Report to the Governor and Legislature:

Status of Efforts to Establish Numeric Interpretations of the Narrative Nutrient Criterion for Florida Estuaries and Current Nutrient Conditions of Unimpaired Waters

Required by Chapter 2013-71, Laws of Florida,

as Part of the "Path Forward" Agreement with EPA

Division of Environmental Assessment and Restoration

Florida Department of Environmental Protection

August 1, 2013

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Report to Governor and Legislature on Nutrients

1. INTRODUCTION

1.1 Purpose of Report

The purpose of this document is to provide the numeric nutrient criteria (NNC) information required by Chapter 2013-71, Laws of Florida, to the Governor and Legislature by the applicable due date (August 1, 2013). This report provides the status of NNC development for all estuaries in Florida, summarizes the NNC that have been approved by the Environmental Regulation Commission (ERC), and provides values representative of the nutrient conditions of unimpaired waters for the remainder of Florida's estuarine segments.

1.2 NNC Rulemaking Conducted to Date

The Florida Department of Environmental Protection's (Department) NNC for lakes, streams, spring vents, and Southwest/South Florida estuaries were adopted by the ERC on December 8, 2011. Ratification was waived by the Florida Legislature. The NNC, including the existing narrative nutrient criterion, were challenged by environmental groups in state court, and on June 7, 2012, Judge Bram Canter upheld the Department's rules. An appellate court subsequently upheld Judge Canter's original ruling.

The vast majority of Florida's freshwater streams, lakes, and springs are covered by numeric interpretations of the nutrient criterion, and only wetlands (except for the Everglades Protection Area) and South Florida canals are not covered by numeric nutrient criteria. Nonperennial streams, man-made or physically altered canals/ditches with poor habitat used primarily as water conveyances for flood control, irrigation, etc., and tidal creeks may also be solely covered by the narrative criterion once properly documented. In addition, the majority of estuaries are covered by numeric interpretations of the nutrient criterion. The ERC previously adopted NNC for the estuaries in Southwest/South Florida (Clearwater Harbor, Tampa Bay, Sarasota Bay, Charlotte Harbor, Caloosahatchee Estuary, Southwest Coast, Florida Bay, Florida Keys, and Biscayne Bay) in 2011 and adopted NNC for the Florida Panhandle (Perdido Bay, Pensacola Bay, Choctawhatchee Bay, St. Andrews Bay, St. Joseph Bay, and Apalachicola Bay) in 2012 (**Figure 1**). On June 20, 2013, the ERC adopted criteria for the Loxahatchee River, Lake Worth Lagoon, Halifax River, Guana River/Tolomato River/Matanzas River, Nassau River, Suwannee River, Waccasassa River, Withlacoochee River, and Springs Coast, and adopted satellite-derived chlorophyll *a* criteria for portions of the Florida coast with insufficient water quality data (**Figure 1**).

As provided for in Subsection 62-302.531(2), Florida Administrative Code (F.A.C.), Total Maximum Daily Loads (TMDLs) for nutrients are primary site-specific **numeric**

interpretations of the nutrient criterion. Major Florida estuaries with nutrient TMDLs include Upper Escambia Bay, Lower St. Johns River, Indian River Lagoon, St. Lucie Estuary, and Caloosahatchee Estuary**.** In some cases, the TMDL only addresses one of the causal variables (total nitrogen [TN] or total phosphorus [TP]), and this report provides the numeric interpretation of the narrative for the remaining causal variable and for chlorophyll *a*.

As required by Chapter 2013-71, Laws of Florida, this report identifies the remaining estuarine areas for the establishment of criteria and provides a calculated numeric value that represents, based on the best available information, the current condition of these unimpaired waters. Additional information and review to establish numeric interpretations of the narrative nutrient criteria by December 1, 2014, will be developed with input from the public and subject to the provisions of Chapter 120, Florida Statutes. Estuarine areas without adopted NNC include portions of the Big Bend from Alligator Harbor to the Suwannee Sound, Cedar Key, St. Marys, Southern Indian River Lagoon, several portions of the Intracoastal Waterway (ICWW) connecting estuarine systems, and a variety of small gaps (**Figures 2** through **15; Table 1**).

1.3 "Path Forward" Agreement

The U.S. Environmental Protection Agency (EPA) and the Department reached a "Path Forward" agreement on March 15, 2013, to finalize NNC development, which if successful, would allow EPA to approve Florida's NNC and cease federal NNC rulemaking activities. As part of this agreement, the Department was responsible for the following:

- *Adopting criteria for additional estuaries by July 1, 2013 (including the Loxahatchee River, Lake Worth Lagoon, Halifax River, Guana River/Tolomato River/Matanzas River, Nassau River, Suwannee River, Waccasassa River, Withlacoochee River, and Springs Coast);*

- *Calculating numeric values representing the current unimpaired conditions of remaining estuaries (including St. Marys River Estuary, Big Bend estuaries, and other gaps such as portions of the Intracoastal Waterway) and submitting these values to the Governor and Legislature by August 1, 2013 (this report); and*

- *Submitting the adopted estuarine NNC, the NNC Implementation Document (Implementation of Florida's Numeric Nutrient Standards), and this report to EPA by August 1, 2013. (The NNC Implementation Document was incorporated by reference in Section 62-302.300, F.A.C., on April 23, 2013, and approved by EPA on June 27, 2013).*

Concepts embedded in the Path Forward agreement were the subject of state legislation (Chapter 2013-71), which does the following:

- *Establishes that the Department will implement the narrative nutrient criterion and protect downstream waters from nutrients;*

- *Authorizes the Department to implement the adopted NNC consistent with the Implementation Document;*

- *Repeals language in Subsection 62-302.531(9) if EPA withdraws federal NNC and ceases NNC rulemaking;*

- *Waives ratification for any estuarine NNC adopted in 2013; and*

- *Requires NNC for all remaining estuaries by December 1, 2014, and establishes that the current conditions of unimpaired waters will be the nutrient standards until NNC are adopted.*

1.4 Approach Used To Develop Estuarine NNC to Date

Because the effects of nutrients in estuaries are highly site specific, the Department developed estuary-specific nutrient criteria as site-specific interpretations of the narrative nutrient criteria.[1] The Department developed numeric interpretations of this narrative standard that would be associated with unimpaired (healthy) conditions using the following:

- *A reference period approach, where data from a period within a waterbody or an individual segment of the waterbody shown to be healthy were used to develop criteria;*

- *A reference site approach, where a data from a nearby and functionally similar healthy estuarine area were used to develop criteria for a segment with data limitations;*

- *A combination of the reference site and reference period approach, where data from an adjacent system was selected during periods that achieved environmental targets (e.g., depth-to-seagrass endpoints), were used to develop criteria for a nearby segment; or*

- *A modeling approach, where mechanistic models determined criteria values associated with healthy conditions (model targets were sometimes based on reference periods).*

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[1] The narrative nutrient criterion in Paragraph 62-302.530(47)(b), F.A.C., states, "In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."

Reference Period and Reference Site Approaches

For the reference period approach, periods were identified when the estuary maintained a well-balanced, natural population of flora and fauna (based on comparisons of either empirical data or model predictions to established biological screens), and criteria were established at levels that preserve the data distribution of the healthy conditions, taking into account natural variability in water quality. This ensures that nutrients are managed in a manner that affords the same level of protection of use support as under natural conditions.

Before screening estuarine segments against the biological endpoints (described below) for the reference period and reference site approaches, the Department first reviewed the 303(d) listing status for all estuarine segments with waterbody identification (WBID) numbers based on the current federally approved 303(d) list of impaired waters and all subsequent listing or delisting actions taken by the Department according to the Impaired Surface Waters Rule (IWR) (Rule 62-303, F.A.C.). The Department generally plans to develop TMDLs for waters that have been verified as impaired for nutrients or dissolved oxygen (DO), and the TMDLs will serve as a site-specific interpretation of the narrative nutrient criterion for these waters. However, the Department concluded that the reference condition approach was valid for developing NNC for some estuarine systems that include areas that were previously listed but have been delisted or areas that are currently listed as impaired but actually meet designated uses based on new criteria and new assessment methodologies. These waters, which FDEP plans to delist as part of the next 303(d) assessment cycle for the basin, include:

1. *Waters that were listed for DO but have subsequently been determined to meet the recently revised marine DO criterion;*

2. *Waters that were listed for DO but have subsequently been determined to be naturally low in DO; and*

3. *Waters listed for historic chlorophyll a but which do not have a statistically significant increasing trend in chlorophyll.*

Next, quantitative data screening thresholds were used to only include data from periods that achieved (1) transparency (where targets were available), (2) chlorophyll (indicating a lack of algal blooms), and (3) DO targets. These three biological endpoints were recommended by the EPA Science Advisory Board and subsequently proposed by EPA in its 2012 proposal of NNC for Florida's estuarine waters, because they are sensitive to nutrients and necessary to ensure the protection of balanced populations of aquatic flora and fauna. The following three targets were used:

- *Site-specific seagrass depth (Z_c) and water clarity (K_d) targets to* ***achieve 20% of surface light at the mean depth of the deep edge of seagrass beds****, relative to mean sea level, based on historical or recent seagrass coverages (where available, as proposed by EPA 2012 and Hagy in press), using Secchi depth measurements;*
- *A chlorophyll a target to prevent nuisance algal blooms (****not to exceed 20 micrograms per liter (µg/L) >10% of the time based on annual data****); and*
- *DO targets to protect aquatic life (****including a minimum allowable daily DO saturation of 42%, 90% of the time, based on annual data****).*

After removing data from years that did not meet any one of the three screening thresholds, the Department evaluated whether there were sufficient data to derive NNC using the reference period or reference site approach. Minimum data requirements for derivation of the criteria are discussed in **Appendix A**.

Modeling Approach

As outlined in the EPA's 2012 document *Methods and Approaches for Deriving Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters*, the application of water quality simulation models is an EPA-accepted approach to develop NNC and to determine unimpaired conditions. The Department obtained from EPA, and worked with EPA modelers to improve, a series of linked watershed and estuarine models for the St. Marys and Big Bend systems. These models link causal variables such as TN and TP to ecological indicators such as chlorophyll *a* and water clarity, and can establish protective nutrient levels based on the above biological assessment endpoints (as applicable to the specific system).

A dynamic watershed model, Loading Simulation Program in C++ (LSPC), was used to estimate the quantity of water and pollutants associated with runoff from rain events associated with the contributing watershed of the estuary. The LSPC model includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms that simulate surface and subsurface flow from pervious land areas and surface flow from impervious land areas to determine nutrient loading. The model also has the ability to simulate direct point sources to the stream reaches. Water quality and hydrology over the 1997 to 2009 period were simulated based on the most current land cover information available. LSPC provides tributary flows and temperature to the hydrodynamic model used and tributary water quality concentrations to the water quality model

Estuarine hydrodynamics were simulated using the Environmental Fluids Dynamic Code (EFDC), which is a multifunctional, surface water modeling system that includes hydrodynamic, sediment contaminant, and eutrophication components. The model uses a curvilinear-orthogonal horizontal grid and a sigma or terrain-following vertical grid.

For the St. Marys estuarine system, the EFDC hydrodynamic model was run independently, and a hydrodynamic linkage file was linked with the Water Quality Analysis Simulation Program (WASP7) to simulate the hydrodynamics and water quality conditions in the estuary. WASP7 is a dynamic compartment–modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange are represented in the basic program. Water quality processes are represented in special kinetic subroutines that are either chosen from a library or written by the user.

While significant improvements were made to the St. Marys model, the Department concluded that the model calibration was not sufficient to develop NNC at this time, and instead the NNC in this report for the St. Marys are based on the reference approach. Model information is provided because the Department anticipates using a further improved model to establish revised NNC for the St. Marys by December 2014.

For the Big Bend, the Department used both the hydrodynamic and water quality components of EFDC to simulate hydrodynamics and water quality conditions, rather than linking EFDC to WASP7, because the model domain was very large.

Estuarine water quality conditions were simulated over the 2002 to 2009 period. Model predictions for water clarity (k_d), chlorophyll *a*, and DO were assessed against the biological endpoints described previously to determine whether the systems were healthy, taking into account whether the system met the target under natural conditions and was sensitive to nutrients. For the DO assessment, the daily volume averaged water column DO percent saturation was calculated from modeled DO, temperature, and salinity values to compare with the marine DO criterion. Daily average chlorophyll *a*, TN, and TP concentrations in surface model cells were processed to obtain volume-weighted, segment-averaged concentrations. These daily concentrations were used to calculate annual geometric mean (AGM) concentrations according to the procedure in FDEP 2010 based on the Department's conclusion that these areas currently reflect a healthy aquatic environment.

Mechanistic modeling was also used for TMDL development for some estuaries. The reductions specified by the TMDLs will result in the full support of a healthy, well-balanced community, and provide for recreation in and on the water.

1.5 Designated Use Support

Transparency and DO targets were designed to directly protect aquatic flora and fauna, while the chlorophyll *a* target was designed to protect human recreation use as well, by preventing anthropogenic algal blooms (EPA 2012). Because aquatic life use (a well-balanced natural population of aquatic flora and fauna) is the most sensitive to nutrients among all uses of Florida marine waters, the Department and EPA concluded that maintaining a well-balanced natural community of aquatic flora and fauna inherently protects all designated uses available under a waterbody's natural biological condition, including recreational, drinking water, and shellfish harvesting uses.

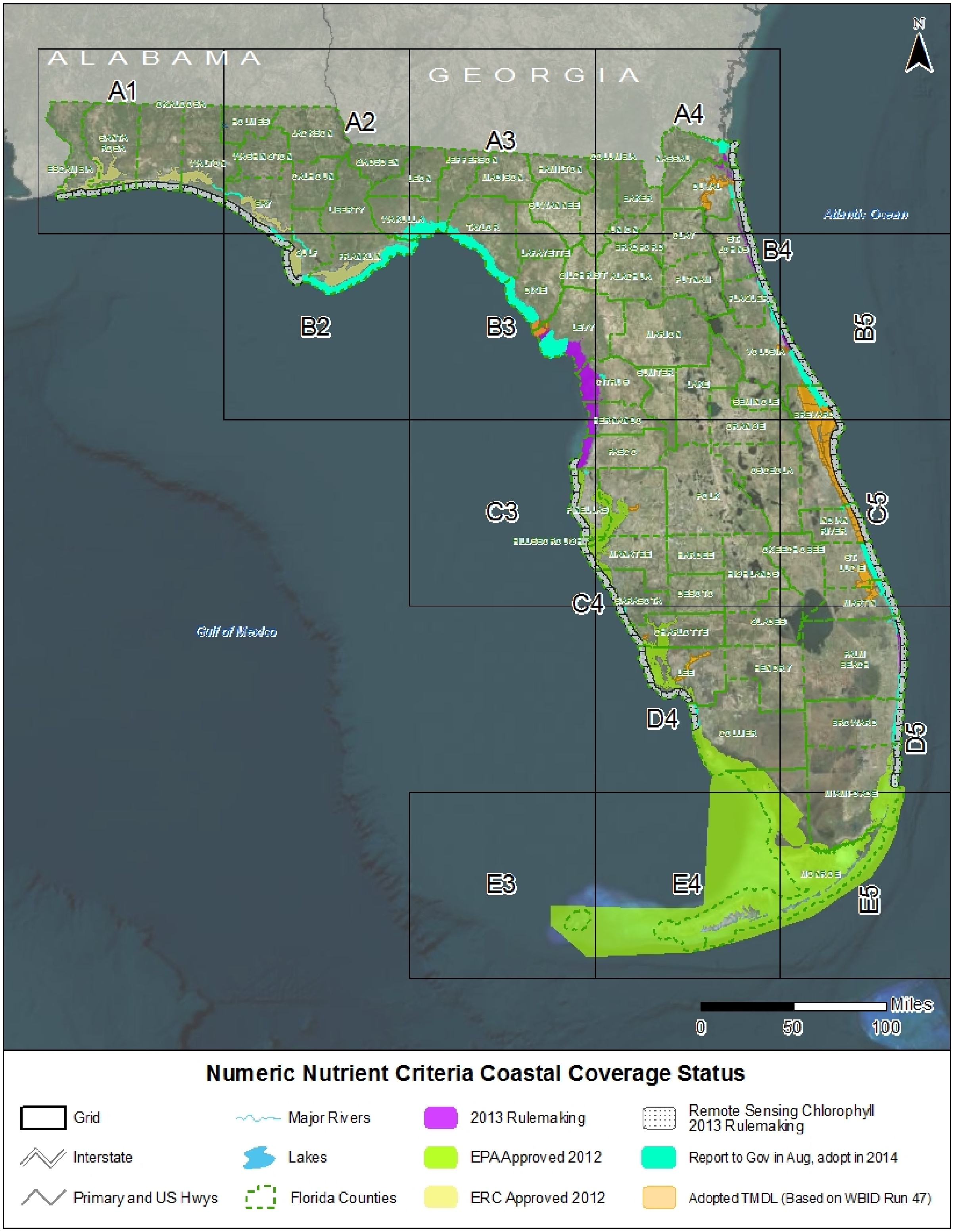

Figure 1. Statewide NNC coverage status.

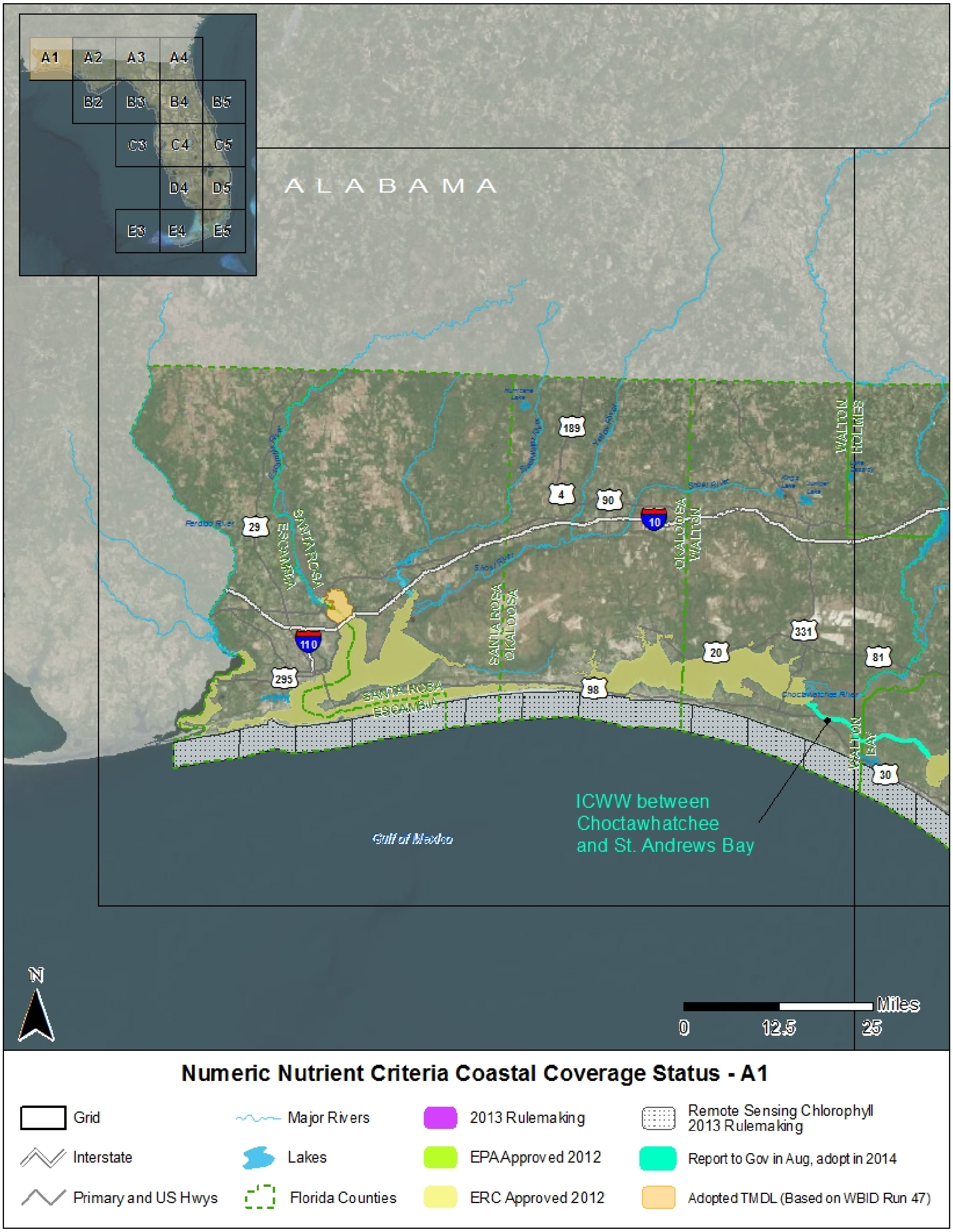

Figure 2. NNC coverage status from Perdido Bay to the Intracoastal Waterway east of Choctawhatchee Bay.

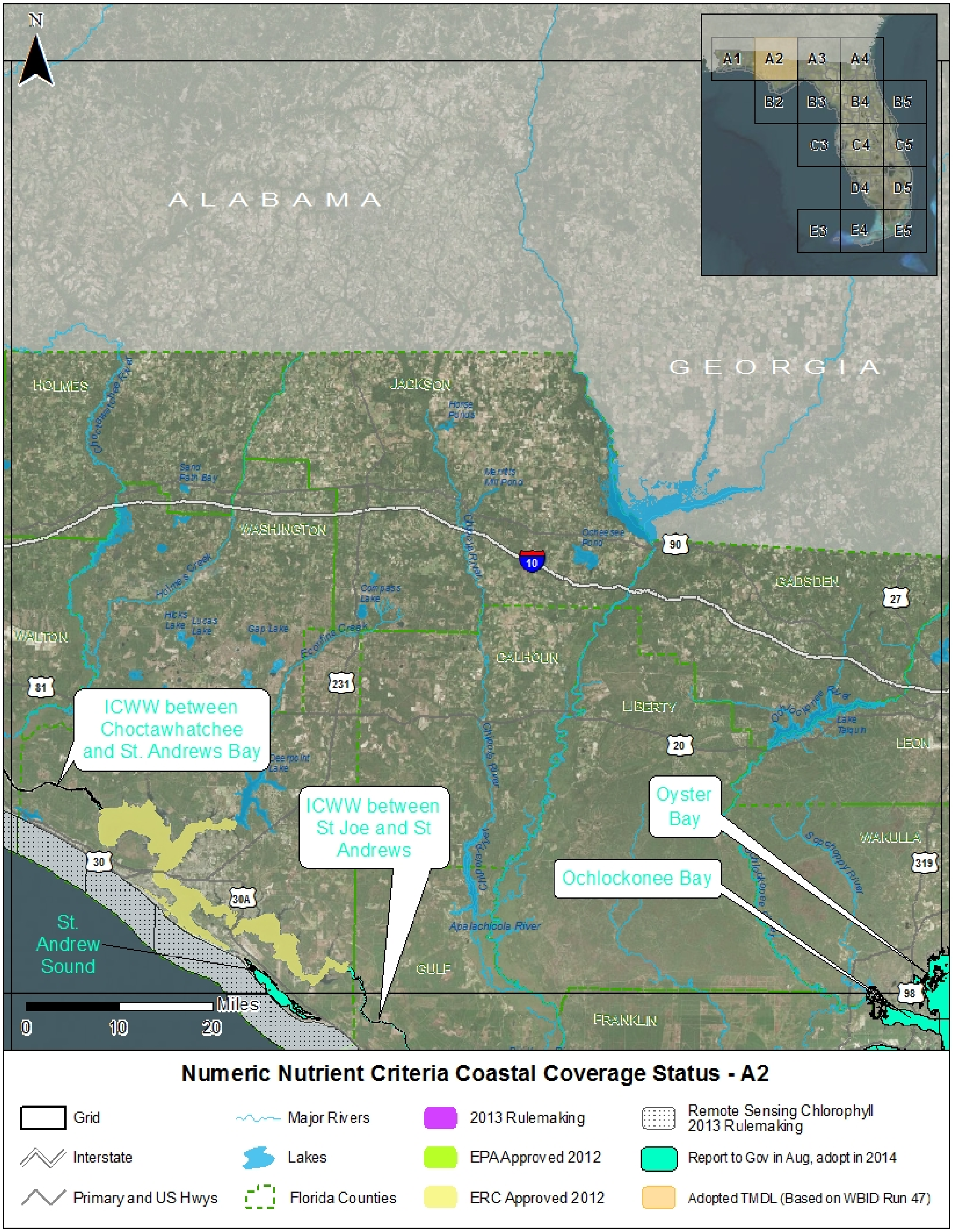

Figure 3. NNC coverage status from the Intracoastal Waterway west of St. Andrews Bay to portions of the Big Bend.

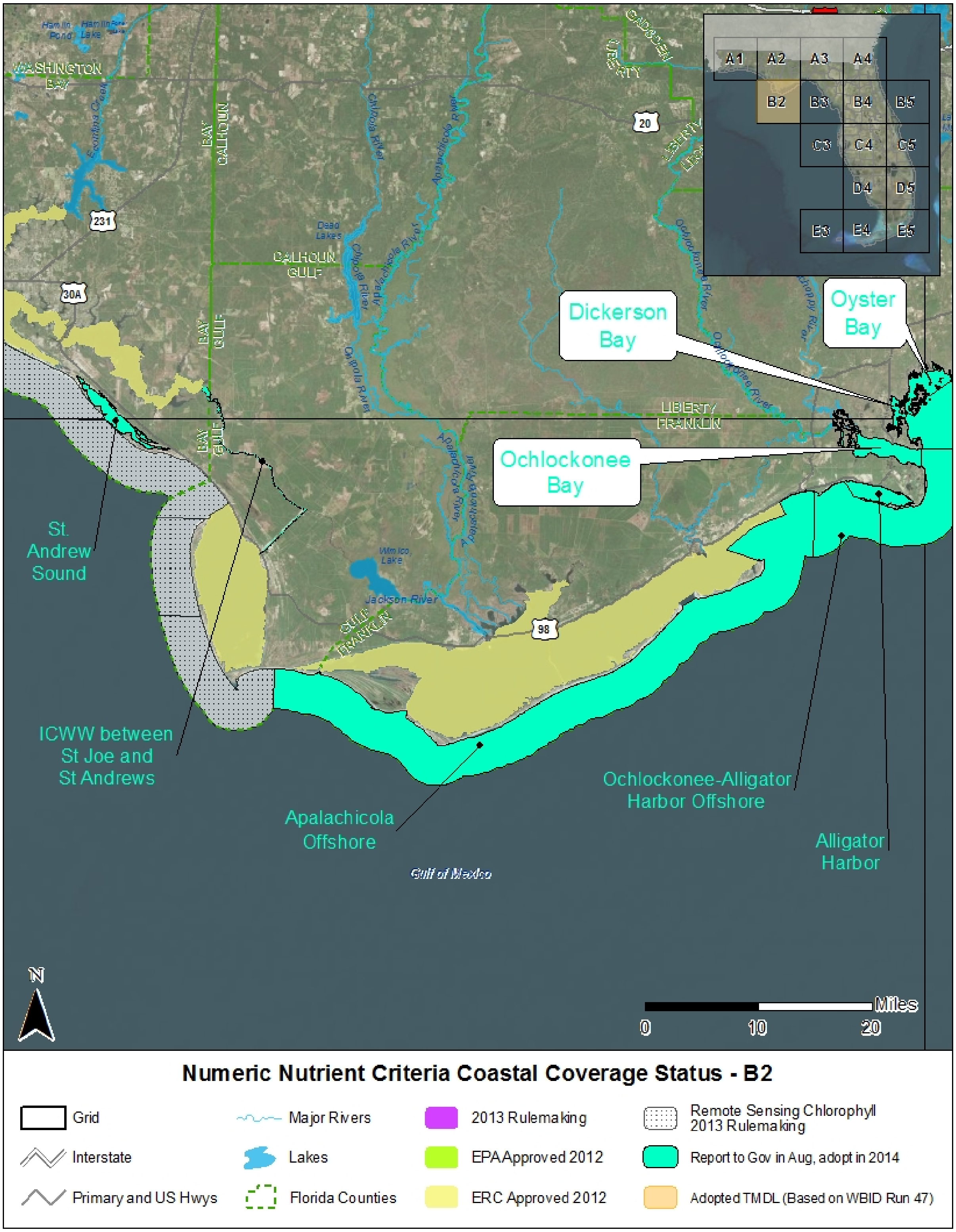

Figure 4. NNC coverage status from St. Andrews Sound to Ochlockonee Bay.

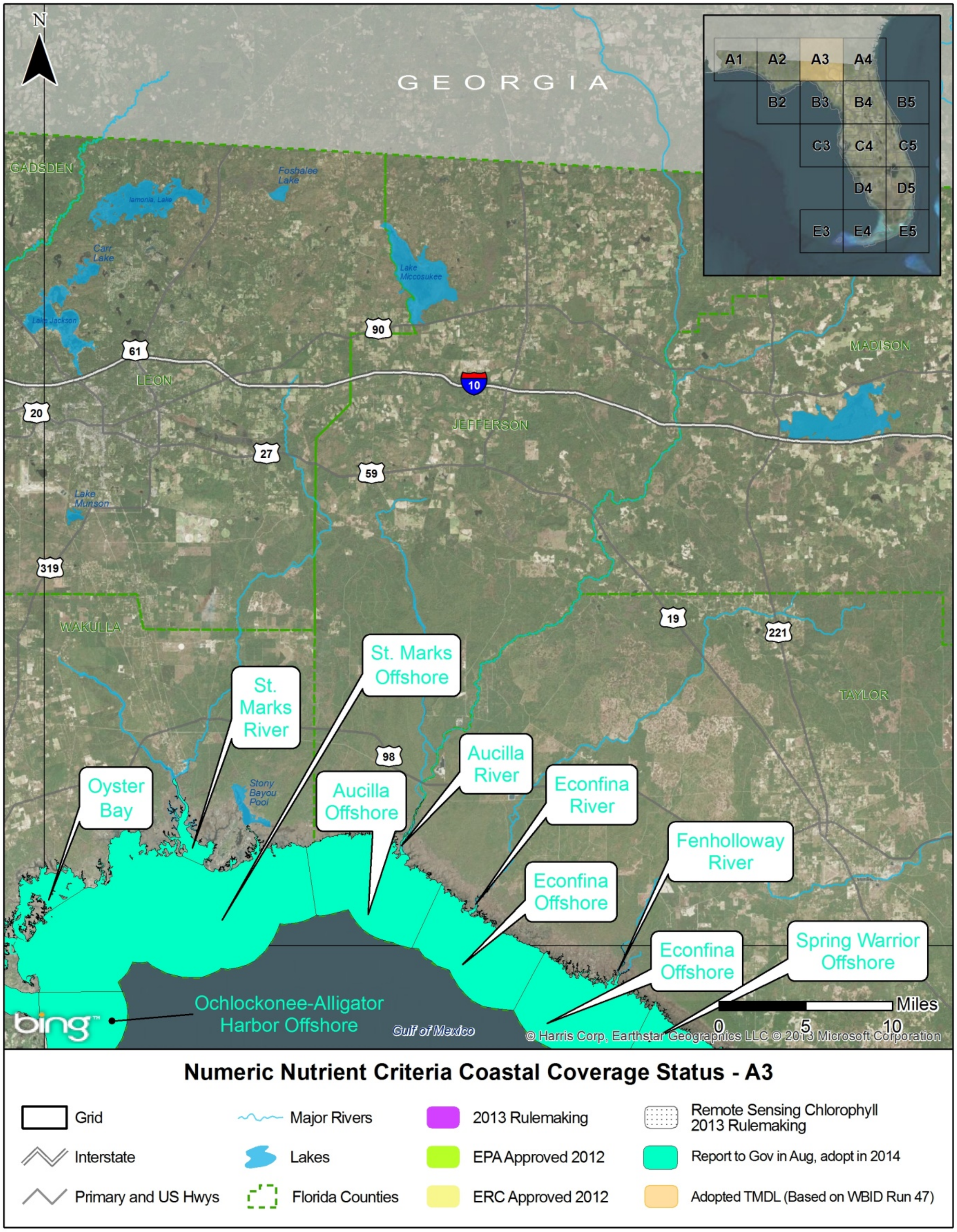

Figure 5. NNC coverage status from to Ochlockonee Bay to the Fenholloway River Estuary.

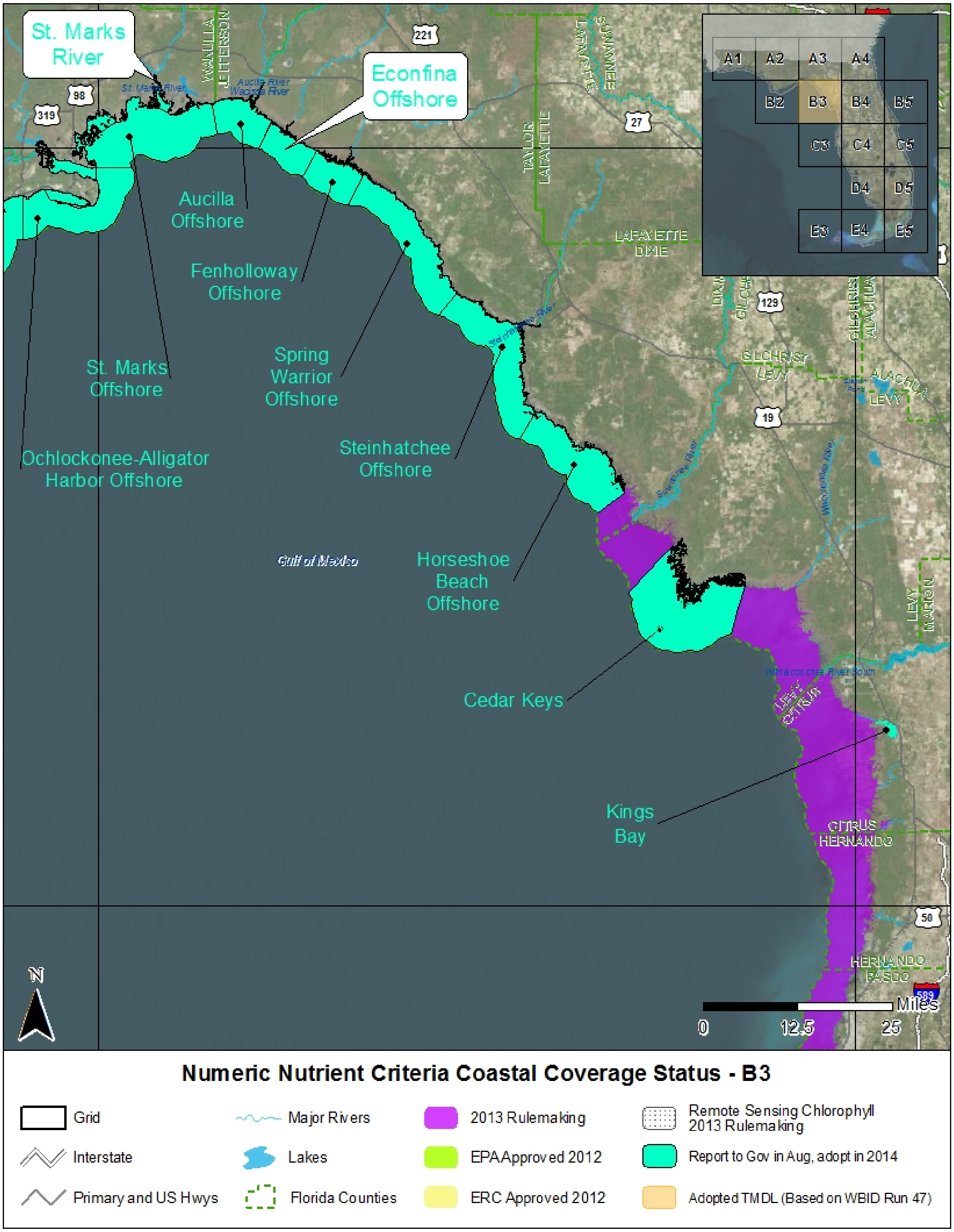

Figure 6. NNC coverage status from the Big Bend to the Waccasassa Bay and northern Springs Coast.

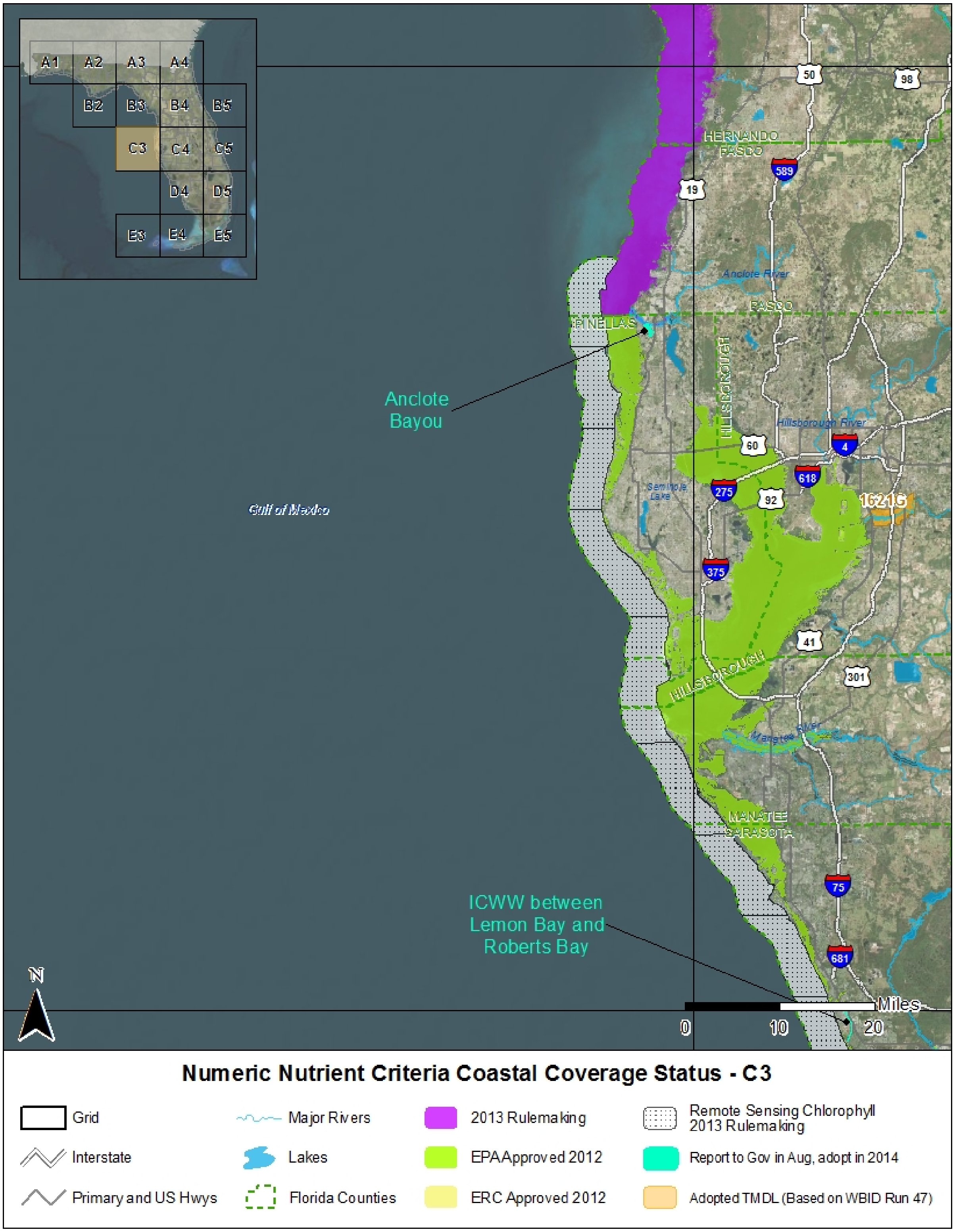

Figure 7. NNC coverage status from northern Springs Coast to Roberts Bay in southern Sarasota County.

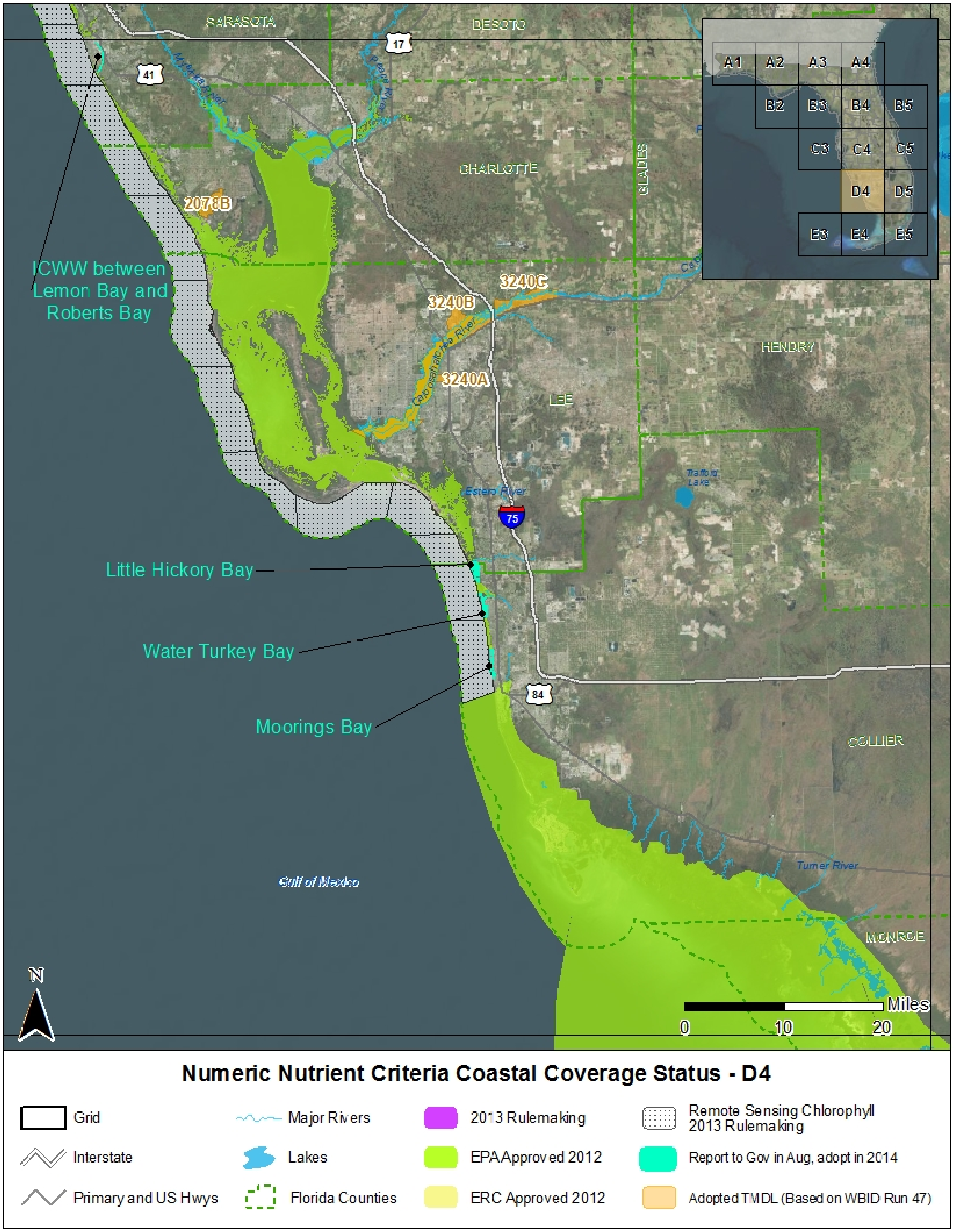

Figure 8. NNC coverage status from southern Sarasota County to northern Monroe County.

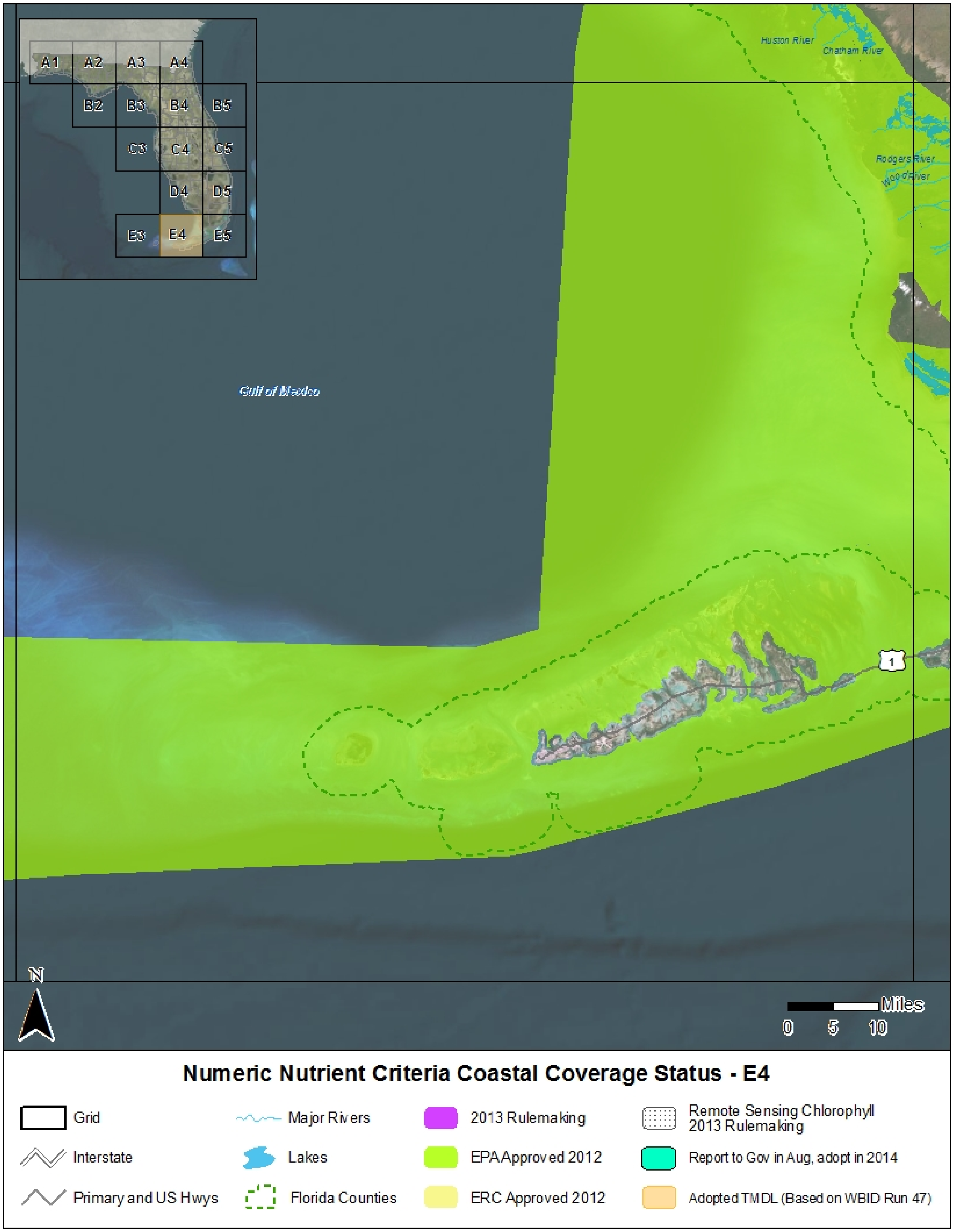

Figure 9. NNC coverage status in portions of Florida Bay and the Florida Keys, including the Marquesas Keys (coverage extends to the Dry Tortugas).

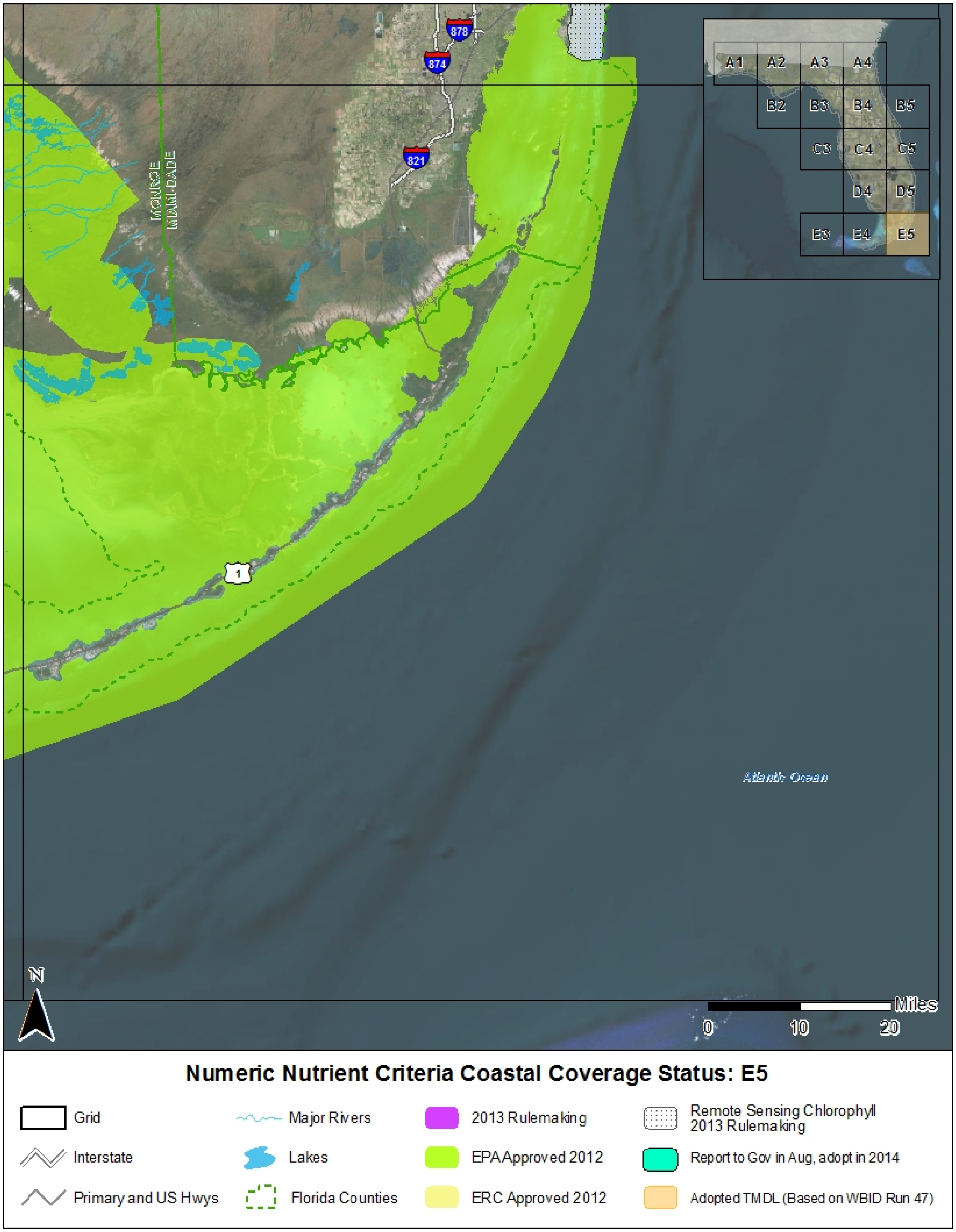

Figure 10. NNC coverage status in portions of Florida Bay and the Florida Keys, extending into Biscayne Bay.

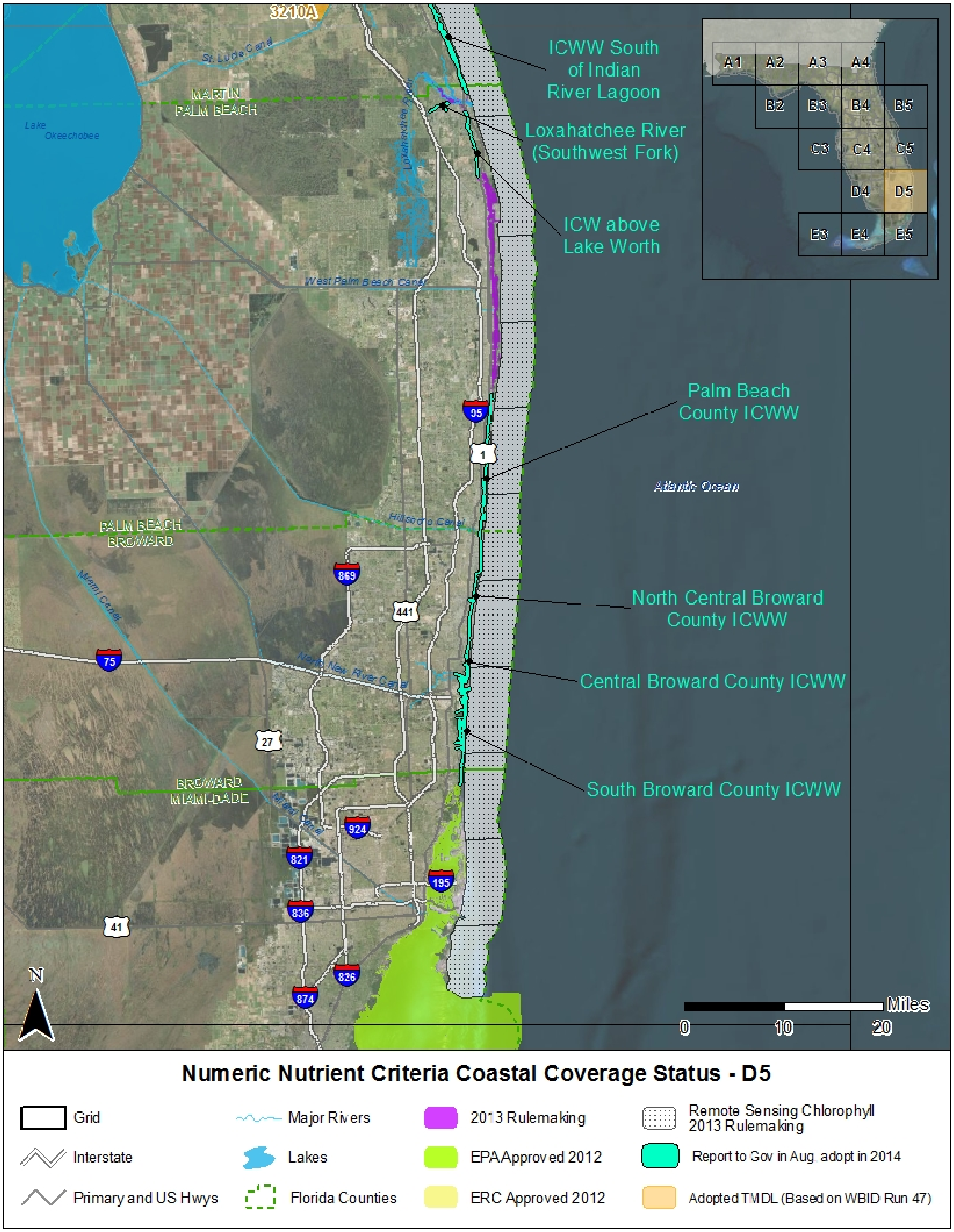

Figure 11. NNC coverage status from northern Biscayne Bay to the Intracoastal Waterway north of the Loxahatchee River Estuary.

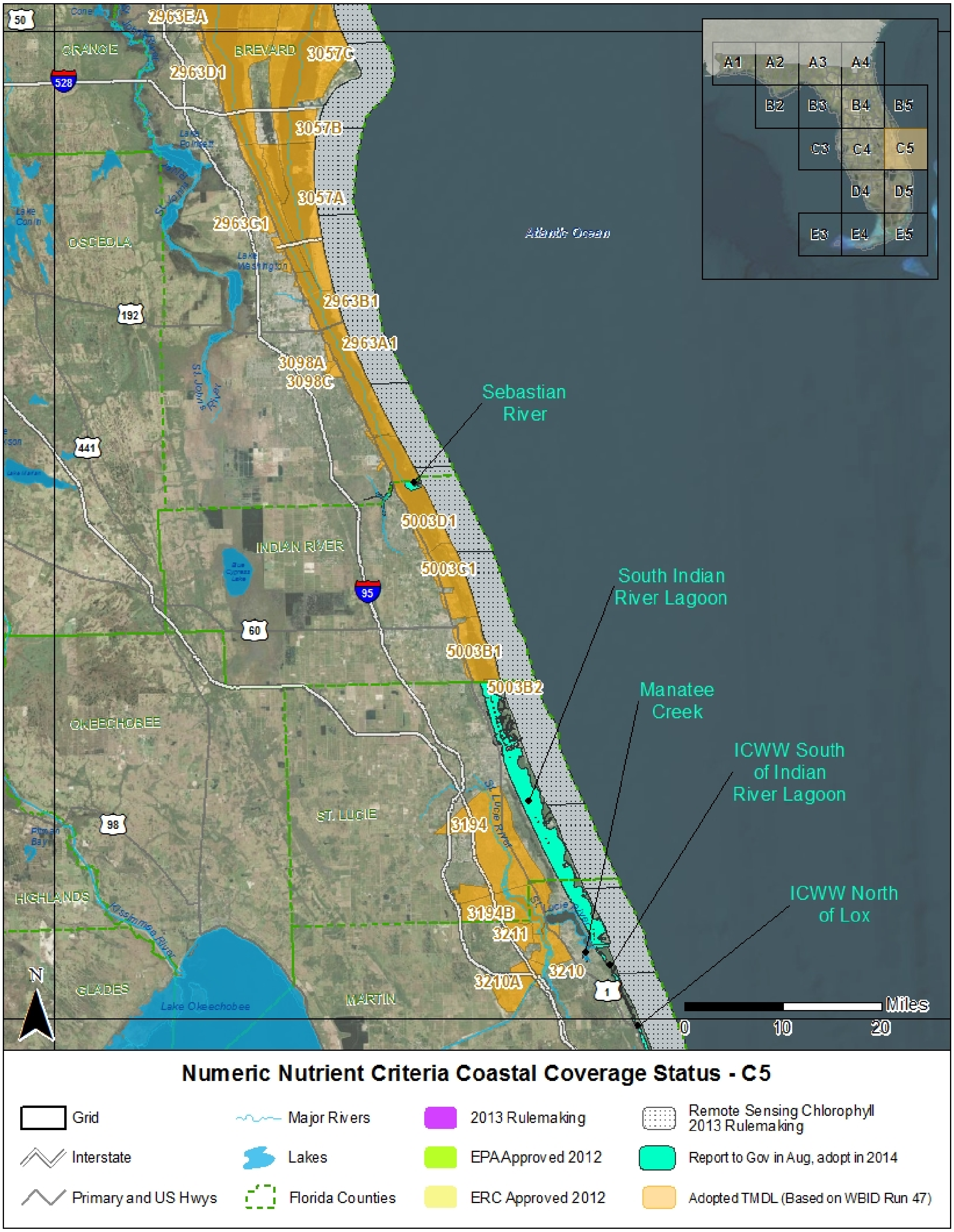

Figure 12. NNC coverage status from the Intracoastal Waterway south of the St. Lucie River Estuary to Cape Canaveral.

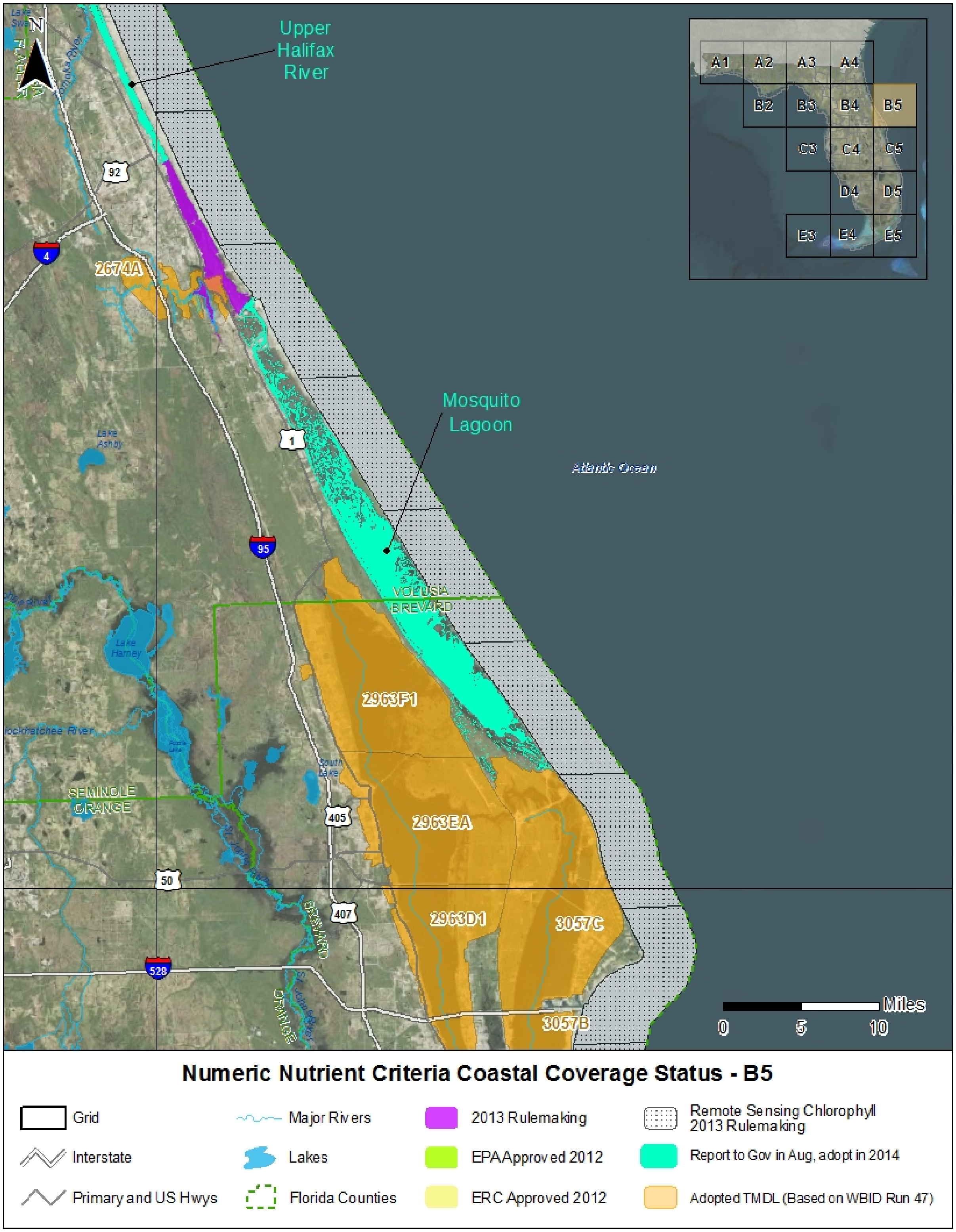

Figure 13. NNC coverage status from Cape Canaveral to the Intracoastal Waterway north of the Halifax River Estuary.

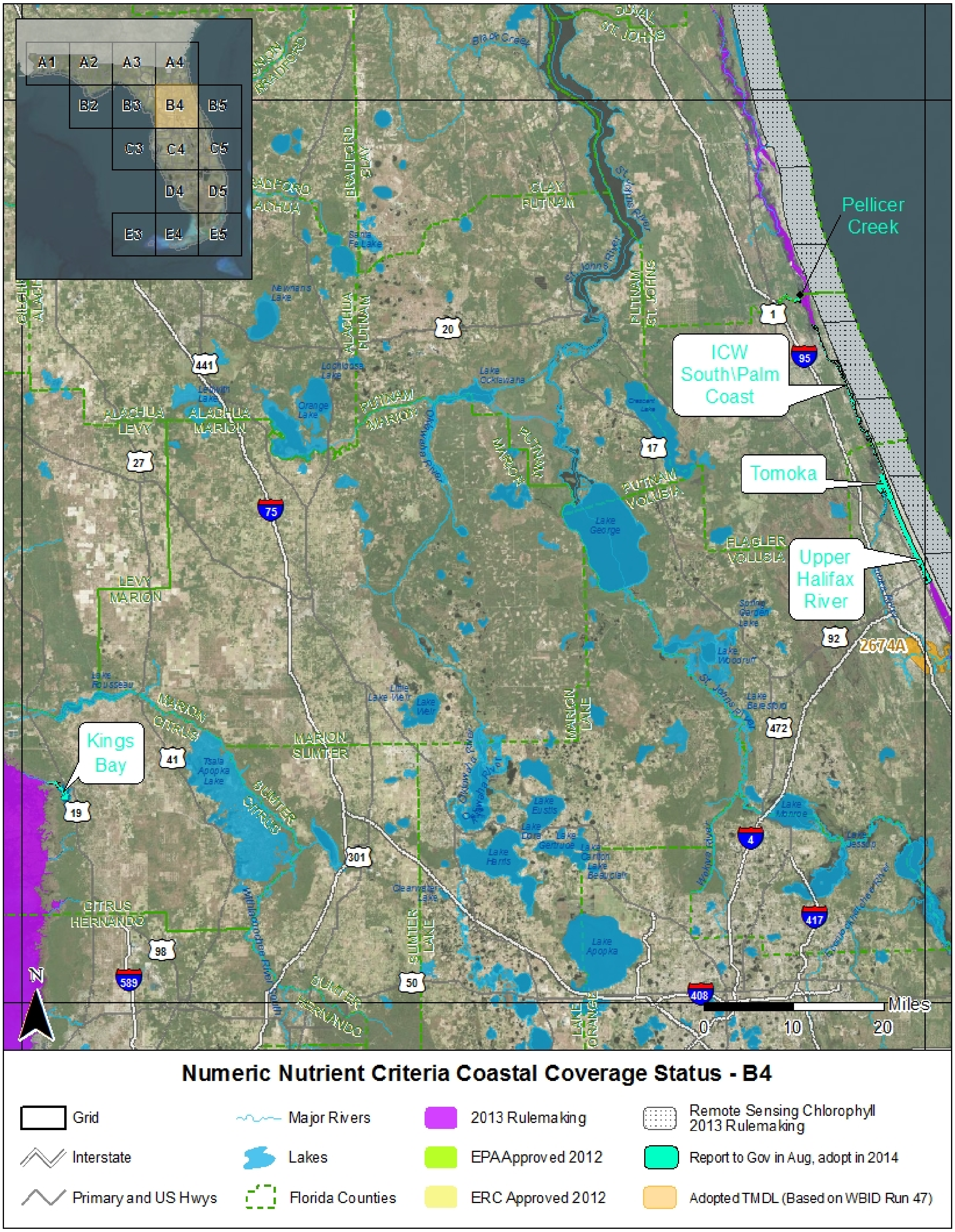

Figure 14. NNC coverage status from the Halifax River Estuary to the Guana/Tolomato/ Matanzas Estuary.

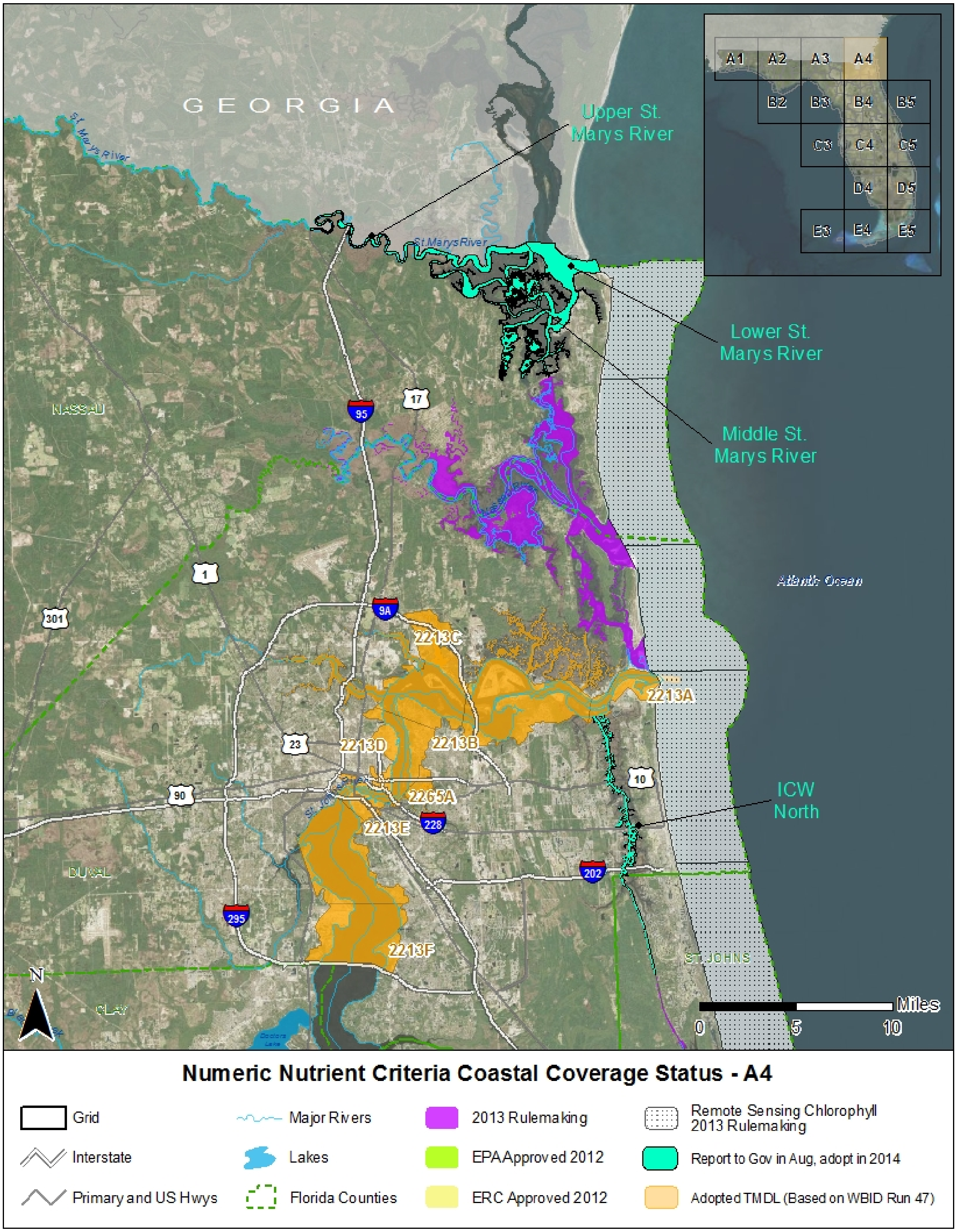

Figure 15. NNC coverage status from the Guana/Tolomato/Matanzas Estuary to the St. Marys River Estuary.

Table 1. Waterbody segments addressed in this report.

Main Estuarine System	How/When Covered
Coastal Areas Not Covered by Adopted NNC	Remote sensing chlorophyll approved by ERC in 2013
Perdido Bay	ERC approved 2012
Pensacola (All Except Upper Escambia)	ERC approved 2012
Pensacola Upper Escambia	TMDLs were ratified and adopted June 7, 2013. A public notice was published in the June 7, 2013 edition of the Florida Administrative Register that included language noting the TMDLs would be adopted as a Hierarchy 1 interpretation of the narrative nutrient criterion. The adopted TMDLs were sent to EPA in July 2013 for review.
Choctawhatchee	ERC approved 2012
ICWW between Choctawhatchee and St. Andrew	Report to Governor, and adopt in 2014
St. Andrew Bay	ERC approved 2012
St. Andrew Sound	Report to Governor, and adopt in 2014
ICWW between St. Joe and St. Andrew	Report to Governor, and adopt in 2014
St. Joseph Bay	ERC approved 2012
Apalachicola Bay	ERC approved 2012
Apalachicola Offshore	Report to Governor, and adopt in 2014
Alligator Harbor	Report to Governor, and adopt in 2014
Ochlockonee/Alligator Harbor Offshore	Report to Governor, and adopt in 2014
Ochlockonee River Estuary	Report to Governor, and adopt in 2014
St. Marks Offshore	Report to Governor, and adopt in 2014
Dickerson Bay	Report to Governor, and adopt in 2014
Oyster Bay	Report to Governor, and adopt in 2014
St. Marks River	Report to Governor, and adopt in 2014
Aucilla Offshore	Report to Governor, and adopt in 2014
Aucilla River Estuary	Report to Governor, and adopt in 2014
Econfina Offshore	Report to Governor, and adopt in 2014
Econfina River Estuary	Report to Governor, and adopt in 2014
Fenholloway Offshore	Report to Governor, and adopt in 2014. Level II Water Quality Based Effluent Limit (WQBEL) Study will provide Hierarchy I Interpretations.
Fenholloway River Estuary	Report to Governor, and adopt in 2014. Level II WQBEL Study will provide Hierarchy I interpretations.
Spring Warrior Offshore	Report to Governor, and adopt in 2014

Main Estuarine System	How/When Covered
Steinhatchee Offshore	Report to Governor, and adopt in 2014
Steinhatchee River Estuary	Report to Governor, and adopt in 2014
Horseshoe Beach Offshore	Report to Governor, and adopt in 2014
Suwannee Offshore	2013 Rulemaking. The 2008 nutrient and DO TMDL for the Suwannee River, Santa Fe River, Manatee Springs (WBID 3422R), Fanning Springs (WBID 3422S), Branford Spring (WBID 3422J), Ruth Spring (3422L), Troy Spring (3422T), Royal Spring (WBID 3422U), and Falmouth Spring (WBID 3422Z) included a nitrate target for the Suwannee Estuary WBIDs (3422D and 3422G) and was among the waters contained on the list of TMDLs submitted to EPA as Hierarchy 1 interpretations of the narrative nutrient criterion in 2012. Approved by EPA July 2, 2013.
Cedar Keys	Report to Governor, and adopt in 2014
Waccasassa Offshore	ERC approved 2013
Withlacoochee Offshore	ERC approved 2013
Crystal Offshore	ERC approved 2013
Crystal River (Marine)	ERC approved 2013
Kings Bay	Report to Governor, and adopt in 2014. TMDL for nitrate will be adopted in 2013.
St. Martins Marsh	ERC approved 2013
Homosassa Offshore	ERC approved 2013
Homosassa River (Marine)	ERC approved 2013
Chassahowitzka National Wildlife Refuge	ERC approved 2013
Chassahowitzka Offshore	ERC approved 2013
Chassahowitzka River	ERC approved 2013
Weeki Wachee Offshore	ERC approved 2013
Weeki Wachee River (marine)	ERC approved 2013. A nitrate TMDL is being developed for the freshwater portion but will not be final until the end of the year (2013). A workshop was held, and the notice included language noting that the TMDL would be adopted as a Hierarchy 1 interpretation of the narrative nutrient criterion.
Aripeka and Hudson Offshore	ERC approved 2013
Pithlachascotee Offshore	ERC approved 2013
Pithlachascotee River	ERC approved 2013
Anclote Offshore	ERC approved 2013
Anclote River (Marine)	ERC approved 2013
Anclote Bayou	Report to Governor, and adopt in 2014

Main Estuarine System	How/When Covered
Clearwater/St. Joseph Sound	ERC approved 2011, and EPA approved 2012
Tampa Bay to Sarasota	ERC approved 2011, and EPA approved 2012
Alafia River Tidal Segment	Previously adopted TMDL for TN. Report to Governor for TP and chlorophyll *a*
Sarasota Bay to Blackburn Bay	ERC approved 2011, and EPA approved 2012
Charlotte Harbor to Estero Bay	ERC approved 2011, and EPA approved 2012
Caloosahatchee River Estuary/ San Carlos Bay	Caloosahatchee Estuary nutrient TMDL for WBIDs 3240A, 3240B, and 3240C was among the list of TMDLs submitted to EPA as a Hierarchy 1 interpretation of the narrative nutrient criterion in 2012 for TN. Approved by EPA July 2, 2013. Report to Governor for TP and chlorophyll *a*.
Cocohatchee to Rookery Bay/ SW Coast	ERC approved 2011, and EPA approved 2012
Little Hickory Bay	Report to Governor, and adopt in 2014
Water Turkey Bay	Report to Governor, and adopt in 2014
Clam Bay	ERC approved 2011, and EPA approved 2012
Moorings Bay	Report to Governor, and adopt in 2014
Florida Bay	ERC approved 2011, and EPA approved 2012
Florida Keys	ERC approved 2011, and EPA approved 2012
Biscayne Bay	ERC approved 2011, and EPA approved 2012
ICWW between Biscayne Bay and Lake Worth Lagoon	Report to Governor, and adopt in 2014
Northern Lake Worth Lagoon	ERC approved 2013
Central Lake Worth Lagoon	ERC approved 2013
Southern Lake Worth Lagoon	ERC approved 2013
ICWW between North Lake Worth Lagoon and South Loxahatchee	Report to Governor, and adopt in 2014
Lower Loxahatchee River Estuary	ERC approved 2013
Middle Loxahatchee River Estuary	ERC approved 2013
Upper Loxahatchee River Estuary	ERC approved 2013
Loxahatchee River (Southwest Fork)	Report to Governor, TMDL
ICWW between Loxahatchee and St. Lucie Estuaries	Report to Governor, and adopt in 2014
St. Lucie Estuary	Nutrient TMDL for TN and TP was among the list of TMDLs submitted to EPA as a Hierarchy 1 interpretation of the narrative nutrient criterion in 2012. Approved by EPA July 2, 2013. Report to Governor for chlorophyll *a*.
Indian River Lagoon from St. Lucie Estuary to Indian River County Line	Report to Governor and adopt in 2014 (this portion not covered by TMDL)

Main Estuarine System	How/When Covered
Indian River Lagoon	A nutrient TMDL for TN and TP that included WBIDs 2963A, 5003D, 2963B, 2963C, 2963D, 2963E, 2963F, 5003B, and 5003C was among the list of waters with TMDLs submitted to EPA as a Hierarchy 1 interpretation of the narrative nutrient criterion in 2012. Report to Governor for chlorophyll *a*.
Sebastian River Estuary	A nutrient TMDL was adopted effective June 7, 2013. The rule notice included language noting that the TMDL would be adopted as a Hierarchy 1 interpretation of the narrative nutrient criterion. The TMDL document and supporting information have been sent to EPA for review.
Banana River Lagoon	A nutrient TMDL for TN and TP that included WBIDs 3057A, 3057B, and 3057C was among the list of TMDLs submitted to EPA as a Hierarchy 1 interpretation of the narrative nutrient criterion in 2012. Report to Governor for chlorophyll *a*.
Mosquito Lagoon	Report to Governor, and adopt in 2014
Sykes Creek Estuary	A nutrient TMDL for TN and TP was adopted effective April 9, 2013. The rule notice included language noting that the TMDL would be adopted as a Hierarchy 1 interpretation of the narrative nutrient criterion. The TMDL document and supporting information has been sent to EPA for review. Report to Governor for chlorophyll *a*.
Lower Halifax River Estuary	ERC approved 2013
Upper Halifax River Estuary	A TMDL has been adopted for TN, TP, and chlorophyll *a*, and the rule notice included language noting that the TMDL would be adopted as a Hierarchy 1 interpretation of the narrative nutrient criterion. The TMDL document and supporting information will be sent to EPA for review in late July. Values are provided in this report.
Tomoka Portion of Upper Halifax River	Report to Governor, and adopt in 2014
Intracoastal Waterway South/Palm Coast	A TMDL for TN, TP, and chlorophyll *a* has been adopted. The rule notice included language noting that the TMDL would be adopted as a Hierarchy 1 interpretation of the narrative nutrient criterion. The TMDL document and supporting information will be sent to EPA for review in late July. Values are provided in this report.
South Matanzas River Estuary	ERC approved 2013
Pellicer Creek Estuary	Report to Governor, and adopt in 2014
North Matanzas River Estuary	ERC approved 2013
Tolomato River Estuary	ERC approved 2013
ICWW from north Tolomato to St. Johns River Estuary	Report to Governor and adopt in 2014

Main Estuarine System	How/When Covered
St. Johns River Estuary, Including Marine Tributaries	The nutrient TMDLs for TN were among the list of TMDLs submitted to EPA as a Hierarchy 1 interpretation of the narrative nutrient criterion in 2012. Approved by EPA June 21, 2013. Report to Governor for TP and chlorophyll *a*
Nassau River Estuary	ERC approved 2013
Lower St. Marys River	Report to Governor, and adopt in 2014
Middle St. Marys River	Report to Governor, and adopt in 2014
Upper St. Marys River	Report to Governor, and adopt in 2014

2. Current Status of NNC Development for Each Major Estuarine System and Unimpaired Conditions of Estuaries without Department-Adopted NNC

This chapter summarizes the current status of NNC development for each major estuarine system, noting which estuaries have adopted NNC and which have nutrient TMDLs (see **Figures 1** through **15**). For those systems without a numeric interpretation of the narrative nutrient criterion, the chapter provides a numeric interpretation of the unimpaired nutrient conditions for the estuary.

2.1 Remotely Sensed Coastal Chlorophyll *a* Criteria

Chlorophyll *a* criteria covering most of the coastal segments with limited water quality data were adopted in June 2013. The criteria were based on criteria proposed by EPA in November 2012, with revisions by EPA in response to comments received from the Department and other entities. These chlorophyll *a* criteria will be assessed in a manner consistent with the way in which they were derived (satellite imagery).

2.2 Perdido River Estuary

Criteria covering all of the estuarine segments of the Perdido River Estuary were adopted by the ERC in November 2012.

2.3 Pensacola Bay Estuary

Criteria covering Lower Escambia Bay, Blackwater Bay, East Bay, Upper and Lower Pensacola Bay, and Santa Rosa Sound were adopted by the ERC in November 2012. Interpretations of the narrative nutrient criteria for Upper Escambia Bay were established under a TMDL for TN and TP that was adopted in 2013. A TMDL was developed for this estuarine segment after it was listed as impaired due to increases in chlorophyll *a* over historical minimums and annual average chlorophyll *a* values exceeding 11 µg/L for five years since 2003. The Department calibrated a series of linked watershed and estuarine models for Upper Escambia Bay that connect causal variables (TN and TP) to ecological indicators such as chlorophyll *a* and water clarity, in order to establish protective nutrient levels based on specific biological assessment endpoints.

The TMDL is expressed as long-term averages of annual means, based on modeling conducted for the 2002 to 2009 period which resulted in the conclusion that a 35% reduction in TP was required to achieve a healthy, well-balanced biological community. While the TMDL does not require reductions in TN, it established the total allowable load (pounds per year) for both TN and TP (see table below) that comprise the numeric interpretation of the narrative nutrient criterion for the bay.

The TMDL also provided a **chlorophyll *a* target for the bay (7.4 µg/L, expressed as long-term average of the annual means, not to be exceeded**) that represents the unimpaired conditions for the bay. Modeling indicated that the range in annual average concentrations of chlorophyll *a* (between 3.5 and 8.4 µg/L), TN (between 0.37 and 0.56 milligrams per liter [mg/L]), and TP (between 0.022 and 0.041 mg/L) for Upper Escambia Bay would result **in meeting all targets for light penetration (20% light at a 0.6-meter depth to protect seagrass), chlorophyll *a*, and DO**. Based on these results, the TMDL for North Escambia Bay (WBID 548AA) is fully protective of this bay segment and all downstream waters.

WBID	Parameter	Total Allowable Load (pounds/year)	Wasteload Allocation for Wastewater (lbs/year)	Wasteload Allocation for Stormwater (% reduction)	Load Allocation (% reduction)	Margin of Safety	TMDL (% reduction)
548AA	TP	601,345	6,704	35%	35%	Implicit	Not applicable
548AA	TN	16,795,853	53,444	Not applicable	Not applicable	-	Not applicable

2.4 Choctawhatchee Bay

NNC covering all of the estuarine segments of Choctawhatchee Bay were adopted by the ERC in November 2012.

2.5 Gulf Intracoastal Waterway between Choctawhatchee Bay and St. Andrew Bay

Completed in 1938, the connection between Choctawhatchee Bay and West Bay (St. Andrew Bay) was the final segment constructed to complete the Gulf Intracoastal Waterway (GIWW). The channel, which spans the boundary between Walton and Bay Counties, is currently maintained by the U.S. Army Corps of Engineers (Corps) to sustain 12 feet of depth and 125 feet of width. Due to insufficient data for this segment, the reference site approach, using data from the adjacent and similar GIWW between St. Andrew and St. Joseph Bays, was used to derive the numeric interpretation (see below).

Protective Numeric Interpretations were developed by including data only from years when the biological targets were met, and are based on the 90% prediction interval of measured values for TN and TP. Because there were less than 20 chlorophyll *a* measurements for this segment, the straight 90th percentile value was rounded down (at the tenth unit), as a conservative measure, and used for the chlorophyll *a* target (see **Appendix A**). These Numeric Interpretations are expressed as values not to be exceeded more than 10% of the time (see table below).

Segment	Parameter	Number of Observations	Mean	90% Prediction Interval (Numeric Interpretation)	90th Percentile (Numeric Interpretation)
GIWW between Choctawhatchee Bay and St. Andrew Bay (based on data from GIWW between St. Andrew and St. Joseph Bays)	TP (mg/L)	38	0.049	**0.108**	-
	TN (mg/L)	38	0.65	**1.14**	-
	Chlorophyll a (µg/L)	16	4.2	-	**6.6**

2.6 Gulf Intracoastal Waterway between St. Andrew Bay and St. Joseph Bay, Including the Gulf County Canal

The channel between St. Andrew Bay and Apalachicola was first constructed between 1911 and 1915, and in 1937 was deepened to 9 feet by 100 feet in width. In 1950, the Corps connected this portion of the GIWW to St. Joseph Bay via the Gulf County Canal. The GIWW and Gulf County Canal are currently maintained by the Corps. The Department used the reference period approach to determine the unimpaired conditions for this portion of the GIWW.

Protective Numeric Interpretations were developed by including data only from years when the biological targets were met, and are based on the 90% prediction interval of measured values for TN and TP. Because there were less than 20 chlorophyll *a* measurements for this segment, the 90th percentile value was determined (rounded down at the tenth unit as a conservative measure), and used for the chlorophyll *a* target (see **Appendix A**). These Numeric Interpretations are expressed as values not to be exceeded more than 10% of the time (see table below).

Segment	Parameter	Number of Observations	Mean	90% Prediction Interval (Numeric Interpretation)	90th Percentile (Numeric Interpretation)
GIWW between St. Andrew and St. Joseph Bays	TP (mg/L)	38	0.049	**0.108**	-
	TN (mg/L)	38	0.65	**1.14**	-
	Chlorophyll *a* (µg/L)	16	4.2	-	**6.6**

2.7 St. Andrew Bay

NNC covering all of the estuarine segments of St. Andrew Bay were adopted by the ERC in November 2012.

2.8 St. Andrew Sound

St. Andrew Sound is a high-salinity lagoon located in Bay County in the Gulf Coastal Lowlands physiographic region, bordered by the protected lands of Tyndall Air Force Base. There is minimal human disturbance in the watershed. There were no nutrient or chlorophyll data available for this segment. The seagrass-rich St. Andrew Sound is directly adjacent to, and has characteristics similar to, the southern segment of St. Andrew Bay immediately west of St. Andrew Sound.

Because of this similarity and a lack of data for the sound, the Department selected the reference site approach for NNC in St. Andrew Sound, using the adopted TP, TN, and chlorophyll values from St. Andrew Bay as the unimpaired conditions for the sound, expressed as annual geometric means, not to be exceeded more than once in a three-year period (see table below).

Segment	Parameter	AGM (Numeric Interpretations)
St. Andrew Sound (based on adjacent St. Andrew Bay)	TP (mg/L)	**0.019**
	TN (mg/L)	**0.34**
	Chlorophyll *a* (µg/L)	**3.7**

2.9 St. Joseph Bay

NNC covering all of St. Joseph Bay were adopted by the ERC in November 2012.

2.8 Apalachicola Bay

NNC covering all of the estuarine segments of Apalachicola Bay were adopted by the ERC in November 2012.

2.9 Apalachicola Offshore

This nearshore coastal area is adjacent to three Franklin County barrier islands with quartz sand beaches. The area, which extends across St. Vincent Island, St. George Island, and Dog Island, is characterized by high salinity, high wave energy, and sandy substrates, with only scattered areas of seagrass.

Numeric interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretation)
Apalachicola Offshore	TP (mg/L)	**0.043**
	TN (mg/L)	**0.72**
	Chlorophyll *a* (µg/L)	**3.9**

2.10 Alligator Harbor

Alligator Harbor is a shallow, high-salinity lagoon partially separated from the nearshore Gulf of Mexico by a barrier sand spit. Located in eastern Franklin County, the harbor is near the towns of Alligator Point, St. Theresa, Turkey Point, and Lanark Village. Alligator Harbor is located entirely within an Aquatic Preserve and is bordered by several prominent offshore shoal systems, including Dog Island Reef to the southwest, South Shoal to the southeast, and the Ochlockonee Shoal to the east. The harbor is approximately 4.5 miles long and 1.5 miles wide. The average depth is approximately 4 meters**.**

Criteria were developed using the reference period approach. Data from 1971 to 2012 were used (only seven years had four or more measurements per year) to derive a nutrient numeric interpretation because nutrient-sensitive biological endpoints for DO and chlorophyll *a* were met during this period. There is significant seagrass coverage in this area, but a site-specific transparency target could not be established due to the lack of bathymetric data for the area. Protective numeric interpretations are expressed as Annual Geometric Means not to be exceeded more than once in a three-year period (see table below).

Segment	Parameter	Number of Observations	Mean	AGM (Numeric Interpretation)	AGM Years
Alligator Harbor	TP (mg/L)	68	0.031	**0.036**	7
	TN (mg/L)	67	0.42	**0.24**	7
	Chlorophyll *a* (µg/L) (uncorrected)	63	6.5	**8.0**	7

2.11 Ochlockonee/Alligator Harbor Offshore

The Ochlockonee/Alligator Harbor Offshore area, located in eastern Franklin County, includes the portion of Apalachee Bay immediately offshore of the Alligator Harbor barrier spit, Bald Point, and Ochlockonee Bay. Some portions have extensive offshore seagrass beds.

Numeric interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretation)
Ochlockonee/Alligator Harbor Offshore	TP (mg/L)	**0.042**
	TN (mg/L)	**0.70**
	Chlorophyll *a* (µg/L)	**5.1**

2.12 Ochlockonee River Estuary (includes portions of the Sopchoppy River)

Ochlockonee Bay is a coastal plain estuary that empties into Apalachee Bay. The major freshwater inflow is tannin-rich water from the Ochlockonee–Sopchoppy River system. The Ochlockonee Bay watershed spans parts of Franklin, Wakulla, Liberty, Leon, and Gadsden Counties in Florida, and parts of Georgia. The Apalachicola National Forest and Tate's Hell State Forest comprise the lower 65 miles of the river's relatively undisturbed watershed. Human land uses in the Florida portion of the watershed include small amounts of agriculture and forestry, with residential and urban land uses around the cities of Tallahassee and Quincy. The bay is small (8.5 kilometers long by 2 kilometers wide), shallow, rapidly flushed, and well mixed. There are extensive shoals throughout the bay, many of which become exposed at low tide. The Ochlockonee system contains extensive tidal marsh (*Spartina/Juncus*) communities. There is a significant salinity gradient, with salinities ranging from 5 to 30 practical salinity units (PSU) depending on river flow.

Numeric interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretation)
Ochlockonee River Estuary	TP (mg/L)	**0.048**
	TN (mg/L)	**0.76**
	Chlorophyll *a* (µg/L)	**2.2**

2.13 Dickerson Bay

Dickerson/Levy Bay is a small, shallow bay surrounded by salt marsh and characterized by oyster bars and unconsolidated bottom. The 11-square-mile watershed is in western Wakulla County and includes the town of Panacea. The bay is bordered on the west by Ochlockonee Bay and on the north and east by the St Marks Wildlife Refuge. The refuge, along with the Mashes Sands area to the south, are designated as Outstanding Florida Waters (OFWs). The bay is approximately 3.3 miles long and 1.0 miles wide at the widest point. The average depth is approximately 1 to 2 meters.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Dickerson Bay	TP (mg/L)	**0.042**
	TN (mg/L)	**1.16**
	Chlorophyll *a* (µg/L)	**2.2**

2.14 Oyster Bay

Oyster Bay is a shallow Wakulla County bay dominated by salt marsh (*Spartina/Juncus*). The watershed is approximately 30 square miles, with much of the land lying within the St. Marks National Wildlife Refuge, and includes the town of Medart. The bay is about 4.0 miles long and 2.5 miles wide and is characterized by oysters and unconsolidated bottom. The average depth is 2 meters.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Oyster Bay	TP (mg/L)	**0.046**
	TN (mg/L)	**0.74**
	Chlorophyll *a* (µg/L)	**2.4**

2.15 St. Marks Offshore

St. Marks Offshore, in Wakulla County, is approximately 17 miles long and 5 miles wide, and is considered a segment of Apalachee Bay. The average depth ranges from 1 to 2 meters nearshore and 6 to 7 meters offshore. The segment is bounded by Ochlockonee Bay (Franklin County) to the west and the Aucilla Offshore area (Jefferson County) to the east. A large portion of the estuary is situated in the Big Bend Seagrass Aquatic Preserve and the St. Marks National Wildlife Refuge. The spring-fed St Marks River is the largest waterbody discharging into this portion of Apalachee Bay.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
St. Marks Offshore	TP (mg/L)	**0.045**
	TN (mg/L)	**0.74**
	Chlorophyll *a* (µg/L)	**1.9**

2.16 St. Marks River Estuary (Includes Marine East River)

The spring-fed St. Marks River is located in Wakulla County, entering Apalachee Bay (along with the estuarine East River) near the St. Marks River Lighthouse in the St. Marks National Wildlife Refuge. The estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds farther offshore.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
St. Marks River Estuary (includes marine East River)	TP (mg/L)	**0.045**
	TN (mg/L)	**0.69**
	Chl a (µg/L)	**1.5**

2.17 Aucilla River Estuary

The Aucilla River is partially swamp-fed and partially spring-fed (Wacissa River), entering Apalachee Bay east of the St. Marks National Wildlife Refuge. The estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds farther offshore.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Aucilla River Estuary	TP (mg/L)	**0.046**
	TN (mg/L)	**0.96**
	Chlorophyll *a* (µg/L)	**1.1**

2.18 Aucilla Offshore

Aucilla Offshore, in Jefferson County is considered a segment of Apalachee Bay. The average depth ranges from 1 to 2 meters nearshore and 6 to 7 meters offshore. The segment is bounded by St. Marks Offshore to the west and Econfina Offshore (Taylor County) to the southeast. A large portion of the estuary is in the Big Bend Seagrass Aquatic Preserve. The Aucilla River is the largest waterbody discharging into this portion of Apalachee Bay.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Aucilla Offshore	TP (mg/L)	**0.052**
	TN (mg/L)	**0.95**
	Chlorophyll *a* (µg/L)	**2.1**

2.19 Econfina River Estuary

The Econfina River, in Taylor County, is a minimally disturbed, swamp-fed river (the headwaters consist of San Pedro Bay), entering Apalachee Bay within Econfina River State Park. The estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Econfina River Estuary	TP (mg/L)	**0.054**
	TN (mg/L)	**0.66**
	Chlorophyll *a* (µg/L)	**3.8**

2.20 Econfina Offshore

Econfina Offshore, in Taylor County, is a segment of Apalachee Bay. The average depth ranges from 1 to 2 meters nearshore and 6 to 7 meters offshore. The segment is bounded by Aucilla Offshore to the northwest and Fenholloway Offshore (Taylor County) to the southeast. A large portion of the estuary is within the Big Bend Seagrass Aquatic Preserve. The Econfina River, which has long been used as a minimally disturbed reference system, is the largest waterbody discharging into this portion of Apalachee Bay.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Econfina Offshore	TP (mg/L)	**0.061**
	TN (mg/L)	**0.87**
	Chlorophyll *a* (µg/L)	**6.6**

2.21 Fenholloway River Estuary

The Fenholloway River, in Taylor County, is swamp-fed (from San Pedro Bay), entering Apalachee Bay near the terminus of Hampton Springs Road. The estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds farther offshore.

Numeric Interpretations were developed using the reference site approach (the adjacent Econfina River Estuary), derived from mechanistic modeling (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period. Note that a Level II WQBEL is under development for the discharge from Buckeye, Inc., and that under Paragraph 62-302.531(2)(a)1.d., F.A.C., the WQBEL would become the site-specific interpretation of the narrative nutrient criterion for the Fenholloway Estuary.

Segment	Parameter	AGM (Numeric Interpretations)
Fenholloway River Estuary (based on Econfina Estuary)	TP (mg/L)	**0.054**
	TN (mg/L)	**0.66**
	Chlorophyll *a* (µg/L)	**3.8**

2.22 Fenholloway Offshore

Fenholloway Offshore, in Taylor County, is a segment of Apalachee Bay, southeast of Econfina Offshore, with which it shares many characteristics. A large portion of the estuary is within the

Big Bend Seagrass Aquatic Preserve. The Fenholloway River is the largest waterbody discharging into this portion of Apalachee Bay.

Numeric Interpretations were developed using the reference site approach (adjacent Econfina Offshore), derived from mechanistic modeling (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period. Note that a Level II WQBEL is under development for the discharge from Buckeye, Inc., and that under Paragraph 62-302.531(2)(a)1.d., F.A.C., the WQBEL would become the site-specific interpretation of the narrative nutrient criterion for Fenholloway Offshore.

Segment	Parameter	AGM (Numeric Interpretations)
Fenholloway Offshore (based on Econfina offshore)	TP (mg/L)	**0.061**
	TN (mg/L)	**0.87**
	Chlorophyll *a* (µg/L)	**6.6**

2.23 Spring Warrior Offshore

Spring Warrior Offshore, in Taylor County, is a segment of Apalachee Bay, southeast of Fenholloway Offshore. As is typical for this part of Florida's Big Bend, this estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Spring Warrior Offshore	TP (mg/L)	**0.070**
	TN (mg/L)	**0.90**
	Chlorophyll *a* (µg/L)	**9.0**

2.24 Steinhatchee River Estuary

The Steinhatchee River, forming the boundary between Taylor and Dixie Counties, is swamp fed, entering Deadman Bay and the Gulf of Mexico near the town of Steinhatchee. The estuarine area is characterized by the presence of dwellings on the north shore (high ground) as well as large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds farther offshore.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Steinhatchee River Estuary	TP (mg/L)	**0.044**
	TN (mg/L)	**0.77**
	Chlorophyll *a* (µg/L)	**1.9**

2.25 Steinhatchee Offshore

Steinhatchee Offshore, in Taylor and Dixie Counties, is a segment of the Gulf Of Mexico Big Bend area, southeast of Spring Warrior Offshore. As is typical for this part of Florida's Big Bend, the estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Steinhatchee Offshore	TP (mg/L)	**0.046**
	TN (mg/L)	**0.65**
	Chlorophyll *a* (µg/L)	**6.5**

2.26 Horseshoe Beach Offshore

Horseshoe Beach Offshore, in Dixie County, is a segment of the Gulf Of Mexico Big Bend area, south of Steinhatchee Offshore. As is typical for this part of Florida's Big Bend, the estuarine area is characterized by large expanses of *Spartina/Juncus* marsh, oyster bars, and extensive seagrass beds.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Horseshoe Beach Offshore	TP (mg/L)	**0.059**
	TN (mg/L)	**0.78**
	Chlorophyll *a* (µg/L)	**5.2**

2.27 Suwannee Offshore, Waccasassa Offshore, Withlacoochee Offshore

NNC covering all of the estuarine segments of Suwannee, Waccasassa, Withlacoochee Offshore segments were adopted by the ERC in June 2013.

2.28 Cedar Keys

The Cedar Keys Estuary segment includes a series of small islands surrounded by protected marine waters, situated at the northern extent of the range of the black mangrove. The Cedar Keys are located approximately 20 kilometers south of the Suwannee River mouth, providing important fishing and shellfish production grounds for this region. Coastal waters surrounding Cedar Keys are shallow and heavily influenced by the freshwater content and volume of flow from the Suwannee River. Concentrations of TN and TP are strongly linked to salinity in these systems.

Submersed aquatic vegetation (SAV) beds are abundant along this part of the coast, but they have only been mapped once based on aerial photography (2001), and so comparisons through time cannot yet be made. The assessment by the Fish and Wildlife Conservation Commission (FWCC) concluded that seagrasses are stable in this region. SAV monitoring from 2006 to 2012 at 25 sites around Cedar Keys by the St. Martins Marsh Aquatic Preserve staff indicated stable seagrass beds during that period. The Southwest Florida Water Management District) (SWFWMD is currently working on a new SAV map based on 2012 aerial photos.

Numeric Interpretations were developed using the mechanistic modeling approach (Big Bend model, see Table below), and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Cedar Keys	TP (mg/L)	**0.060**
	TN (mg/L)	**0.79**
	Chlorophyll *a* (µg/L)	**10.9**

2.29 Springs Coast

NNC covering all of the estuarine segments of the Springs Coast, including Anclote Offshore, Anclote River Estuary, Aripeka and Hudson Offshore, Chasshowitzka National Wildlife Refuge, Chasshowitzka River Estuary, Cystal River Estuary, Homosassa Offshore, Homosassa River Estuary, Pithlachascotee River Estuary, Pithlachascotee Offshore, St. Martins Marsh, Weeki Wachee Offshore, and Weeki Wachee River Estuary, were adopted by the ERC in June 2013. Kings Bay is addressed separately, below.

2.30 Kings Bay

Kings Bay (WBID 1341) is the headwaters of Crystal River, and is located in northern Citrus County. It is a shallow (1 to 3 meters deep) 600-acre embayment that contains a cluster of approximately 70 spring vents. Various developments of the city of Crystal River border Kings Bay. Kings Bay was historically a freshwater system but now often has specific conductance high enough (>4,580 micromohs per centimeter [µmhos/cm]) to be considered marine. It was added to the Verified List of impaired waters in 2012 due to nuisance algal mats (observed in 1990, 1995, 2004–06, and 2011).

The Department is currently developing a nutrient TMDL for nitrate and orthophosphorus for Kings Bay, and has included in this report the protective values for TN and TP, which were derived through mechanistic modeling (see table below). The limit for chlorophyll *a* is based on the reference period approach using data from an 11-year period that achieved the designated use screens described in **Section 1.4**. The TN and TP Numeric Interpretations are expressed as long-term averages not to be exceeded, while the chlorophyll criterion is expressed as an Annual Geometric Mean, not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretation)	Long-Term Average (Numeric Interpretations)
Kings Bay (WBID 1341)	TP (mg/L)	-	**0.033**
	TN (mg/L)	-	**0.29**
	Chlorophyll *a* (µg/L)	**8.4**	-

2.31 Anclote Bayou

Anclote Bayou (WBID 1440A), near Tarpon Springs, is a poorly flushed tidal waterbody adjacent to the Anclote River segment, and is connected to the Anclote River by narrow channels. It was verified as impaired for nutrients based on chlorophyll *a* in 2012, and a TMDL will be developed in the future. This segment was previously listed as impaired for DO but would not have been listed under the revised marine DO criteria (> 42% saturation).

Protective Numeric Interpretations were based on the similar and adjacent Anclote River segment, for which criteria were approved by the ERC in June 2013, and are expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Anclote Bayou (WBID 1440A)	TP (mg/L)	**0.063**
	TN (mg/L)	**0.65**
	Chlorophyll *a* (µg/L)	**3.8**

2.32 Clearwater/St. Joseph Sound

NNC covering all of the estuarine segments of Clearwater Harbor/St. Joseph Sound were adopted by the ERC in December 2011.

2.33 Tampa Bay

NNC covering all of the estuarine segments in Tampa Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.34 Alafia River Tidal Segment

The Alafia River is located in south-central Hillsborough County. The Alafia River Tidal Segment is approximately 7.5 miles long and extends from the river's confluence with Buckhorn Creek downstream to the mouth of the river, at Hillsborough Bay. A nutrient and DO TMDL was developed for the tidal segment (WBID 1621G) in 2009. The TMDL established a TN reduction of 54% in the ambient concentrations that existed during the 2000 to 2006 period, in order to achieve a **long-term average of annual mean TN of 0.65 mg/L, not to be exceeded** (see table below). The TN load from the one NPDES facility that discharges to the tidal segment was found to be less than 1% of the total load entering the lower Alafia River, and therefore the existing TN load discharged by the facility was applied as the wasteload allocation.

Since TP is not a limiting nutrient in this system, the existing TP concentrations were determined to be fully protective. The average of the annual TP concentrations during the 2000 to 2006 period was **0.86 mg/L and is established as the Numeric Interpretation for TP, expressed as a long-term average of annual means, not to be exceeded.** The analogous Numeric Interpretation for **chlorophyll *a* of 15 µg/L, which is also expressed as a long-term average of annual means, not to be exceeded,** is based on the restoration and protection of seagrass in lower Hillsborough Bay (there is no seagrass in the tidal Alafia River). The Department uses this water quality target as a site-specific chlorophyll *a* threshold for the Hillsborough Bay segments (and the estuary segments tributary to the bay) to perform nutrient assessments using the IWR methodology.

WBID	Parameter	Wasteload Allocation for Wastewater (lbs/yr)	Wasteload Allocation for Stormwater (% reduction)	Load Allocation (% reduction)	Margin of Safety	TMDL (mg/L)
1621G	TN	5,140	54%	54%	Implicit	0.65

2.35 Sarasota Bay to Blackburn Bay

NNC covering all of the estuarine segments from Sarasota to Blackburn Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.36 Gulf Intracoastal Waterway between Roberts Bay and Lemon Bay

This segment of the GIWW extends between Roberts Bay and Lemon Bay, with an authorized depth of 11 to 12 feet. Natural habitats present are primarily mangroves.

Protective Numeric Interpretations were developed using the reference period approach by only including data from years when the biological targets were met, and are expressed as an Annual Geometric Means not to be exceeded more than once in a three-year period (see table below).

Segment	Parameter	Number of Observations	AGM Years	AGM (Numeric Interpretations)
ICWW between Roberts Bay and Lemon Bay	TP (mg/L)	78	10	**0.253**
	TN (mg/L)	79	11	**0.59**
	Chlorophyll *a* (µg/L)	66	9	**4.0**

2.37 Charlotte Harbor to Estero Bay

NNC covering all of the estuarine segments in the Charlotte Harbor to Estero Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.38 Caloosahatchee River Estuary/San Carlos Bay

The marine portion of the Caloosahatchee River is a mangrove-dominated tidal river that discharges into San Carlos Bay, near Sanibel Island. A TMDL was developed for the marine portions of the Caloosahatchee River to reduce chlorophyll *a* to a level necessary to protect seagrass photosynthesis in San Carlos Bay, which was determined to be the most nutrient-sensitive endpoint in the system. This TMDL, derived through mechanistic modeling, required a 23% reduction of the TN load to the Caloosahatchee Estuary (WBIDs 3240A, 3240B, and 3240C). Because TP was found to have no relationship with chlorophyll *a* in San Carlos Bay, the TP levels from the "Existing" conditions model run for the TMDL development were determined to be fully protective and are the basis for the TP criteria in the table below. Chlorophyll *a* targets were derived based on the reduction scenario.

The resulting numeric interpretations are fully protective of both the tidal Caloosahatchee River segments and the downstream San Carlos Bay. All numeric interpretations are expressed as long-term averages not to be exceeded.

Segment	Parameter	Long-Term Mean (Numeric Interpretations)
Upper Caloosahatchee River Estuary (WBID 3240C)	TP (mg/L)	**0.086**
	TN (mg/L)	**0.82**
	Chlorophyll *a* (µg/L)	**4.2**
Middle Caloosahatchee River Estuary (WBID 3240B)	TP (mg/L)	**0.055**
	TN (mg/L)	**0.67**
	Chlorophyll *a* (µg/L)	**6.5**
Lower Caloosahatchee River Estuary (WBID 3240C)	TP (mg/L)	**0.040**
	TN (mg/L)	**0.50**
	Chlorophyll *a* (µg/L)	**5.6**
San Carlos Bay	TP (mg/L)	**0.045**
	TN (mg/L)	**0.44**
	Chlorophyll *a* (µg/L)	**3.7**

2.39 Cocohatchee to Rookery Bay/ SW Coast

NNC covering all of the estuarine segments from the Cocohatchee Estuary to Florida Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.40 Little Hickory Bay

Little Hickory Bay is located adjacent to the Barefoot Beach State Reserve, in Collier County. The bay is separated from the Gulf of Mexico by a barrier island, and is characterized by mangrove and tidal habitat. Little Hickory Bay is ultimately connected to Wiggins Pass to the south.

Protective Numeric Interpretations were developed via the reference site approach, using data from the adjacent and similar Estero Bay segment (see table below), not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Little Hickory Bay (based on Estero Bay)	TP (mg/L)	0.070
	TN (mg/L)	0.63
	Chlorophyll a (µg/L)	5.9

2.41 Water Turkey Bay

Water Turkey Bay, consisting of mangroves and tidal back bay habitat, is located in Collier County, contiguous with the Delanor-Wiggins Pass State Park, just south of Wiggins Pass. Water Turkey Bay is designated as an OFW.

Protective Numeric Interpretations were developed via the reference site approach, using data from the adjacent and similar Tidal Cocohatchee River segment (see table below), not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM (Numeric Interpretations)
Water Turkey Bay (based on tidal Cocohatchee)	TP (mg/L)	**0.057**
	TN (mg/L)	**0.47**
	Chlorophyll *a* (µg/L)	**5.8**

2.42 Clam Bay

NNC applicable to Clam Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.43 Moorings Bay

Moorings Bay, which includes Inner and Outer Doctors Bays and Venetian Bay, is a narrow mangrove-dominated bay connected to the Gulf of Mexico at Doctors Pass to the south and to Clam Bay to the north. Moorings Bay has relatively high salinity (35 PSU) and relatively clear water for a mangrove-dominated system (1.3-meter Secchi depth).

Protective Numeric Interpretations were developed using the reference period approach, including data only from years when the biological targets were met, and are based on the 90% prediction interval of measured values. These Numeric Interpretations are expressed as values not to be exceeded more than 10% of the time (see table below).

Segment	Parameter	Number of Observations	Mean	90% Prediction Interval (Numeric Interpretations)	AGM Years
Moorings Bay	TP (mg/L)	61	0.042	**0.129**	6
	TN (mg/L)	56	0.45	**1.01**	5
	Chlorophyll *a* (µg/L)	53	3.5	**11.3**	6

2.44 Florida Bay

NNC covering all of the estuarine segments of Florida Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.45 Florida Keys

NNC covering all of marine segments of the Florida Keys were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.46 Biscayne Bay

NNC covering all of the estuarine segments Biscayne Bay were adopted by the ERC in December 2011 and approved by EPA in November 2012.

2.47 Intracoastal Waterway between Biscayne Bay and Lake Worth Lagoon

A segment of the Atlantic ICWW, this section extends between Biscayne Bay and Lake Worth Lagoon, with an authorized depth of 10 feet. Broward County has subdivided this portion of the ICWW into five segments: Palm Beach County ICWW, North Broward County ICWW, North Central Broward County ICWW, Central Broward County ICWW, and South Broward County ICWW. Natural habitats present are primarily mangroves. Inlets to the Atlantic Ocean in this segment include the Port Everglades channel, Hillsboro Inlet, and Boca Raton Inlet.

Protective Numeric Interpretations were developed using the reference period approach, including data only from years when the biological targets were met. Parameters with seven or more years of data (four observations per year) are expressed as an Annual Geometric Mean (AGM) not to be exceeded more than once in a three-year period (see table below). For parameters with less than seven years of data, criteria are based on the 90% prediction interval of measured values and expressed as not to be exceeded more than 10% of the time.

Segment	Parameter	Number of Observa-tions	Mean	90% Prediction Interval (Numeric Interpretations)	AGM Years	AGM (Numeric Interpretations)
Palm Beach County ICWW	TP (mg/L)	88	-	-	7	**0.137**
	TN (mg/L)	88	-	-	9	**1.07**
	Chlorophyll *a* (µg/L)	36	4.8	**14.3**	4	-
North Broward County ICWW	TP (mg/L)	133	-	-	28	**0.070**
	TN (mg/L)	133	-	-	28	**0.89**
	Chlorophyll *a* (µg/L)	52	-	-	10	**3.1**
North Central Broward County ICWW	TP (mg/L)	142	-	-	24	**0.093**
	TN (mg/L)	127	-	-	25	**0.99**
	Chlorophyll *a* (µg/L)	44	-	-	10	**3.6**
Central Broward County ICWW	TP (mg/L)	287	-	-	34	**0.075**
	TN (mg/L)	272	-	-	33	**0.86**
	Chlorophyll *a* (µg/L)	87	-	-	11	**2.7**
South Broward County ICWW	TP (mg/L)	222	-	-	28	**0.046**
	TN (mg/L)	167	-	-	26	**0.79**
	Chlorophyll *a* (µg/L)	40	-	-	9	**2.2**

2.48 Lake Worth Lagoon

NNC covering all of the estuarine segments of Lake Worth Lagoon were adopted by the ERC in June 2013.

2.49 Intracoastal Waterway between North Lake Worth Lagoon and South Loxahatchee

This segment of the Atlantic ICWW extends between north Lake Worth Lagoon and south Loxahatchee, with an authorized depth of 10 feet. Natural habitats present are primarily mangroves.

Protective Numeric Interpretations (NI) were developed using the reference period approach, including data only from years when the biological targets were met. Parameters with seven or more years of data (four observations per year) are expressed as an AGM not to be exceeded more than once in a three-year period (see table below). For parameters with less than seven years of data, criteria are based on the 90% prediction interval of measured values and expressed as not to be exceeded more than 10% of the time.

Segment	Parameter	Number of Observations	Mean	90% Prediction Interval (Numeric Interpretation)	AGM Years	AGM (Numeric Interpretations)
ICWW between North Lake Worth Lagoon and Lower Loxahatchee	TP (mg/L)	87	-	-	15	**0.036**
	TN (mg/L)	59	-	-	9	**0.78**
	Chlorophyll *a* (µg/L)	42	3.9	**8.7**	6	-

2.50 Loxahatchee River Estuary and Loxahatchee River Estuary (Southwest Fork)

NNC covering the Loxahatchee River Estuary were adopted by the ERC in June 2013; however, the Southwest Fork was not included. Natural communities in the Southwest Fork consist primarily of mangroves and oyster beds. Protective Numeric Interpretations for the Southwest Fork were developed using the reference period approach, including data only from years when the biological targets were met, and are expressed as an AGM not to be exceeded more than once in a three-year period (see table below). Note that a TMDL will be developed for this area, and under Paragraph 62-302.531(2)(a)1.d., F.A.C., the TMDL would become the site-specific interpretation of the narrative nutrient criterion for the this portion of the Loxahatchee River Estuary.

Segment	Parameter	AGM Years	AGM (Numeric Interpretations)
Loxahatchee River Estuary Southwest Fork	TP (mg/L)	35	**0.052**
	TN (mg/L)	34	**1.08**
	Chlorophyll *a* (µg/L)	9	**12.4**

2.51 Intracoastal Waterway between Loxahatchee and St. Lucie Estuaries

This segment of the Atlantic ICWW extends between the Loxahatchee River Estuary and St. Lucie Estuary, with an authorized depth of 10 feet. It connects Hobe Sound, Peck Lake, and Great Pocket and is subdivided into a southern unit (Loxahatchee to Hobe Sound) and a northern unit (Hobe Sound to St. Lucie). Natural habitats present are primarily mangroves.

Protective Numeric Interpretations were developed using the reference period approach, including data only from years when the biological targets were met, and are expressed as an AGM not to be exceeded more than once in a three-year period (see table below).

Segment	Parameter	AGM Years	AGM (Numeric Interpretations)
ICWW between Loxahatchee up to and including Hobe Sound	TP (mg/L)	21	**0.022**
	TN (mg/L)	20	**0.58**
	Chlorophyll *a* (µg/L)	17	**2.7**
ICWW between Hobe Sound and St. Lucie	TP (mg/L)	17	**0.066**
	TN (mg/L)	17	**0.67**
	Chlorophyll *a* (µg/L)	12	**5.8**

2.52 St. Lucie Estuary

The St. Lucie River Estuary, located in Martin and St. Lucie Counties, empties into the Southern Indian River Lagoon and then into the Atlantic Ocean through the St. Lucie Inlet. Its watershed occupies about 832,500 acres. Extensive man-made canal networks, including those associated with C-44, C-23, C-24, and C-25, which discharge to the South and North Forks of the St. Lucie River, have altered the natural hydrology of the watershed. Depending on the freshwater input from the estuary watershed, the salinity of the St. Lucie Estuary can fluctuate from close to 0 PSU to about 30 PSU.

In 2009, the Department adopted a set of nutrient and/or DO TMDLs for five impaired St. Lucie Estuary segments (WBIDs) that represent the numeric interpretation of the narrative nutrient criteria under Section 62-302.531, F.A.C. The TMDL established allowable TN and TP concentrations, expressed as long-term annual average concentrations, for WBID 3193, and allowable loads, expressed as annual average loads that should not be exceeded in any year, for the other four WBIDs (see table below). Manatee Creek (WBID 3208) was not included in the original TMDL development. However, the Department is considering expanding the scope of the adopted TMDL to include Manatee Creek. In the interim, the TMDLs for the St. Lucie Estuary (WBID 3193), which are protective of the creek, will also apply to WBID 3208.

WBID	Waterbody	Maximum Allowable TN (Criteria)	Maximum Allowable TP (Criteria)	Chlorophyll *a* Targets (µg/L) (Numeric Interpretations)
3193	St. Lucie Estuary	**0.72 mg/L**	**0.081 mg/L**	**4.3**
3208	Manatee Creek	**0.72 mg/L**	**0.081 mg/L**	**4.3**
3194	North Fork St. Lucie River	**140,134 lbs/year**	**15,765 lbs/year**	**3.9**
3194B	North Fork St. Lucie Estuary	**103,747 lbs/year**	**11,672 lbs/year**	**6.6**
3210	South Fork St. Lucie Estuary	**24,463 lbs/year**	**2,752 lbs/year**	**5.6**
3210A	South Fork St. Lucie River	**90,471 lbs/year**	**10,178 lbs/year**	**3.9**

The target areal nutrient loads were considered the areal nutrient loads that would result in no more than 10% deviation (reduction) of the depth limit from the maximum possible seagrass depth limit. For all the lagoon segments, the maximum possible seagrass depth limits were determined as the median depth limits of the deep edge of seagrass beds when geographic information system (GIS) shapefiles of multiple years of seagrass coverage were overlaid. Using optical models developed by the St. Johns River Water Management District (SJRWMD), a target chlorophyll *a* concentration was calculated for each segment that was based on achieving the seagrass depth limits. The target chlorophyll *a* concentration was estimated as the median value of the chlorophyll *a* concentrations of those segments and years. The chlorophyll *a* target of 3.1 µg/L that was previously established for the South Indian River Lagoon for seagrass protection was used to establish chlorophyll *a* targets for all the WBIDs (see table above) by calculating the expected chlorophyll *a* for each WBID when the nutrient loading targets are achieved. These chlorophyll numeric interpretations, which were designed to protect seagrass growth and propagation in the IRL, would also protect any potential seagrass in each WBID. The values shown represent the long-term means that should not be exceeded.

2.53 Indian River Lagoon from St. Lucie Estuary to Indian River County Line

This portion of the Indian River Lagoon (see full description below) was not included in the TMDL. Protective Numeric Interpretations were developed using the reference period approach by only including data from years when the biological targets were met, and are expressed as an AGM not to be exceeded more than once in a three-year period (see table below).

Segment	Parameter	AGM Years	AGM (Numeric Interpretations)
Indian River Lagoon from St. Lucie Estuary to Indian River County Line	TP (mg/L)	13	**0.067**
	TN (mg/L)	13	**0.76**
	Chlorophyll *a* (µg/L)	11	**5.1**

2.54 Indian River Lagoon

The Indian River Lagoon (IRL) system is a 156-mile-long estuary located along the east-central Florida coast. The system includes three interconnected sublagoons: the Indian River Lagoon, Banana River Lagoon, and Mosquito Lagoon. Six counties are located in the natural drainage basin of the lagoon system: from north to south, Volusia, Brevard, Indian River, St. Lucie, Martin, and Palm Beach Counties. Circulation in the IRL is influenced by winds, freshwater inflows from tributaries, and tidal exchange via direct connections to the Atlantic Ocean. Because of the IRL's long and narrow shape, tidal influence attenuates quickly as the distance from ocean inlets increases. Salinity at the lagoon segments close to the two inlets is around 35 PSU, while the salinity in the northern part of the lagoon is generally about 20 parts per thousand (ppt). Elevated salinity (around 30 ppt) was observed in the northernmost part of the sublagoon system because of evaporation.

In 2009, the Department adopted nutrient TMDLs for the IRL to address the seagrass loss resulting from elevated nutrient loads from the IRL watershed. The TMDLs represent the numeric interpretation of the narrative nutrient criteria under Section 62-302.531, F.A.C. Developed based on the Pollutant Load Reduction Goal (PLRG) created by the SJRWMD, they established the TP and TN loading targets for sublagoon segments based on the target areal TP and TN loads and watershed areas for these segments. To establish the areal TP and TN targets, regression analyses were conducted between the areal watershed TP and TN loads and the deviation of seagrass depth limit from the maximum possible seagrass depth limit in each sublagoon segment. The target areal nutrient loads were considered the areal nutrient loads that will result in no more than 10% deviation (reduction) of the depth limit from the maximum possible seagrass depth limit. For all the lagoon segments, the maximum possible seagrass depth limits were determined as the median depth limits of the deep edge of seagrass beds when GIS shapefiles of multiple years of seagrass coverage were overlaid.

The TN and TP allowable loads, expressed as annual average loads that should not be exceeded in any year, are provided in the table below. During development of the TMDL, a statistically significant relationship was not found between chlorophyll *a* and seagrass health, and consequently, a chlorophyll target was not established through the TMDL process. For this report, protective Numeric Interpretations were developed for chlorophyll *a* using the reference period approach, including data only from years when the biological targets were met, and are expressed as an AGM not to be exceeded more than once in a three-year period (see table below).

Segment	WBID Included	Allowable TN Loads (lbs/yr) (Criteria)	Allowable TP Loads (lbs/yr) (Criteria)	Chlorophyll *a* (µg/L) AGM (Numeric Interpretations)
North Indian River Lagoon	2963B, 2963C, 2963D, 2963E, and 2963F	**687,045**	**56,550**	**5.8**
Central Indian River Lagoon	5003B, 5003C, 5003D, and 2963A	**962,988**	**165,193**	**4.8**

2.55 Sebastian River Estuary

The Sebastian River is one of the tributaries that discharges into the IRL Estuary, located near the Sebastian Inlet. The Sebastian River watershed occupies an area that spans southern Brevard County and northern Indian River County.

In 2013, the Department adopted nutrient TMDLs for the Sebastian River (WBIDs 3129A, 3129B2, and 3135A) that did not require nutrient reductions from the Sebastian River watershed beyond those needed to meet the areal nutrient loading limits established for the Central IRL (**2.90 lbs/acre/year of TN and 0.54 lbs/acre/year of TP**). These load limits represent annual average loads that should not be exceeded in any one year.

Because seagrass is not typically present in the Sebastian River, the **chlorophyll *a* numeric interpretation** designed to protect seagrass in the downstream Central IRL (**4.8 µg/L,** expressed as an AGM not to be exceeded more than once in a three-year period), is also applicable to the Sebastian River Estuary. To be consistent with its derivation, this chlorophyll *a* numeric interpretation should be assessed using Sebastian River stations located proximally to the IRL.

2.56 Banana River Lagoon

As one of the three interconnected sublagoons in the IRL Basin, the Banana River Lagoon (BRL) is located to the east of the IRL. The BRL watershed is completely within Brevard County and includes WBIDs 3057A, 3057B and 3057C. Municipalities located near the BRL include Cape Canaveral, Cocoa Beach, Satellite Beach, and Indian Harbor Beach. The BRL joins the IRL in areas around Satellite Beach and north Melbourne. The sublagoon also interacts with the IRL and Atlantic Ocean through the Cape Canaveral Barge Canal across Merritt Island in an east-west direction. The salinity of the sublagoon generally ranges from 24 to 28 PSU and is strongly influenced by evaporation.

In 2009, the Department adopted nutrient TMDLs for the BRL to address seagrass loss due to elevated nutrient loads from point and nonpoint sources in the BRL watershed that represent the numeric interpretation of the narrative nutrient criteria under Rule 62-302.531, F.A.C. These nutrient TMDLs established the allowable TP and TN loading for the BRL using the same approach that was used to develop the TP and TN TMDLs for the IRL. **The TMDL allowable loads of TP and TN are 23,253 lbs/yr and 291,756 lbs/yr, respectively**.

During development of the TMDL, a statistically significant relationship was not found between chlorophyll *a* and seagrass health, and consequently, a chlorophyll target was not established through the TMDL process. For this report, protective Numeric Interpretations were developed for chlorophyll *a* using the reference period approach, including data only from years when the biological targets were met, and are expressed as an Annual Geometric Means (AGM) not to be exceeded more than once in a three-year period (see table below).

Segment	WBID Included	Allowable TN Loads (lbs/year) (Criteria)	Allowable TP Loads (lbs/year) (Criteria)	Chlorophyll *a* (µg/L) AGM (Numeric Interpretations)
Banana River Lagoon	WBIDs 3057 A, 3057 B and 3057 C	**291,756**	**23,253**	**6.1**

2.57 Mosquito Lagoon

Mosquito Lagoon, another of the three sublagoons in the IRL system, includes WBIDs 2824, 2924B1, and 2924B2. Its watershed spans southern Volusia County and northern Brevard County. Major municipalities in the Mosquito Lagoon watershed include Ponce Inlet, New Smyrna Beach, Edgewater, Ariel, Oak Hill, and Shiloh. The only connection between the lagoon and Atlantic Ocean is Ponce De Leon Inlet. Tidal amplitude attenuates very quickly as the distance from the inlet increases, from about 0.7 meter in the northern part of the lagoon to about 0.05 to 0.1 meter in the southern part of the lagoon. Over the past 20 years, the salinity of Mosquito Lagoon has remained stable and high, between 30 and 35 ppt.

When the Department adopted nutrient TMDLs for the IRL and BRL in 2009 that represent the numeric interpretation of the narrative nutrient criteria under Rule 62-302.531, F.A.C., no nutrient TMDLs were proposed for Mosquito Lagoon because the seagrass communities in the southern Mosquito Lagoon were considered healthy and there were no impairments for nutrients. In addition, based on chlorophyll *a*, TN, and TP data for the period from 1989 through 2008, general decreasing trends were observed for all three nutrient-related parameters, especially for the period from 2004 through 2008, when chlorophyll *a*, TN, and TP concentrations reached their lowest point for the 20-year period of record.

Hydrologic data analyses indicated that the 2004 to 2008 period showed an average hydrologic condition similar to the long-term record. Therefore, chlorophyll *a*, TN, and TP concentration-based criteria for different Mosquito Lagoon segments were developed as five-year annual averages using the 2004 to 2008 data based on the reference period approach proposed by the SJRWMD.

Results from several other types of data analyses conducted by SJRWMD supported the target values calculated using the reference period approach. For example, an optic model method was used to estimate the chlorophyll *a* concentration target for Mosquito Lagoon Segment ML 3-4 because this is the segment where seagrass coverage dominates the biological community type. The result from the analysis was very similar to that established using the reference period method. In addition, regression models between chlorophyll *a* concentrations and TN, and TP concentrations, and two general models that link TN and TP targets with water residence time, were also used to estimate the target TN and TP concentrations, and were supportive of the TN and TP targets established using the reference period approach.

Protective targets for chlorophyll *a*, TN, and TP for Mosquito Lagoon segments, using the reference period approach proposed by the SJRWMD are provided in the table below, expressed as five-year averages. These numeric interpretations, which are based on data collected in the 2004 to 2008 period, are not to be exceeded during any five-year rolling average period.

Mosquito Lagoon (ML) Segment	Chlorophyll *a* (µg/L) (Numeric Interpretations)	TN (mg/L) (Numeric Interpretations)	TP (mg/L) (Numeric Interpretations)
ML1 (Ponce De Leon to Edgewater), WBID 2824	**2.9**	**0.44**	**0.055**
ML2 (Edgewater to Oak Hill), WBID 2924B1	**2.3**	**0.56**	**0.036**
ML3-4 (Oak Hill to the Southern Terminus), WBID 2924B2	**2.2**	**0.79**	**0.027**

2.58 Sykes Creek Estuary

Sykes Creek Estuary is located in northeast Brevard County, between the IRL on the west and BRL on the east. This small, narrow tidal system drains part of the town of Merritt Island (part of WBID 3044B), with salinities fluctuating from less than 5 PSU to more than 30 PSU.

Sykes Creek was verified for nutrient impairment in February 2012; however, the adopted TMDLs did not require nutrient reductions from Sykes Creek (including Newfound Harbor) beyond those needed to achieve the areal nutrient loading limits established for the BRL (2.18 lbs/acre/yr of TN and 0.37 lbs/acre/yr of TP). Based on these areal nutrient limits, the **TP and TN loading limits** established for the Sykes Creek (and Newfound Harbor) watershed are **3,174 lbs/yr and 30,030 lbs/yr, respectively,** and represent the numeric interpretation of the narrative nutrient criteria under Section 62-302.531, F.A.C. These load limits represent annual average loads that should not be exceeded in any year.

Protective Numeric Interpretations were developed for chlorophyll *a* in the BRL using the reference period approach, including data only from years when the biological targets were met. Because seagrass is not typically present in Sykes Creek, the **chlorophyll *a* numeric interpretation** designed to protect seagrass in the downstream Banana River (**6.1 µg/L,** expressed as an AGM not to be exceeded more than once in a three-year period), is also applicable to Sykes Creek Estuary. To be consistent with its derivation, this chlorophyll *a* numeric interpretation should be assessed using Sykes Creek stations located proximally to the BRL.

2.59 Lower Halifax River Estuary

NNC covering the Lower Halifax River Estuary were adopted by the ERC in June 2013.

2.60 Upper Halifax River Estuary

The Halifax River is a 23-mile-long tidal estuary located on the Atlantic coast near Daytona Beach (Volusia County), with its major ocean connection situated at Ponce de Leon Inlet. The tidal amplitude is approximately 0.7 meters. The NNC applicable to this segment, north of the tidal node (WBID 2363B), were developed through the TMDL process and represent the numeric interpretation of the narrative nutrient criteria under Rule 62-302.531, F.A.C., that is expected to be adopted in summer 2013. The TMDL requires a 9% reduction in TN to achieve a chlorophyll *a* annual average target of 9 µg/L or less, and the corresponding allowable annual average TN and TP values are 1.13 mg/L and 0.185 mg/L, respectively (see table). These values are expressed as long-term averages, not to be exceeded.

Segment	Parameter	Mean (Criteria)
Upper Halifax River Estuary	TP (mg/L)	**0.185**
	TN (mg/L)	**1.13**
	Chlorophyll *a* (µg/L)	**9.0**

2.61 Tomoka Portion of Upper Halifax Estuary

The Tomoka Basin represents the area of confluence between the Tomoka River and the Halifax River in northern Volusia County. The segment has an area of approximately 4.3 square miles, approximately 39% of which is water and another 39% is wetlands. The Tomoka Basin was listed as impaired for nutrients in 2012, based on an annual average chlorophyll *a* concentration of 14 µg/L in 2010.

Numeric interpretations for the Tomoka portion of the Upper Halifax (Tomoka Basin, WBID 2363C), which were calculated based on achieving the chlorophyll *a* target for the adjacent

Upper Halifax River, are provided in the table below, and expressed as Annual Geometric Means not to be exceeded more than once in a three-year period.

Segment	Parameter	AGM Years	AGM (Numeric Interpretations)
Tomoka Portion of Upper Halifax River Estuary (Tomoka Basin)	TP (mg/L)	12	**0.105**
	TN (mg/L)	12	**1.20**
	Chlorophyll *a* (µg/L)	13	**7.1**

2.62 Intracoastal Waterway South/Palm Coast (Tomoka Basin to the Pellicer Creek Portion of the Matanzas River Estuary)

The segment of the ICWW from the Tomoka Basin to Pellicer Creek is approximately 30 kilometers long. It receives freshwater inputs from the Tomoka River and Bulow Creek, and is tidally flushed through the Matanzas Inlet (one of the few inlets in the state that is not artificially stabilized). Salinities in this well-flushed system are generally around 30 PSU but drop to below 25 PSU during the spring and summer wet season. Natural habitats consist primarily of salt marsh (*Spartina/Juncus*).

Protective numeric interpretations were developed using mechanistic modeling, as part of a TMDL for WBID 2363D, which was applied to adjacent WBIDs 2363J and 2363EC. TN and TP are loadings not to be exceeded in any year, and chlorophyll is expressed as a long-term average not to be exceeded (see table below).

Segment	Parameter	Numeric Interpretations
ICWW Palm Coast	TP (kg/year)	**42,907**
	TN (kg/year)	**408,840**
	Chlorophyll *a* (µg/L)	**4.5**

2.63 Guana/Matanzas/Tolomato Estuary

NNC covering all of the estuarine segments of the Guana/Matanzas/Tolomato River Estuary were adopted by the ERC in June 2013.

2.64 Pellicer Creek Estuary

Pellicer Creek is located approximately 16 miles south of St Augustine, serving as the dividing line between Flagler and St. Johns Counties. The creek flows east for approximately five miles from the crossing at U.S. Highway 1 to its confluence with the Matanzas Estuary. This area has experienced very little development, is currently classified as an Aquatic Preserve, and includes a conservation area owned by the SJRWMD. Undisturbed salt marsh borders Pellicer Creek through the entire length of its estuary. Almost all (99.8%) of the watershed has a density of less than 1,000 people per square kilometer. Both WBIDs that make up Pellicer Creek are classified as Class II (shellfish harvesting) waters.

Pellicer Creek is tidally flushed through the Matanzas Inlet (one of the few inlets in the state that is not artificially stabilized). The average depth at this site is approximately 2.3 meters, with a tidal range of about 0.6 meters; the bottom type is muddy sand. Salinity ranged from 0.1 to 39.3 PSU during 2012. There is very little urban development in the watershed, and a large portion of the Pellicer Creek Estuary, from U.S. Highway 1 to its confluence with the Matanzas River, lies within an Aquatic Preserve. Land use is composed primarily of pine flatwoods (67%), forested wetland/cypress forests (7%), salt marshes (4%), longleaf pine/xeric oak (4%), and freshwater wetlands (3%). Undisturbed salt marsh borders Pellicer Creek along its estuarine segment, providing exceptional habitat for wildlife and recreational use.

The estuarine portion of Pellicer Creek (WBID 2580A) was not impaired for nutrients or DO during the period of record. The Upper Pellicer Creek Estuary (WBID 2580B) was placed on the 1998 303(d) list for DO, and was subsequently delisted in 2006; no causative pollutant could be identified. Based on Pellicer Creek's watershed LDI of 1.7, and 100-meter riparian buffer LDI of 1.5, the Department determined that Pellicer Creek is an undisturbed, natural system, typical of blackwater tidal systems with large areas of natural leaf litter input from mesic flatwoods, swamps, and salt marshes.

Despite this evidence that low DO is a natural occurrence in Upper Pellicer Creek, available data indicate there were eight years that met the generally applicable DO criteria (42% saturation when predominantly marine and 38% saturation when predominantly freshwater). This WBID was also listed in 1998 as impaired for nutrients, however all years meet the 11 ug/L chlorophyll *a* nutrient impairment threshold for estuaries in the IWR when assessed as AGMs, meaning that it would not be listed for nutrients using the current methodology.

Protective Numeric Interpretations were developed using the reference period approach by including data only from years when the biological targets were met, based on the 90% prediction interval of measured values. The Numeric Interpretations are expressed as values not to be exceeded more than 10% of the time (see table below).

Segment	Parameter	Number of Observations	Mean	AGM Years	90% Prediction Interval (Numeric Interpretations)
Pellicer Creek Estuary	TP (mg/L)	47	0.076	5	**0.132**
	TN (mg/L)	47	0.72	5	**1.6**
	Chlorophyll *a* (µg/L)	43	0.69	6	**5.7**

2.65 Intracoastal Waterway from North Tolomato River Estuary to St. Johns River

This segment of the Atlantic ICWW extends from the North Tolomato River Estuary to the St. Johns River, with an authorized depth of 10 feet. It includes an historic estuary known as Pablo Creek. Natural habitats present are primarily salt marsh (*Spartina/Juncus*) and oysters.

Protective numeric interpretations were developed using the reference period approach by including data only from years when the biological targets were met. Parameters with seven or more years of data (four observations per year) are expressed as an Annual Geometric Mean (AGM) not to be exceeded more than once in a three-year period (see table below). For parameters with less than seven years of data, criteria were based on the 90% prediction interval of measured values and are expressed as not to be exceeded more than 10% of the time.

Segment	Parameter	Number of Observations	Mean	90% Prediction Interval (Numeric Interpretations)	AGM Years	AGM (Numeric Interpretation)
ICWW from north Tolomato to St. Johns River	TP (mg/L)	58	-	-	7	**0.191**
	TN (mg/L)	41	0.66	**1.28**	-	**-**
	Chlorophyll *a* (μg/L)	39	4.0	**10.3**	-	-

2.66 Lower St. Johns River, Including Marine Tributaries

The Lower St. Johns River (LSJR) is that portion of the St. Johns River that flows between the mouth of the Ocklawaha River, its largest tributary, and the Atlantic Ocean, encompassing a 2,750-square-mile (mi^2) drainage area. Within this reach, the St. Johns River is 101 miles long and has a water surface area of approximately 115 square miles. Major population centers in the LSJR Basin include Palatka, a city of 10,700 at the southern entrance to the basin; Green Cove Springs, a city of 4,700 at the midpoint; and the Orange Park, Middleburg, and Jacksonville metropolitan area, with a population of over 1 million, in the northern portion of the basin. The LSJR is a sixth-order, darkwater river estuary, and along its length, it exhibits characteristics associated with riverine, lake, and estuarine aquatic environments. The marine portion extends from Black Creek north to the Atlantic Ocean, near Mayport.

The LSJR was verified as impaired by nutrients based on elevated chlorophyll *a* and Trophic State Index (TSI) levels in the freshwater and marine portions of the river, and was included on Florida's Verified List of impaired waters for the LSJR Basin that was adopted by Secretarial Order in 2003. The Department adopted revised TMDLs in 2008 that establish the allowable loadings of TN and TP to the freshwater and marine portions of the LSJR that would restore the river so that it meets its applicable water quality criteria for nutrients and a SSAC for DO. The TMDL required a 30% reduction in TN but found that existing levels of TP were acceptable.

Protective numeric interpretations were based on a model simulation (including 1995 to 1999) under the scenario that the necessary nutrient reductions were achieved (see table below). The loading-based numeric interpretations are not to be exceeded in any year. The chlorophyll numeric interpretation represents a long-term annual average based on a TMDL scenario simulation over the 1995 through 1999 period. As such, the chlorophyll criterion is expressed as a long-term annual average not to be exceeded. In June 2013, EPA approved the TN TMDL as a site-specific interpretation of the narrative criterion.

Segment	Parameter	Long-term Annual Average (Numeric Interpretation)	TMDL Loading (kg/yr) (Numeric Interpretations)
Lower St. Johns River, including marine tributaries	TP (mg/L)	**-**	**412,720**
	TN (mg/L)	**-**	**1,376,855**
	Chlorophyll *a* (µg/L)	**5.4**	**-**

2.67 Nassau River Estuary

NNC covering all of the estuarine segments of the Nassau River Estuary were adopted by the ERC in June 2013.

2.68 St. Marys River Estuary

The St. Marys River Estuary is a predominately swamp-fed riverine system along the Florida–Georgia border in northeast Florida. The system originates in the Okefenokee Swamp and is dominated by floodplains and extensive marsh systems, with no seagrass. Land use in the basin consists primarily of forest and wetlands, covering approximately 85% of the land area in Florida and 82% in Georgia. This system is significantly tidally influenced (~2 meter tidal range) with poor drainage due to its low topography. A portion of the St. Marys River Estuary, from the Jolly River to the Atlantic Ocean, lies within state and federal managed (protected) lands. Due to the extensive floodplains and wetlands, the small amount of urban development is concentrated in the coastal area between the Amelia River and Atlantic Ocean, primarily in Fernandina Beach. Undisturbed salt marsh is extensive throughout the St. Marys estuarine segments, providing exceptional habitat for wildlife and recreational use.

As noted previously, the Department is working on a mechanistic model of the St. Marys estuarine system, but the model is not sufficiently calibrated to derive NNC at this time. While refinement of the mechanistic model for this system is ongoing, protective numeric interpretations were developed for this report using the reference period approach by including data only from years when the biological targets were met. Parameters with seven or more years of data (four observations per year) are expressed as AGM not to be exceeded more than once in a three-year period (see table below). For parameters with less than seven years of data, criteria were based on the 90% prediction interval of measured values and are expressed as not to be exceeded more than 10% of the time.

Segment	Parameter	Number of Observations	Mean	90% Prediction Interval (Numeric Interpretations)	AGM Years	AGM (Numeric Interpretation)
Upper St. Marys	TP (mg/L)	112	-	-	12	**0.087**
	TN (mg/L)	90	-	**-**	11	**1.24**
	Chlorophyll *a* (µg/L)	59	-	**-**	9	**1.4**
Middle St. Marys	TP (mg/L)	46	-	**-**	8	**0.101**
	TN (mg/L)	43	-	**-**	7	**1.04**
	Chlorophyll *a* (µg/L)	31	2.2	**6.5**	-	-
Lower St. Marys	TP (mg/L)	22	0.088	**0.135**	-	-
	TN (mg/L)	21	0.68	**0.95**	-	-
	Chlorophyll *a* (µg/L)	20	0.7	**2.8**	-	-

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APPENDIX A. MINIMUM SAMPLE SIZE FOR 90TH PERCENTILE CALCULATION

The Department conducted a Monte-Carlo analysis, in Oracle Crystal Ball, to determine the minimum number of samples needed to accurately estimate the true long-term 90th percentile. The analysis consisted of randomly generating 100 simulated nutrient values and calculating 90th percentile values for sample sizes ranging from 2 to 100. The simulations were based on an assumption of a log-normal distribution defined by the mean and standard deviation of log-transformed data from Florida estuaries. Test estuaries with at least 200 samples were used to define the simulation input parameters. Estuaries with high sample sizes were selected for the evaluation to provide a high level of confidence that the true long-term geometric and variance had been established and thus the true 90th percentile (**Table 1**). A total of 10,000 model iterations was run for each simulation to ensure central tendency convergence. Average 90th percentiles for each sample size were calculated based on the results of the 10,000 iterations and plotted (**Figures A.1** through **A.3**).

The results of the analyses show that the 90th percentile estimates converge on a consistent value at sample sizes ranging from 20 to 30. The curves shown in **Figures A.1** through A.**3** reach their respective asymptotes at sample sizes between 20 and 30. Although the asymptote for TN depicted in **Figure A.2** appears to be reached at approximately 40 samples, the predicted 90th percentile values for all sample sizes between 16 are 100 are equivalent to 1.16 mg/L when the values are rounded to two decimal places. The analysis supports requiring a minimum of 30 samples to characterize an upper 90th percentile value with a high degree of confidence. In fact, for all three parameters, the differences in 90th percentile estimates for sample sizes between approximately 15 and 20 is in the final significant figure. Sample sizes of approximately 20 can be used with caution, particularly in cases where the Department has committed to re-evaluating the criteria by December 2014 and will thus collect additional data. Ninetieth percentile estimates should not be calculated for sample sizes less than 15. Estimates for sample sizes between 15 and 20 should be rounded down as a conservative measure. Rounding in this manner is more accurate than selecting an alternative lower percentile (*e.g.,* 75th) to be expressed as a 90th.

Table A.1. Summary of Monte-Carlo input parameters. Log-normal distributions were fit for each chlorophyll *a*, TP, and TN dataset sample based on the measured long-term mean and standard deviation natural log (Ln) transformed data from estuarine segments with at least 200 samples.

Segment	Constituent	Long-Term Mean Ln Nutrient	Standard Deviation Ln Nutrient	Number of Samples	90th Percentile
Tomoka	Corrected Chlorophyll *a*	1.601	0.984	200	17.5
South Indian River Lagoon	TN	-0.580	0.566	225	1.16
Central Broward County ICWW	TP	-2.983	0.796	287	0.140

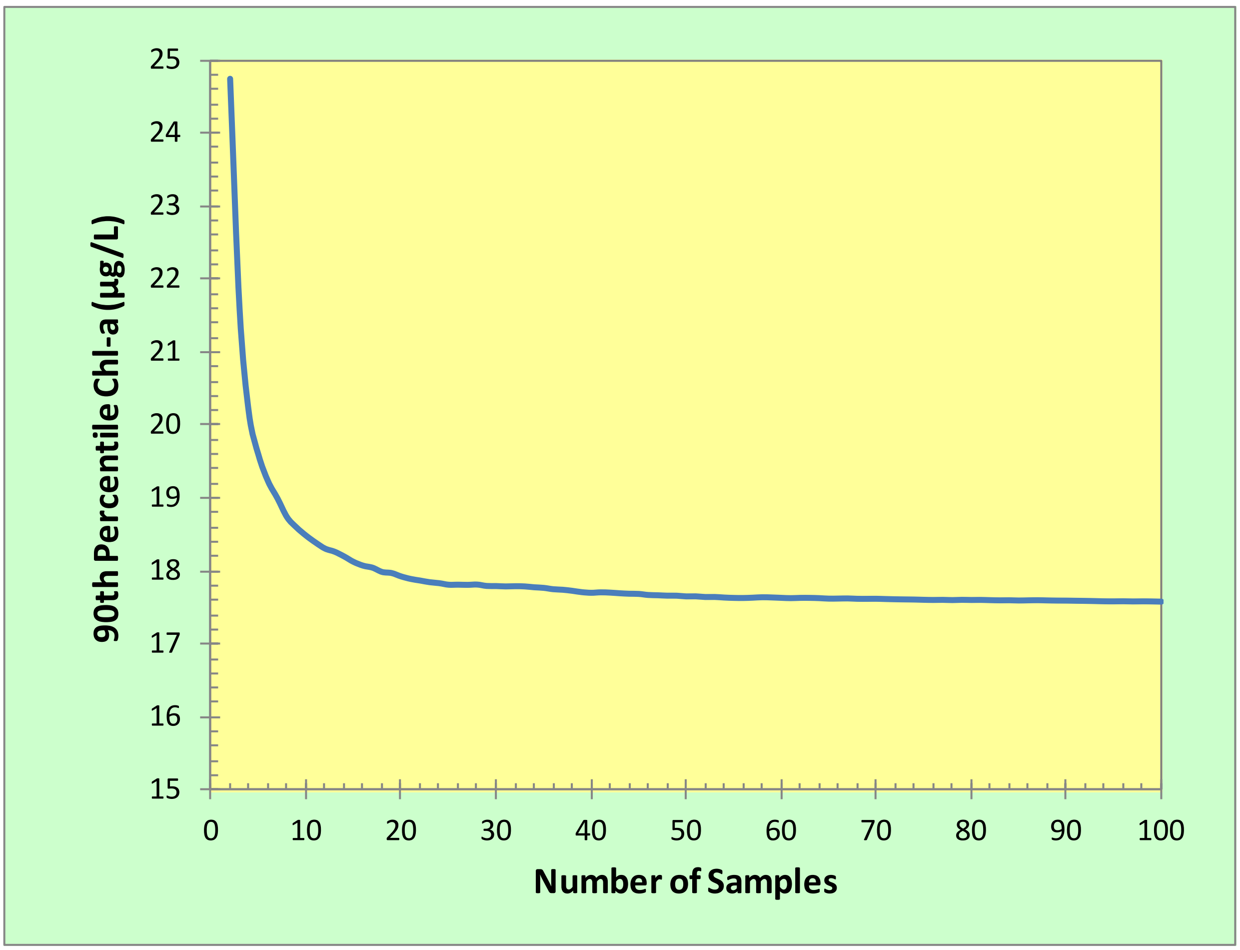

Figure A.1. Results of Monte-Carlo analysis to determine minimum data requirements for calculation of an upper 90th percentile value. The simulation was based on corrected chlorophyll *a* data from the Tomoka River. The curve depicts the central tendency (mean) 90th percentile estimates from 10,000 model iterations.

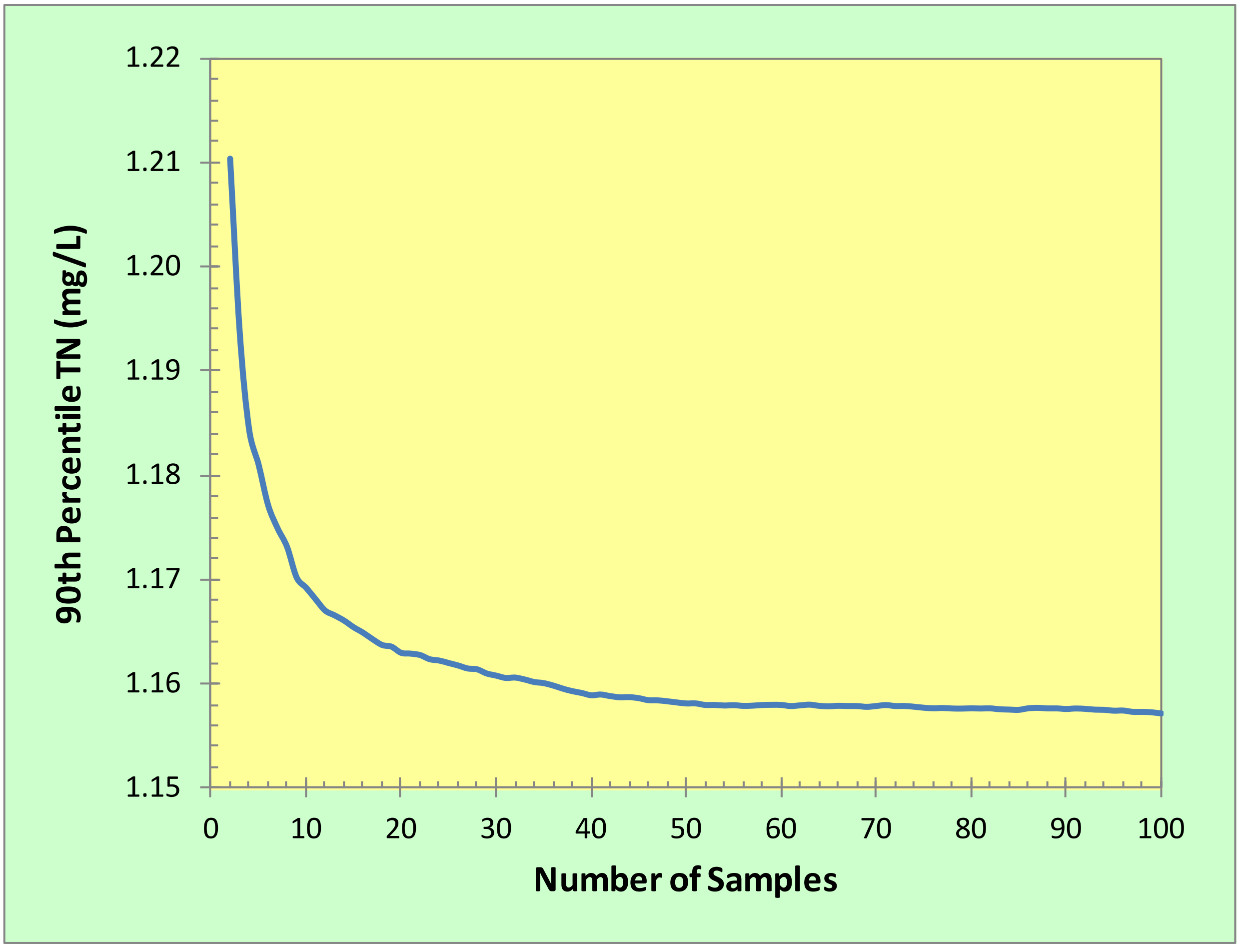

Figure A.2. Results of Monte-Carlo analysis to determine minimum data requirements for calculation of an upper 90th percentile value. The simulation was based on TP data from the Central Broward County ICWW. The curve depicts the central tendency (mean) 90th percentile estimates from 10,000 model iterations.

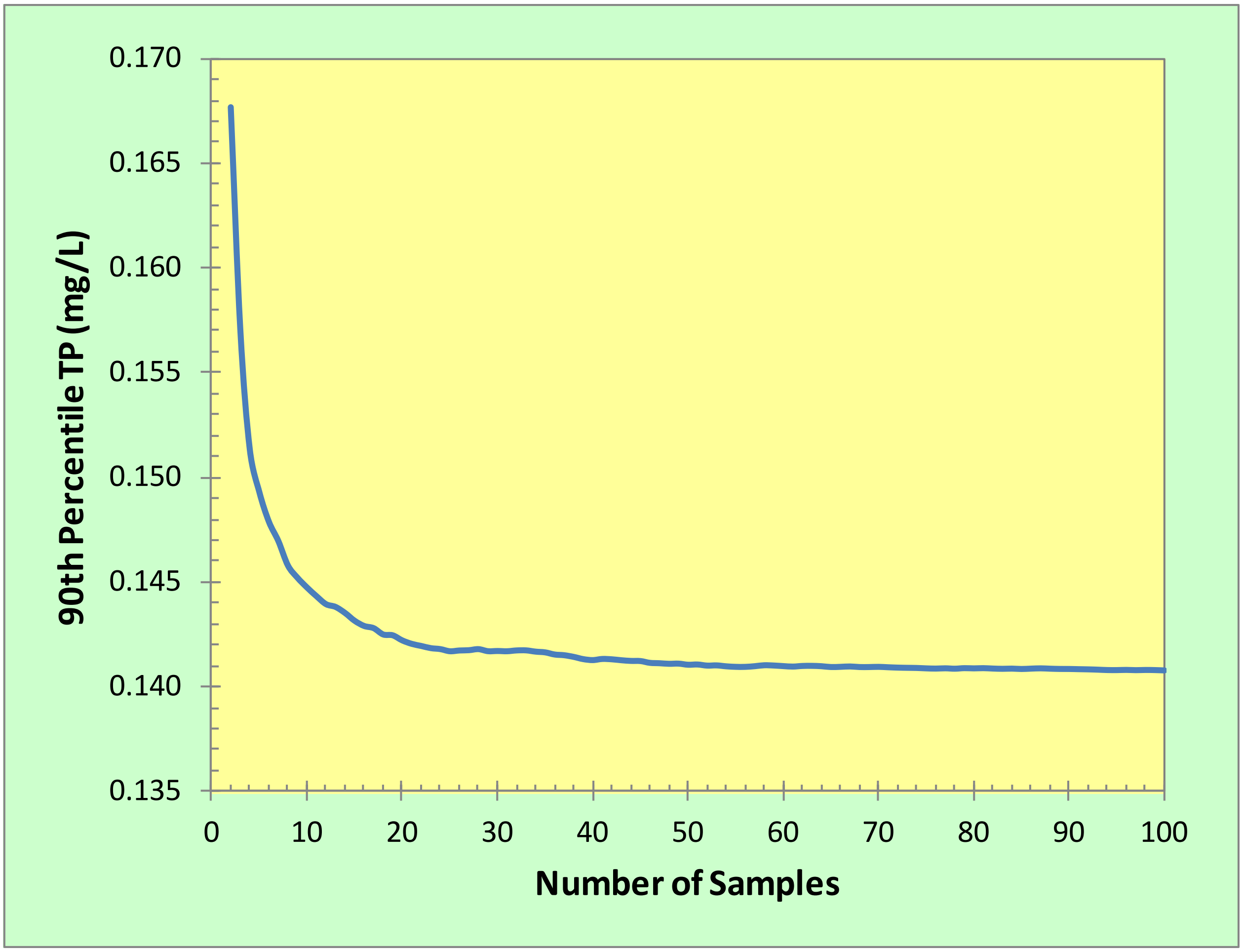

Figure A3. Results of Monte-Carlo analysis to determine minimum data requirements for calculation of an upper 90th percentile value. The simulation was based on TN data from the South IRL. The curve depicts the central tendency (mean) 90th percentile estimates from 10,000 model iterations.