the Caloosahatchee River and Estuary during periods when additional flows are needed to

---

[507] EPA 2010 Amended Determination to Restore Water Quality to the Everglades. https://www.epa.gov/sites/production/files/2014-01/documents/1-ad-final-version-09-03-10.pdf.

[508] Corps. 2010. C-43 PIR 2010. CENTRAL AND SOUTHERN FLORIDA PROJECT, COMPREHENSIVE EVERGLADES RESTORATION PLAN CALOOSAHATCHEE RIVER (C-43) WEST BASIN STORAGE RESERVOIR PROJECT, FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT, November 2010.

[509] Corps. 2010. C-43 PIR 2010. CENTRAL AND SOUTHERN FLORIDA PROJECT, COMPREHENSIVE EVERGLADES RESTORATION PLAN CALOOSAHATCHEE RIVER (C-43) WEST BASIN STORAGE RESERVOIR PROJECT, FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT, November 2010.

[510] SFWMD September 2000. Technical Documentation to Support Development of Minimum Flows and Levels for the Caloosahatchee River and Estuary, South Florida Water Management District, Water Supply Division, September 6, 2000 Draft; SFWMD April 2000 Caloosahatchee Water Management Plan Appendix (K).

meet estuary flow targets. The additional water delivered from the reservoir to meet estuary flow targets (as measured by flows at the S-79 structure over the period of analysis) ranged from approximately 160,000 ac-ft at least ten percent of the time to approximately 27,600 ac-ft 90 percent of the time, with a median value of approximately 106,000 ac-ft per year.[511]

2. Herbert Hoover Dike

While reinforcing the dike is necessary to protect public health and safety, it will not greatly increase the storage capacity of the lake, because lake levels are also limited by the impact of raising lake levels above 15.5 feet on lake vegetation and the cascading effect that would have on water quality, algae blooms, and other ecological impacts.[512] As previously explained above, the failure to meet past HHD repair deadlines should preclude the Corps from relying on those promised repairs for implementing elements of LOSOM.

B. Dry Season Schedule

Florida has two distinct climatic seasons – the rainy season (June - October) and the dry season (November – May).[513] High-volume discharges during the rainy season and associated harmful algal blooms, as discussed previously, have significant negative impacts on salinity, water quality, wildlife, human health, and the economy. Conversely, dry season impacts to the Caloosahatchee from the current LORS operations are also extremely damaging to the river and estuary. High salinity conditions as a result of insufficient freshwater flow can destroy submerged aquatic vegetation beds and kill oysters, in addition to damaging other aquatic resources.[514] Over the past two decades, flows to the estuary have been less than the currently established target 28% of the time.[515] Moreover, the current flow targets are shown by recent monitoring data to be insufficient to maintain downstream salinity levels,[516] compounding the harm caused by inadequate freshwater releases. There are a number of factors that have contributed to this situation, including lack of watershed storage capacity and over-allocation of available water through consumptive use permits, in addition to LORS management decisions.

---

[511] Corps. 2010. C-43 PIR 2010. CENTRAL AND SOUTHERN FLORIDA PROJECT, COMPREHENSIVE EVERGLADES RESTORATION PLAN CALOOSAHATCHEE RIVER (C-43) WEST BASIN STORAGE RESERVOIR PROJECT, FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT, November 2010.
[512] SFWMD. 2010. Final Adaptive Protocols for Lake Okeechobee Operations. http://www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/ap_lo_final_20100916.pdf; UF 2015.
[513] https://apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/2019_sfer_highlights_hr.pdf.
[514] https://www.sfwmd.gov/sites/default/files/documents/ne_crwpp_main_123108.pdf.
[515] Graham 2015.
[516] SCCF monitoring data.

1. Codify Operational Flexibility

The Corps has been utilizing operational flexibility since late 2018 to provide higher flows than LORS generally calls for during the dry season to the Caloosahatchee, and has also taken steps to keep releases to the St. Lucie to a minimum.[517] As a result, the Caloosahatchee has seen better dry season salinity regimes in the estuary. LOSOM should ensure that additional operational flexibility is a readily available tool for future Lake Okeechobee management decisions. Additional operational flexibility during the dry season will also benefit Lake management/health and the estuaries during the rainy season. The management decisions that have proved effective during this current dry season with the use of operational flexibility should be modeled and included in the suite of alternatives for LOSOM.

2. Adopt Performance Measures

The Corps should include in the modelling of alternatives and LOSOM outcomes appropriate performance measures for the Caloosahatchee estuary. For example, performance measures - including flow targets – should be set that achieve the downstream salinity targets based on measured data and ecosystem responses. Measured data indicate flows in the range of 800-1,000 cfs are optimal for the Caloosahatchee.[518] Flows in this range have been further confirmed as appropriate performance measures during the Army Corps' current use of operational flexibility.

3. Shared Adversity

During dry or drying conditions and in the low band, releases to the Caloosahatchee are often cut off before any other users, resulting in too high of salinity levels in certain areas of the system. The Army Corps should reevaluate triggers for allowable releases to the estuaries and remove language stating that very dry conditions may require releases to be discontinued.

4. Flow Measurement Locations

Currently, Caloosahatchee flow measurements are taken at two structures in the river: either at Moore Haven Lock (S-77) or the Franklin Lock and Dam (S-79) based on various conditions. During times when flows are measured at S-77, the vast upper Caloosahatchee watershed runoff input is not captured and does not consider the actual flow rates reaching the estuary. Conversely, in the St. Lucie, all flows are measured at the S-80 lock (at the estuary boundary), regardless of lake, meteorological, or other conditions. LOSOM should adopt the same practice for the Caloosahatchee and measure flows consistently at S-79.

[517] https://www.saj.usace.army.mil/Media/News-Releases/Article/1672591/corps-to-maintain-flows-from-lake-okeechobee/.
[518] SCCF monitoring data.

C. Cyanobacteria Limits

The damaging discharges from Lake Okeechobee in 2005, 2008, 2013, 2016, and 2018 had a significant impact on the ecology of the northern estuaries and inflicted significant economic losses in commercial fishing, recreation tourism, and the real estate sectors.[519] Cyanotoxins produced by harmful blue green algae blooms have killed family pets,[520] forced local businesses to close,[521] and diminished waterfront property values.[522] Scientists have expressed increasing concern about the long-term health effects of families being exposed to cyanotoxins in Florida's waters.[523] The Corps must identify alternatives that would reduce the amount of cyanotoxins forming in the Lake and being discharged into the coastal estuaries.

The EPA has stated, "Nutrient pollution of water is one of America's most widespread, costly and challenging environmental problems, caused by excess nitrogen and phosphorus in the air and water. More than 100,000 miles of rivers and streams, close to 2.5 million acres of lakes, reservoirs and ponds, and more than 800 square miles of bays and estuaries in the United States have poor water quality because of nitrogen and phosphorus pollution."[524] According to a 2012 EPA study, approximately 35% of lakes have excessive levels of total nitrogen and 40% of lakes have excessive levels of total phosphorus.[525] In 2015, EPA Administrator Gina McCarthy remarked, "Nutrient pollution and harmful algal blooms are among America's most serious and growing environmental challenges."[526]

Nutrient over-enrichment is a key environmental driver that influences the proportion of cyanobacteria in the phytoplankton community, the cyanobacterial biovolume, cyanotoxin

---

[519] South Florida Water Management District. 2018. Central Everglades Planning Project Post Authorization Change Report: Feasibility Study and Draft Environmental Impact Statement. (SFWMD 2018b).

[520] Treadway, T. 2016. Toxic algae killed east coast dog after contact with St. Lucie River, owner says necropsy reveals, TC Palm (Sept. 17, 2018) at https://www.naplesnews.com/story/news/environment/2018/09/17/report-shows-dog-killed-toxic-blue-green-algae-st-lucie-river/1339559002/.

[521] *See* Hagan, Alex. 2018. Stuart business owner: 'Algae killed us,' Jul. 3, 2018, WPTV, at https://www.wptv.com/news/region-martin-county/stuart-business-owner-algae-killed-us-.

[522] *See* Ruane, Laura. 2018. Florida's algae crisis and lingering red tide hurt waterfront home sales, Jul. 13, 2018. Fort-Myers News Press, at https://www.news-press.com/story/news/2018/07/13/floridas-algae-crisis-and-lingering-red-tide-hurt-home-sales/769673002/.

[523] *See, e.g.,* Metcalf, J., S.A. Banack, J.T. Powell, F.J.M. Tymm, S.J. Murch, L.E. Brand, L.E., and P.A. Cox. 2018. Public health responses to toxic cyanobacterial blooms: perspectives from the 2016 Florida event, Water Policy 20 (5): 919-932.

[524] EPA, EPA Issues Health Advisories to Protect Americans from Algal Toxins in Drinking Water (May 6, 2015), at https://archive.epa.gov/epa/newsreleases/epa-issues-health-advisories-protect-americans-algal-toxins-drinking-water.html.

[525] Congressional Research Service, *Freshwater Harmful Algal Blooms: Causes, Challenges, and Policy Considerations* (Aug. 20, 2018) (citing EPA, National Lakes Assessment 2012: A Collaborative Survey of Lakes in the United States, EPA 841-R-16-113, December 2016).

[526] EPA, EPA Issues Health Advisories to Protect Americans from Algal Toxins in Drinking Water (May 6, 2015), at https://archive.epa.gov/epa/newsreleases/epa-issues-health-advisories-protect-americans-algal-toxins-drinking-water.html.

production, and the impact that cyanobacteria may have on ecosystem function and water quality.[527] Loading of nitrogen and/or phosphorus to water bodies from agricultural, industrial, and urban sources affects the development of cyanobacterial blooms and are associated with cyanotoxin production.[528]

As EPA explained in a 2016 memorandum to state environmental protection agencies and water managers, nutrient pollution is contributing to an increasing trend in observed HABs in surface waters across the nation.[529] According to the agency, studies strongly suggest that "reductions in nutrient pollution are needed to stem eutrophication and cyanobacterial bloom expansion."[530] Unfortunately, states across the country have been unable to effectively manage nutrient pollution, particularly from agriculture.[531]

The State has long been aware of the problem of nonpoint source pollution and the increasing threats posed by HABs. In 2008, the Department remarked:

> Freshwater harmful algal blooms (HABs) are increasing in frequency, duration, and magnitude and therefore may be a significant threat to surface drinking water resources and recreational areas. Abundant populations of blue-green algae, some of them potentially toxigenic, have been found statewide in numerous lakes and rivers. In addition, measured concentrations of cyanotoxins – a few of them of above the suggested guideline levels-have been reported in finished water from some drinking water facilities.[532]

In 2010, the Department similarly stated:

> Nutrient loading and the resulting harmful algal blooms continue to be an issue. The occurrence of blue-green algae is natural and has occurred throughout history; however, algal blooms caused by nutrient loading from fertilizer use,

[527] EPA 2016 at 17.
[528] *Id.*
[529] EPA. 2016. Memorandum from Joel Beauvais, Deputy Assistant Administrator to State Environmental Commissioners, State Water Directors, "Renewed Call to Action to Reduce Nutrient Pollution and Support for Incremental Actions to Protect Water Quality and Public Health", p. 2 (Sept. 22, 2016).
[530] EPA 2016 at 18.
[531] *See* James S. Shortle et. al., *Reforming Agricultural Nonpoint Pollution Policy in an Increasingly Budget-Constrained Environment*, 46 Envtl. Sci. & Tech. 1316, 1316 (2012)("It has been well established that agricultural [nonpoint source pollution] policies are not having the desired outcomes."); State-EPA Nutrient Innovations Task Group, *An Urgent Call to Action: Report of the State-EPA Nutrient Innovations Task Group* 1 (2009).
[532] Florida Department of Environmental Protection. 2008. Integrated Water Quality Assessment for Florida: 2008 305(b) Report and 303(d) List Update, p. 67.

> together with a growing population and the resulting increase in residential landscapes, are an ongoing concern.[533]

Unsurprisingly, nutrient pollution, especially phosphorus and nitrogen, continues to plague Florida's waters. According to a 2018 report prepared by the Department, of the 4,393 waterbody segments assessed in the state, 2,440 were impaired.[534] Of these impaired waters, 1,893 segments required a TMDL.[535] "The most frequently identified causes of impairment include dissolved oxygen (DO), fecal coliform, and nutrients."[536] The major sources of nitrogen and phosphorus pollution are generally the same as those found nationally: urban and suburban stormwater runoff, wastewater discharges, row crop agriculture, livestock production, and atmospheric deposition.[537] This pollution is fueled by an ever increasing population.[538]

The ill effects of nutrient pollution are perhaps most evident in Florida's largest freshwater lake-Lake Okeechobee. As Graham et al. (2015) explain, for the past several decades phosphorus imported into the basin, primarily to improve agricultural production, has largely accumulated in soils and sediments. In addition, legacy phosphorus has become a constant source of additional phosphorus loading to the lake and estuaries. These increased phosphorus loads have accelerated the eutrophication process across the south Florida landscape.[539]

The situation appears to be only getting worse. A 2014 environmental report prepared by the SFWMD revealed that the five-year phosphorus load was 451 metric tons, which is 311 metric tons or 322% of the water quality goal of 140 metric tons per year.[540] The amount of phosphorus loading since then has only increased. The most recent 5-year average annual load of total phosphorus to Lake Okeechobee (2014-2018) is 633 metric tons per year.[541] The majority of these nutrients entered the watershed from agricultural and urban sources. There have been no significant reductions in phosphorus loading in many of the Okeechobee sub-watersheds,[542]

---

533 EPA, Water Quality Standards for the State of Florida's Lakes and Flowing Waters; Final Rule, 75 Fed. Reg. 75762, 75769 (Dec. 5, 2010) (citing Florida Department of Environmental Protection. 2010. Integrated Water Quality Assessment for Florida: 2010 305(b) Report and 303(d) List Update) (emphasis added).

534 Florida Department of Environmental Protection. 2018. Final Integrated Water Quality Assessment for Florida: 2018 Sections 303(d), 305(b), and 314 Report and Listing Update, p. 17.

535 *Id.*

536 *Id.*

537 *See* Environmental Protection Agency, Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters, Proposed Rue, 77 Fed. Reg. 74924, 74930 (Dec. 18, 2012).

538 *Id.*

539 Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 63.

540 SFWMD South Florida Environmental Report 2014. Pg. 8-3, 8-34, 8-35 at http://apps.sfwmd.gov/sfwmd/SFER/2014_SFER/v1/chapters/v1_ch8pdf.

541 SFWMD. 2019. South Florida Environmental Report, 8B-7.

542 SFWMD South Florida Environmental Report 2011, Pg. 10-49 at http://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_sfer/portlet_prevreport/2011_sfer/v1/chapters/v1_ch10.pdf.

despite several phosphorus reducing projects.[543] The Lake has been a net sink, with more phosphorus entering the lake than leaving it.[544] As the SFWMD summarized in its 2011 environmental report, "more aggressive nutrient control measures still need to be implemented in all the surrounding basins that discharge to the lake in order to reach the lake's [Total Maximum Daily Load] TMDL goal of 140 mt of phosphorus per year."[545]

Although phosphorus has long been considered the primary limiting nutrient for HABs in freshwater systems[546] reducing phosphorus alone may not be an adequate strategy for many surface waters.[547] HABs may proliferate in response to combined phosphorus and nitrogen additions, or in some instances, only the addition of nitrogen.[548] Microcystis, for example, cannot fix atmospheric nitrogen and requires combined nitrogen sources for growth.[549] Increased usage of nitrogen fertilizers, urban and agricultural nitrogen wastes, and atmospheric nitrogen deposition have increased bioavailable nitrogen in receiving waters.[550] In addition to phosphorus, nitrogen is being delivered to Lake Okeechobee and the loading rates are highly correlated.[551] The total nitrogen load average is 6,772 tons- a 470-ton increase from the average for WY2013-WY2017.[552] External nitrogen input can be "a key driver" of eutrophication and *Microcystis* can dominate in areas despite phosphorus focused controls.[553] Thus, management of phosphorus loading alone may not be enough to control the growth and/or toxicity of cyanobacteria such as microcystis.[554]

Increased nitrogen loading may also be contributing to the increased frequency of red tides in Florida. Brand and Compton (2007) examined data on *K. brevis* along the southwest coast of

---

[543] NAS Report at 115.
[544] *Id.*
[545] *Id*. at 10-48.
[546] Gobler, C.J., J.M. Burkholder, T.W. Davis, M.J. Harke, T. Johengen, C. Stow, and D.B. Van de Waal. 2016. The dual role of nitrogen supply in controlling the growth and toxicity of cyanobacterial blooms, Harmful Algae, 54: 87-97; Paerl, H.W., W.S. Gardner, M.J. McCarthy, B.L. Peierls, and S.W. Wilhelm. 2014. Letters, Algal blooms: noteworthy nitrogen, Science, 346: 175, DOI: 10.1126/science.346.6206.175-a.
[547] *Id.*
[548] *Id.*
[549] *Id.*
[550] *Id.*
[551] Graham, W.D., et al. 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute, at 63.
[552] *See* SFWMD. 2019. South Florida Environmental Report, 8B-7 (documenting a 7% increase in TN loading for WY2014-WY2018).
[553] Paerl Paerl, H.W., W.S. Gardner, M.J. McCarthy, B.L. Peierls, and S.W. Wilhelm. 2014. Letters, Algal blooms: noteworthy nitrogen, Science, 346: 175, DOI: 10.1126/science.346.6206.175-a.
[554] Gobler, C.J., J.M. Burkholder, T.W. Davis, M.J. Harke, T. Johengen, C. Stow, and D.B. Van de Waal. 2016. The dual role of nitrogen supply in controlling the growth and toxicity of cyanobacterial blooms, Harmful Algae, 54: 87-97.

Florida from 1954 to 2002.[555] They hypothesized that greater nutrient availability in the ecosystem is most likely the cause of an increase in *K. brevis* biomass.[556] A large increase in human population and associated activities (e.g. more sewage, more disturbance of terrestrial and wetland ecosystems that sequester nutrients, and more land surface runoff) in South Florida over the past fifty years is a major factor.[557] Brand and Compton estimated the total amount of nitrogen available to phytoplankton in the Caloosahatchee and Peace Rivers is approximately two to three times larger than just the inorganic nitrogen (which is produced from river flow for example).[558] They opined that a combination of river flow, non-point source inputs, and groundwater provide sufficient nutrients to generate the *K. brevis* blooms that have been observed inshore.[559]

The EPA has recognized the role both nitrogen and phosphorus play in HABs and the agency has identified the need for both nitrogen and phosphorus criteria to help prevent eutrophication and the proliferation of HABs.[560] The Department and the Florida Fish and Wildlife Conservation Commission (FWC) also recently identified the importance of limiting nutrient pollution to prevent toxic red tide and cyanobacteria blooms.[561]

D. Everglades Action Area

Multiple studies have highlighted the need to use land, enough to store at least 1.2 million acre-feet of water, to provide the necessary storage, conveyance and treatment to divert harmful discharges.[562] Further, several elements of the original CERP have been determined to be infeasible creating storage needs that were not contemplated in CERP this includes the proposed 330 underground Aquifer Storage and Recovery wells and the EAA Reservoir deeper storage project originally planned on Talisman Tract which now needs to be located elsewhere since it has been used for a shallower Flow Equalization Basin.[563]

Ouellette et al (2018) explored using croplands in the EAA to provide additional storage to help meet CERP restoration goals.[564] It found that not only could raising water tables on active

---

[555] Brand, L and A. Compton. 2007. Long-term increase in Karenia brevis abundance along the Southwest Florida Coast. Harmful Algae. 2007. 6(2): 232-252. doi:10.1016/j/hal.2006.08.005.
[556] *Id.*
[557] *Id.*
[558] *Id.*
[559] *Id.*
[560] EPA, Office of Water. 2015. Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria, EPA-820-S-15-001 (Feb. 2015), available at, https://www.epa.gov/sites/production/files/documents/nandpfactsheet.pdf.
[561] Ali Schmitz, Red tide, algae blooms: reducing nutrients is best way to prevent pollution, say DEP, FWC TC Palm (Jan. 23, 2019).
[562] Graham 2015.
[563] Graham 2015.
[564] Ouellette, K. et al. 2018. The concept of water storage on agriculture lands: Exploring the notion in South Florida. Water Science 32 (2018) 138-150.

farmlands meet CERP goals of additional water storage and Everglades restoration, but it would also reduce soil oxidation rates, prolonging the economic life of soils and agriculture in the EAA.

Water storage in the EAA provides a superior option to conventionally built reservoirs because the construction and operation of reservoirs reduces the ecosystem benefits of the land by taking valuable Everglades habitat out of the ecosystem and removing naturally occurring water cleaning processes, and rendering it virtually unusable for native species; whereas the EAA already exists and would require little or no additional infrastructure or habitat loss. With 700,000 acres, it also appears to provide the greatest potential for water storage in terms of capacity.

1. The Corps has the Authority to Exercise Eminent Domain

While it may be preferable to seek voluntary sale/lease of EAA lands, the Corps should consider all reasonable alternatives that would eliminate discharges to the coast estuaries, including the use of eminent domain where necessary. "The United States has the authority to take private property for public use by eminent domain,…but [it] is obliged by the Fifth Amendment to provide 'just compensation' to the owner thereof."[565] Given that the use of private property to protect the state's natural environment is most certainly a public use for purposes of the Fifth Amendment, the Corps and the federal government would have to determine what "just compensation" is owed.

"Just Compensation" is the value of the property at the time of the taking and most often its "fair market value." Fair market value is "the price a reasonable and willing buyer would pay a reasonable and willing seller given market conditions."[566] In determining what a hypothetical willing buyer would pay, courts often look to actual, comparable sales on the open market between other willing buyers and sellers.[567] If a market does not exist, a party may establish market value by showing the cost to replace the property in the current market.[568] A Court may choose not to apply the market value standard and rely on an alternative measure of compensation where there is no market for the property, the market value cannot be determined, or where the application of the market value approach would result in "manifest injustice" to the owner or public.

To determine the property's market value, Courts will examine the property's "highest and best use." The doctrine of "highest and best use" has its origins in the 1934 Supreme Court case of

---

[565] *Kirby Forest Indus., Inc. v. United States*, 467 U.S. 1, 9 (1984).
[566] *United States v. 480 Acres*, 557 F.3d 1297, 1306-07 (11th Cir. 2009).
[567] *United States v. 480 Acres*, 557 F.3d 1297, 1306-07 (11th Cir. 2009).
[568] *See* Glynn S. Lunney, *Compensation for Takings, How Much Is Just?*, 42 Cath. U.L. Rev. 721, 728 (1993)(citing *Albert Hanson Lumber Co. v. United States*, 26 U.S. 581, 589-90 (1923)).

Olson v. United States.[569] In *Olson*, the Court found that the amount of compensation does not depend upon the uses to which the property owner has devoted his land but rather a consideration of all uses for which it is suitable.[570] Courts presume, however, that the highest and best use of a property is its current use, unless the landowner shows that a different highest and best use is "reasonably probable" within the "reasonably foreseeable future," and not merely within the realm of possibility."[571] "Speculative and remote probabilities cannot become a guide for the ascertainment of value, especially when the creation of such a potential use would require a substantial investment of capital."[572]

Whether a particular use is the highest and best use must be considered in light of the history of the region in general,[573] pre-existing zoning and land use regulations,[574] and "regulatory contingencies associated with a potential use."[575] "[W]here the likelihood of the future exercise of police power is so great as to have an observable effect upon present market value, it may properly be considered in determining the compensation to be paid for such property when it is taken by eminent domain."[576]

While eminent domain is a complex, often-times murky area of the law, and the amount of just compensation owed to a landowner can only be determined on a case-by-case basis, the Corps should carefully scrutinize the "highest and best use" of any property over which it may decide to exercise eminent domain. The Everglades Agricultural Area is subject to existing land use restrictions which limit most properties within its boundaries to agricultural and other low-density, low intensity uses. Many other rural lands outside the EAA also are subject to similar land use restrictions to protect agriculture, environmental lands, parks, and natural areas. The Corps should also scrutinize any claims that a more intense use is "reasonably probable," and examine whether property owners can demonstrate that they have taken affirmative steps to make future plans a reality.

---

[569] 292 U.S. 246 (1934).

[570] *Olson*, at 255. *See also United States v. Powelson*, 319 U.S. 266, 275 (1943) ("valuations in eminent domain proceedings 'may reflect not only the use to which the property is presently devoted but also that use to which it may be readily converted."); *United States v. 480 Acres*, 557 F.3d at 1306-07 ("[j]ust compensation is not limited to the value of the property as it is presently used but also includes any additional market value it may command because of the prospects for developing it to the 'highest and best use' for which it is suitable.").

[571] *E. Tenn. Natural Gas Co. v. 7.74 Acres*, 228 Fed. Appx. 323, 327 (4th Cir. 2007) (citing *United States v. 69.1 Acres of Land*, 942 F.2d 290, 292 (4th Cir. 1991)).

[572] *United States v. L.E. Cooke Company, Inc.,* 991 F.2d 336, 341 (6th Cir. 1993)(citing *United States v. 1,291.83 Acres of Land*, 411 F.2d 1081, 1083-84 (6th Cir. 1969)).

[573] *United States v. Benning*, 330 F.2d 527, 531 (9th Cir. 1964).

[574] *See United States v. 480 Acres*, at 1307; *United States v. 191.07 Acres of Land*, 482 F.3d 1132, 1138 (9th Cir. 2006)(citing *Palazzolo v. Rhode Island*, 533 U.S. 606, 625 (2001)).

[575] *United States v. 62.50 Acres*, 953 F.2d 886, 890 (5th Cir. 1992)(citing *United States v. 320 Acres*, 605 F.2d 762, 818 (5th Cir. 1979); United States v. 174.12 Acres, 671 F.2d 313, 316 (9th Cir. 1982); *Powelson*, at 284)).

[576] *United States v. 174.12 Acres*, 671 F.2d at 316.

Even if a landowner can demonstrate that a proposed use is "reasonably probable," courts will look to see whether 1) the property is suitable for the proposed use and there is a need for such a use, (2) the proposed use is legally permissible, (3) the proposed use is financial feasible, and (4) the proposed use is the maximum profitable.[577] To prove that a prospective use is "reasonably probable" it must be shown that the land is physically adaptable for the use and there is a need or demand for such use in the reasonably foreseeable future.[578] For example, lands within close proximity to a national park, wildlife management area, national wildlife refuge, state park, or other public conservation lands would be ill-suited for a large residential or commercial development, large-scale mining operation, or similarly intense present or future use. To establish that the proposed use would be legally permissible, there would need to be a showing that relevant federal environmental permits and state and local land use and environmental approvals could be obtained.[579] This would be particularly challenging in areas that contain large amounts of sensitive wetlands and where future development plans would negatively impact a national park or other special areas.[580] Lastly, even if a landowner could demonstrate that the use is legally permitted and the site is conducive to a higher intensity and/or higher density proposed use, they would still have to demonstrate that the proposal is financially feasible and the maximum profitable use of the land. In remote areas miles from transportation corridors this could be a significant challenge.

In sum, the Corps should consider all options, and not be intimidated by the prospect of exercising eminent domain given the substantial hurdles many landowners in the region would likely have to overcome to prove that they deserve compensation for future uses that would greatly exceed that which they would be entitled to based on their present use.

2. The Corps has the Authority to Inversely Condemn Land

The Corps should further consider modifying its operations even if the impacts would result in inverse condemnation and just compensation would need to be paid to property owners. The Corps is immune from tort liability arising from flood control projects, however, takings claims could still be brought by local landowners to recover compensation for fluctuations in

[577] *See Bassett*, 55 Fed. Cl. At 69; *Bd. Of County Supervisors v. United States*, 47 Fed. Cl. 714 (2000).
[578] *See Olson*, 292 U.S. at 255-56; *United States v. 62.50 Acres*, 953 F.2d 886.
[579] *See United States v. 480 Acres*, at 1307. If the likelihood of a future exercise of the police power is sufficiently great that it has an observable effect on the present market value, that likelihood may be considered as evidence supporting a reduction in the market value. 26 Am Jur. 2d Eminent Domain 292 (citing *United States v. 158.24 Acres*, F.2d 559 (8th Cir. 1982)).
[580] For example, to obtain a dredge and fill permit under Section 404 of the Clean Water Act, an applicant would have to demonstrate that the action would not be contrary to the public interest. *See* 33 C.F.R. §320.4. Particular attention is paid to impacts set aside for study, sanctuaries, or refuges, wetlands which are scarce in quantity to the region or local area, and wetland resources protected under federal or state law, including, National Narks and such other areas as may be established under federal or state law for similar and related purposes. *See id*; 33 C.F.R. § 336.1.

environmental conditions that may arise due to a change in operations. The Corps, however, should not assume that all surface and subsurface flooding that may arise in the future would necessarily be caused by a change in the operations schedule. Moreover, the Corps should also not be under the impression that all operational changes that result in periodic flooding, and particularly, subsurface elevation of groundwater, would constitute a "taking" for purposes of the Fifth amendment. While every individual case is unique, the Corps would likely not be liable in many instances where operational changes have a temporary impact that does not interfere with the landowner's reasonable investment backed expectations.

The Fifth Amendment to the United States Constitution guarantees that "private property [shall not] be taken for public use, without just compensation." The Fifth Amendment applies to the states through the Fourteenth Amendment.[581] Florida's Constitution provides essentially the same guarantee.[582] A taking occurs where a government action goes "too far" and the government must compensate a landowner.[583] This is known as inverse condemnation. Inverse condemnation can occur when a government action "compel[s] the property owner to suffer a physical 'invasion' of his property"[584] and "denies all economically beneficial or productive use of land." This is known as a categorical taking. It can also occur when a government action otherwise deprives the landowner of the use of its land and requires the Court to engage in and ad hoc balancing test.[585] The balancing test set forth by the Supreme Court some 40 years ago in *Penn Central*, requires the Court to consider several factors, which include, the economic impact of the regulation on the property owner, the extent to which the regulation interferes with distinct, investment backed expectations, and the character of the government's action. The last factor is best understood by looking at whether there is a physical invasion or whether the alleged interference is due to a governmental attempt to adjust the economic benefits and burdens "to promote the common good."[586] There is a greater chance that a taking will be found when a physical invasion occurs.[587]

The Corps' management of Lake Okeechobee throughout the years has often prioritized the interests of surrounding agricultural landowners over the interests of the natural system and the coastal communities affected by harmful algae blooms. While LOSOM is not subject to the "savings clause" of the Water Resources Development Act, some property owners may expect the Corps to maintain its current operations and argue that any temporary flooding or rise in groundwater levels that would result from a change in operations and disrupt the status quo is a deprivation of a compensable property right and would constitute a taking. There should be no

---

[581] *See Chicago, B. & Q.R. Co. v. City of Chicago*, 166 U.S. 226 (1897); Const. art. 10, sec. 6.
[582] *See* Fla. Const. art. 10. 6
[583] *Pennsylvania Coal v. Mahon*, 260 U.S. 393, 415 (1922).
[584] *Lucas v. South Carolina Coastal Council*, 505 U.S. 1014, 1015 (1922).
[585] *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 124 (1978).
[586] *Penn Central*, at 124.
[587] *Id.*

expectation to maintain the status quo or provide even greater level of service of flood protection. Further, in many instances, landowners have been unsuccessful when they could not prove that a flood control project or change in water management operations caused the flooding they incurred on their property. Moreover, the Corps should not be fearful of the threats of "takings" in every instance when deciding whether to implement operational changes to better protect the natural system. Not all temporary invasions or increases in subsurface waters amount to a taking.

a. Landowners Likely Do Not Have a Compensable Property Right in the Benefits of Current Water Management Operations

There is substantial support for the position that the Corps' operations through LORS have not created a compensable property right should the Corps decide to make significant operational changes through LOSOM. At no time have the regulation schedules for Lake Okeechobee been represented as permanent in nature. Throughout the decades, these regulation schedules have been modified on several occasions at the Corps' discretion. Courts have found in such instances that no compensable property right has been established by the government's actions.

In *Bensch v. Metropolitan Dade County*,[588] property owners in the eastern Everglades sued the water management district, alleging that emergency relief measures taken by the District to restore water flows to Everglades National Park resulted in the elevation of their ground water levels. The plaintiffs claimed they incurred increased risks of flooding and actual flood damage. The argued that the District's actions had "driven [their] land values toward zero; prevented them from obtaining financing or from selling their property; and damaged their roads, personal property, trees and other land improvements.[589] The District contended on the other hand that the withdrawal and/or failure to provide flood control benefits is a discretionary government decision aimed at protecting a party against an inevitable, naturally occurring condition. Thus, "no taking had occurred where the government had modified a flood control project to eliminate drainage benefits, which it had no duty to provide in the first instance."[590]

The Court agreed with the District's position and its reliance on *Creppel v. United States Army Corps of Engineers,*[591] for the proposition that a withdrawal of proposed flood protection benefits is not actionable. In *Creppel*, the Corps withdrew a proposed plan that would have benefited landowners by draining their property via a proposed pumping station. The Corps completed Phase I of a flood control plan but did not complete Phase II construction because of non-compliance with the Clean Water Act. The Court found the Corps was not prohibited from

---

588 798 F. Supp. 678 (S.D. Fla. 1992).
589 Id. at 684.
590 *Id*. at 683.
591 500 F. Supp. 1108 (E.D. La. 1980); rev'd in part, 670 F.2d 564 (5th Cir. 1982).

altering its plans: "An agency is not forever bound by its prior determinations for they are neither congressional directives nor scriptural admonitions. Moreover, an agency may adjust its policies and rulings in light of its experience."[592]

It also does not appear that property owners can rely on estoppel or a theory of prescriptive right by adverse use to establish a protected right to lower groundwater levels or other forms of flood protection.[593] Courts in Washington state[594] and Minnesota[595] for example have rejected such claims where governments have removed certain benefits afforded by flood control projects.

b. Most Takings By Floodwaters Involve Permanent Invasions

Notwithstanding the extreme difficulty in establishing a vested, compensable right to a fixed level of service and flood protection afforded under LROS, property owners could argue that changes to the current schedule that result in a permanent, physical invasion of flood waters would constitute a taking. The Supreme Court has found the government liable for a taking where a property is permanently flooded by government action.[596] In these instances, a categorical taking occurs and no further analysis is required.[597]

But we would submit that through careful decisionmaking and a rigorous hydrological and engineering analysis, these instances can be avoided and should not serve as an obstacle to bolder action being taken by the Corps to reduce the harmful effects of the discharges. While temporary surface flooding or higher ground water levels could result in some areas, such instances often do not arise to the level of a taking.

In 2012, the United States Supreme Court held in *Arkansas Game and Fish Commission v. United States* that temporary invasions of flood waters can constitute a taking.[598] The Court did not find, however, that government-induced flooding is per se a taking just because it constitutes a physical invasion of land. Rather, the Court remanded the case so that the trial court could evaluate the facts under the balancing test of *Penn Central*.[599] This is an extremely important point to note because not all temporary invasions of floodwaters by a change in the operation's schedule would constitute a taking. Under *Penn Central*, a court would consider the duration of

---

592 *Bensch* at 683 (citing *Creppel*, 670 F.2d at 571 (citation omitted)). Because Plaintiffs alleged the District actually diverted water onto their lands and raised water levels beyond pre-project levels, rather than simply modifying a flood control program, the court sustained the sufficiency of the allegations of the complaint in this regard.
593 *See* Sharon S. Tisher, *Everglades Restoration: A Constitutional Takings Analysis*, 10 J. Land Use & Envtl. L. 27-32 (1994).
594 *See Drainage District No. 2 v. City of Everett*, 18 P.2d 53, 55 (Wash. 1933).
595 *In re Lake Elysian High Water Leve*, 293 N.W. 140 (Minn. 1940).
596 *See Pumpelly v. Green Bay Co*., 80 U.S. (13 Wall.) 166, 181 (1871).
597 *Lucas v. South Carolina Coastal Council*, 505 U.S. 1014, 1015 (1992).
598 *Arkansas Game & Fish Commission v. United States*, 568 U.S. 23 (2012).
599 *Ark. Game & Fish Comm'n v. United States*, 133 S. Ct. 511, 521 (2012).

flooding, the intent and foreseeability of the invasion, the character of the land being affected, and the "reasonable investment-backed expectations" of the property owner.[600] Thus, the prospect of occasional, intermittent flooding should not deter the Corps from carefully evaluating a host of reasonable alternatives.

Even if a landowner does not experience permanent or temporary surface flooding, they could argue that changes to the operation's manual that result in increased ground water levels causing damage to root zones of crops would constitute a taking. Such claims would be extremely difficult to maintain. Although the Supreme Court has recognized a cause of action for a taking where increased ground water levels lead to the total destruction of one's agricultural lands, it has only done so where it was so destructive that it was as if the land had been permanently submerged.[601] Since then, and in most instances, claimants have not prevailed on such claims, particularly due to the inability to establish causation and substantial enough of a loss that would compensable under the Fifth Amendment.[602]

V. Conclusion

Thank you for the opportunity to provide scoping comments on the LOSOM. We recommend that the Corps' improve the process by (1) broadening the scope of the Corps' review to allow implementation of elements of LOSOM as early as possible and prior to completion of HHD repairs and CERP projects; and (2) compressing the review timeline from three years and nine months to eighteen months.

As these comments detail, ongoing Lake Okeechobee operations are significantly harming the human environment and federally endangered and threatened species, and future, planned infrastructure projects may not fully address those issues. The alternatives proposed in these comments do not require additional infrastructure projects or authorization and may be implemented immediately and help address the above referenced concerns.

Please continue to keep us informed about the Corps' progress in evaluating and implementing LOSOM and do not hesitate to contact us with any questions or concerns about this letter at jlopez@biologicaldiversity.org or 727-490-9190.

---

[600] *See Ark. Game & Fish Comm'n v. United States*, 133 S. Ct. 511, 522 (2012).
[601] *See United States v. Kansas City Life Ins. Co.*, 339 U.S. 799, 810 (1950).
[602] *See, e.g., Williams Farms Partnership v. Am. Citrus Prods. Corp.*, 2007 U.S. Dist. LEXIS 46160 (M.D. Fla. 2007); *Alost v. United States*, 73 Fed. Cl. 480 (2006); *Laughlin v. United States,* 22 Cl. Ct. 85, 99 (1990); *Diamond K. Corp. v. Leon County*, 677 So. 2d 90, 91 (Fla. 1st DCA 1996).

Sincerely,

Jaclyn Lopez
Florida Director
Center for Biological Diversity

Katie Tripp, Ph.D.
Director of Science & Conservation
Save the Manatee

John Cassani
Calusa Waterkeeper

Alex Gillen
Policy Director
Bullsugar

Diana Umpierre, AICP
Organizing Representative
Everglades Restoration Campaign
Sierra Club